

Bridging Western and Indigenous knowledge
to promote safe birth in cultural safety in Guerrero, Mexico

Iván Sarmiento

Department of Family Medicine

McGill University, Montreal

August 2021

A thesis submitted to McGill University in partial fulfilment of the requirements of
the degree of Doctor of Philosophy (PhD).

© Ivan Sarmiento, 2021

*In memory of Dr Ascencio Villegas and Taita José Becerra,
whose roots have nourished this work.*

*Doña Martina Martínez Lauro and doña Cleofás Basurto Sierra
(two elder traditional midwives from Guerrero) died during the study.
We are grateful with the many lives they helped to birth
and the heritage left in their apprentices.*

Table of contents

List of tables.....	iii
List of figures.....	iv
List of appendices	v
List of acronyms.....	vi
Abstract	viii
Résumé	xi
Acknowledgements.....	xv
Contributions to original knowledge	xvii
Contribution of authors	xix
Chapter 1: Introduction	1
Chapter 2: Research approach and methods	3
SECTION 1. CONTEXTUALIZING SAFE BIRTH IN LOCAL INDIGENOUS CULTURES	20
Chapter 3: Fuzzy cognitive mapping and soft models of indigenous knowledge on maternal health in Guerrero, Mexico (manuscript 1).....	22
Chapter 4: Combining conceptual frameworks on maternal health in Indigenous communities – Fuzzy cognitive mapping using participant and operator-independent weighting (manuscript 2)	47
Chapter 5: Maternal health and Indigenous traditional midwives in southern Mexico: contextualization of a scoping review (manuscript 3)	66
SECTION 2. TESTING THE IMPACT OF SUPPORTING TRADITIONAL MIDWIVES.....	95
Chapter 6: Safe birth in cultural safety in southern Mexico: a pragmatic non-inferiority cluster-randomised controlled trial (manuscript 4).....	96
SECTION 3. IMPLICATIONS OF THE EVIDENCE AND ENGAGEMENT	123
Chapter 7: Bridging Western and Indigenous knowledge through intercultural dialogue: lessons from participatory research in Mexico (manuscript 5).....	124
Chapter 8: Discussion and conclusions.....	142
Thesis references	155

APPENDICES	174
Appendix 1. Factors influencing maternal health in indigenous communities with presence of traditional midwifery in the Americas: protocol for a scoping review	174
Appendix 2. Safe Birth and Cultural Safety in southern Mexico: study protocol for a randomised controlled trial.....	207
Appendices of Chapter 3 (manuscript 1)	239
Appendices of Chapter 4 (manuscript 2)	241
Appendices of Chapter 5 (manuscript 3)	250
Appendices of Chapter 6 (manuscript 4)	277

List of tables

Table 2-1. My research program.....	14
Table 3-1. Matching table of the concepts grouping the risk and protective factors	29
Table 3-2. Pattern marching table of the cumulative net influence of each category on maternal health.....	33
Table 4-1. Factors with higher outdegree centrality	56
Table 5-1. Categories that emerged from the factors in the maps.....	76
Table 5-2. Pattern matching table to compare the maps from three different sources about factors influencing positive maternal health	81
Table 6-1. Baseline characteristics of intervention and control arms in 2015.....	105
Table 6-2. Demographic characteristics of intervention and control arms in 2017.....	106
Table 6-3. Effect measures for the primary outcomes (intention to treat analysis)	107
Table 6-4. Secondary outcomes (intention to treat analysis)	108
Table 6-5. Sensitivity analyses incorporating levels of fidelity to the intervention.....	110
Table A1-1. List of systematic reviews related to the field of traditional midwifery in relation to maternal health.....	176
Table A2-1. Content of the course for training intercultural brokers in Guerrero State (May to June 2015).....	216

List of figures

Figure 2-1 Map of the participating municipalities.....	11
Figure 3-1. Fuzzy cognitive map of the most influential categories of risk factors	32
Figure 3-2. Fuzzy cognitive map of the most influential categories of protective factors on maternal health..	35
Figure 4-1. Map of the three strongest categories and their internal dynamics	55
Figure 4-2. Map of categories affecting maternal health in Indigenous communities.....	58
Figure 5-1. Flow diagram of the selection of sources of evidence (PRISMA-ScR)	74
Figure 5-2. Fuzzy cognitive map of the most influential categories identified in the scoping review	79
Figure 6-1. Flow diagram of progress of clusters and individuals through phases of the randomised trial	104
Figure 7-1. Scheme to represent the interaction between Indigenous and Western health systems.....	130
Figure A1-1. Fuzzy cognitive map of protective factors for maternal health from <i>Me'Phaa</i> and <i>Nancue ñomda</i> traditional midwives in Guerrero	187
Figure A2-1. Map of the participating municipalities.....	213
Figure A2-2. Schedule of enrolment, interventions and assessments for the study Safe Birth and Cultural Safety.....	218
Figure A2-3 Flow diagram of the study Safe Birth and Cultural Safety.....	222
Figure A2-4. Power of the sample in relation to the margin of non-inferiority for maternal mortality and birth complications.....	225

List of appendices

Appendices of Chapter 3 (manuscript 1)

Appendix M1 - 1. Adjacency matrix of the final map showing categories of risk factors for maternal health in the South of Guerrero.....	239
Appendix M1 - 2. Adjacency matrix of the final map showing categories of protective factors for maternal health in the South of Guerrero	240

Appendices of Chapter 4 (manuscript 2)

Appendix M2 - 1. Profile of researchers who contributed their fuzzy cognitive maps.....	241
Appendix M2 - 2. Pattern matching table of factors and categories across all the maps.....	242
Appendix M2 - 3. Step by step explanation of the condensation process.....	244
Appendix M2 - 4. Adjacency matrices of the category maps	248
Appendix M2 - 5. Comparison of factor-level outdegree centrality.....	249

Appendices of Chapter 5 (manuscript 3)

Appendix M3 - 1. Study characteristics and list of references.....	250
Appendix M3 - 2. References of the studies that mentioned factors in each of the categories used to condense the maps	265
Appendix M3 - 3 Adjacency matrix of the category map	276

Appendices of Chapter 6 (manuscript 4)

Appendix M4 - 1. Evaluation of the implementation of the intervention and baseline characteristics.....	277
Appendix M4 - 2. Comparison of groups as treated using GLMMs.....	279

List of acronyms

ANC: antenatal care

CHW: community health workers

CI: confidence intervals

CIET: *Cento de Investigación de Enfermedades Tropicales*

CINAHL: Cumulative Index to Nursing and Allied Health Literature

CONSORT: Consolidated Standards of Reporting Trials

FCM: fuzzy cognitive mapping

GLMM: generalised linear mixed model

HH: household

ICC: intra-cluster correlation coefficient

ITT: intention to treat

LHW: lay health workers

LMIC: low- and middle-income countries

LILACS: Latin American and Caribbean Health Sciences Literature

MMAT: Mixed Methods Appraisal Tool

OR: odds ratio

PRAM: Participatory Research at McGill

PRISMA: Preferred Reporting Items for Systematic Reviews and Meta-Analyses

RCT: randomised controlled trial

RD: risk difference

RR: relative risk

SD: standard deviation

TBA: traditional birth attendant

WHO: World Health Organization

WHC: western health care

Abstract

Background

Indigenous women in Guerrero, Mexico, face poor maternal health outcomes. They live at or beyond the periphery of the Western health system, where health services often lack human and financial resources. For several centuries, traditional midwives accompanied women through motherhood in these communities, but the colonial history and modern economic development have weakened their role in safe motherhood. Mutual mistrust between Western providers and traditional midwives hampers collaboration that could afford indigenous women the best of both worlds. The consequence for indigenous mothers is low-quality Western health care services and attenuated traditional resources. Interventional studies have explored assimilating birth attendants into the Western system, but not much research has focused on supporting traditional midwifery.

Objectives

This thesis explores the role of authentic traditional midwives in promoting safe birth in cultural safety among indigenous communities of Guerrero, Mexico. It has several specific objectives:

1. Understand how traditional midwives and intercultural researchers contextualise safe birth in local indigenous cultures;
2. Test the impact of supporting traditional midwives, in their own terms, in a cluster randomised controlled trial;
3. Reflect on generalisable implications of the evidence and engagement in these settings.

Methods

This doctoral project applied a participatory research approach and was part of a bigger initiative in partnership with academics at the *Centro de Investigación de Enfermedades Tropicales* and four indigenous groups in Guerrero (*Nabua*, *Na savi* (Mixteco), *Me'phaa* (Tlapaneco), and *Nancue ñomndaa* (Amuzgo)).

Specific objective 1: I used a synthesis procedure based on fuzzy cognitive mapping (FCM) to collate knowledge of 29 traditional midwives about risk and protective factors for maternal health in their communities. In a second application of FCM, I explored the perspectives of eight intercultural Western researchers on factors affecting maternal health in indigenous communities. These maps served to develop a method based on Harris' discourse analysis to weight factors' influence based on

their frequency. I used FCM to portray a scoping review of studies reporting influences on maternal health in indigenous communities with traditional midwives in the Americas and adapted the *Weight of Evidence* technique to ground the literature in local stakeholder perspectives.

Specific objective 2: I analysed a parallel-group non-inferiority cluster randomised controlled trial (RCT) that tested whether supporting traditional midwives on their own terms increased cultural safety (respect of indigenous traditions) without worsening maternal health outcomes. In forty communities in two intervention municipalities, traditional midwives and their apprentices received a monthly stipend and support from a trained intercultural broker, and local official health personnel attended a workshop for improving attitudes towards traditional midwifery. Forty communities in two control municipalities continued with usual health services.

Specific Objective 3: I described and reflected on the experience in Guerrero in support of cultural safety and intercultural dialogue to inform future practice of intercultural research.

The project received ethical approval from the participating communities, the *Universidad Autónoma de Guerrero*, and McGill's Faculty of Medicine Institutional Review Board.

Results

Specific objective 1: For traditional midwives, the strongest risks for maternal health were not following traditional self-care practices, traditional diseases, and women's mental health and experience of violence. The strongest protectors were male involvement, support of traditional healers, and protective rituals. Participating researchers shared attitudes of respect for indigenous traditions and assigned indigenous cultural continuity and cultural safety the strongest positive influence on maternal health. Operator-independent weighting, based on Harris' discourse analysis, produced similar results to participant-weighting of influences. Most of the 87 selected studies in the scoping review focussed on access to Western health care, and they included a wide variety of practitioners described as traditional midwives. In the map produced from the findings of the scoping review, self-care practices and traditional midwifery had the strongest positive effects on maternal health, followed by the negative effect of disempowerment of communities, families and women. The literature, traditional midwives and researchers all identified promotion of cultural practices as important to protect Indigenous maternal health.

Specific objective 2: Among 872 births, mothers in intervention communities had lower rates of perinatal deaths or childbirth or neonatal complications (Risk Difference (RD) -0.06 95% Confidence Intervals (CI) -0.11- -0.01) and more births at home with a traditional midwife and family present (RD 0.10 95%CI 0.02-0.18). Among institutional childbirths, women from intervention communities had more traditional management of the placenta (RD 0.34 95%CI 0.21- 0.48) but also more non-traditional cold-water baths (RD 0.10 95%CI 0.02-0.19).

Specific objective 3: Three steps contribute to intercultural dialogue: (1) trust building and partnership, (2) listening and adjusting lexicon to identify contributions from traditional midwives and (3) codesign, evaluation and discussion to identify benefits of supporting traditional practices.

Conclusions

Traditional midwives have detailed knowledge of what affects maternal health that complements published research and can inform culturally safe interventions in their communities. This thesis developed an approach and specific tools to facilitate intercultural dialogue between stakeholders with differing perspectives. To my knowledge, the cluster RCT was the first published trial to test the impact of supporting traditional midwifery rather than replacing it. It confirmed non-inferior maternal health outcomes with more births at home with a traditional midwife and family present. The experience provides a starting point for advancing collaboration with traditional midwives to promote maternal health in indigenous communities.

Résumé

Rapprocher les connaissances occidentales et autochtones pour promouvoir un accouchement sans risque dans le cadre de la sécurité culturelle à Guerrero, au Mexique

Contexte

Les femmes autochtones de Guerrero, au Mexique, sont confrontées à de mauvais résultats en matière de santé maternelle. Elles vivent dans la périphérie, au-delà du système de santé occidental, là où les services de santé manquent souvent en ressources humaines et financières. Depuis des siècles, les sages-femmes traditionnelles vivant dans ces communautés ont accompagné les femmes durant leur maternité. Or l'histoire coloniale et le développement économique moderne ont grandement affaibli leur rôle. La méfiance mutuelle entre les intervenants occidentaux et sages-femmes traditionnelles entrave une collaboration qui pourrait offrir aux femmes autochtones le meilleur des deux mondes. Conséquemment, les mères autochtones reçoivent des services de santé occidentaux de mauvaise qualité et des ressources traditionnelles réduites. Des études-intervention ont exploré l'assimilation des préposées à la naissance au sein du système occidental, mais peu de recherche a porté sur le soutien de l'obstétrique traditionnelle.

Objectif

Cette thèse explore le rôle des sages-femmes traditionnelles authentiques dans la promotion d'une naissance culturellement sécuritaire au sein des communautés autochtones de Guerrero, au Mexique. Elle se donne plusieurs objectifs spécifiques :

1. Comprendre comment les sages-femmes traditionnelles et les chercheurs interculturels contextualisent une naissance sécuritaire dans les cultures autochtones locales.
2. Tester l'impact du soutien aux sages-femmes traditionnelles, selon leurs propres termes, dans un essai contrôlé randomisé en grappes.
3. Réfléchir aux implications généralisables des preuves et de l'engagement dans ces contextes.

Méthodes

Ce projet doctoral applique une approche de recherche-participation et fait partie d'une initiative plus large, en partenariat avec le *Centro de Investigación de Enfermedades Tropicales* (Centre de recherche

sur les maladies tropicales) et avec quatre groupes autochtones de Guerrero (*Nabua*, *Na savi* (Mixteco), *Me'phaa* (Tlapaneco) et *Nancue ñomndaa* (Amuzgo)).

Objectif spécifique 1 : J'ai utilisé une procédure de synthèse basée sur la cartographie cognitive floue (*fuzzy cognitive mapping*, ou FCM) pour rassembler les connaissances de 29 sages-femmes traditionnelles sur les facteurs de risque et de protection de la santé maternelle dans leurs communautés. Dans une deuxième application de la FCM, j'ai exploré les perspectives de huit chercheurs occidentaux interculturels sur les facteurs affectant la santé maternelle dans les communautés autochtones. Ces cartes ont servi à développer une méthode basée sur l'analyse du discours de Harris a fin d'évaluer l'influence des facteurs en fonction de leur fréquence. J'ai utilisé le FCM pour représenter une revue de la portée des études faisant état des influences sur la santé maternelle dans les communautés autochtones avec des sages-femmes traditionnelles dans les Amériques. J'ai adapté la technique du poids de la preuve (*Weight of Evidence*) pour ancrer la littérature dans les perspectives des parties prenantes locales.

Objectif spécifique 2 : J'ai analysé un essai contrôlé randomisé (RTC) en grappes de non-infériorité avec un groupe parallèle pour évaluer si le soutien aux sages-femmes traditionnelles selon leurs propres termes augmentait la sécurité culturelle (respect des traditions autochtones), sans pour autant détériorer les résultats en matière de santé maternelle. Dans les quarante communautés dans deux municipalités d'intervention, les sages-femmes traditionnelles et leurs apprenties ont reçu une allocation mensuelle ainsi que le soutien d'un courtier interculturel qualifié. Le personnel de santé a participé à un atelier visant à améliorer les attitudes envers les sages-femmes traditionnelles. Quarante communautés dans deux municipalités de contrôles ont continué à bénéficier des services de santé habituels.

Objectif spécifique 3 : J'ai décrit l'expérience de Guerrero. La réflexion résultante vise à promouvoir la sécurité culturelle et du dialogue interculturel pour éclairer la pratique future de la recherche interculturelle.

Ce projet a reçu l'approbation éthique des communautés participantes, de l'*Universidad Autónoma de Guerrero* et du comité d'éthique médicale (*Institutional Review Board*) de la faculté de médecine de l'Université McGill.

Résultats

Objectif spécifique 1 : Selon les sages-femmes traditionnelles, les risques les plus importants pour la santé maternelle consistaient à ne pas suivre les pratiques traditionnelles de soins auto-administrés, les maladies traditionnelles, la santé mentale des femmes et leur expérience de violence. Les facteurs de protection étaient l'implication des hommes, le soutien des guérisseurs traditionnels, et les rituels protecteurs. Les chercheurs participants ont fait part d'attitudes de respect pour les traditions autochtones et ont attribué à la continuité culturelle autochtone et à la sécurité culturelle la plus forte influence positive sur la santé maternelle. La pondération des relations causales, basée sur l'analyse de discours de Harris, a fourni des résultats similaires à ceux de l'évaluation des influences par les participants. La principale préoccupation des 87 études sélectionnées dans l'examen de la portée était l'accès aux soins de santé occidentaux. Ces études incluaient une grande variété de praticiens décrits comme des sages-femmes traditionnelles. Dans la carte produite à partir des résultats de l'examen de la portée, les pratiques de soins auto-administrés et celles de sages-femmes traditionnelles montraient les effets positifs les plus importants sur la santé maternelle, suivis par l'effet négatif de la marginalisation des communautés, des familles et des femmes. La littérature, les sages-femmes traditionnelles et les chercheurs ont tous identifié la promotion des pratiques culturelles comme étant importante pour protéger la santé maternelle autochtone.

Objectif spécifique 2 : Parmi 872 naissances, les mères des communautés d'intervention avaient des taux plus faibles de décès périnataux ou de complications à la naissance ou néonatales (différence de risque (RD)-0,06 95 % intervalle de confiance (CI) -0,11- -0,01) et plus de naissances à la maison avec une sage-femme traditionnelle et en présence de la famille (RD 0,10 95 % CI 0,02-0,18). Parmi les accouchements institutionnels, les femmes des communautés d'intervention avaient plus de gestion traditionnelle du placenta (RD 0,34 95 % CI 0,21-0,48) mais aussi plus de bains d'eau froide non traditionnels (RD 0,10 95 % CI 0,02-0,19).

Objectif spécifique 3 : Trois étapes contribuent au dialogue interculturel : 1. le renforcement de la confiance et le partenariat, 2. l'écoute et l'ajustement lexical pour identifier les contributions des sages-femmes traditionnelles, et 3. la co-conception, évaluation et discussion afin d'identifier les avantages du soutien aux pratiques traditionnelles.

Conclusions

Les sages-femmes traditionnelles ont une connaissance détaillée d des facteurs qui affectent la santé maternelle, ce qui enrichit les travaux de recherche publiés et peut servir de base à des interventions culturellement sécuritaires au sein de leurs communautés. Cette thèse a permis de développer une approche et des outils spécifiques pour faciliter le dialogue interculturel entre des acteurs aux perspectives différentes. À ma connaissance, cet essai contrôlé randomisé en grappes est le premier essai publié à tester l'impact du soutien à la sage-femme traditionnelle, plutôt que de la remplacer. Il confirme des résultats non inférieurs en matière de santé maternelle avec un plus grand nombre de naissances à domicile en présence d'une sage-femme traditionnelle et de la famille. Cette expérience constitue un point de départ pour faire avancer la collaboration avec les sages-femmes traditionnelles afin de promouvoir la santé maternelle dans les communautés autochtones.

Acknowledgements

This thesis was conducted in the territory of *Nabua*, *Na savi*, *Me'phaa* and *Nancue ñomndaa* Indigenous people in Guerrero, Mexico, and mostly written in the unceded territory of the *Kanein:keba'ka* (People of the Flint) nation in Quebec, Canada.

The authentic traditional midwives generously shared their knowledge throughout the research process. Their commitment to women's health in their communities will remain an inspiration beyond the limits of this project. The Indigenous communities participating in the project, led by their traditional authorities, contributed to systematising knowledge and to promoting action. The apprentices and intercultural brokers represent our hopes for a time in which the shadows of colonialism might fade or even disappear in the light of intercultural dialogue.

The *Centro de Investigación de Enfermedades Tropicales* (CIET) of the *Universidad Autónoma de Guerrero* is the sponsor of the RCT under the direction of Dr Sergio Paredes, a member of my thesis committee, and the CIET team he directed in Acapulco was central to the implementation of the study. Dr Neil Andersson, my PhD supervisor, designed the pilot of the RCT in Guerrero (BMx) and, along with Dr Sergio Paredes, Dr German Zuluaga, and Dr Robert Ledogar supported its adaptation for the full RCT (BMx2). Carolina Amaya designed and supervised the training program for intercultural brokers in Guerrero. The late Dr Ascencio Villegas Arrizón was a tireless promoter of the cultural safety of Indigenous groups of Guerrero State, and he supported the dialogue with traditional midwives until his death in 2012. I am deeply thankful for the opportunity offered by the strong technical and social bases they built.

As my PhD supervisor, Dr. Neil Andersson provided generous guidance and support, suggested avenues of research and offered constant advice to produce high-quality research. Dr Anne Cockcroft guided the preparation of the manuscripts and supervision of the products. Her support has been invaluable to disseminate my work despite language barriers. Dr Anne Marie Chomat contributed insights to the refinement of the main study. Abraham de Jesus García and Nadia Maciel Paulino generously developed my understanding of the local communities and fieldwork.

Colleagues at PRAM in the Department of Family Medicine contributed time and critical reviews of multiple drafts (David Loufi, Kendra Tonkin, Anna Dion, Juan Pimentel, and Nadia O'Brien). I feel blessed by their support and friendship, and the collegial environment they provided. I am grateful to Dr Tibor Shuster for his advice on advanced statistical methods and to Sherrie Child for her

administrative support. Multiple peer reviewers and editors contributed insights and ideas to enhance the communication of my work. Drs Anne Marie Chomat and Ángeles Toharia kindly helped to translate the abstract into French.

Araceli, Diego, Ángeles, Al, Nadia, Lala, and many other generous friends, provided a genuine network of support that allowed my family and me to feel safe and happy during five beautiful winters. Without the support of my parents and the many sacrifices of my wife and children, this thesis would not have been possible.

Funding acknowledgement

The pilot study (BMx) received support from UBS Optimus Foundation. CONACyT, the National Council of Science and Technology of Mexico, funded the full (BMx2) randomised controlled trial (PDCPN-2013-214858). The Quebec Population Health Research Network contributed to fieldwork, publication of the BMx2 protocol and the manuscript on fuzzy cognitive maps of traditional midwives. The Faculty of Medicine and the Department of Family Medicine of McGill University provided additional support for fieldwork and dissemination of partial results in academic environments. *La Fundación CeiBA* and the Center of Intercultural Medical Studies in Colombia, the Fonds de recherche du Québec Santé (IVASA1701, 255253) and the Canadian Institutes of Health Research (201804HI9-406583-290461) funded the PhD. The Department of Family Medicine at McGill University and CIET contributed to tuition, fieldwork and dissemination costs associated with this PhD project.

The design, management, analysis and reporting of this PhD project is entirely independent from all sources of funding.

Contributions to original knowledge

This manuscript-based dissertation comprises five scientific articles, two published, one in press and two currently under review. In addition, two first author published protocols are included as appendices. I intended the thesis as an original contribution to the field of Indigenous maternal health and participatory research, with a special focus on methods to incorporate stakeholder perspectives into the research process despite cultural barriers (Chapters 3 to 5); evidence on the impact of traditional midwifery on maternal health in Guerrero (Chapter 6); and promotion of cultural safety and intercultural dialogue between Indigenous and Western perspectives (Chapter 7).

Manuscript 1 (Chapter 3), published in a biomedicine methods journal, applies well-known fuzzy cognitive mapping (FCM)[1] to describe knowledge of traditional midwives about determinants of maternal health in their communities. The approach synthesises Indigenous views in a reproducible and informative way, opening a door for meaningful participation of traditional Indigenous communities in health research. Its application in other cultural contexts confirms wide relevance for giving voice to those who are not usually heard (Nigeria,[2] Uganda,[3,4] Botswana and Nunavik[5]).

Manuscript 2 (Chapter 4) presents the perspectives of eight intercultural researchers on factors that affect maternal health. My innovation, at the suggestion of Professor Andersson, adapted Zellig Harris' original discourse analysis[6] to weight the strength of causal relationships in fuzzy cognitive maps in the absence of participant estimates. Three other doctoral and one master's theses at the Department of Family Medicine have incorporated this method. Additional contributions of this thesis include a method to combine and condense concept maps. This manuscript is currently in press in a methods journal focused on human thought and behaviour.

Manuscript 3 (Chapter 5) is currently under review. I present the first comprehensive assessment of published and unpublished literature on maternal health and traditional midwifery in Indigenous communities in the Americas. Combining Giles and colleagues' contribution of using FCM to synthesise literature reviews[7] and the adaptation of Harris' discourse analysis offers a novel and practical method to present and to analyse the content of scoping reviews. The approach integrates quantitative and qualitative findings into soft models, allowing readers a visual understanding of relationships between variables. This offers a practical way to deal with the heterogeneity of studies and definitions characteristic of scoping reviews. Modifying the Weight of Evidence approach

developed by Anna Dion,[8] I contextualised the findings of the scoping review in stakeholder perspectives.

Manuscript 4 (Chapter 6), currently under peer-review, presents my analysis of the first randomised controlled trial testing the impact of supporting traditional midwifery on maternal and perinatal health outcomes. My role in the implementing team led by Dr Sergio Paredes was to contribute to the design and to lead the analysis. This unique study represents a major departure from the last century of inquiry focused on the assimilation of Indigenous communities into Western culture. Its result – that supporting traditional midwifery increased culturally safe childbirth without worsening health outcomes – opens a new horizon for evidence-based improvement of maternal and perinatal health in Indigenous communities.

Manuscript 5 (Chapter 7) is a practice paper published in an international journal on global health. I wrote this reflective piece to describe how the process in Guerrero has incorporated the concepts of cultural safety and intercultural dialogue. In this paper I identified concrete steps towards intercultural dialogue that could inform future research and practice. Building on my almost two decades of work with Indigenous elders, my primary motivation during this PhD project has been to bring Western and Indigenous knowledge closer to promote respectful research *with* Indigenous people. After completing my doctoral studies, I offer this thesis as a contribution to bridging a culturally safe encounter of two worlds.

Contribution of authors

Under the supervision of Dr Neil Andersson, I was responsible for the thesis design and the data gathering, analysis, interpretation, and writing of each manuscript included in this dissertation. My PhD is a product of my collaboration with the Safe Birth in Cultural Safety trial (BMx2), a participatory project in Guerrero led by Dr Sergio Paredes, a member of my thesis committee.

In the years preceding my involvement, CIET had built important levels of trust with participating communities in Guerrero, the most time-consuming stage in participatory research. As an MPH student at CIET, I took part in the BMx pilot surveys in the quality assessment of data collection and digitisation of the data. In 2015, I joined BMx2 as a PhD student with knowledge and understanding of its local context, intervention, and theoretical foundations. One of my early contributions was the write-up and publication of the protocol in *Trials* together with the key co-authors, provided as Appendix 1 to this thesis.[9] The Mexican team led by Dr Sergio Paredes rolled out the intervention and conducted the measurement. They requested my non-involvement in the RCT's fieldwork in order to reduce the bias in completing the formal analysis presented here.

Manuscript 1. *Fuzzy cognitive mapping and soft models of indigenous knowledge on maternal health in Guerrero, Mexico* (published in BMC Medical Research Methodology)

Iván Sarmiento, Sergio Paredes-Solís, David Loutfi, Anna Dion, Anne Cockcroft and Neil Andersson

I designed and conducted the fieldwork for this study and obtained additional funding. As lead author, I analysed the data, drafted the manuscript and interacted with peer-reviewers. Dr Neil Andersson supervised the research and guided the application of FCM. Sergio Paredes developed collaboration with traditional midwives and advised on the field procedures. Anna Dion and Drs Anne Cockcroft and David Loutfi provided advice for the methods and interpretation of results. Drs Andersson and Cockcroft advised on the English version of the text. All authors read, contributed to, and approved the final manuscript.

Manuscript 2. *Combining conceptual frameworks on maternal health in Indigenous communities – Fuzzy cognitive mapping using participant and operator-independent weighting* (in press in SAGE Field Methods)

Iván Sarmiento, Anne Cockcroft, Anna Dion, Sergio Paredes-Solís, Abraham De Jesús-García
David Melendez, Anne Marie Chomat, Germán Zuluaga, Alba Meneses-Rentería, Neil Andersson

I conducted the individual mapping sessions in this study and analysed all maps. I developed the pattern matching tables to combine multiple maps and documented the procedure to condense factor maps into category maps. Dr Andersson supervised the work and recommended exploration of Harris' discourse analysis for operator-independent weighting. I developed the procedure used in this article. Dr Cockcroft read and corrected the manuscript to improve clarity and conciseness. Anna Dion reviewed the methods and advised on their presentation. Abraham García, David Melendez and Drs Paredes, Chomat, Zuluaga and Meneses contributed to refining the categorisation of factors in the maps. All authors read, contributed to, and approved the final manuscript.

Manuscript 3. *Maternal health and Indigenous traditional midwives in southern Mexico: contextualization of a scoping review* (under review in BMJ Open)

Iván Sarmiento, Sergio Paredes-Solís, Anna Dion, Emily Vargas, Paloma Cruz, Hilah Silver, Juan Pimentel, Germán Zuluaga, Anne Cockcroft, Neil Andersson

I designed and published the protocol of the study in the journal BMJ Open, provided as an Annex to this thesis.[10] Then, I conducted the scoping review and wrote the manuscript. Dr Andersson supervised the work. Drs Paredes and Cockcroft contributed to the design and running of the study. Dr Zuluaga helped resolve discrepancies in the definition of categories, draft the manuscript, and discuss results. Emily Vargas, Paloma Cruz, Dr Juan Pimentel, and I selected the studies and extracted data. Anna Dion and Hilah Silver collaborated in development and adjustment of mapping procedures. All authors read, contributed to, and approved the final manuscript.

Manuscript 4. *Safe birth in cultural safety in southern Mexico: a pragmatic non-inferiority cluster-randomised controlled trial* (under review in BMC Pregnancy and Childbirth)

Iván Sarmiento, Sergio Paredes-Solís, Abraham de Jesús García, Nadia Maciel Paulino, Felipe René Serrano de los Santos, José Legorreta Soberanis, Germán Zuluaga, Anne Cockcroft, Neil Andersson

I contributed to the design and conducted the statistical analysis and qualitative evaluation of the intervention with traditional midwives and drafted the manuscript. Dr Andersson proposed the idea of the study and supervised my contribution to the work. Felipe Serrano and Drs Paredes and Legorreta managed the trial fieldwork and coordinated data collection. Abraham García and Nadia Maciel supported the implementation as field coordinators. Dr Zuluaga designed the training program for intercultural brokers and advised the intercultural approach. Dr Cockcroft supported the analysis and the final drafting of the article reporting the results. All authors read, contributed to, and approved the final manuscript.

Manuscript 5. *Bridging Western and Indigenous knowledge through intercultural dialogue: lessons from participatory research in Mexico* (published in BMJ Global Health)

Iván Sarmiento, Germán Zuluaga, Sergio Paredes-Solís, Anne Marie Chomat, David Loutfi, Anne Cockcroft, Neil Andersson

I developed the concept and drafted the document that identified steps in intercultural dialogue under Dr Andersson's supervision. Drs Paredes and Zuluaga participated in the codesign of the interventions reported here and established the basis of the intercultural dialogue approach in Guerrero. Drs Cockcroft, Chomat and Loutfi provided a critical appraisal of the approach and its theoretical considerations. All authors read, contributed to, and approved the final manuscript.

Chapter 1: Introduction

The issue

Maternal morbidity and mortality remain inequitable burdens for Indigenous women in Mexico as in many other countries.[11–13] Modern obstetric care, especially in emergencies, can be key to maternal and infant survival.[14,15] Yet in remote Indigenous communities where needs might be more pressing, women almost invariably receive poorer than average health services.[16,17] Inappropriate allocation of state resources and weak local governments are part of the problem on the supply side.[18] On the demand side, many Indigenous women shun these services due to the lack of interaction in Western medical facilities with traditional culture.[19–21] Long distances to facilities, costs, family influence, social status, apprehension about perceived low quality medical interventions, and discrimination on the part of health workers, further reduce access to facility-based health care.[22–25]

Over their long histories, Indigenous groups have developed traditional health systems that include practitioners, knowledge, skills and practices to promote and maintain their health.[26,27] Traditional midwives are usually part of these traditional health systems and, in Mexico's Guerrero State, they have accompanied women through motherhood for several centuries. Colonial history and modern economic development have weakened their role in contemporary safe motherhood. The consequence for Indigenous mothers is low-quality Western health care services at the periphery of that system, and attenuated resources in their own systems.

There is growing international recognition of Indigenous traditions[28,29] and their potential contributions in primary health care.[30,31] National legislation in Mexico encourages protection of Indigenous people and promotion of their traditional medicine.[32–34] This is at odds with international recommendations that promote Western standards as the only valid source of skilled attendance for mothers.[35] Without recognising traditional practices, local health services often lack cultural relevance for Indigenous peoples.[21,36] An environment of mutual mistrust between Western providers and traditional midwives hampers collaboration that could afford Indigenous women the best of both worlds.

A consultation with 113 countries reported three main challenges for adequately regulating the interactions between Western and traditional health systems: lack of research data, lack of financial support for research and lack of mechanisms to monitor safety of traditional practices.[27] There is

almost no research on safety or efficacy of traditional midwifery in the Americas. In addition to methodological challenges,[37] biomedical practitioners' disregard for and lack of knowledge of Indigenous traditions hampers research on these topics.[38] The WHO position is that research on traditional medicine, including midwifery, is needed to guarantee the safety and efficacy of traditional procedures but should not weaken these traditions.[37] But these recommendations do not correspond with the content of international guidelines for maternal health promotion, and current research and interventions on traditional midwifery continue to focus on replacement of traditional midwives or their assimilation into the Western health system.[39,40]

As part of a response to this assimilation and replacement of traditional practices, the notion of *cultural safety* appeared in New Zealand in the late 1980s.[41] A key tenet of cultural safety is that patients and communities should define culturally safe care.[42] This is particularly relevant for safe birth because a positive environment for childbirth in one culture might be inappropriate or unacceptable in another.[3,4] Few initiatives in Latin America or Mexico have implemented this approach.

Research objectives

In the context of appalling maternal health outcomes threatening Indigenous mothers and babies in Guerrero, this project addressed a major gap that required new knowledge and action: Where traditional midwives are the only perinatal care available, few empirical studies have assessed impact of their role on health outcomes or how Western health services can best work *with* them.

My research question was: What is the influence of traditional midwifery in birth outcomes and cultural safety experience among four Indigenous groups in Guerrero, Mexico?

The thesis overall objective was to explore the role of authentic traditional midwives in promoting safe birth in cultural safety among Indigenous communities of Guerrero, Mexico. This involved meeting three specific objectives:

1. Understand how traditional midwives and intercultural researchers contextualise safe birth in local Indigenous cultures;
2. Test the impact of supporting traditional midwives, in their own terms, in a cluster randomised controlled trial;
3. Reflect on generalisable implications of the evidence and engagement in these settings.

Chapter 2: Research approach and methods

Terminology used and justification

This section introduces the concepts of the traditional Indigenous midwife and skilled birth attendant, terminology that is central to understanding the contemporary approach to traditional midwifery. It includes a summary of the evidence on re-training of traditional midwives; this does not form part of Chapter 5, a systematic scoping review of traditional midwifery and maternal health in the Americas.

Traditional midwives

For purposes of this thesis, I distinguish between three categories of birth attendants in Indigenous contexts:[43] (1) casual or coincidental birth helpers, who might help in a family or neighbourhood emergency; (2) trained birth attendants, who are individuals who have received training in Western birth practices and who might have received an official certification; and (3) authentic traditional midwives, whose recognition by their communities is reflected in the number of births they attend each year, the outcomes for their patients and the traditional knowledge they hold. The methods section of Appendix 1 expands on these definitions and how these roles differ from those of other health care providers.

The central character in my thesis is the authentic traditional midwife. For economy of words, I use the contract term "traditional midwife", and I deliberately avoid the presumed limitation of tasks in the term traditional birth attendant or acronyms easily confused with Western concepts of trained or traditional birth attendant (TBA).

Beyond their technical role in pregnancy and birth, in Indigenous societies traditional midwives are counsellors and knowledge bearers, transmitters of culture and cultural values.[44] Distinguishing them from trained birth attendants, traditional midwives are rooted in community and culture, their role confirmed year after year by the confidence their communities place in them. Even global health specialists who advocate for replacing traditional midwives generally acknowledge it is worth keeping aspects of their accepted role: "the sense of caring, the human approach, and the response to cultural and spiritual needs".[45]

With notable exceptions in some Indigenous groups, most traditional midwives in Mexico are female – the *Me'phaa* or Tlapaneco of Guerrero also have male *parteros*. Traditional midwives are

often involved in ceremonies of menarche and accompany women through pregnancy, attend the birth, and advise on care of the new-born. This is very different to Western obstetric care, where an obstetrician or even a Western-trained birth attendant might meet the woman for the first time during a childbirth, perhaps to see her only once again post-childbirth. In addition to sharing the same culture as their patients, traditional midwives have similar socio-economic conditions and access to similar resources for health care.[43]

Some traditional midwives in Mexico do take government training courses, as do other women who are later identified as trained birth attendants, because the official training allows them to obtain birth certificates for the children they deliver; sometimes they need the training for permission from health authorities to practise.[46,47] Traditional midwives often incorporate some aspects of Western lexicon or practice, such as cutting of the umbilical cord with scissors instead of using a small piece of reed, as they accommodate requirements of the dominant system.[48–50]

Skilled attendance and enabling environments

In 1997, a gathering of multilateral institutions co-sponsoring the International Safe Motherhood Initiative suggested the term *skilled attendants* was relevant to safe motherhood.[35,51] Promoters of this appellation assumed that compliance with international regulations and standards would assure a higher level of competency and quality of care.[52] According to this initiative, a *skilled attendant* is someone trained:

"to provide competent care during pregnancy and childbirth and is able to manage normal labour and delivery, recognise the onset of complications, perform essential interventions, start treatment, and supervise the referral of mother and baby for interventions that are beyond their competence or not possible in the particular setting." [53]

Based on this definition, the World Health Organization (WHO) excluded traditional midwives from the category of skilled birth attendants,[54] regardless of their experience in pregnancy care, normal labour management or demonstrated response to complications. According to Jordan, this is a cultural definition of authoritative knowledge, seen as the knowledge that counts at the moment of deciding and acting.[55]

Excluding traditional midwives from the category of skilled birth attendants is based on the premise that authoritative knowledge is outside the reach of traditional practitioners, in what Davis-Floyd called the Western technocratic model.[56] There is no unanimously accepted international definition of what constitutes "skilled". Among *licenced midwives* who completed an accredited

program and who are legally licenced to practise, for example, there is a discussion on whether practitioners should conform to a restrictive Western definition or celebrate the diversity of cultural perspectives.[57,58]

With the paucity of reliable RCT data on the health effects of differently defined skilled attendants, a review of available evidence led Graham and colleagues to suggest that three other evidential bases supported the "belief that risk of maternal death can be reduced by skilled attendance"[59]: first, modeling causal pathways indicated likely impact for individuals; second, historical epidemiological data from countries in Northern Europe suggested population or aggregate level impact; and third, country-level correlations between proportion of skilled attendance and maternal mortality.

At least part of the problem of generating stronger evidence on the impact of skilled attendants could be lack of consensus around a definition.[39] MacDonald and Starrs reported the movement promoting skilled attendants recognized this category of health worker alone cannot make the difference; timely access to quality maternity care and working with communities are crucial.[53] Consequently, the term *skilled attendance* comprises both skilled attendants and an enabling environment.[60]

An enabling environment comprises interacting contextual elements that contribute to reach the maximum positive impact of skilled attendants on maternal health. The concept has been conflated with a functioning health system or provision of quality care.[61] The elements that constitute an enabling environment would change depending on the contexts and practices, while some would focus on operative dimensions, such as "relevant training, ongoing professional support, adequate infrastructure, equipment and drugs and timely referral pathways",[61] others would put emphasis on dimensions such as political commitment of governments and communities, gender equity, strong professional identity or interprofessional relationships.[62,63]

Jordan's comparative approach to the study of birthing systems has described how different conditions are necessary to enable safe birth across multiple cultural contexts.[38] Engagement of family members, fulfilment of protective rituals, having territories that provides resources of enough quality and amount, rapport between traditional midwives and their patients, are examples of these elements in indigenous communities. Unfortunately, with cultural loss and disruption of indigenous birthing systems, indigenous enabling environments are also disrupted and decrease their potential to contribute to safe birth.

Application of the same concept of enabling environments to traditional midwives surfaces three ideas:

- The centuries-old enabling environment of Indigenous communities has been disrupted and this could prejudice health outcomes. Chalmers explains that Indigenous groups in South Africa are cultures in transition, no longer with their own traditional birthing systems, while Western medicine does not fully provide a new one.[44] The same jagged edges are likely to affect Indigenous peoples in Mexico.
- Traditional midwives usually provide services in places with higher maternal mortality (like Guerrero State in Mexico) that also have lower income levels, weaker governmental services and poor coverage with schools and health services. Any assessment of traditional midwives' impact should consider the effect of these covariates,[64] and this is not easy in ecological comparisons.
- In the context of eroded enabling environments in Indigenous communities, it is reasonable to ask whether extending Western health care environments to collaborate *with* the skills of traditional midwives might generate positive maternal outcomes.

Cultural safety

The notion of *cultural safety* appeared in the late 1980s in nursing services provided to Maori groups.[41] This idea recognises the colonial, historical and sociopolitical context in which health disparities appear and invites service providers to self-reflect on the impact that cultural identity and assumptions have in perpetuating power imbalances behind these disparities.[65]

Cultural safety depends on service users' perception of respect from the service providers and the delivery of quality care that contributes to improved health and well-being, while empowering and fortifying the cultural identity of the patient.[66] Cultural safety enables a scenario that people regard as spiritually, socially, emotionally and physically safe because there is no assault or denial of who they are or what they need.[67] An important implication of cultural safety is that this can only be assessed by those whose culture is threatened because only they know what is harmful according to their worldviews. The progress towards achieving health equity is also a measurement of cultural safety.[42]

One criticism of the cultural safety discourse is that, by placing all the power and potential for aggression on one side of the balance, it might approach culture in terms of vulnerability rather than strengths, thus potentially contributing to essentialising and stereotyping ethnocultural groups.[68]

I revisit this concept in Chapter 7 and in the Discussion.

Traditional midwives and safe birth

The term safe birth recognises that childbirth is a complex process that starts even before pregnancy and includes the postpartum period, with multiple steps in between that contribute the health of the mothers and their children. According to Graham, maternal health is commonly conceptualised as a discrete state of negative outcomes in terms of morbidity and mortality, characterised by physical rather than social or mental manifestations, and by a narrow time perspective.[69] Especially in the context of Indigenous communities, spiritual and environmental domains are highly relevant.

Graham suggested the need for flexible interpretations to recognise that "maternal health encompasses positive or negative outcomes—physical, social or mental, in a woman from any cause related to childbearing or its management".[69] In this thesis, I used Safe Birth in its broad meaning as an equivalent to positive health outcomes. The methods section of Appendix 1 describes the concept of maternal health in more detail.

The contribution of traditional midwives to safe birth in Indigenous communities is the subject of ongoing debate.[70,71] Between the early 1980s and mid-1990s, several studies in low income settings considered short-term task-oriented training of non-traditional birth attendants, and "re-training" of traditional midwives in Western birthing concepts and practices.[72] There is documentation of training traditional birth attendants in colonial contexts dating back to 1921, when a British missionary midwife started such a program in Sudan.[73] The main argument behind these programs was that, with additional training, traditional birth attendants would become Western health workers and extend the provision of those health services to a greater proportion of the population.[74–77]

Research on re-training and its benefits assumes inferiority of traditional practice or at least a lack of competence in birthing techniques.[78] The lexicon and content emphasis in this literature is about compliance with Western birthing concepts, rarely addressing the strengths or relevance of traditional midwifery.[74]

The re-training approach suggests that traditional midwives

"must be welcomed by the health care system and seen as an extension of it to serve as an advocate for skilled care, encouraging women to seek care from skilled attendants."

"The younger and the most able [...] with educational backing and access to appropriate adult education programmes, may be able to enter a midwifery programme. Alternatively, they may become auxiliary midwives or support workers for skilled attendants." [54]

Since 2015, international recommendations for maternal and newborn health have formally recognized the role that traditional midwives can play in supporting the health of women and newborns.[79] This recognition translates into a redefinition of the roles for traditional midwives in support of Western views of skilled attendance.[48,80–83] The WHO's 2017 international guidelines suggests these new roles might include "promoting the uptake of a number of maternal and newborn-related health care behaviours and services, providing continuous social support during labour in the presence of a skilled birth attendant".[84]

A systematic review of 60 experimental and quasi-experimental studies of re-training traditional birth attendants, mostly in low and middle-income countries, found that participants remembered the content of the courses ("improvement in knowledge, attitude, behaviour, and advice") and a reported statistically significant if small reduction of perinatal and postnatal mortality.[85]

A 2009 systematic review reported low to moderate quality evidence suggesting that training birth attendants can improve linkages with facilities and improve perinatal outcomes; meta-analysis indicated an 11% reduction in intrapartum-related neonatal mortality.[86] In the same year, another systematic review identified four prospective cohort studies (Senegal, Gambia and Bangladesh) and one RCT in Pakistan testing community-level interventions involving traditional birth attendants; only the study in Bangladesh reported significant reduction of maternal mortality.[87]

A 2011 meta-analysis considered six cluster randomised controlled trials (RCT) and six non-randomised studies providing support to traditional birth attendants in Western terms. The studies offered training on Western techniques, kits with supplies to implement them and enhanced referral pathways.[88] All six RCTs reported a reduction in perinatal death (NNT 35, 95%CI 24-70) and neonatal death (NNT 98, 95%CI 66-170). Three RCTs reported on maternal mortality, and all showed a non-significant reduction (relative risk (RR) 0.79 IC95% 0.53-1.05); three non-randomised studies yielded similar results (RR 0.8 IC95% 0.44-1.15).

A 2012 Cochrane review of six studies (one multicounty study in Democratic Republic of Congo, Guatemala, India, Pakistan and Zambia, two studies in Bangladesh and other studies in Malawi, Pakistan and Zambia) with heterogeneous results concluded there was potential benefit in training birth attendants to reduce perinatal mortality when combined with improved health services. There was a non-significant reduction in maternal mortality (adjusted odds ratio ORa 0.74, 95%CI 0.45 to 1.22) across the studies.[89]

A synthesis of systematic reviews published in 2014 reported significant improvement in referrals (RR: 1.4, 95% CI: 1.19-1.65), significant reductions in maternal morbidity (RR: 0.75, 95% CI: 0.61-0.92), neonatal mortality (RR: 0.76 95% CI: 0.68-0.84) and perinatal mortality (RR: 0.80, 95% CI: 0.71-0.91) in low and middle income countries of community based intervention packages that included training traditional birth attendants[90,91]

A multicounty before and after study in 2010 found reduced stillbirth rates but no reduction in neonatal mortality when traditional attendants received training,[92] a similar study in Zambia found reduction of neonatal mortality among urban communities (N=71 689).[93] In 2012, an unblinded cluster randomised trial (N=3497) reported reduced neo-natal mortality among infants delivered by traditional attendants who received training and equipment (rate ratio 0.55, 95%CI 0.33-0.90).[94] In 2019, a large (N=48 956) prospective population-based study in Zambia found home childbirths by trained traditional birth attendants were related to significant reductions in early neonatal and perinatal mortality, and fresh stillbirth or day-1 neonatal mortality.[95]

A 2012 cluster randomized trial in Zambia recommended re-training traditional midwives as a highly cost effective way to reduce neonatal mortality,[96] and a 2014 systematic review offered additional evidence in favour of this.[97] However, the cost-effectiveness of re-training traditional midwives is not well established as an intervention to reduce maternal mortality and the general recommendation has been to focus on increasing skilled attendance and Western high-quality care.[98,99]

A limitation of the published knowledge syntheses described in this section is the potential duplication of studies among them. An analysis to disentangle the overall effects of the interventions will require identifying each of the studies and evaluating the quality of the reviews using AMSTAR.[100] This is outside the scope of this thesis. The heterogeneity of countries, interventions and traditional practices included in the studies makes it more difficult to compare the results with

the context of Guerrero. None of the literature reviews identified a published RCT that tested the value of original practices of traditional midwives.

In conclusion, the evidence on impact of re-training traditional midwives was highly context-specific.[81] Positive impacts were related to (1) better communication between traditional birth attendants and the formal health care system[101,102] and (2) being part of complex community-based intervention packages that included additional components such as transport to facilities or support of community health workers, among others.[103]

Description of study setting

In Guerrero, Mexico's third poorest state in 2016 when this project formally began,[104] about 14% of the population is Indigenous.[105] Of 460,000 Indigenous people in the state, one in every four (23.2%) do not speak Spanish; *Nahua* make up 36%, *Na savi* (Mixteco) 29%, *Me'phaa* (Tlapaneco) 25%, and *Nancue ñomndaa* (Amuzgo) some 10%.[106] They live in scattered and often remote communities with poor access to government services and subsist mainly on income from migrant labour, small-scale agriculture and cattle. These remote communities face high rates of violence associated with the production and trafficking of illegal drugs. The violence that characterises the region also affects women during pregnancy.[107] The culture of *machismo* in the region adds a layer of complexity by precluding a more active role for women in decision making about the type of care they receive.[108]

Only one half of Guerrero's population over the age of 15 years has completed secondary education, a requirement for training as a skilled birth attendant in government programs. Some 13.6% of this population is illiterate.[109] This reduced access to education is exaggerated among Indigenous populations: only one in four Indigenous women has completed secondary education, and illiteracy rates are five times higher than those in the general population.[110]

Guerrero state has the second-lowest life expectancy at birth of 32 Mexican states (31 and the federal district) (72.9 years).[111] It had the highest maternal mortality in the country in 2016 (61.6 deaths/100,000 live births in 2016 and 72.4 deaths/100,000 live births by the end of 2020),[112–115] and the fourth-highest infant mortality (13.1 deaths/1,000 children under one year).[116] There are other important differences between regions of Guerrero. The municipalities participating in the study are among the most disadvantaged. They have a high proportion of Indigenous groups in the population: *La Montaña* (municipalities of Acatepec and Atlixnac) and *Costa Chica* (municipalities of

Xochistlahuaca and San Luis Acatlán) (Figure 2-1).[109] The average monthly income in *La Montaña* is about USD40 per person, and for Indigenous language speakers, it is lower (about USD34).[111]

Figure 2-1 Map of the participating municipalities



Source: the author drew the map using vector maps from CIET

The alarming health situation in this region has motivated responses from public authorities and maternal mortality has decreased since the turn of the century. But these results have been insufficient to relieve the burden of ill health.[111] A government conditional cash transfer program offers a monthly incentive to Indigenous women to attend official health care services.[117] Where health services are available outside the cities, notwithstanding the cash incentive to attend, facilities are almost invariably poorly staffed and of poor quality. In part, this is due to a low budget, lack of

preventive programs, and staffing by recently-qualified temporary medical personnel, who are only there to complete their obligatory social service.[111,118,119]

A cross-sectional study in Guerrero reported a significantly lower risk of perineal trauma in women attended by a traditional midwife when compared to other sources of care (adjusted OR 0.41, IC95% 0.32-0.54); women delivering in a health facility reported episiotomy and perineal shaving as a source of discomfort.[120] These are routine practice in many official health facilities in the region, despite evidence and recommendations discouraging these procedures.[121,122]

In Mexico, maternal and perinatal mortality have reportedly decreased since 2009,[109] although how this happened in Indigenous groups is poorly documented. Notwithstanding the improvement across the board, a pregnant woman who speaks an Indigenous language is still three times more likely to die during pregnancy or childbirth than one who does not speak an Indigenous language.[13] Maternal death is four times more likely among women living in the poorest municipalities of the country.[13] Despite national improvements in maternal health, marked inequities persist, and marginalised groups with low access to schools and to medical care have worse outcomes.[123] A pregnant woman living in either *La Montaña* or *Costa Chica* regions of Guerrero state is ten times more likely to die than a woman in any other of the seven regions of Guerrero.[124] Between 2002 and 2013, one out of every three women who died in childbirth in *La Montaña* had not received institutional health care.[111] Two additional statistics stand out in the study area: there is a higher demand for support services for domestic violence,[111] and at least one out of every five pregnant women is 15- to 19-year old.[125]

Most perinatal care for Indigenous women in *La Montaña* region is provided by Western-trained physicians (54.6%); Western-trained nurses reach 4.2% of pregnant women, and traditional midwives reach one in every five (20.7%). Some 20.5% of the Indigenous mothers in the region do not have any antenatal care. Among those who do, three out of every ten receive less than five antenatal check-ups, the minimum indicated by Mexican official guidelines. About one-third of births (36%) are attended by Western physicians, 8% by nurses, 48% by traditional midwives, and 8% of Indigenous women have "other" or no assistance.[126]

Positionality statement

I was not brought up in an Indigenous culture, but I joined this research project with a 15-year history of living and working with Indigenous communities in the Colombian Amazon. As a geographer, I was invited in 2001 to implement a geographic information system linking Indigenous and scientific knowledge in the Colombian Amazon. Communities used this tool to protect over 1500 km² of Indigenous territories, and to explain to the Colombian Government the Indigenous elders' views about environmental management. Since then, I worked with Indigenous groups in understanding their knowledge and bridging their relationships with Western counterparts, mostly in the area of health. Over the years, the shamans of these Indigenous communities generously shared with me some of their complex understanding of health, which includes natural and cultural dimensions. I am fully aware their purpose was to have a broker who could help to bring Western science closer to them. During this process, I became one of their patients and benefitted greatly from their medicine.

Under the supervision of family doctor Germán Zuluaga and an Ingano healer Taita José Becerra, I worked as a member of the *Grupo de Estudios en Sistemas Tradicionales de Salud* (Traditional Health Systems Studies Group), affiliated to the Faculty of Medicine and Health Sciences at the *Universidad del Rosario*, one of the most conservative and conventional institutions in Colombia. Coming from a background in geography, I was aware from early in my career of the need for both quantitative and qualitative methods in research. Under the mentorship of Drs Neil Andersson and Germán Zuluaga, I completed a Master in Public Health in Guerrero, with an emphasis in Epidemiology, which provided a solid foundation in quantitative health research. My PhD studies consolidated an interest in mixed methods and my commitment to participatory research. The program increased my understanding of Western scientific thinking and provided good examples of rigorous research. As a student in the Department of Family Medicine, I consider my research situated on the Western shore of the intercultural divide. I value and respect Western medicine and intend to contribute to its improvement.

Notwithstanding my current position on the Western shore, I believe in the importance of the spiritual dimensions of health and health care, dimensions that are central to Indigenous knowledge and often overlooked in Western science. I see this as one of several elements that dialogue with Indigenous knowledge bearers could help us to understand better. I am married and have three

children, one was borne at home, and the other two were born in a high-quality hospital, all with the support of family doctors.

Methodological overview

Participatory research provides a conceptual and practical approach to work in partnership with people affected by research issues and those who use research results.[127] According to Andersson, core components of authentic participatory research include co-ownership of the research, primacy of local evidence or experience, and innovation by participants.[128] I will describe below how this framed and informed in my project. The methodological challenge was to apply tools that respect different ways of understanding reality, contrasting and, where possible, combining conclusions derived from multiple perspectives. The research of this thesis used a mixed methods design with a dialectic stance, as defined by Greene and Hall,[129] to allow for meaningful engagement of multiple ways of seeing and knowing into the same study. According to these authors, dialectic stance recognises points of convergence and divergence between multiple traditions as sources of insights that contribute to increased understanding of the research topic. Table 2-1 describes the research program of the doctoral project according to the three specific objectives of the thesis.

Table 2-1. My research program

General research question: What is the influence of traditional midwifery in birthing outcomes and cultural safety experience among four Indigenous groups in Guerrero, Mexico?			
General objective: To explores the role of authentic traditional midwives in promoting safe birth in cultural safety among Indigenous communities of Guerrero, Mexico.			
Objective	Methods	Participants	Outcomes
1. Understand how traditional midwives and intercultural researchers contextualise safe birth in local Indigenous cultures	FCM modelling the knowledge of traditional midwives on factors related to safe birth Chapter 3	29 traditional midwives	Relevant factors for maternal health according to stakeholder perspectives
	FCM modelling the understanding of the researchers on factors related to safe birth in cultural safety Chapter 4	8 intercultural researchers	Relevant factors for maternal health according to stakeholder perspectives Method for FCM operator-independent weighting
	Scoping review of studies that identify factors associated with safe birth in Indigenous communities in Latin America Fuzzy cognitive mapping Adaptation of the Weight of evidence Chapter 5 and Appendix 1.	Not applicable	Map of available evidence on traditional midwifery Relevant factors for maternal health according to the literature Models that incorporate literature and stakeholder perspectives
2. Test the impact of supporting traditional midwives, in their own terms, in a cluster RCT	Parallel group cluster randomised controlled trial Cluster-level analysis of risk differences Generalized linear mixed models Efficacy analyses (per-protocol) Chapter 6 and Appendix 2	872 completed pregnancies	Evidence on the non-inferior performance of an intervention based on supporting traditional midwives' role and additional benefits on culturally safe childbirth.

3. Reflect on generalisable implications of evidence/ engagement in these settings	Narrative summary of the program in Guerrero Chapter 7	Not applicable	A practice paper to describe the experience of bridging Western and Indigenous knowledge in the promotion of maternal health
--	--	----------------	--

Co-ownership of the research

This PhD is a part of the larger Safe Birth in Cultural Safety (BMx2) project, which aimed to improve maternal and newborn health in Indigenous communities in a way that respects and strengthens local cultures and traditional midwifery. The local CIET team has a long-lasting partnerships with Indigenous communities, researchers and international advisors. As part of its decades-long relationship with *Nancue ñomndaa* (Amuzgo) communities in the municipality of Xochistlahuaca in Guerrero, researchers at CIET, in the *Universidad Autónoma de Guerrero*, responded to a 2008 request from these communities to help them address poor maternal health. As explained in Chapter 7, CIET's respectful attitude towards Indigenous ways generated an environment of trust and facilitated co-ownership of the research by Indigenous counterparts. My project builds on the strong bases established during these initial stages.

Local evidence and experience as knowledge

A recurring issue in intercultural research is whose knowledge informs the conceptualisation and design of projects or interventions. The challenge here is to hold local knowledge on a level playing field through the shared conceptualization of problems and decision making about solutions.[128] In my thesis, this task began with documenting and juxtaposing the views of three stakeholder groups: the scientific literature, the research team, and the traditional midwives (Section 1). Fuzzy cognitive mapping (FCM) was the key tool for reconciling the three knowledge sources. FCM is a graphic representation of soft models composed of nodes or concepts and relations between those concepts. Each concept is a node, and each relationship represented as an arrow linking nodes. These graphs represent assumptions on causal relations and can be based on empirical study data or on unwritten knowledge.[130] The direction of the arrows indicates the causal relationship.[131] The relationships receive different weights to quantify their strength in a relative way (hence the term fuzzy). As the causal knowledge is often uncertain, or at least different from the viewpoints of different stakeholders (for each of whom it might feel certain), fuzzy models allow us to understand "hazy degrees of causality between hazy causal concepts" using fuzzy causal logic.[132]

Analysis of fuzzy cognitive maps in my work used fuzzy transitive closure,[133] an algorithm to identify the logical effect of one node on another when considering all the relationships in the map. Graph theory offers additional measures to describe the influence of nodes based on their incoming and outgoing arrows and their respective weights (indegree or outdegree centrality).[134,135] Giles and colleagues used FCM to portray Indigenous perspectives on diabetes in Canada, and my application with traditional midwives was possibly the first time this technique was used with Indigenous groups who exclusively spoke their traditional languages (Chapter 3).

The *Weight of Evidence* procedure developed by Anna Dion and colleagues uses FCM to contextualise literature-based evidence according to the knowledge of relevant stakeholders.[8] This development took place during my thesis, providing an opportunity to participate and to adapt its application in my work. I used FCM to summarise the results of a scoping review that followed well-accepted methodological guidelines[136,137] and a pattern matching table to contrast the literature map with stakeholder maps (Chapter 5).

Although FCM is relatively culturally neutral and its graphical language facilitates communication across cultural and educational divides, its application in Canada,[5] Nigeria[2] and Uganda[3,4] found participant weighting could be challenging. Participant weighting is time-consuming and can affect participant engagement in adverse ways. In cultures that do not parse elements of causality, including the Inuit of northern Quebec (Nunavik), it was difficult to assign different strengths to the causal components identified in the maps. Although this was not a source of concern in my work with traditional midwives in Mexico, I worked with Dr Neil Andersson in addressing this issue with a method based on Harris' original discourse analysis. We used the maps of the intercultural researchers in an innovative way to contrast the results of this procedure with maps initially weighted by their authors (Chapter 4).

Beyond the scope of this research project but answering the same methodological concern of relevance of local evidence and experience, the project in Guerrero proposes using the maps produced in this thesis as Bayesian priors in a stakeholder-lead analysis of the experiment described in the next section.

Participant innovations

Recognising the evidential value of local knowledge opened the ground for participant innovations in the form of a co-designed intervention. Based on Andersson's methodological innovations in

participatory trials,[138,139] a parallel group pragmatic cluster-randomised controlled trial (ISRCTN 12397283) tested the non-inferiority of maternal health outcomes of the intervention. This differed from conventional trials, in which the authorship of the interventions belongs exclusively to researchers or their funders. In the Safe Birth study in Guerrero, the intervention resulted from a co-design exercise during the BMx pilot study and subsequent discussions with traditional midwives in the four Indigenous groups. The intervention included activities to revitalize traditional midwifery and improve traditional midwives' interface with the Western healthcare system. In forty communities in two intervention municipalities, traditional midwives and their apprentices received a monthly stipend and support from a trained intercultural broker. Local official health personnel attended a workshop to improve attitudes towards traditional midwifery. Forty communities in two control municipalities continued with usual health services.

The intervention did not question the management of motherhood in these communities nor try to retrain already experienced traditional midwives, who remained autonomous in their own practice. Traditional midwives defined their activities in the communities and implemented them with the support of an apprentice and an intercultural broker. I present the study protocol in Appendix 2, which includes a detailed description of the intervention.[9] At the request of CIET's team, I was not involved in the RCT fieldwork but assigned, as part of the protocol to reduce bias, to complete the formal analysis presented in this thesis.

The hypothesis of the Safe Birth in Cultural Safety trial was that the co-designed intervention in support of traditional midwifery would not result in worse maternal and newborn health outcomes but would increase secondary effects favouring cultural safety and health outcomes. The statistical analysis of the RCT used conventional techniques to compare the effect of the intervention at the cluster- and individual-level using a cluster t-test and generalised linear mixed modelling, respectively (Chapter 6).

I designed and conducted a qualitative evaluation with participating traditional midwives to establish different implementation levels and incorporated its results in a sensitivity analysis using three techniques. First, per-protocol analysis compared control communities with those intervention communities with good performance in all the intervention components. Second, an analysis of communities as treated compared four different levels of implementation. And, third, an instrumental variable analysis compared all the communities as allocated and adjusted the effect

measures by the proportion of communities with good performance in all the intervention components.

The project in Guerrero includes an additional qualitative evaluation of participant experiences during the trial and an economic analysis, which are not part of this PhD project.

Ethical considerations

A pilot study preceding my project provided evidence that BMx2 and its analysis involved minimal risk, adverse events or side effects for participants.[140] As communities in the pilot project adopted traditional midwives supported by the project, they continued and probably increased use of government services for complications traditional midwives did not deal with. The pilot study found significantly lower complication rates and infection rates among those using traditional midwives, suggesting improved referral and self-referral (see Appendix 2). There were no negative reactions from the government health services responsible for complicated cases, either during the pilot or the full-study period.

The Ethics Committee of the Centro de Investigación de Enfermedades Tropicales of the Universidad Autónoma de Guerrero approved the BMx2 in October 2013 (Reference 2013-014). Community assemblies representing the Indigenous peoples involved in the trial approved the project in January and February 2015. The Institutional Review Board (IRB) at McGill's Faculty of Medicine approved my analysis of the BMx2 data and the modelling of fuzzy cognitive mapping in June 2017 (A06-B28-17B).

BMx2 adopted the ethical principles for medical research in Indigenous communities proposed by the Research Group on Traditional Health Systems.[141] These principles incorporate the International Ethical Guidelines for Health-related Research Involving Humans (CIOMS, 2012 and maintain compliance with the 2016 version), Declaration of Helsinki (2013) and the TCPS2 chapter 9.

Informed consent for surveys and FCM: during the surveys, trained interviewers explained to respondents the objectives of the study and the voluntary nature of their participation, using the local language. They explained that participants could decline to answer any questions they did not wish to answer, refuse to participate in any activity, and end the interview at any time. Interviewers clarified the procedures to ensure confidentiality and asked each respondent for verbal informed

consent to conduct the interview. The study used oral consent due to the high rates of illiteracy among the participants and the low risk of the intervention.

Before the group or individual sessions to draw fuzzy cognitive maps, the facilitator used a predefined script to describe the activity and provide the information required to obtain informed consent according to the TCPS2.[140] McGill's Faculty of medicine IRB approved the scripts for verbal consent.

Ensuring confidentiality and data security: Facilitator training emphasised their responsibility for maintaining the confidentiality of all information accessed during the work. In this PhD project, I reported grouped findings or codified information that does not allow identifying any individual author or community. Traditional midwives in Guerrero who participated in the mapping sessions agreed to publish their names to recognise their shared authorship.

I will safely preserve paper records for at least seven years following the CIET Policy on Security, Storage and Destruction of Records. Files for analysis will be kept on password protected computers with anti-virus protection. The analyses used a database with information that did not contain any participant identification.

When the journals required a statement of availability of data, I explained that the datasets used or analysed during the study would be available from the corresponding author on reasonable request. According to the agreements with participating communities, to ensure the protection of participants and governance of data, before the information can be shared, the requester would need to present a plan for data analysis. Also, the requester will need to complete the procedure for ethical approval of the secondary analysis in accordance with the procedures defined by the Ethics Board of the *Universidad Autónoma de Guerrero*.

Normative pressure within communities: The intervention did not involve any pressure on women to seek help from the authentic traditional midwives in intervention communities. The governmental conditional cash transfer programs (which pay women if they attend government health centres) might have influenced women to use government supported health centres in both intervention and control clusters. The clinical practice of the staff in the public health centres of the intervention municipalities remained independent of the BMx2 project in both intervention and control clusters.

SECTION 1.

CONTEXTUALIZING SAFE BIRTH IN LOCAL INDIGENOUS CULTURES

Preface

This section addresses the first specific objective of my thesis, to understand how traditional midwives and intercultural researchers contextualise safe birth in local Indigenous cultures. It comprises three papers on knowledge about influences on maternal health: traditional midwives in Guerrero (Chapter 3), intercultural researchers (Chapter 4) and a scoping review of published literature (Chapter 5). Appendix 1 complements the content of this section with the published protocol of the scoping review. The methodological contribution of this section is a systematic application of FCM in documenting, analysing and contrasting stakeholder views. The thematic contribution addresses what Cameron et al. described as a cultural bias of systematic reviews that are limited to Western scientific knowledge.[142]

Chapter 3 is the first published paper in which traditional midwives set the priorities of what needs to change in their communities to promote maternal health. Chapter 4 presents the perspectives of a group of researchers and uses their maps to describe FCM and a technique for operator-independent weighting. Appendix 1 describes in detail the methods of the review and expands on the definition of traditional midwifery and maternal health. Chapter 5 presents the scoping review and the application of FCM to summarise its results, informs the evidence about factors contributing to maternal health where traditional midwives are present and contrasts the findings with stakeholder views. I published the first two papers of this section in methods journals for biomedical (BMC Medical Research Methodology) and social sciences (SAGE Field Methods).

What is the contribution of traditional midwifery to safe birth in cultural safety? In Section 1, participating stakeholders and reviewed evidence suggested that supporting traditional practices could benefit mothers, but the measurement of this contribution remained underdeveloped. Only three pilot studies had used randomisation to test interventions involving traditional midwives. Among these, only the pilot of the trial in Guerrero (BMx) tested an intervention focused on promoting traditional practices.[9]

I translated Chapter 3 into Spanish to disseminate the results among researchers in Latin America and presented it in a seminar for senior researchers and students in Guerrero in 2020. In Canada, I presented the results of Chapter 3 in the Indigenous Health Conference in 2018 and the North American Primary Care Research Group Annual Meeting in 2019, and I shared the methods in Chapter 4 in a workshop at What Works Global Summit 2019, hosted by the Campbell Collaboration in Mexico, and in the 6th Annual McGill Family Medicine Research Symposium.

Two PhD projects on maternal health in Indigenous communities in Guatemala and Nunavik, Canada, and one addressing the health care needs of women living with HIV in Canada, have applied the methods described in this section. A master's project at the Department of Family medicine will use the procedures in Chapter 4 to explore cultural safety in health care in Nunavik. With Dr Anne Cockcroft, professor at the Department of Family Medicine, we applied the same procedure described in Chapter 3 to explore causes of short birth interval in Northern Nigeria[2] and causes of violence against women and youth suicide in Botswana. I advised the application of similar methods in Dr Loubna Belaid's project on maternal health in Uganda[3,4] and Dr Paul Brossard's work on screening for human papillomavirus infection with Inuit women in Nunavik.[5]

Chapter 3: Fuzzy cognitive mapping and soft models of indigenous knowledge on maternal health in Guerrero, Mexico (manuscript 1)

Iván Sarmiento^{1,2}, Sergio Paredes-Solís³, David Loutfi¹, Anna Dion¹, Anne Cockcroft¹, Neil Andersson^{1,3}

1. CIET-PRAM, Faculty of Medicine, Department of Family Medicine, McGill University. Canada.

2. *Grupo de Estudios en Sistemas Tradicionales de Salud. Universidad del Rosario.* Colombia.

3. *Centro de Investigación de Enfermedades Tropicales. Universidad Autónoma de Guerrero.* Mexico.

Abstract

Background: Effective health care requires services that are responsive to local needs and contexts. Achieving this in indigenous settings implies communication between traditional and conventional medicine perspectives. Adequate interaction is especially relevant for maternal health because cultural practices have a notable role during pregnancy, childbirth and the postpartum period. Our work with indigenous communities in the Mexican state of Guerrero used fuzzy cognitive mapping to identify actionable factors for maternal health from the perspective of traditional midwives.

Methods: We worked with twenty-nine indigenous women and men whose communities recognized them as traditional midwives. A group session for each ethnicity explored risks and protective factors for maternal health among the *Me'phaa* and *Nancue ñomndaa* midwives. Participants mapped factors associated with maternal health and weighted the influence of each factor on others. Transitive closure summarized the overall influence of each node with all other factors in the map. Using categories set in discussions with the midwives, the authors condensed the relationships with thematic analysis. The composite map combined categories in the *Me'phaa* and the *Nancue ñomndaa* maps.

Results: Traditional midwives in this setting attend to pregnant women's physical, mental, and spiritual conditions and the corresponding conditions of their offspring and family. The maps described a complex web of cultural interpretations of disease – "frío" (cold or coldness of the womb), "espanto" (fright), and "coraje" (anger) – abandonment of traditional practices of self-care,

women's mental health, and gender violence as influential risk factors. Protective factors included increased male involvement in maternal health (having a caring, working, and loving husband), receiving support from traditional healers, following protective rituals, and better nutrition.

Conclusions: The maps offer a visual language to present and to discuss indigenous knowledge and to incorporate participant voices into research and decision making. Factors with higher perceived influence in the eyes of the indigenous groups could be a starting point for additional research. Contrasting these maps with other stakeholder views can inform theories of change and support co-design of culturally appropriate interventions.

Background

Childbirth involves a range of cultural practices and meanings [1] that contribute to women's perinatal experience and their health outcomes [2]. Many indigenous communities in Latin America have poor access to conventional health services and face harsh living conditions [3]. As we try to understand the dramatic health disparities between indigenous and non-indigenous communities [4], it is difficult to disentangle the effects of poor access to conventional health services from effects of communities losing their own cultures and traditions. There is a need for methods that assess how culture and traditions can impact health outcomes [5].

Effective perinatal care requires services that are responsive to local needs and contexts [6]. Since the 1980s, the concept of cultural safety has gained recognition as a key ingredient in the delivery of quality care, particularly among indigenous communities. Culturally safe practice recognizes that power imbalances shape intercultural interactions and have historical effects on health disparities by influencing the lives and opportunities of marginalized groups [7]. The central idea of cultural safety is to provide health care without diminishing or disrespecting the cultural identity of patients and their communities.

Indigenous communities in Mexico's Guerrero state lost much of their ancestral traditions as they embraced new elements from Western culture. In transitions like this, in theory people have access to both conventional and traditional health care. In practice, they face complex health choices [8] as the transition from traditional to conventional health care is incomplete in many places, leaving important gaps [9]. Because they usually live in remote parts, many indigenous communities have access only to the very periphery of conventional health services. Distance, inappropriate allocation of state resources, and weak local governments are part of the problem on the supply side [10]. The

perceived lack of respect for their traditional knowledge systems leads to an aversion to conventional health services among many indigenous people [11]. This hinders access to conventional medical facilities [12]. In the indigenous communities in the southern mountainous areas of Guerrero in Mexico, traditional midwives are either the only source of perinatal care or the one that women prefer [12, 13].

Traditional midwives are the cornerstone of health care developed over generations by indigenous communities [14]. These systems are culturally specific and have strong links with the environmental conditions grounding each group [15]. Anthropologists have described some elements of traditional health care, mostly using ethnography and interviews [1]. Almost invariably, however, the scientific literature describes these systems from the perspectives of outsiders and using cultural reference points that do not necessarily coincide with those of the indigenous community themselves [16].

Our objective was to systematize the knowledge of traditional midwives about risks and protective factors for maternal health among indigenous communities in southern Mexico, to improve the interface between traditional practitioners and the local health services [17]. The work in this manuscript is part of a bigger project to promote safe birth in cultural safety among indigenous communities in the south of Guerrero State. The overall project includes a cluster randomized controlled trial comparing maternal health outcomes in indigenous communities with and without a co-designed intervention to support the role of traditional midwives [17]. The intervention asserts the principles of cultural safety [18] and intercultural dialogue [19]. The mapping process described in this manuscript will contribute to elicit prior stakeholder knowledge to inform Bayesian analysis of the trial.

Methods

In recent years, fuzzy cognitive mapping [20] has allowed inclusion of the knowledge of stakeholders into models to describe their understanding of determinants of poor health [21] and, in an additional step, juxtapose this knowledge with conventional biomedicine evidence [22]. These maps describe different knowledge systems and can thus contribute to establishing common reference points to advance shared views of specific health issues [23]. "Fuzzy" refers to the stakeholder assigned weights to grade influences of different factors on each other and on a specific outcome [24]. The maps represent soft models of the way people reason, depicting their knowledge structures [20].

In fuzzy cognitive mapping, each factor is drawn as a node, and each relationship is represented as an edge (arrow) linking nodes. The arrows represent assumptions about causal relationships that can be based on data or on unwritten knowledge [20]. Authors of the maps attribute different values to weight the strength of each arrow. Weights can have positive signs to indicate that, as one node increases, the linked node also increases (excitatory relationship), or negative signs for inhibitory relationships (as one node increases, the linked node decreases). The causal weights express knowledge-holder opinions, their explanatory models and theory of change, rather than a predictive statistical model. By contrasting different stakeholder groups, fuzzy cognitive maps can highlight similarities and differences of alternative explanatory models and theories of change [25].

Participants

The *Nancue ñomndaa* and *Me'phaa* people have experienced cultural loss associated with the growing Western influence in their area. Nonetheless, both indigenous groups still maintain their identities. This is reflected in the use of traditional languages and, especially in the case of the *Nancue ñomndaa*, clothing. The main economic activities of both indigenous groups are subsistence agriculture, raising cattle, and migrant labor. During the last two decades, these communities have experienced out-migration mainly of male adults and youth looking for jobs in other states, Canada and the United States, to send money back to their families in Guerrero. The minimum wage in the region is about USD40 monthly, but for indigenous populations is around USD34 [13].

Traditional midwives accompany indigenous women throughout pregnancy, provide support through labour and advise on care of the newborn [1, 26, 27]. We recruited 29 indigenous traditional midwives, 18 from the *Me'phaa* indigenous group (Tlapaneco) in the municipality of Acatepec and 11 from the *Nancue ñomndaa* (Amuzgo) indigenous group in the municipality of Xochistlahuaca. A household survey in 2015 interviewed each indigenous woman who had delivered their children in the last two years [17]. The answers allowed us to identify active traditional midwives with de facto recognition in their communities, based on the number of births they attended, the health outcomes of their patients, and the traditional knowledge they hold. The traditional midwives invited to the mapping sessions also took part in the intervention of the cluster randomized controlled trial. We invited each midwife in person, as expected in indigenous customs, some weeks before the meeting. All accepted the invitation. The group in Acatepec included two male traditional midwives.

Drawing the maps

Two community members fluent in both Spanish and the indigenous language who were trained as intercultural brokers [17], two field coordinators from the *Centro de Investigación de Enfermedades Tropicales* (CIET) at the *Universidad Autónoma de Guerrero*, and the lead author facilitated the mapping sessions. After the participants gave their oral informed consent to participate, the lead author gave a further detailed explanation of the mapping steps, using lay language. Participants constructed their maps in one three-hour group session in each indigenous community. The intercultural brokers translated into Spanish the ideas voiced by the traditional midwives. Two additional local translators identified any distortion of the meaning introduced in translation.

Once participants confirmed they understood the mapping process, we invited them to map their answers to the question: To your knowledge, what are the factors related to maternal health in your communities? Each group completed two maps: one of factors that promote safe motherhood (protective factors) and another for factors that impede safe motherhood (risks). Through group discussion, participants first listed the factors they considered to be related to maternal health in their communities. The facilitator wrote each factor on a card and stuck the cards on a wall. Some factors described concepts defined by the participants' traditional culture. In these cases, the facilitator asked for additional information to clarify the meaning. When no additional factors were forthcoming, the facilitator then asked the participants to identify the causal relationships between factors. The facilitator drew the arrows linking factors and confirmed at each time with the participants that the arrow represented the causal relation they wanted to convey, asking for more details as necessary to understand why they identified that relationship.

After defining all the relationships, participants then ranked the strength of each relationship, using a scale from one to five (with five being the strongest influence, one being the weakest influence). The facilitator explained that the strongest influence (5) was a relationship where the factor in question would almost always cause the linked outcome, while the weakest influence (1) was a relationship where the factor would seldom cause the linked outcome. The midwives decided the weight of each link by consensus. When one irreconcilable difference of opinion about the influence of hospitals occurred, we incorporated this in a sensitivity analysis. An experienced researcher fluent in indigenous language took notes of the explanations and discussion during the session, without recording any personal identifying data about participants. At the end of the session, facilitators took

pictures to record the final maps. We used multiple translators to increase the likelihood of capturing the meaning correctly.

Analysis of the maps

We digitized the maps using the free software yEd [28] and generated a list of nodes and adjacency matrices for the numerical analysis of the relationships. An adjacency matrix presents the structure of the map as a square table with n number of rows and n number of columns, where n equals the total number of nodes. The value of each cell is the weight of the relationship between two nodes (directed from the row to the column). For the matrices of the original maps, we scaled the weights 1 to 5 by dividing all with a constant 5.

For each original map, we calculated the fuzzy transitive closure [29] between nodes, to measure the influence each node had on others in the map. Transitive closure takes account of each pair of linked concepts in the context of all the possible connections in the map. A "walk" is any succession of edges (arrows) that allows transit from one node to another. The value of the fuzzy transitive closure between two nodes A and B is the maximum weight of any of the walks from A to B, and the weight of each walk is the minimum weight of any of the edges (arrows) involved in the walk. After transitive closure, the maps had a new architecture that included all the possible connections between nodes, with values from 0 to 1 representing the strength of the influence (with one being the highest influence) and positive or negative signs to represent excitatory and inhibitory relationships respectively. After transitive closure, we combined the maps using a weighted average of the strength of the influences [23]. The weight assigned to each map was the cumulative experience of the midwives who made it, defined by the number of them in each.

We used thematic analysis to condense the concepts (nodes) into fewer categories to facilitate the communication of the content [30, 31]. The lead author developed a first level of aggregation using a pattern matching table to arrange the nodes of each map with similar meanings and their corresponding categories (Table 3-1). Each factor represented an idea that was discussed and agreed upon, with traditional midwives clarifying the words and specifying their meaning. Identifying categories from factors across maps thus incorporated those deeper meanings described in the notes from the mapping session. A group of researchers with extensive experience with indigenous communities in Guerrero, including two who participated in the mapping sessions, confirmed the categories developed in the first aggregation (SP, NA, AC, Abraham de Jesús García, Nadia Maciel

Paulino, and Germán Zuluaga). In a member checking exercise [32] in July 2018, IS presented the maps to the traditional midwives who confirmed their agreement with the results of the analysis.

Using the aggregation categories, we described similarities and differences of maps from each municipality (Table 3-2). A formal comparison between maps identified: (a) validated connections (both maps share the non-zero connection with the same sign), (b) non-validated connections (it is only mentioned in one map), and (c) conflicting connections (both maps include the edge but with different directions). We summarized the cumulative net influence of each category from the thematic analysis as a proportion of total weight for each factor in two steps. First, we calculated the cumulative weight for each category as the sum of weights of the influences of the factors in the transitive closure maps in the corresponding category. Second, we divided each cumulative weight by the maximum total cumulative weight across all the categories in the synthesis map. As a measure of the overall agreement in the cumulative net influence, we divided the total size of all differences (summation of the absolute value of the differences) by the number of differences. An average difference closer to one indicates less agreement about the weight of the relationships.

Results

The traditional midwives from Acatepec described unsafe maternity as a set of traditional diseases that can affect women, symptoms associated with those diseases, and events that affect the women and their babies' health and well-being. They included two additional categories to describe the concrete events of maternal and infant deaths. When describing safe maternity, in addition to not having a disease, they emphasized the happiness and confidence of the women. Traditional views characterized a healthy woman as one who can give birth at home. In a similar integrated approach to healthy maternity, midwives in Xochistlahuaca explicitly included as outcomes in this category the health status of the offspring and even the health status of the husband.

Risk factors

In the map from Acatepec, participants described 44 risk factors (nodes) with 87 relationships (edges). Xochistlahuaca traditional midwives included 42 nodes and 87 edges. The thematic analysis grouped the nodes into 17 categories of risk factor. Table 3-1 presents the factors included in each category. Factors with the same meaning in both municipalities align in the same row. Figure 3-1 presents the fuzzy cognitive map of categories with the highest cumulative net influence. The full adjacency matrix with all the relationships for this map is available as Appendix M1 - 1.

Table 3-1. Matching table of the concepts grouping the risk and protective factors

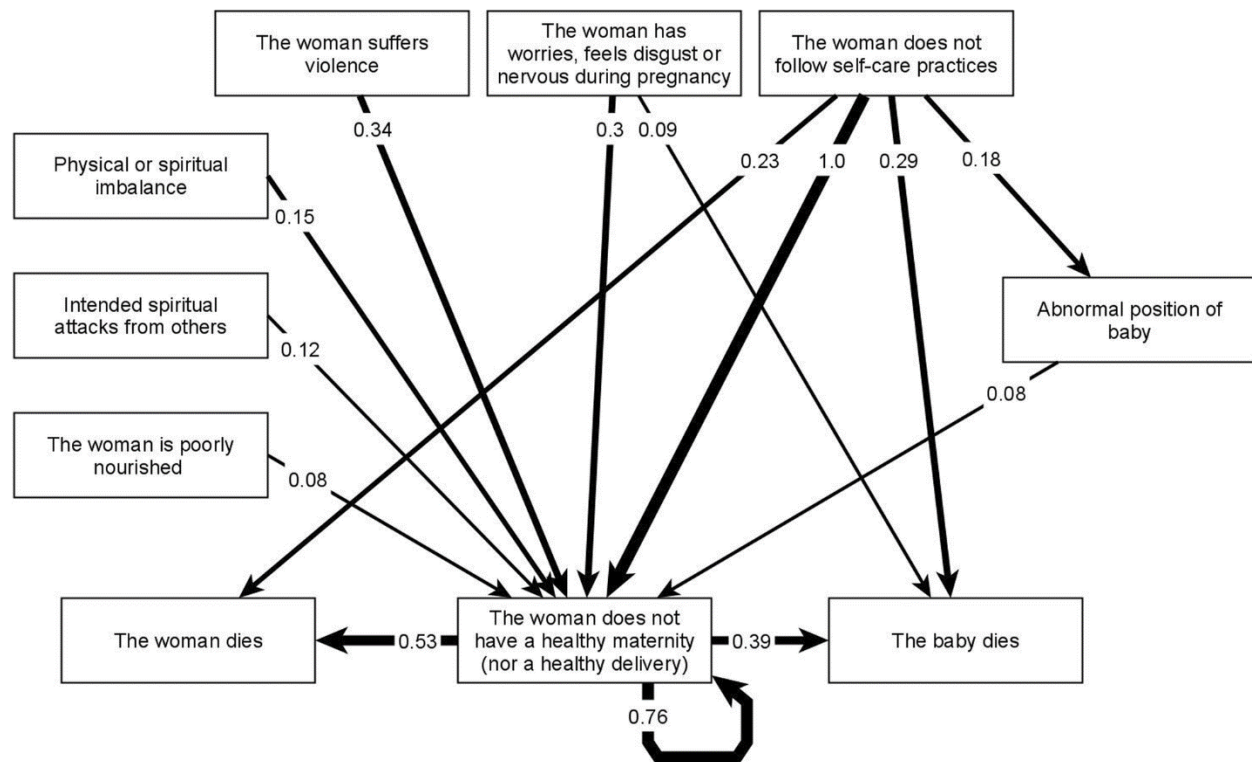
Risk factors in Acatepec	Risk factors in Xochistlahuaca
<i>Category: The woman does not have a healthy maternity (nor a healthy delivery)</i>	
The woman suffers "Espanto" (fright)	The woman suffers "Espanto" (fright) (traditional disease)
The woman suffers "Antojo"/Craving	The woman suffers "Antojo"/Craving (traditional disease)
The woman suffers "Shaime" (traditional disease)	
The woman suffers "Smoke" (traditional disease, different from smoking)	
The woman suffers "The evil eye" (traditional disease)	
	The woman suffers "Nahual" (traditional disease)
	The woman suffers "Coraje" (anger) (traditional disease)
	The baby suffers "Nquio" (traditional disease)
Woman's body and face swelling	Woman's feet swelling, abdominal swelling
Cold / Coldness of the womb	Cold / Coldness
Hemorrhage (pregnancy)	Bleeding (pregnancy)
Headache (pregnancy)	
Decreased appetite	
Chills (fever and cold)	
Cough	
	Flatulence
	Seizures
	Weight loss
	Vaginal discharge, itching
	Dizziness, nausea, vomiting (during pregnancy and delivery)
	Painful labor and delivery
	Vaginal swelling (delivery)
Breech presentation (delivery)	
Baby wrapped in umbilical cord (delivery)	
Prolonged labor	Prolonged labor
Tiredness (delivery)	Fatigue (delivery)
	Seeing flashing lights (delivery)
	Faint during delivery
Headache	Headache (delivery)
Hemorrhage during delivery	Hemorrhage during delivery
Retained placenta	Retained placenta
<i>Category: The woman dies</i>	
Maternal Death	Maternal Death
<i>Category: The baby dies</i>	
Infant death	Infant death
Pregnancy loss	
<i>Category: Abnormal position of baby</i>	
Abnormal position of baby	Abnormal position of baby
<i>Category: Abortion</i>	
Abortion	Abortion
<i>Category: The woman suffers violence</i>	
Violence (partner or family, sexual abuse, absent father, extramarital children, threats from the father to make her abort)	Violence (domestic violence related with alcohol consumption)
	Disagreement or fight
<i>Category: Unsupportive family environment</i>	
Unsupportive family environment	
<i>Category: The woman does not follow protective rituals</i>	

Not following protective rituals (lighting candles in the mountain or prayers)	
<i>Category: The woman does not follow self-care practices</i>	
Practices such as: cooking too close to the fire, using long thread when sewing.	Practices such as: carrying heavy loads, shower with cold water, eating cold tortillas, eating pork, eating too much chili pepper, or not covering the head after delivery.
Eating forbidden food (a long list of fruits and animals)	
The woman has multiple sexual partners	
Shower with cold water	
Expose to cold environments	
Heavy work	
	Poor hygiene
	Ignorance of when to push
	Wrong position while sleeping
	Sexual relations too early after delivery
	Drinking alcohol (getting drunk) and infidelity
<i>Category: Accidents</i>	
Accidents	
Poisonous animal bites	
<i>Category: Intended spiritual attacks from others</i>	
Intended spiritual attacks from others	
Envy	
<i>Category: Physical or spiritual imbalance</i>	
Someone with "heavy" sight looks the women	
	Physical or spiritual imbalances
<i>Category: Primigravida</i>	
Primigravida	
<i>Category: The woman has poor health condition (before pregnancy)</i>	
	The woman has "weak blood"
<i>Category: The woman is poorly nourished</i>	
Bad nutrition	Bad nutrition
<i>Category: The woman has worries, feels disgust or nervous during pregnancy</i>	
The woman feels nervous during pregnancy	
The woman has fright caused by thunders, animals, or accidents	The woman has fright
The woman feels embarrassment or sadness	
	The woman finds something disgusting
<i>Category: Unwanted pregnancy</i>	
Unwanted pregnancy	Unwanted pregnancy
Protective factors enumerated in Acatepec	Protective factors enumerated in Xochistlahuaca
<i>Category: The woman has a safe birth and healthy maternity</i>	
The woman is happy	The woman is happy, beautiful, good worker, not lazy, does not get "coraje" (anger). Also, she has a healthy husband
The woman is strong and brave	
The woman is able to give birth at home	A good labor and delivery: healthy pains, less blood loss, fast healing
The woman does not get sick	Healthy postpartum: healthy baby / the woman is willing to eat after labor
<i>Category: The woman has support of a traditional midwife or healer</i>	
Support of a midwife or traditional healer	The woman receives care from the traditional midwife (and she takes care of the position of the baby)
	Traditional midwives in the community
A midwife counsels the husband	
<i>Category: Healthcare center or hospital is available</i>	
Healthcare centers available	Hospital available (Hospital básico comunitario)

<i>Category: The woman follows protective rituals</i>	
The woman follows protective rituals (lighting candles or indigenous prayers)	The woman follows protective rituals associated with traditional medicine
Praying in the church (Christian or Catholic) asking for health	
<i>Category: The woman follows self-care practices</i>	
	The woman takes care of herself
<i>Category: The woman does not suffer violence</i>	
The woman does not suffer violence	
<i>Category: The woman lives without worries</i>	
	The woman lives without worries
<i>Category: The woman has a caring, working, and loving husband</i>	
	The woman is well treated by the husband
The woman has a caring and loving husband	The woman has a caring and working husband
	The husband talks to the baby in the womb
<i>Category: The woman has good communication with husband</i>	
	Good communication with husband
	The woman discusses (talks) with husband about pregnancy and delivery
<i>Category: The woman has a good health condition (before pregnancy)</i>	
	The woman does not get sick
	The woman heals from her diseases
<i>Category: The woman has economic stability</i>	
	Economic stability
<i>Category: The woman is well nourished</i>	
The woman eats good (enough) food	The woman eats good (enough) food

The most influential category of risk for unsafe maternity was "not following self-care practices" as defined in the customs and traditions of these communities. These practices can include dietary restrictions, reduction of heavy work, less exposure of mother's body to cold water, or hygiene practices. Midwives from both communities included this category, although the actual contents of these practices are heterogeneous and could be culture specific. During thematic analysis, the researchers recognized that factors in other categories (such as rituals or nourishment) could also correspond to self-care practices, which would increase their relevance within the system. This category appeared as protective in Xochistlahuaca ("The woman follows self-care practices"), but not explicitly mentioned in the Acatepec protection map. Among the risk categories, the midwives identified gender violence and mental health of women ("The woman has worries, feels disgust or nervous during pregnancy") as highly influential (second and third order importance respectively). They described an unsupportive family environment as a cause of violence against women.

Figure 3-1. Fuzzy cognitive map of the most influential categories of risk factors



Legend: To simplify the graph, we only included the highest-weighted relationships. Appendix M1 - 1 contains all the relationships on the map. Strong lines represent excitatory relationships. The numbers on the edges represent the cumulative net influence of one category on another, where 1 is the highest influence in the map

In the final map, the multi-concept category "the woman does not have a healthy maternity" has a self-pointing edge with a cumulative net influence of 0.76 (Figure 3-1). This loop, from the node back to itself, implies that factors within the category influence other factors grouped in the same category. We reviewed the initial maps to identify concepts with greater influence within the category. Three factors showed a strong influence in maternal health outcomes, "cold or coldness of the womb", "espanto" (literally translated as fright), and "coraje" (literally translated as anger). They also had a strong influence on maternal and infant death. Both indigenous groups confirmed "coldness of the womb" and "espanto", but "coraje" was a specific factor for the *Nancue ñomndaa* from Xochistlahuaca (Table 3-2). Even with translation, the words do not hold an equivalent meaning in English or Spanish. Traditional midwives explained that "coldness of the womb" resulted from exposing the mother's body to cold elements such as water, fresh air, or certain foods considered of cold nature. They explained the womb needs to remain warm to allow for the correct

development of the baby and to function properly during delivery. The concept of "espanto" (fright) describes a strong emotional impact that alters one's mental health. Examples include violence, an animal attack, or an accident. They explained that "coraje" (anger) as caused by an imbalance produced by violence, not necessarily directed at the woman, that affects the "aire" (air) or environment of the mother and consequently affects her health.

Table 3-2. Pattern marching table of the cumulative net influence of each category on maternal health

Risk factors							Protective factors						
Me'phaa Acatepec		Nancue ñomndaa Xochistlahuaca				Final map	Me'phaa Acatepe		Nancue ñomndaa Xochistlahuaca				Final map
Factors	CNI	Factors	CNI	Validation	Difference	CNI	Factors	CNI	Factors	CNI	Validation	Difference	CNI
Category: The woman does not have a healthy maternity (nor a healthy delivery)							Category: The woman has a safe birth and healthy maternity						
17	0.29	23	1.00	Val.	0.71	0.76	4	0.00	3	0.30	Val.	0.30	0.18
Category: The woman dies													
1	0.00	1	0.00	Val.	0.00	0.00							
Category: The baby dies													
2	0.00	1	0.00	Val.	0.00	0.00							
Category: The woman suffers violence							Category: The woman does not suffer violence						
1	0.11	2	0.46	Val.	0.35	0.34	1	0.50	0	0.00	Nval.	0.50	0.24
Category: The woman has worries, feels disgust or nervous during pregnancy							Category: The woman lives without worries						
3	0.29	2	0.18	Val.	0.11	0.30	0	0.00	1	0.36	Nval.	0.40	0.22
Category: The woman does not follow protective rituals							Category: The woman follows protective rituals						
1	0.11	0	0.00	Nval.	0.11	0.07	2	1.00	1	0.36	Val.	0.60	0.70
Category: The woman does not follow self-care practices							Category: The woman follows self-care practices						
6	1.00	6	0.71	Val.	0.29	1.00	0	0.00	1	0.36	Nval.	0.40	0.22
Category: The woman has poor health condition (before pregnancy)							Category: The woman has a good health condition (before pregnancy)						
0	0.00	1	0.07	Nval.	0.07	0.04	0	0.00	2	0.73	Nval.	0.70	0.44
Category: The woman is poorly nourished							Category: The woman is well nourished						
1	0.04	1	0.09	Val.	0.05	0.08	1	0.81	1	0.42	Val.	0.41	0.65
Category: Abnormal position of baby													
3	0.11	1	0.02	Val.	0.09	0.08							
Category: Abortion													
1	0.04	1	0.00	Val.	0.04	0.02							
Category: Unsupportive family environment													
1	0.11	0	0.00	Nval.	0.11	0.07							
Category: Accidents													
2	0.04	0	0.00	Nval.	0.04	0.02							
Category: Intended spiritual attacks from others													
2	0.21	0	0.00	Nval.	0.21	0.12							
Category: Physical or spiritual imbalance													
1	0.04	1	0.21	Val.	0.17	0.15							
Category: Primigravida													
1	0.04	0	0.00	Nval.	0.04	0.02							
Category: Unwanted pregnancy													
1	0.04	1	0.00	Val.	0.04	0.02							
							Category: The woman has support of a traditional midwife or healer						

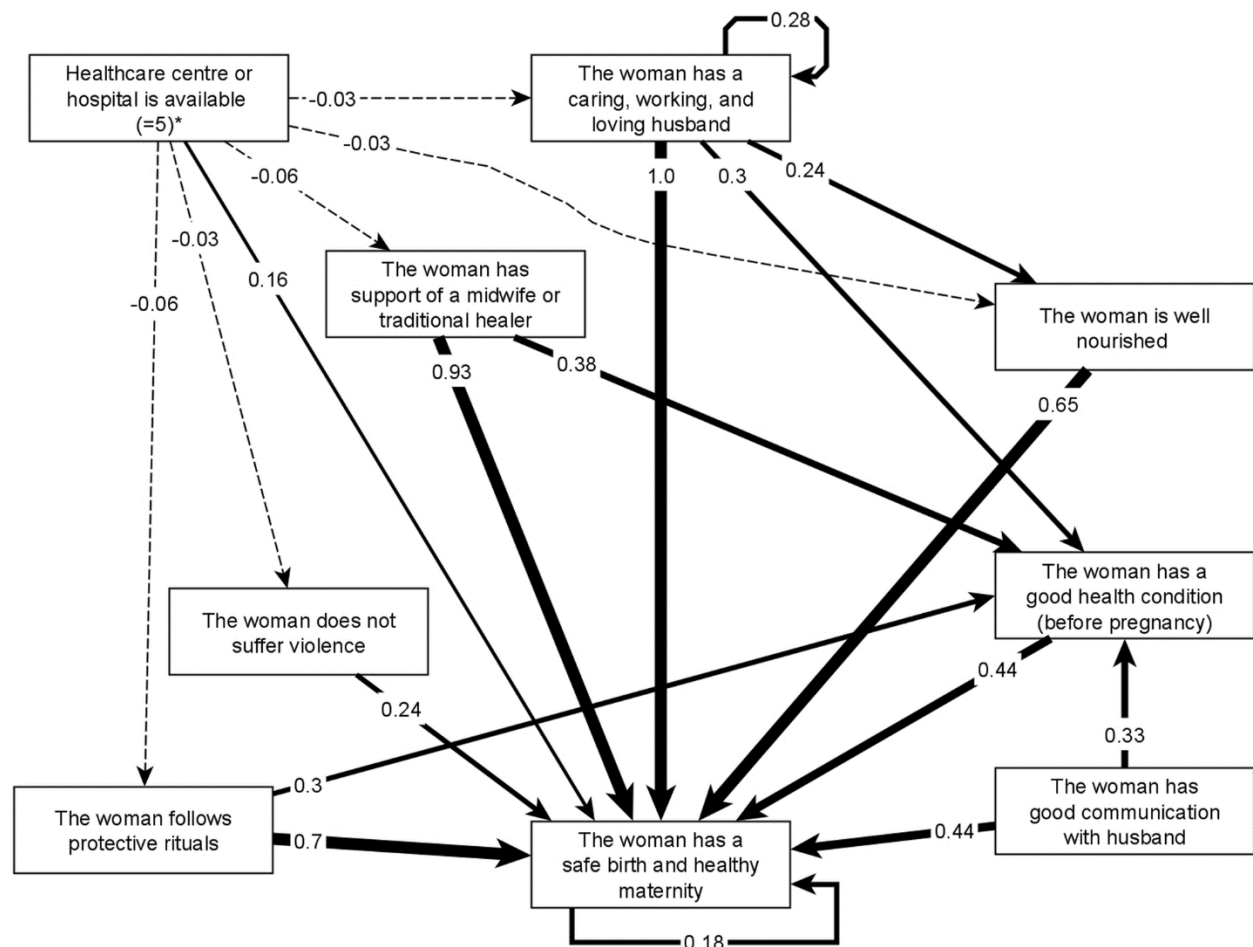
							2	0.94	2	0.79	Val.	0.14	0.93
							<i>Category: Healthcare center or hospital is available</i>						
							1	-0.13	1	0.36	Con.	0.43	0.16
							<i>Category: The woman has a caring, working, and loving husband</i>						
							1	0.81	3	1.00	Val.	0.19	1.00
							<i>Category: The woman has good communication with husband</i>						
							0	0.00	2	0.73	Nval.	0.70	0.44
							<i>Category: The woman has economic stability</i>						
							0	0.00	1	0.33	Nval.	0.30	0.20
44		41			0.14	–	12		18			0.42	–

Legend: # factors: number of factors included in the category; Validation: *Val* validated, *Nval* non-validated, *Con* conflictive; *CNI* cumulative net influence by municipality and final map. Difference: absolute value of the difference between CNI in the two municipalities.

Protective factors

In Acatepec, traditional midwives reported 12 protective factors (nodes) with 38 relationships while in Xochistlahuaca, traditional midwives included in their map 18 nodes and 31 relationships. The thematic analysis condensed the protective factors into 12 shared categories (Table 3-1). Figure 3-2 presents the map of the strongest protective factors and Appendix M1 - 2 has the full adjacency matrix with all the relationships among categories. Protection maps highlighted the importance of male support (described as having a caring, working, and loving husband) and support from traditional midwives in promoting maternal health. Midwives in both municipalities mentioned both these two factors (Table 3-2). They rated protective rituals and access to adequate food for pregnant women in third and fourth place for influence. The map also showed the influence of protective factors over the intermediate outcome of women's health condition before pregnancy (Figure 3-2, category P10 in Appendix M1 - 2).

Figure 3-2. Fuzzy cognitive map of the most influential categories of protective factors on maternal health



Legend: To simplify the graph, we only included the highest-weighted relationships. Appendix M1 - 2 contains all the relationships on the map. Strong lines represent excitatory relationships and dashed lines represent inhibitory relationships. The numbers on the edges represent the cumulative net influence of one category on another, where 1 is the highest influence in the map. For this map we used the maximum positive influence reported by participants for the role of hospitals and health centers.

In line with the risk map, the map of protective factors showed non-exposure to violence as a strong influence. The map showed how other factors were protective through decreasing the levels of violence that women experience. These factors included counseling by traditional midwives, protective rituals, access to food, economic stability, and having a caring husband. Having a caring husband was validated across both indigenous groups. The map of protectors included other "mirror images" of risk categories for mental health of women, practicing protective rituals and self-

care practices, good nutrition and health condition of the women before pregnancy (at the top of Table 3-2).

One category, "Healthcare center or hospital is available", had a conflictive validation. Acatepec midwives showed it as a negative influence on safe maternity whereas it was a positive influence in Xochistlahuaca, where it was the only relationship for which participants did not reach consensus (Appendix M1 - 2). Individual traditional midwives weighted its protective influence on women's health between no protective effect at all (0) and a high positive effect (5). Per protocol, we sought reasons for this divergence: one participant wanted to assign a 5 and the others were discussing between 0 and 1. The participant who suggested a weight of 5 was a very experienced traditional midwife who was well-respected by the medical staff at the healthcare center, suggesting that strong inter-professional and cross-cultural relationships can greatly change the role that healthcare centers can play in indigenous communities. Appendix M1 - 2 includes an additional row to present the variation of the cumulative influence when assuming a positive effect of five or no-effect in the map from Xochistlahuaca. The negative effect assigned in the map from Acatepec not only affected safe maternity, but also had negative impacts on other categories, particularly those related with the services of traditional practitioners, following traditional rituals, male involvement, violence against women, and access to food (dashed lines in Figure 3-2). These effects did not emerge in the Xochistlahuaca map.

Discussion

We used fuzzy cognitive mapping to document traditional indigenous knowledge related to maternal health. FCM is particularly useful in multicultural contexts, as it can be used across language barriers and educational levels [20]. Fuzzy cognitive mapping offered a transparent and systematic way to organize and to summarize indigenous views despite intercultural differences. Traditional midwives described a broad understanding of maternal health that included their well-being and their surroundings. This comprehensive approach to health highlights the need for better indicators, measures, and benchmarks to assess quality of care [33]. We will use the models to support discussion of future actions to promote maternal health with health providers and community members.

The views of indigenous traditional midwives on maternal health in their communities included a complex set of concepts and relationships. Prominent among the risk factors mentioned by the

traditional midwives were failure to follow traditional practices of self-care, those associated with cultural concepts of disease ("espanto" (fright), "coraje" (anger), and "coldness of the womb"), and women's mental health and experience of violence. Among the protective factors, male involvement (having a caring, working, and loving husband), support of traditional healers, protective rituals and adequate nourishment were most influential.

The literature is replete with examples of traditional practices for childbirth and maternal health [34-39]. Traditional practices associated with maternal health are best viewed as complex interventions with many interacting aspects. This makes it difficult to tease out the key element in any change [40]. Despite this lack of understanding, potential benefits or harms of these practices are usually defined authoritatively from a conventional medicine perspective [41]. A cultural gap prevents many of us going beyond initial judgements of implausibility based on Western worldviews. This in turn hampers research on the etiology, symptoms, and indigenous health concerns [1]. Methods like FCM can help to document and interpret traditional practices, thus helping to bridge this gap [16, 42]. With these methods in hand, Western epistemological frameworks need not go unchallenged in intercultural settings [43, 44].

The culturally specific conditions listed by the traditional midwives are not limited to pregnancy and childbirth. A study of Mexican populations in the United States associates "espanto" (fright in English also called *susto* in Spanish) with the onset of type 2 diabetes [45]. Other studies present "espanto" as the somatic expression of psychiatric disorders, often as a consequence of domestic violence or other traumatic experiences [46]. And some other authors see these diseases as physical consequences of unfulfilled social expectation, inequities, or harsh environmental conditions [47-49]. The cold-hot dichotomy associated with "coldness of the womb" is a theory of disease etiology found in traditional health systems of indigenous groups in the Americas, Africa, Europe and Asia [40]. The concept is complicated by the relative independence from temperature as understood in conventional medicine [50]. Recent reports suggest an association, however, between this indigenous classification of diseases and physical responses to chemical stimuli of medicinal plants for their treatment [51].

Traditional midwives promote male involvement and increase family and community support for women. Supporting them in this role can use existing cultural dynamics to promote positive change, for example to decrease domestic violence [52]. Reducing the role of traditional midwives to "birth attendants" ignores the crucial fact that they also work as counselors of women, men, families and

communities in general. Even those who advocate replacing traditional midwives with practitioners trained in conventional medicine acknowledge it is worth keeping positive aspects of their role: "the sense of caring, the human approach, and the response to cultural and spiritual needs" [53].

The map of protective factors also highlighted traditional rituals of fertility and proper nourishment of women. The health effects of traditional rituals remains an unexplored field with significant methodological challenges, mainly associated with the multifactorial nature of these interventions [5, 54], as we have explained before for the category of self-care practices. Poor nutrition is an important concern for populations like those in our study, who have a disproportionately lower income, depend on subsistence agriculture, and have been displaced to less productive land. Poor nutritional indicators are common among indigenous communities [55], which often suffer from structural inequities [56]. Cultural continuity and preservation of local resources, both goals of a culturally safe approach, can improve food security among indigenous groups [57].

Strengths and limitations

The advantages of FCM are several. It takes only a short time necessary to summarize a lot of information. The graph language facilitates data collection, analysis, and interpretation across cultural, language and educational barriers, and it is easily adjusted for different knowledge systems [20]. It can take into account complex socio-cultural mechanisms that effect the well-being of women, offspring and communities [33]. It is easy to share knowledge in an accessible form to facilitate discussion with others and can facilitate intercultural dialogue [19] to improve the interface of indigenous communities with conventional medicine.

In research, fuzzy cognitive mapping helps to summarize participant views of causality. The maps can identify theories of change and frame hypotheses for empirical research and decision making. The bigger project with indigenous communities in southern Guerrero used a parallel group randomized controlled trial to test some of the causal relationships in the maps, particularly the influence of traditional midwifery on health outcomes [17]. The maps also opened opportunities for evidence-based conversations to deepen our understanding of the factors involved in safe birth [58].

One risk category defined with the midwives to consolidate the maps turned out to be larger than other categories and it included what seemed like heterogeneous factors. At first glance, for example, "coldness of the womb" seems very different from "hemorrhage". But for traditional midwives hemorrhage is the outcome of coldness and it can lead to the death of a woman. Category maps are

models of individual concepts generalized to a larger scale, which simplify the contents to facilitate communication. But scale matters, and interpretation of maps has to follow the level of generalization of the model [59]. We cannot assume that relationships between categories apply equally to all the factors within those categories. Doing so would constitute a cross-level fallacy [59, 60]. It is possible to unpack aggregated category maps by going back to the transitive closure maps to identify specific paths through which individual factors influence each other.

Interpretation across languages is a challenge in most intercultural settings, especially when full translation is not practical (as in a group discussion). As researchers, we made several assumptions during the thematic classification of factors and the overall weight assigned to the maps from the two groups to calculate the weighted average. We documented these assumptions so their impact in the analysis can be assessed. Member checking with the authors of the maps encouraged us to believe that researcher assumptions during the analysis did not contradict the meaning of the information the traditional midwives provided. The mapping exercise took place in the context of years of work and trust building with the communities concerned, and it was greatly helped by the involvement of local personnel with skills and experience in intercultural dialogue. Implementing a similar exercise in settings without a history of collaboration would be challenging.

Conclusions

Fuzzy cognitive mapping provided a robust way to summarize and to value the complex knowledge of indigenous midwives. In our example, the maps identified locally relevant cultural concepts related to maternal health in Guerrero State. Better understanding of these could promote collaboration and help to defuse disagreements between conventional health services and indigenous communities; thus, increasing the effectiveness of perinatal care in those disadvantaged communities.

More broadly, fuzzy cognitive mapping is a tool for indigenous and other marginalized communities to communicate their way of seeing things to health authorities and to open discussions about health initiatives. In combination with maps from other sources, such as researchers or published literature, the maps can be used to develop composite theories of change. They can identify key factors for inclusion in questionnaires and to frame health outcomes and weight stakeholder prior beliefs to serve in Bayesian analysis. From clarifying the causal concepts through to formal statistical analysis,

fuzzy cognitive mapping helps to build the voices of indigenous participants into modern health research.

Declarations

Availability of data and materials

The datasets generated during or analyzed during the current study will be available upon request from CIET. Before the information can be shared, the requester will need to present a plan for data analysis. Also, the requester will need to complete the procedure for ethical approval of the secondary analysis in accordance with the procedures defined by the Ethics Board of the *Universidad Autónoma de Guerrero* and the agreements with communities to ensure the protection of the participants.

Acknowledgements

The traditional midwives generously have shared their knowledge throughout the research process. Their commitment to women's health in their communities will remain an inspiration beyond the limits of this research. Abraham de Jesús García, Nadia Maciel and Germán Zuluaga supported the interpretation of results. Abraham de Jesus García and Nadia Maciel Paulino generously served as intercultural brokers to facilitate the dialogue with the indigenous communities. Dr Mateja Šanja kindly advised the mathematical aspects of the analysis. The participating traditional midwives agreed to publication of their names in recognition of their contribution. In Acatepec: Albina Francisco Dolores, Rafaela Santiago de Jesús, Marcelina Linares Francisco, Marcela Jacinto Albina, María Cayetano Carmen, Cornelio García Jesús, Julia Santiago Neri, María Florencia Ferrer, Bernardino Basurto Sánchez, María Morales Flores, Cleofás Basurto Sierra, Ernesta Hernández Sixto, Rutilia Candía Bernardo, Pascuala Hernández Espinosa, María Florencia Dolores, Sofía Santiago Elidía, Nieves Palmirez Santiago and Maximina Dircio. In Xochistlahuaca: Cefia Crescencia De la Cruz, Margarita López López, Tranquilina López, Severa Máxima Ramos, Rosa Ramos Victoria, María De los Santos Teresa, Natalia López Granado, Catalina Victoria De los Santos, Anselma Santiago López, Martina Martínez Lauro and Concepción Calista Agapito Flores.

Funding

CONACyT, the National Council of Science and Technology of Mexico funded the fieldwork in 2017 (PDCPN-2013-214858). The Faculty of Medicine of McGill University and the Quebec Population Health Research Network (QPHRN) provided support for fieldwork in 2017 and 2018,

respectively. The CeIBA Foundation and the Canadian Institutes of Health Research funded the work of Ivan Sarmiento (201804HI9–406583-290461). The authors thank the QPHRN for its contribution to the financing of this publication. The funders had no role in the study design, data collection and analysis, decision to publish, or preparation of the manuscript.

Ethics declarations

Ethics approval and consent to participate: The methods and procedures received ethical approval from all participating communities (2015), the Ethics Committee of the *Centro de Investigación de Enfermedades Tropicales* of the *Universidad Autónoma de Guerrero* (reference 2013–014), and McGill's Faculty of Medicine Institutional Review Board (reference A06-B28-17B). Participants provided oral consent using predefined formats authorized during the ethics reviews.

Consent for publication

Participants authorized the publication of the results during the mapping sessions. They confirmed this authorization on July 2018 during the member checking sessions to review the results.

Competing interests

The authors declare that they have no competing interests.

References

1. Jordan B. Birth in four cultures: a crosscultural investigation of childbirth in Yucatan, Holland, Sweden, and the United States. 4.a edition. Long Grove: Waveland Press; 1993.
2. Davis-Floyd R, Sargent C. Introduction: The anthropology of birth. In: Davis-Floyd R, Sargent C, editors. Childbirth and authoritative knowledge: Cross-cultural perspectives. Berkeley: University of California Press; 1997. p. 1–53.
3. King M, Smith A, Gracey M. Indigenous health part 2: the underlying causes of the health gap. *Lancet*. 2009;374:76–85. [https://doi.org/10.1016/S0140-6736\(09\)60827-8](https://doi.org/10.1016/S0140-6736(09)60827-8).
4. Leonard SA, Main EK, Scott KA, Profit J, Carmichael SL. Racial and ethnic disparities in severe maternal morbidity prevalence and trends. *Ann Epidemiol*. 2019. <https://doi.org/10.1016/J.ANNEPIDEM.2019.02.007>.
5. World Health Organization. General guidelines for methodologies on research and evaluation of traditional medicine. Geneva: World Health Organization; 2000. <http://apps.who.int/medicinedocs/en/d/Jwhozip42e/>.
6. Koblinsky M, Moyer CA, Calvert C, Campbell J, Campbell OMR, Feigl AB, et al. Quality maternity care for every woman, everywhere: a call to action. *Lancet*. 2016;388:2307–20. [https://doi.org/10.1016/S0140-6736\(16\)31333-2](https://doi.org/10.1016/S0140-6736(16)31333-2).

7. Papps E, Ramsden I. Cultural safety in nursing: The New Zealand experience. *Int J Qual Heal care*. 1996;8:491–7.
8. Chukwuneke FN, Ezeonu CT, Onyire BN, Ezeonu PO. Culture and biomedical care in Africa: the influence of culture on biomedical care in a traditional African society, Nigeria, West Africa. *Niger J Med J Natl Assoc Resid Dr Niger*. 2012;21:331–3.
9. Chalmers B. Changing childbirth in Eastern Europe. Which systems of authoritative knowledge should prevail? In: Davis-Floyd R, Sargent C, editors. *Childbirth and authoritative knowledge: Cross-cultural perspectives*. Berkeley: University of California Press; 1997. p. 263–283.
10. World Health Organization. The world health report 2005: make every mother and child count. Geneva: World Health Organization; 2005. <http://www.who.int/whr/2005/en/>.
11. Stephens C, Porter J, Nettleton C, Willis R. Disappearing, displaced, and undervalued: a call to action for indigenous health worldwide. *Lancet*. 2006;367:2019–28. [https://doi.org/10.1016/S0140-6736\(06\)68892-2](https://doi.org/10.1016/S0140-6736(06)68892-2).
12. de Jesús-García A, Paredes-Solís S, Valtierra-Gil G, FRS I S, Sánchez-Gervacio BM, Ledogar RJ, et al. Associations with perineal trauma during childbirth at home and in health facilities in indigenous municipalities in southern Mexico: A cross-sectional cluster survey. *BMC Pregnancy Childbirth*. 2018;18:198. <https://doi.org/10.1186/s12884-018-1836-8>.
13. Meneses S, Pelcastre B, Vega M. Maternal mortality and the coverage, availability of resources, and access to women's health services in three indigenous regions of Mexico: Guerrero Mountains, Tarahumara Sierra, and Nayar. (In) Schwartz DA, editor. *Maternal death and pregnancy-related morbidity among indigenous women of Mexico and Central America*. Cham: Springer International Publishing; 2018. p. 169–88. https://doi.org/10.1007/978-3-319-71538-4_9.
14. World Health Organization. The promotion and development of traditional medicine. Geneva: World Health Organization; 1978. https://extranet.who.int/iris/restricted/bitstream/10665/40995/1/WHO_TRS_622.pdf.
15. International Council for Science. ICSU Series on science for sustainable development No. 4: Science, traditional knowledge and sustainable development. 2002. <http://unesdoc.unesco.org/images/0015/001505/150501eo.pdf>.
16. Segato R. Una paradoja del relativismo: el discurso racional de la Antropología frente a lo sagrado. En: Gorbach F, Rufer M, editores. (In) *Disciplinar la investigación: archivo, trabajo de campo y escritura*. Mexico: Grupo Editorial Siglo Veintiuno, Universidad Autónoma Metropolitana-Xochimilco; 2016. p. 25–62.
17. Sarmiento I, Paredes-Solís S, Andersson N, Cockcroft A. Safe birth and cultural safety in southern Mexico: study protocol for a randomised controlled trial. *Trials*. 2018;19:354. <https://doi.org/10.1186/s13063-018-2712-6>.

18. Cameron M, Andersson N, McDowell I, Ledogar R. Culturally safe epidemiology: oxymoron or scientific imperative. *Pimatisiwin J Aborig Indig Community Heal*. 2010;8:89–116
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2962656/>.
19. Pérez Ruíz ML, Argueta AV. Saberes indígenas y dialogo intercultural. *Cult y Represent Soc*. 2011;Año 5:31–56. <http://www.journals.unam.mx/index.php/crs/article/view/24448>.
20. Gray S, Zandre E, Gray SRJ. Fuzzy cognitive maps as representations of mental models and group beliefs. (In) Papageorgiou EI, editor. *Fuzzy cognitive maps for applied sciences and engineering*. Berlin: Springer; 2014. p. 29–48. https://doi.org/10.1007/978-3-642-39739-4_2.
21. Giles BG, Findlay CS, Haas G, LaFrance B, Laughing W, Pembleton S. Integrating conventional science and aboriginal perspectives on diabetes using fuzzy cognitive maps. *Soc Sci Med*. 2007;64:562–76. <https://doi.org/10.1016/j.socscimed.2006.09.007>.
22. Dion A, Joseph L, Jimenez V, Gutierrez AC, Ben Ameer A, Robert E, et al. Grounding evidence in experience to support people-centered health services. *Int J Public Health*. 2018.
<https://doi.org/10.1007/s00038-018-1180-9>.
23. Kosko B. Hidden patterns in combined and adaptive knowledge networks. *Int J Approx Reason*. 1988;2:377–93. [https://doi.org/10.1016/0888-613X\(88\)90111-9](https://doi.org/10.1016/0888-613X(88)90111-9).
24. Gray S, Chan A, Clark D, Jordan R. Modeling the integration of stakeholder knowledge in social–ecological decision-making: benefits and limitations to knowledge diversity. *Ecol Model*. 2012;229:88–96. <https://doi.org/10.1016/j.ecolmodel.2011.09.011>.
25. Özesmi U, Özesmi SL. Ecological models based on people's knowledge: a multi-step fuzzy cognitive mapping approach. *Ecol Model*. 2004;176:43–64.
<https://doi.org/10.1016/j.ecolmodel.2003.10.027>.
26. Sesia PM. "Women come here on their own when they need to": prenatal care, authoritative knowledge, and maternal health in Oaxaca. *Med Anthropol Q*. 1996;10:121–40.
27. Pigg SL. Authority in translation. Finding, knowing, naming, and training «traditional birth attendants» in Nepal. En: Davis-Floyd R, Sargent CF, editores. *Childbirth and authoritative knowledge: Cross-cultural perspectives*. Berkeley: University of California Press; 1997. p. 233–262.
28. yWorks. yEd Graph Editor Manual. <https://yed.yworks.com/support/manual/index.html>.
29. Niesink P, Poulin K, Šajna M. Computing transitive closure of bipolar weighted digraphs. *Discret Appl Math*. 2013;161:217–43. <https://doi.org/10.1016/J.DAM.2012.06.013>.
30. Braun V, Clarke V. Using thematic analysis in psychology. *Qual Res Psychol*. 2006;3:77–101.
<https://doi.org/10.1191/1478088706qp063oa>.
31. Saldaña J. *The coding manual for qualitative researchers*. Los Angeles: Sage Publications Inc; 2016. https://www.sagepub.com/sites/default/files/upm-binaries/24614_01_Saldana_Ch_01.pdf.

32. Birt L, Scott S, Cavers D, Campbell C, Walter F. Member Checking: A Tool to Enhance Trustworthiness or Merely a Nod to Validation? *Qual Health Res.* 2016;26:1802–11. <https://doi.org/10.1177/1049732316654870>.
33. Kennedy HP, Cheyney M, Dahlen HG, Downe S, Foureur MJ, Homer CSE, et al. Asking different questions: a call to action for research to improve the quality of care for every woman, every child. *Birth.* 2018;45:222–31. <https://doi.org/10.1111/birt.12361>.
34. Raman S, Nicholls R, Ritchie J, Razee H, Shafiee S. Eating soup with nails of pig: thematic synthesis of the qualitative literature on cultural practices and beliefs influencing perinatal nutrition in low and middle income countries. *BMC Pregnancy Childbirth.* 2016;16:192. <https://doi.org/10.1186/s12884-016-0991-z>.
35. Raman S, Nicholls R, Ritchie J, Razee H, Shafiee S. How natural is the supernatural? Synthesis of the qualitative literature from low and middle income countries on cultural practices and traditional beliefs influencing the perinatal period. *Midwifery.* 2016;39:87–97. <https://doi.org/10.1016/j.midw.2016.05.005>.
36. Withers M, Kharazmi N, Lim E. Traditional beliefs and practices in pregnancy, childbirth and postpartum: a review of the evidence from Asian countries. *Midwifery.* 2018;56:158–70. <https://doi.org/10.1016/j.midw.2017.10.019>.
37. Aziato L, Omenyo CN. Initiation of traditional birth attendants and their traditional and spiritual practices during pregnancy and childbirth in Ghana. *BMC Pregnancy Childbirth.* 2018;18. <https://doi.org/10.1186/s12884-018-1691-7>.
38. Selin H, Stone PK. Introduction. En: Selin H, editor. *Childbirth Across Cultures*. Dordrecht: Springer Netherlands; 2009. p. 1. doi:<https://doi.org/10.1007/978-90-481-2599-9>.
39. Dennis C-L, Fung K, Grigoriadis S, Robinson GE, Romans S, Ross L. Traditional postpartum practices and rituals: a qualitative systematic review. *Womens Heal.* 2007;3:487–502. <https://doi.org/10.2217/17455057.3.4.487>.
40. Logan MH. Selected references on the hot-cold theory of disease. *Med Anthropol Newsl.* 1975;6:8–14 <http://www.jstor.org/stable/647601>.
41. Grigoriadis S, Robinson GE, Fung K, Ross LE, Chee C, Yin I, Dennis C-L, et al. Traditional postpartum practices and rituals: clinical implications. *Can J Psychiatr.* 2009;54:834–40. <https://doi.org/10.1177/070674370905401206>.
42. Hovey R, Delormier T, McComber A, Lévesque L, Martin D. Enhancing indigenous health promotion research through two-eyed seeing: a hermeneutic relational process. *Qual Health Res.* 2017;27:1278–87. <https://doi.org/10.1177/1049732317697948>.
43. Hall BL, Tandon R. Decolonization of knowledge, epistemicide, participatory research and higher education. *Res All.* 2017;1:6–19. <https://doi.org/10.18546/RFA.01.1.02>.
44. Santos BDS. *Epistemologías del Sur*. Siglo XXI: México; 2009.

45. Caban A, Walker EA. A systematic review of research on culturally relevant issues for Hispanics with diabetes. *Diabetes Educ.* 2006;32:584–95. <https://doi.org/10.1177/0145721706290435>.
46. Castaldo M. Susto: etiology of mental disorders in mothers and children in Mexico. *J Pregnancy Child Heal.* 2015;02. <https://doi.org/10.4172/2376-127X.1000206>.
47. Gross T. Letting the air out: Aire as an empty signifier in Oaxacan understandings of illness. *Cult Med Psychiatry.* 2016;40:707–25. <https://doi.org/10.1007/s11013-016-9501-z>.
48. Mysyk A. Susto: an illness of the poor. *Dialect Anthropol.* 1998;23:187–202. <http://www.jstor.org/stable/29790573>.
49. Rubel AJ. The epidemiology of a folk illness: Susto in Hispanic America. *Ethnology.* 1964;3:268–83.
50. Zhao Y-L, Wang J-B, Xiao X-H, Zhao H, Zhou C, Zhang X, et al. Study on the cold and hot properties of medicinal herbs by thermotropism in mice behavior. *J Ethnopharmacol.* 2011;133:980–5. <https://doi.org/10.1016/j.jep.2010.09.014>.
51. Geck MS, Cabras S, Casu L, Reyes García AJ, Leonti M. The taste of heat: how humoral qualities act as a cultural filter for chemosensory properties guiding herbal medicine. *J Ethnopharmacol.* 2017;198:499–515. <https://doi.org/10.1016/j.jep.2017.01.027>.
52. Turinawe EB, Rwemisisi JT, Musinguzi LK, de Groot M, Muhangi D, de Vries DH, et al. Traditional birth attendants (TBAs) as potential agents in promoting male involvement in maternity preparedness: insights from a rural community in Uganda. *Reprod Health.* 2016;13:24. <https://doi.org/10.1186/s12978-016-0147-7>.
53. World Health Organization, The United Nations Children's Emergency Fund, United Nations Population Fund. Traditional birth attendants: a joint WHO/UNFPA/UNICEF statement. Geneva: World Health Organization; 1992. <http://www.who.int/iris/handle/10665/38994>.
54. Zuluaga G, Andersson N. Initiation rites at menarche and self-reported dysmenorrhoea among indigenous women of the Colombian Amazon: a cross-sectional study. *BMJ Open.* 2013;3:e002012. <https://doi.org/10.1136/bmjopen-2012-002012>.
55. Anderson I, Robson B, Connolly M, Al-Yaman F, Bjertness E, King A, et al. Indigenous and tribal peoples' health (The Lancet–Lowitja Institute Global Collaboration): a population study. *Lancet.* 2016;388:131–57. [https://doi.org/10.1016/S0140-6736\(16\)00345-7](https://doi.org/10.1016/S0140-6736(16)00345-7).
56. de Graaf JP, Steegers EAP, Bonsel GJ. Inequalities in perinatal and maternal health. *Curr Opin Obstet Gynecol.* 2013;25:98–108. <https://doi.org/10.1097/GCO.0b013e32835ec9b0>.
57. Kuhnlein HV, Erasmus B, Spigelski D, Food and Agriculture Organization of the United Nations, McGill University. Centre for Indigenous Peoples' Nutrition and Environment. Indigenous peoples' food systems: the many dimensions of culture, diversity and environment for nutrition and health. Rome: Food and Agriculture Organization of the United Nations; 2009. <http://www.fao.org/docrep/012/i0370e/i0370e00.htm>.

58. Sarmiento I, de Jesús-García A, Paredes-Solís S, et al. Indigenous factors relevant for Safe Birth in Cultural Safety among Nancue ñomndaa communities in Guerrero, Mexico: Protocol of a qualitative study based on conversations. *Int J Indig Heal*. 2019;14:7–18.
<https://doi.org/10.32799/ijih.v14i2.31946>.
59. Montello DR. Scale in geography. En: *International Encyclopedia of the Social & Behavioral Sciences*. Elsevier; 2015. p. 1–3.
<https://www.sciencedirect.com/referencework/9780080970875/international-encyclopedia-of-the-social-and-behavioral-sciences#book-info>.
60. Harary F, Norman RZ, Cartwright D. *Structural models: an introduction to the theory of directed graphs*. New York SE - ix, 415 pages illustrations 24 cm: Wiley; 1965.

Chapter 4: Combining conceptual frameworks on maternal health in Indigenous communities – Fuzzy cognitive mapping using participant and operator-independent weighting (manuscript 2)

Iván Sarmiento^{1,2}, Anne Cockcroft¹, Anna Dion¹, Sergio Paredes-Solís³, Abraham De Jesús-García³, David Melendez⁴, Anne Marie Chomat¹, Germán Zuluaga², Alba Meneses-Rentería³, Neil Andersson^{1,3}

1. CIET-PRAM, Faculty of Medicine, Department of Family Medicine, McGill University. Canada.
2. *Grupo de Estudios en Sistemas Tradicionales de Salud. Universidad del Rosario.* Colombia.
3. *Centro de Investigación de Enfermedades Tropicales. Universidad Autónoma de Guerrero.* Mexico.
4. *Comité Promotor por una Maternidad Segura en México.* Mexico.

Abstract

A recurring issue in intercultural research is whose knowledge informs conceptualisation and design of projects or interventions. Fuzzy cognitive mapping uses arrows and weights to represent stakeholder knowledge on causal relationships and can generate composite theories to inform research and action. Cognitive mapping is accessible across different cultures, but participant weighting is not always straightforward. We describe a procedure to combine and condense maps from different stakeholders and an alternative operator-independent weighting procedure adapted from Harris' discourse analysis.

As part of an initiative to contrast conceptual frameworks of intercultural researchers and traditional midwives, eight intercultural researchers each produced a map of factors they saw contributing to maternal health in Indigenous communities. We compared the strength of each factor's outgoing arrows and the influence of categories of factors between participant- and operator-independent weighting. The maps from both procedures reflected the perspectives of the eight researchers in a consistent way. Almost identical condensed maps from the two weighting procedures suggests Harris' discourse analysis is relevant in exploratory inquiries using fuzzy cognitive mapping.

Introduction

Grounded knowledge synthesis incorporates information from experience and local realities or cultural contexts (Andersson 2018). Combining stakeholder perspectives with formal literature is often an effective basis for local decision-making and action (Davidoff et al. 2015). A recurring issue in intercultural research is whose knowledge should inform project conceptualisation and design. A related concern is how to contrast or combine different theories or knowledge, ranging from standard literature reviews to informal knowledge.

Fuzzy cognitive mapping (FCM) has been used to combine different perspectives into composite theories that inform research and action (Andersson and Silver 2019; Giles et al. 2008). Cognitive maps are directed graphs composed of three elements: factors (causes or outcomes), relationships between factors, and weights of relationships. The maps depict causal factors as nodes linked by arrows to describe how changes can happen (Harary, Norman, and Cartwright 1965). The maps are graphic forms sharable across different cultures and literacy levels. They collate complex knowledge as multiple sets of relatively simple components of cause, link and outcome. As long as each component cause and outcome can be identified or translated into the same language or symbols, the language or culture of authors of each individual map does not affect interpretation. A common communication format for different cultural backgrounds facilitates intercultural dialogue and the synthesis of evidence from multiple sources.

FCM recognises uncertainty and accepts that multiple answers exist for the same question (Kosko 1994). Instead of using a binary indicator such as the presence or absence of an arrow to define certainty of relationships in the map, fuzzy maps allow a range of weights allocated to the relationship. Since causal knowledge is often uncertain and varied from the viewpoints of different stakeholders – for each of whom it might feel certain – FCM allows modelling of "hazy degrees of causality between hazy causal concepts" (Kosko 1986a:1). The technique provides a visual representation of different knowledges (Andersson and Silver 2019) using well-established analytical tools (Felix et al. 2019). These maps can represent cyclic dynamics (Gray, Zandre, and Gray 2014; Osoba and Kosko 2019) when a factor is both a cause and an effect of another or when a self-pointing arrow indicates reinforcing internal dynamic (Osoba and Kosko 2019).

Intercultural researchers have used fuzzy cognitive mapping to explore Indigenous perspectives on maternal health (Sarmiento et al. 2020) and to examine how stakeholder perspective vary from and expand upon published literature in diabetes and maternal health (Dion et al. 2019; Giles et al. 2008).

The *Weight of Evidence* method uses FCM to contextualise literature-based evidence according to the knowledge of relevant stakeholders (Dion et al. 2020). Previous FCM analysis with multiple stakeholder groups in Canada (Tratt et al. 2020), Mexico (Sarmiento et al. 2020), Nigeria (Sarmiento et al. 2021), Uganda (Belaid et al. 2020) and Botswana, combined multiple maps within each stakeholder group. Matching and reduction of concepts juxtapose concepts across maps, before consolidating individual maps into a single collective combined one (Papageorgiou and Kontogianni 2012). Combined maps are easier to communicate as there is less to visualise, but the process of combining maps can be easily influenced by the researchers, raising concerns about whose views are ultimately reflected in the maps (Andersson and Silver 2019).

An additional concern is that weighting the strength of relationships on the maps increases the length of the mapping sessions considerably, which risks reducing participant engagement. This challenge is more significant when multiple participants build the maps. In some concepts of causality, an outcome is the result of all interactions across the whole system. Although the elements can be identified, their working together defies weighting the influence of any one component against another. FCM is relatively simple to do and easy to understand by participants from different backgrounds (Gray et al. 2012), but weighting of relationships can be challenging for stakeholders who do not, as part of their culture, parse elements of causality (Tratt et al. 2020). In these views of causality, establishing a hierarchy of factors that contribute to an outcome may be incompatible with their overall understanding of an issue.

Research context and objectives

This project is part of the Safe Birth in Cultural Safety project in Mexico, which aimed to improve maternal health outcomes in Indigenous groups without undermining their culture or identity. This approach recognized equal value of Indigenous and Western knowledge and aimed to bridge them through an intercultural dialogue in the search for solutions. The project used FCM to contrast and combine three knowledge sources about factors that affect maternal health in Indigenous communities. The first two sources were traditional midwives in the South of Guerrero state (Sarmiento et al. 2020) and a literature review of published and unpublished evidence (Sarmiento, Paredes-Solís, et al. 2020). This paper describes the third source, researchers with experience in Indigenous health promotion. We introduce a procedure to combine and condense maps made by different stakeholders. We also describe and test an alternative procedure to calculate the weights of

relationships within the maps as an alternative to obtaining the weights directly from mapping participants, and compare the results obtained from the two weighting approaches.

Methods

We invited eight international researchers with extensive experience in culturally safe health promotion to participate in online sessions to map their understanding of factors affecting maternal health in Indigenous communities in 2019. All the researchers had contributed to our work in Mexico (Sarmiento et al. 2018). Appendix M2 - 1 shows characteristics of the participants.

Drawing maps and initial rationalisation

FCM participants (mappers) can create maps individually or in groups to describe their knowledge of complex systems one relationship at a time. They begin with the factors (nodes), then show how they are related to one another (arrows), and then weight the strength of the relationships.

Individual FCM sessions followed a standardised protocol (Andersson and Silver 2019). We opted for individual sessions to accommodate the busy schedules of researchers and, given the different backgrounds of the researchers, to reflect as much variation in perspectives as possible. The lead author (IS) provided each researcher with a guide about the process before facilitating individual mapping sessions. After informed consent, IS drew the maps using yEd (yWorks 2017) following the mapper's directions and recorded each session to document discussions behind each decision. The mappers indicated the factors, relationships and weights. They then rationalised their maps by identifying duplicated concepts and unnecessary distinctions between similar factors to reduce their number. Mappers weighted the causal influence of each relationship using a scale from one for the weakest to five for the strongest. To facilitate weighting, the lead author asked two "if-then" questions for each relationship in the map (Stylios, Groumpos, and Georgopoulos 1999). First, if (the origin factor) increases, then would (the resulting factor) increase or decrease? Weights were positive for the former and negative for the latter. Second, if (the origin factor) increases, then would (the resulting factor) change rarely (weight of 1) or very often (weight of 5)? After each session, each mapper received an electronic version of the individual map to confirm the content.

We calculated the fuzzy transitive closure (Niesink, Poulin, and Šajna 2013) for each map, and combined the results into a single average map. Transitive closure is an algorithm that identifies all the possible paths between factors and calculates the total influence that one factor might have on another when all the possible paths between those factors are considered. Fuzzy transitive closure

implies that indirect relationships between factors are only as strong as the weakest weight within the paths between them. It is the algorithm of choice when the number of factors and relationships differ across maps (Niesink et al. 2013).

We used a pattern matching table (Appendix M2 - 2), in which each column reflects one map with factors in the map arranged by rows to line up with the factors of the other maps that share meanings. We used the row label as the standard name for factors mentioned in several maps. Sometimes the map authors described the same factor but as opposites in name and weight. For example, one map included violence with a negative effect on maternal health, while another included "no violence" with a positive effect on maternal health. Before combining the maps, we adjusted these differences. If one factor in a causal chain had to change from a positive to a negative relationship, the sign of the relationship would change. If both factor and outcome changed, the sign of the relationship remained the same.

Once all factors received a standard name, we calculated the average weight for each relationship. The resulting value was the sum of all the weights for that relationship across the maps divided by the total number of maps in the set (Kosko 1986b). The average is a simple way to combine stakeholder maps with equivalent perspectives and relevance. Weighted averages or Bayesian updating can help to adjust for differences in expertise, relevance or uncertainty around the weights (Dion et al. 2020). Group discussion among mappers can also be a way to define summary values for the relationships in a combined map.

Condensation

Condensation reduces the number of nodes and relationships by grouping them. Condensation helps to avoid semantic differences that might hide similar meanings of concepts and facilitates combining multiple maps (Papageorgiou and Kontogianni 2012). It is particularly useful when a large number of factors hinders interpretation. A qualitative step identifies categories, and a quantitative step condenses factors and calculates the influence of each category (Gray et al. 2012; Özesmi and Özesmi 2004). We followed principles of coding and categorisation (Saldaña 2016) for the former and principles of directed graphs theory (Harary et al. 1965) for the latter.

Defining categories

Categorisation allows organisation and grouping of factors based on shared characteristics (Saldaña 2016) relevant for the research question that represent some level of patterned response or meaning

within the data set (Braun and Clarke 2006). Using inductive analysis, the lead author initially arranged the factors in the maps into categories, aided by the records from the mapping sessions. In a member checking exercise (Birt et al. 2016), each of the eight mappers examined the categories and suggested any necessary adjustments. After two iterations, the participating researchers agreed on a final set of categories. The matching table (Appendix M2 - 2) shows the final classification.

Condensation of factors and category weights

Harary (1965) initially described condensation in the analysis of unweighted directed graphs as the process of reducing parts of the map (nodes and arrows) into single nodes and arrows. Several authors have described procedures for condensation (Balakrishnan 1995; Iwasaki and Simon 1994; Louati, Aufaure, and Lechevallier 2011; Sterling 2004) based on the weights of nodes, arrows or both. Here, we used only the arrow weights because mapping sessions focused on weighting the relationships between factors, rather than the factors themselves. Condensation of factors followed a qualitative procedure.

We renamed the factors (nodes) in the combined map described above (under subheading Condensation) with the agreed-upon categories. We then listed all the relationships in the map to indicate one cause and one outcome linked by an arrow. Condensation is equivalent to aggregating multiple sub-maps (sub-graphs) each corresponding to a relationship (cause-arrow-outcome). We then added the weights of all the relationships with the same category names (Kosko 1988). The resulting list had the relationships of the map condensed at the category level. In this map, the weights of each arrow indicated the strength of the influence of one category on another, and we normalised these weights into a range between 0 (no relationship) and 1 (the maximum category weight) to facilitate comparability. If an initial and landing factor belonged to the same category, condensation will result in a self-pointing loop indicating reinforcing dynamics within the category. Loops are common results of operations with maps (Osoba and Kosko 2019). Appendix M2 - 3 has a step by step graphical description of the condensation process.

Following the same procedure, we then generated a condensed map for each of the eight individual maps. The comparison of these eight condensed maps identified: (a) validated connections (all maps share the non-zero connection with the same sign), (b) non-validated connections (the connection is not mentioned in all the maps), and (c) conflicting connections (the connection is positive in some maps and negative in others). As described elsewhere (Sarmiento et al. 2020), we used a similar

process with traditional midwives to identify shared and conflicting views to develop intervention strategies grounded in community understanding of maternal health.

Harris' discourse analysis and comparison with participant weights

Zellig Harris proposed the earliest formal discourse analysis in the 1950s to explore meaning based on the frequency of occurrence of discourse elements (Harris 1952). The approach identified the role of morphemes (part of a word, word or several words with an irreducible meaning) exclusively from their relative frequency in the text without assuming any prior meaning for them. The comparison of frequencies between texts allowed Harris to identify similar structural meanings of morphemes. Harris' analysis thus collated the patterns of relationships between words (internal structure) to understand how interactions between words held meaning. Because it was based on frequency of occurrence, among other criteria (partial order, redundancies and dependencies), it did not depend on the researcher assumptions of meaning. This operator/researcher independence is a major advantage in the intercultural context.

We applied the concept of morpheme frequency across different maps to establish weights of causal relationships between two factors. A factor that caused an outcome across multiple maps would have stronger influence than a factor that causes the same outcome only in one or two maps. In the eight original individual maps of the independent researchers, we ignored the participant weights. We kept only the indication of whether a mapper said a causal relationship and whether it was positive or negative. We used a weight of 1 if the relationship was on the map and 0 if it was not. For the relationships with weight 1, we maintained the sign (positive or negative) as indicated by the mappers. The analysis started by calculating the transitive closure of each map to identify direct and indirect relationships, revealing the internal structure of the map (Niesink et al. 2013). We then calculated the number of times each relationship repeated across all the individual transitive closure maps and established their relative frequency by dividing each occurrence by the highest frequency across the eight maps. Thus, we obtained a value between 0 for the relationships that did not exist and 1 for the relationship that was most frequently mentioned. We then used the same procedure described before to create a condensed map.

To compare participant-weighting and Harris' discourse analysis at the factor level, we calculated outdegree centrality on the combined maps (described above) as the sum of the absolute values of the weights for each factor's outgoing edges (Papageorgiou and Kontogianni 2012). This measure indicates the total strength of the factor in terms of its outgoing relationships (Gray et al. 2012).

Higher outdegree centrality suggests a higher level of influence of one node in the map and signals actionable factors, that could be of interest to promote change. The free software yEd (yWorks 2017) generated this and a graphical output scaling the size and position of the factors in a relative order from the highest to the lowest for each map. To measure the overall agreement of category weights between participant-generated and operator-independent weights, we calculated the average of the absolute value of the difference in weights. A small average difference indicates similarity of the weighting approaches and higher values indicate less agreement.

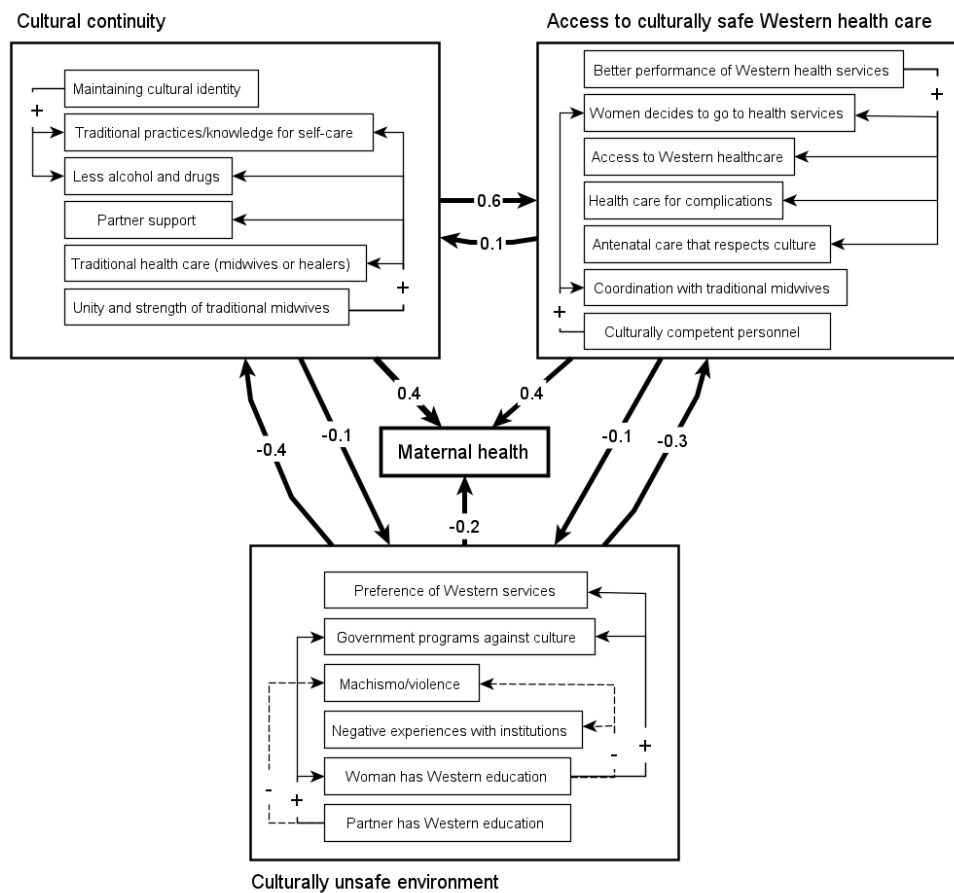
Results

For the eight researchers, maternal health was a broad concept that included all aspects of woman's wellbeing during pregnancy, childbirth and postpartum periods, including for example the spiritual dimension, the physical condition and positive mental condition. The eight individual maps each identified between 10 to 24 causal factors for maternal health, and between 32 to 99 relationships between those factors – between 1.9 and 4.3 relationships per factor. The eight maps together identified 106 unique factors, which we grouped into 12 categories, linked by 886 relationships identified after transitive closure.

The values of all the relationships in the condensed maps are available as Appendix M2 - 4. We describe below the three categories with the highest influence on maternal health based on 330 relationships between 67 factors identified after transitive closure. Figure 4-1 presents a sub-map of the relationship at the category level and the factors involved in the strongest internal dynamics of each category.

Cultural continuity included maintaining Indigenous identity and support of traditional midwifery as the two most influential factors (higher outdegree). This category also included spiritual practices, access to traditional midwifery, following traditional self-care practices (diets, purge, menstruation care, etc.), and respectful behaviour in the family. A self-pointing loop described the reinforcing dynamics of maintaining identity in higher engagement with self-care practices, including traditional diets, and less use of alcohol and drugs. The reinforcing role of traditional midwifery was reflected through a range of paths, including: more self-care practices, more support from traditional midwives for women during pregnancy and delivery, more positive partner attitudes and less alcohol consumption. This category was validated across all the maps.

Figure 4-1. Map of the three strongest categories and their internal dynamics



Legend: Each box corresponds to a category and the thick arrows to category-level relationships. Within the categories some factors had positive and negative interactions, thus indicating internal dynamics.

Access to culturally safe Western health care included quality and accessibility of health care services, especially for complications, as the most influential factors (higher outdegree centrality). Other factors in this category referred to respectful health care and antenatal care within an intercultural framework, coordination with traditional midwives, and cultural competence of health personnel. A prominent self-pointing loop depended on a better performance of health services that contribute to women's decision to seek care and increasing access to health services; and the impact of culturally competent personnel on increasing coordination with traditional midwives and reducing women's delay in deciding to visit health services.

A culturally unsafe environment had a negative impact on maternal health, decreased access to Western medicine and impaired cultural continuity. This category included institutions and programs that do not value Indigenous culture, religious missionaries or Western education that replaced cultural values, structural or personal racism, loss of territories, negative experiences of Indigenous people in their interaction with Western institutions, a culture of violence and inadequate communication strategies. The most influential factors according to their outdegree centrality were Western education of the woman and her partner guided by Western values with ambiguous positive and negative effects via direct or indirect displacement or de-valuing of traditional approaches to maternity care. Another category with negative, although weaker, influence on maternal health was woman's comorbidities, particularly diabetes.

Comparison of participant and Harris' discourse analysis weights

All but one of the ten factors with the highest outdegree centrality in the participant-weighted consolidated map coincided with the top ten in the Harris' discourse analysis consolidated map (Appendix M2 - 5 shows the outdegree centrality of each factor). The order of importance as cause across the system varied for these factors (Table 4-1). When we considered only the influence on maternal health, the strongest factors were previous poor health conditions of the woman in the discourse analysis map and maintaining cultural practices and support from a traditional midwife in the participant weighted map.

Table 4-1. Factors with higher outdegree centrality

Centrality (and order) in participant-based weights				Centrality (and order) in Harris' discourse analysis	
Support from partner or family	1.00	—————	1.00	Support from partner or family	
Woman has caring and working husband	0.99	—————	1.00	Support from the community	
Western health services are available	0.90	—————	1.00	Western health services are available	
Maintain the cultural identity	0.88	—————	0.97	Woman has Western education	
Woman has Western education	0.87	—————	0.90	Traditional practices (food, purge, others)	
Woman's economic stability	0.86	—————	0.90	Woman has caring and working husband	
Strength and unity of traditional midwives	0.85	—————	0.83	Strength and unity of traditional midwives	
Support from the community	0.80	—————	0.79	Woman's economic stability	
Traditional practices (food, purge other)	0.76	—————	0.69	Maintain the cultural identity	
Western education against culture (community) ^a	0.74	—————	0.62	Traditional midwives in the community	

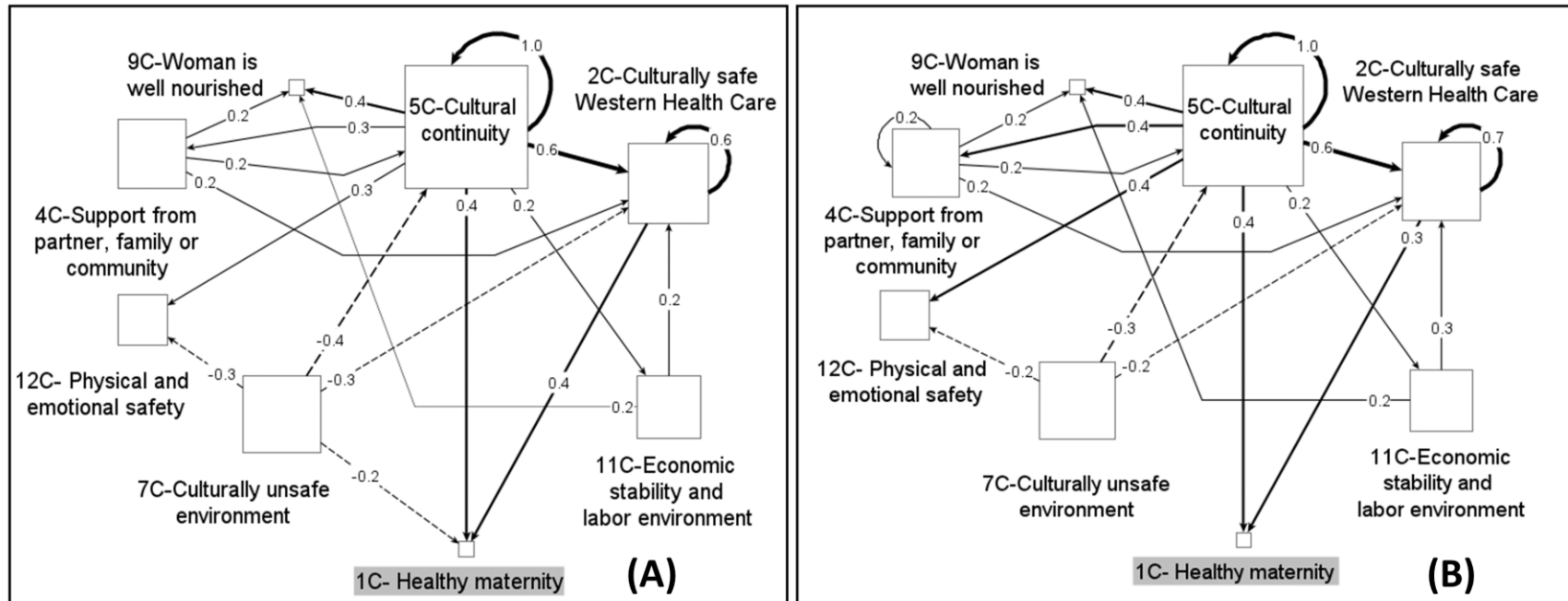
Legend: ^a These factors did not appear among the most important factors identified by the other weighting procedure.

Figure 4-2 shows the condensed maps with each node scaled according to its outdegree centrality. The condensed maps showed an almost identical internal structure, whether based on participant or discourse analysis weighting. Both similarly identified those categories with stronger influence in the

system. The average difference of relationships between the two weighting procedures was 0.01, and the largest difference was 0.08, for the effect of culturally unsafe environment on cultural continuity. Cultural continuity had the highest outdegree centrality or the strongest influence on the system for both weighting procedures. Similarly, in the second order of importance of both condensed maps was access to culturally safe Western health care. Cultural continuity and access to culturally safe Western health care also had the most prominent positive influence on maternal health in both weighting procedures (Figure 4-2).

(Figure 4-2 is in the next page)

Figure 4-2. Map of categories affecting maternal health in Indigenous communities



Legend: The figure compares the condensed maps obtained from participant-based (panel A) and discourse analysis weighting (panel B). To simplify the graph, we only included the strongest relationships between the categories with the strongest levels of influence. Appendix M2 - 4 contains all the relationships on the map. Solid lines represent positive relationships and dashed lines negative ones. The numbers on the edges represent the cumulative net influence of one category on another, where 1 is the highest influence in the map.

Discussion

The combined map is a soft model (Strickland 2011) of the views of eight knowledge sources (independent researchers) about influences on maternal health in Indigenous communities. The researchers shared several characteristics, including positive attitudes towards participatory approaches and respect for Indigenous traditions. The purposive sampling explains the prominence of Indigenous cultural continuity and cultural safety as strong positive influences. Recognition of these influences is growing (Curtis et al. 2019), particularly in the Americas, where Indigenous groups are increasingly vocal about the value of their worldview and knowledge (Dietz 2018; Walsh 2008). At best, however, the soft model generated by these experienced intercultural researchers would only be generalisable to a certain type of intercultural researcher, not all researchers.

Fuzzy cognitive mapping offers a sharable language to collate knowledges from multiple sources. Combining maps offers a partial answer to uncertainty about the "correct" knowledge of causes of a particular outcome (Kosko 1986b). Peirce proposed a pragmatic response to uncertainty of beliefs as "the final opinion", the one which is fated to be ultimately agreed to by all who investigate it. (The Peirce Edition Project et al. 1998). Although new inquiry may modify what is known about something, the aggregation of knowledge contributed by an indefinite community of inquiry reduces uncertainty (Kosko 1994).

In conventional research, researchers trained in Western scientific methods have conventionally held a monopoly of inquiry. FCM extends the boundaries of what could be included in research synthesis (Dion et al. 2019). This expansion of what is perceived as valid knowledge is particularly relevant for Indigenous groups who have developed complex bodies of knowledge, know-how and practices over many generations (International Council for Science 2002), and whose knowledge has been systematically ignored for centuries (Santos 2009). Increased collaboration across cultural differences opens space for intercultural dialogue (Dietz 2018; Pérez Ruíz and Argueta 2011), a communication process in which different parties contribute their knowledge to identify solutions for a shared concern (Council of Europe 2008).

Participant weighting of influence and Harris' discourse analysis of the frequency of relationships showed very similar outdegree centrality for the ten most important individual factors and almost identical broader categories. Harris' discourse analysis uses binary indicators of the presence or absence of a relationship across multiple texts or, in this case, across multiple maps. This analysis cannot work for a single map. Our application of discourse analysis considered each cause-outcome

set as we would consider a similar causal concept in an interview/discussion. Our intention was not to eliminate participant weighting of influence, but to adapt FCM to stakeholder settings where participants declined or could not generate the weights.

Limitations and challenges

The causal relationships in the maps is a soft model of participant knowledge and, as such, bound to be partial. One makes the models not so much for prediction as for learning about how different stakeholders see possible paths that would lead to an outcome (Mingers 2006). In this application, FCM allowed us to present perspectives of a small number of participants with similar viewpoints about maternal health. The smaller the number of maps, the less amenable this would be to Harris' discourse analysis and the generalizability of results.

Condensation of factors into categories carries the risk of any summary of complex information from multiple sources (Louati et al. 2011). Categories are an abstraction to deal with different framing of factors across individual perspectives (Felix et al. 2019). In our case, we included map authors in the categorization process, an option that might not always be available.

Analysis at this higher level of abstraction (categories) often addresses structural issues, like behaviours shared by groups or maintained for a long time, often overriding important details within the categories. We should thus not infer factor level conclusions from category level results. A relationship between two categories does not imply that all factors in one category will have the same summary influence on all factors in the outcome category (Harary et al. 1965). Once categories help to clarify the general picture, it may be appropriate to revert to factor-specific measures identified by outdegree centrality as the most influential.

Conclusions

The most influential factors in maternal health identified in the combined maps were consistent with the mappers' experience with Indigenous traditions. These eight researchers believe culturally safe approaches and adequate intercultural interactions can make positive contributions to Indigenous maternal health. The procedure to combine and condense maps allowed us to present the perspectives of this group in a concise yet meaningful format. Increasing the level of abstraction using categories made the combined map more accessible. The condensed maps explored structural issues and offered suggestions for future research. Exploring internal dynamics of condensed maps indicated relevant factors that could contribute to promote change.

Harris' discourse analysis to generate operator-independent weights of influence makes FCM relevant in communities where participant-weighting is not feasible. It could thus increase participation of stakeholders with causal philosophies that do not include parsing causes and their relative importance. This should complement, not replace, a commitment to intercultural dialogue.

Declarations

Acknowledgements and credits

Dr David Loutfi helped to test operator-independent weighting. Paloma Cruz offered advice during the drafting of the manuscript. The members of Participatory Research at McGill University and Dr Mateja Šanja kindly reviewed initial versions of this work.

Conflict of interests

The authors declare that they have no competing interests.

Ethics

The research project received approval of the Ethics Committee of the *Centro de Investigación de Enfermedades Tropicales* of the *Universidad Autónoma de Guerrero*, Mexico, and of the McGill University Faculty of Medicine IRB.

References

- Andersson, Neil. 2018. "Participatory Research-A Modernizing Science for Primary Health Care." *Journal of General and Family Medicine* 19(5):154–59. doi: 10.1002/jgf2.187.
- Andersson, Neil, and Hilah Silver. 2019. "Fuzzy Cognitive Mapping: An Old Tool with New Uses in Nursing Research." *J Adv Nurs* 2019;75:3823–30. doi:10.1111/jan.14192
- Balakrishnan, V. K. 1995. *Network Optimization*. 1st ed. London ; SE - viii, 248 pages : illustrations ; 24 cm.: Chapman & Hall.
- Belaid, Loubna, Pamela Atim, Eunice Atim, Emmanuel Ochola, Martin Ogwang, Pontius Bayo, Janet Oola, Isaac Wonyima Okello, Ivan Sarmiento, Laura Rojas-Rozo, Kate Zinszer, Christina Zarowsky, and Neil Andersson. 2021. "Communities and Service Providers Address Access to Perinatal Care in Postconflict Northern Uganda: Socialising Evidence for Participatory Action." *Family Medicine and Community Health* 9(2):e000610. doi: 10.1136/fmch-2020-000610.

- Birt, Linda, Suzanne Scott, Debbie Cavers, Christine Campbell, and Fiona Walter. 2016. "Member Checking: A Tool to Enhance Trustworthiness or Merely a Nod to Validation?" *Qualitative Health Research* 26(13):1802–11. doi: 10.1177/1049732316654870.
- Braun, Virginia, and Victoria Clarke. 2006. "Using Thematic Analysis in Psychology." *Qualitative Research in Psychology* 3(2):77–101. doi: 10.1191/1478088706qp063oa.
- Council of Europe. 2008. *White Paper on Intercultural Dialogue: Living Together as Equals in Dignity*. Strasbourg.
- Curtis, Elana, Rhys Jones, David Tipene-Leach, Curtis Walker, Belinda Loring, Sarah-Jane Paine, and Papaarangi Reid. 2019. "Why Cultural Safety Rather than Cultural Competency Is Required to Achieve Health Equity: A Literature Review and Recommended Definition." *International Journal for Equity in Health* 18(1):174. doi: 10.1186/s12939-019-1082-3.
- Davidoff, Frank, Mary Dixon-Woods, Laura Leviton, and Susan Michie. 2015. "Demystifying Theory and Its Use in Improvement." *BMJ Quality & Safety* 24(3):228–38. doi: 10.1136/bmjqs-2014-003627.
- Dietz, Gunther. 2018. "Interculturality." Pp. 1–19 in *The International Encyclopedia of Anthropology*, edited by H. Callan. Oxford, UK: John Wiley & Sons, Ltd.
- Dion, Anna, Alessandro Carini-Gutierrez, Vania Jimenez, Iván Sarmiento, A. Ben Ameer, Lawrence Joseph, Emilie Robert, and Neil Andersson. 2020. "Weight of Evidence: Incorporating Stakeholder Knowledge in Evidence Synthesis to Advance Mixed Methods Research." *Journal of Mixed Methods Research*.
- Dion, Anna, Lawrence Joseph, Vania Jimenez, Alessandro Carini Gutierrez, Amal Ben Ameer, Emilie Robert, and Neil Andersson. 2019. "Grounding Evidence in Experience to Support People-Centered Health Services." *International Journal of Public Health* 64(5):797–802. doi: 10.1007/s00038-018-1180-9.
- Felix, Gerardo, Gonzalo Nápoles, Rafael Falcon, Wojciech Froelich, Koen Vanhoof, and Rafael Bello. 2019. "A Review on Methods and Software for Fuzzy Cognitive Maps." *Artificial Intelligence Review* 52(3):1707–37. doi: 10.1007/s10462-017-9575-1.

- Giles, Brian G., G. Haas, M. Šajna, and C. S. Findlay. 2008. "Exploring Aboriginal Views of Health Using Fuzzy Cognitive Maps and Transitive Closure: A Case Study of the Determinants of Diabetes." *Canadian Journal of Public Health / Revue Canadienne de Santé Publique* 99(5):411–17. doi: 10.1111/j.1467-7717.2009.01126.x.
- Gray, Steven, Alex Chan, Dan Clark, and Rebecca Jordan. 2012. "Modeling the Integration of Stakeholder Knowledge in Social–Ecological Decision-Making: Benefits and Limitations to Knowledge Diversity." *Ecological Modelling* 229:88–96. doi: 10.1016/j.ecolmodel.2011.09.011.
- Gray, Steven, E. Zanre, and S. R. J. Gray. 2014. "Fuzzy Cognitive Maps as Representations of Mental Models and Group Beliefs." Pp. 29–48 in *Fuzzy cognitive maps for applied sciences and engineering*, edited by E. I. Papageorgiou. Berlin: Springer.
- Harary, Frank., Robert Z. Norman, and Dorwin Cartwright. 1965. *Structural Models: An Introduction to the Theory of Directed Graphs*. New York SE - ix, 415 pages illustrations 24 cm: Wiley.
- Harris, Zellig S. 1952. "Discourse Analysis." *Language* 28(1):1. doi: 10.2307/409987.
- International Council for Science. 2002. *ICSU Series on Science for Sustainable Development No. 4: Science, Traditional Knowledge and Sustainable Development*. 4.
- Iwasaki, Yumi, and Herbert A. Simon. 1994. "Causality and Model Abstraction." *Artificial Intelligence* 67(1):143–94. doi: 10.1016/0004-3702(94)90014-0.
- Kosko, Bart. 1986a. "Fuzzy Cognitive Maps." *International Journal of Man-Machine Studies* 24(1):65–75. doi: 10.1016/S0020-7373(86)80040-2.
- Kosko, Bart. 1986b. "Fuzzy Knowledge Combination." *International Journal of Intelligent Systems* 1(4):293–320. doi: 10.1002/int.4550010405.
- Kosko, Bart. 1988. "Hidden Patterns in Combined and Adaptive Knowledge Networks." *International Journal of Approximate Reasoning* 2(4):377–93. doi: 10.1016/0888-613X(88)90111-9.
- Kosko, Bart. 1994. *Fuzzy Thinking: The New Science of Fuzzy Logic*. New York, NY: Hyperion.

- Louati, Amine, Marie-Aude Aufaure, and Yves Lechevallier. 2011. "Graph Aggregation: Application to Social Networks." Pp. 157–77 in *Advances in Theory and Applications of High Dimensional and Symbolic Data Analysis*, HDSDA, 2011, October 27-30. Beijing, China: Beihang University.
- Mingers, J. 2006. "A Critique of Statistical Modelling in Management Science from a Critical Realist Perspective: Its Role within Multimethodology." *Journal of the Operational Research Society* 57(2):202–19. doi: 10.1057/palgrave.jors.2601980.
- Niesink, Patrick, Keven Poulin, and Mateja Šajna. 2013. "Computing Transitive Closure of Bipolar Weighted Digraphs." *Discrete Applied Mathematics* 161(1–2):217–43. doi: 10.1016/J.DAM.2012.06.013.
- Osoba, O., and Bart Kosko. 2019. "Beyond DAGs: Modeling Causal Feedback with Fuzzy Cognitive Maps." Cornell University Repository.
- Özesmi, Uygur, and Stacy L. Özesmi. 2004. "Ecological Models Based on People's Knowledge: A Multi-Step Fuzzy Cognitive Mapping Approach." *Ecological Modelling* 176(1–2):43–64. doi: 10.1016/j.ecolmodel.2003.10.027.
- Papageorgiou, Elpiniki I., and Areti Kontogianni. 2012. "Using Fuzzy Cognitive Mapping in Environmental Decision Making and Management: A Methodological Primer and an Application." in *International Perspectives on Global Environmental Change*. InTech.
- Pérez Ruíz, Maya Lorena, and Arturo Villamar Argueta. 2011. "Saberes Indígenas y Dialogo Intercultural." *Cultura y Representaciones Sociales Año* 5(10):31–56.
- Saldaña, Johnny. 2016. *The Coding Manual for Qualitative Researchers*. Los Angeles, Calif.: Sage Publications Inc.
- Santos, Boaventura De Sousa. 2009. *Epistemologías Del Sur*. edited by J. Gandarilla. México: Siglo XXI.
- Sarmiento, Ivan, Umaira Ansari, Khalid Omer, Yagana Gidado, Muhammad Chadi Baba, Adamu Ibrahim Gamawa, Neil Andersson, and Anne Cockcroft. 2021. "Causes of Short Birth Interval (Kunika) in Bauchi State, Nigeria: Systematizing Local Knowledge with Fuzzy Cognitive Mapping." *Reproductive Health* 18(1):74. doi: 10.1186/s12978-021-01066-2.

- Sarmiento, Iván, Sergio Paredes-Solís, Neil Andersson, and Anne Cockcroft. 2018. "Safe Birth and Cultural Safety in Southern Mexico: Study Protocol for a Randomised Controlled Trial." *Trials* 19(1):354. doi: 10.1186/s13063-018-2712-6.
- Sarmiento, Iván, Sergio Paredes-Solís, David Loutfi, Anna Dion, Anne Cockcroft, and Neil Andersson. 2020. "Fuzzy Cognitive Mapping and Soft Models of Indigenous Knowledge on Maternal Health in Guerrero, Mexico." *BMC Medical Research Methodology* 20(1):125. doi: 10.1186/s12874-020-00998-w.
- Sarmiento, Iván, Sergio Paredes-Solís, Martin Morris, Juan Pimentel, Anne Cockcroft, and Neil Andersson. 2020. "Factors Influencing Maternal Health in Indigenous Communities with Presence of Traditional Midwifery in the Americas: Protocol for a Scoping Review." *BMJ Open* 10(10):e037922. doi: 10.1136/bmjopen-2020-037922.
- Sterling, Sara E. 2004. "Aggregation Techniques to Characterize Social Networks." Air Force Institute of Technology.
- Strickland, President Jeffrey. 2011. *Simulation Conceptual Modeling*. [Place of publication not identified] SE -: Lulu Com.
- Stylios, C. D., Peter P. Groumpos, and Voula C. Georgopoulos. 1999. "Fuzzy Cognitive Map Approach to Process Control Systems Chrysostomos." *Journal of Advanced Computational Intelligence and Intelligent Informatics* 3(5):409–17. doi: 10.20965/jaciii.1999.p0409.
- The Peirce Edition Project, Andre De Tienne, Jonathan R. Eller, Albert C. Lewis, Cathy L. Clark, and D. Bront Davis, eds. 1998. *The Essential Peirce: Selected Philosophical Writings (1893-1913)*. Vol. 1. Bloomington; Indianapolis: Indiana University Press.
- Tratt, Elyse, Iván Sarmiento, Rachel Gamelin, Jeannie Nayoumealuk, Neil Andersson, and Paul Brassard. 2020. "Fuzzy Cognitive Mapping with Inuit Women: What Needs to Change to Improve Cervical Cancer Screening in Nunavik, Northern Quebec?" *BMC Health Services Research* 20(1):529. doi: 10.1186/s12913-020-05399-9.
- Walsh, Catherine. 2008. "Interculturalidad, Plurinacionalidad y Decolonialidad: Las Insurgencias Político-Epistémicas de Refundar El Estado." *Tabula Rasa* (9):131–52.
- yWorks. 2017. "YED." <https://www.yworks.com/products/yed>

Chapter 5: Maternal health and Indigenous traditional midwives in southern Mexico: contextualization of a scoping review (manuscript 3)

Iván Sarmiento^{1,2}, Sergio Paredes-Solís³, Anna Dion¹, Hilah Silver¹, Emily Vargas⁴, Paloma Cruz², Juan Pimentel^{1,2}, Germán Zuluaga², Anne Cockcroft¹, Neil Andersson^{1,3}

1 CIET-PRAM, Faculty of Medicine, Department of Family Medicine, McGill University. Canada.

2 *Grupo de Estudios en Sistemas Tradicionales de Salud. Universidad del Rosario.* Colombia.

3 *Centro de Investigación de Enfermedades Tropicales. Universidad Autónoma de Guerrero.* Mexico.

4 *Facultad de Enfermería, Universidad Autónoma de Yucatán,* Merida, Mexico

Abstract

Objectives: Collate published evidence of factors that affect maternal health in Indigenous communities and contextualise the findings with stakeholder perspectives in the Mexican State of Guerrero.

Design: Scoping review and stakeholder fuzzy cognitive mapping

Inclusion and exclusion: The scoping review included empirical studies (quantitative, qualitative or mixed method) that addressed maternal health issues among Indigenous communities in the Americas and reported on the role or influence of traditional midwives before June 2020. The contextualization drew on two previous studies of traditional midwife and researcher perspectives in southern Mexico.

Results: The initial search identified 4,461 references. Of 87 selected studies, 63 came from Guatemala and Mexico. Three small randomised trials involved traditional midwives. One addressed the practice of traditional midwifery. With diverse approaches to cultural differences, the studies used contrasting definitions of traditional midwives. A fuzzy cognitive map graphically summarized the influences identified in the scoping review. When we compared the literature's map with those from 29 traditional midwives in Guerrero and eight international researchers, the three sources coincided in the importance of self-care practices, rituals and traditional midwifery. The primary

concern reflected in the scoping review was access to Western health care, followed by maternal health outcomes. For traditional midwives, the availability of hospital or health centre in the community was less relevant and had negative effects on other protective influences, while researchers conditioned its importance to its levels of cultural safety. Traditional midwives highlighted the role of violence against women, male involvement and traditional diseases.

Conclusions: The literature and stakeholder maps showed maternal health resulting from complex interacting factors in which promotion of cultural practices was compatible with a protective effect on Indigenous maternal health. Future research challenges include traditional concepts of diseases, and the impact on maternal health of gender norms, self-care practices and authentic traditional midwifery.

Strengths and limitations of this study

- Contextualizing published evidence with stakeholder perspectives added value in understanding influences on maternal health in Indigenous communities
- Fuzzy cognitive mapping contrasted and combined knowledges in a transparent and traceable way
- An adaptation of Harris' discourse analysis synthesised quantitative, qualitative and mixed study results into a unified soft model
- The weights of the relationships in the final maps are best interpreted as grades of consensus about influence, not as pooled estimates of impact
- Additional discussion with other groups of local stakeholders is still relevant and necessary

Introduction

Modern perinatal care aims to ensure that all women deliver in a safe environment, and this is especially relevant for those at the periphery of the health system where risks are usually higher.[1] Universal access to safe birth means responding to specific local conditions, and community engagement can inform this response.[1,2] What constitutes a safe environment in one culture might be inappropriate or unacceptable in another.[3,4]

In Latin America, failure to incorporate cultural dimensions in the design and delivery of perinatal care has generated resistance to health services among Indigenous peoples.[5] Despite political recognition of Indigenous traditions, there is still mistrust between Western health services and

Indigenous traditional health care, particularly for childbirth.[5,6] A climate of mistrust reduces the access of Indigenous women to Western health care.[7]

Evaluation of traditional practices themselves faces many methodological challenges,[8] including scarcity of epidemiological data, small size and remoteness of many Indigenous groups, and lack of clarity about the role and definition of traditional practitioners. There is little published evidence on the impact of traditional practices. Systematic reviews of available literature suggest improvements in maternal and child health outcomes from interventions that rely on Western re-training of traditional midwives.[9–14] Kruske's 2004 literature review noted that retraining traditional midwives ignores the important social and cultural role of traditional midwives and treats local knowledge as a barrier to improve maternal health.[15] International recommendations in the last two decades place more emphasis on increasing access to Western health care.[16] The new emphasis ignores traditional practices and promotes a new cadre of younger literate women, trained exclusively in Western perinatal care.[16,17] This approach fails to take into account the complexity of broader economic, geographical and sociocultural factors and the diversity of stakeholders in Indigenous communities.[2] These intersectional factors affect access to services[18] and health outcomes for women.[15]

Rationale and objectives

This study was part of a larger initiative on the role of traditional midwifery in safe birth. The first of its two objectives was to collate and assess published evidence that identifies influences, including traditional midwives, on maternal health in Indigenous communities in the Americas. The second objective was to contextualise the literature with local perspectives and experience, by combining a scoping review with stakeholder cognitive mapping.

Methods

We used a conventional scoping review to identify the influences on maternal health in Indigenous communities in the Americas in the published and grey literature.[19] Fuzzy cognitive mapping (FCM) portrayed the findings in a graphical format and provided a formal platform to reconcile diverse sources of knowledge.[20] We contrasted the map from the scoping review with stakeholder perspectives of the same outcome, to make sense of complex evidence grounded in the experience of local stakeholders.[21] We applied fuzzy logic to deal with the diversity of definitions and synthesize multiple sources of evidence into a soft model of causal theories.[22]

The scoping review

The scoping review [23] followed Arksey and O'Malley's methodological framework [24] and the updated guidelines by Peters et al.[19] The reporting follows the Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) Checklist. The review sought to answer the question: What factors, including the role and influence of traditional midwives, promote or reduce maternal health in Indigenous settings in the Americas and what is the relative weight of their influence?

Eligibility criteria

We included empirical studies on maternal health, which reported on the role or influence of traditional midwives and were conducted in Indigenous communities in the Americas. This geographic restriction was intended to limit the heterogeneity of cultural practices in other continents. The protocol contains a detailed description of eligibility criteria.[23] We did not limit publication dates, and we included studies in any of the main languages spoken in the Americas (English, Spanish, French or Portuguese). The review excluded theoretical models or editorials that did not report empirical findings, and ethnographies which did not report on maternal health outcomes.

Information sources

Supported by a librarian specialized in Indigenous health, in June 2020 we searched CINAHL, Scopus, LILACS, MEDLINE, Embase, and Google Scholar databases. We used Google to search for unpublished studies. The search strategy accompanies the protocol.[23] To identify additional unpublished reports, we used the procedure of the Canadian Agency for Drugs and Technologies for Health tool. A librarian based in Colombia extended the search strategy to include other 15 databases specific to research in Latin-America (CEPAL, Repositorio FLACSO, BVS, BVS MTCTI, PAHO, PAHO IRIS, Red de repositorios Latinoamericanos, La referenica Dialnet, Redalyc, BDCOL, Biblioteca digital Bogotá, CLACSO, BRISA, WHO, WHO IRIS). Hand-searching of the references in the included documents identified additional studies.

Study selection and data extraction

Using EndNote X9.0 and Rayyan,[25,26] we eliminated duplicates through screening article titles and abstracts. Three independent reviewers (IS, EV and PC) identified eligible studies and extracted data using predesigned instruments. After an initial selection, we reviewed full-texts for eligibility and hand-searched the reference lists to identify additional documents. Before starting data extraction,

IS, EV and JP finalised the extraction instrument in two rounds using a random sample of five references each time. The instrument collected information about each study (year, authors, design, country, language, and participants), the maternal health outcome reported, characteristics of traditional midwives involved and approach to cultural differences. The second part of the instrument listed all influences affecting maternal health and their relationships using a 3-column edge list: initiating factor, landing factor and sign of the relationship (+1 or -1). If the study reported that an increment of one factor increased another factor, the relationship was positive (+1); if it decreased the second factor, it was negative (-1). If the study reported additional influences between factors, we documented them using the same format. For quantitative studies, we included relationships that were supported by effect estimates or higher proportions of the outcomes among exposed (significant at the 5% level). For qualitative studies, we included relationships indicated by a statement supported by quotes or reported direct observations that suggested the increment of one factor could lead to an increment (positive relationship) or reduction (negative relationship) of the landing factor. We assessed the quality of aspects of included studies using the Mixed Methods Appraisal Tool (MMAT).[27]

Data mapping

We used fuzzy cognitive mapping to portray influences mentioned in the literature. Fuzzy cognitive maps have nodes representing influences, linked with arrows to indicate the presumed causal relationships.[28] The data can also be summarised as an edge list of the relationships. We used graph theory and fuzzy logic to identify the role of different influences and understand their interaction.[29,30]

We created an edge list for each included study and, using an algorithm developed by Mateja Šajna[31] in CIETmap 2.2,[32] calculated the fuzzy transitive closure to identify the influence of each node on other nodes when taking into account all the relationships mentioned in the study.[31] An operator-independent procedure inspired by Harris' original discourse analysis[33] used the relative frequency of each relationship (node, arrow, node) across all the transitive closure maps to calculate its weight.[34] Because this step occurs after calculating transitive closure, the relative frequency incorporates both the relationships reported in the articles and those identified with the algorithm. In this application of Harris' discourse analysis, the relative frequency of a relationship between two nodes is taken to reflect the function of the initial node in the map, in a similar way that linguists can identify the function of a word in the structure of a text. In fuzzy cognitive

mapping the structural function of the node is causality. The initial node often influences the occurrence of the landing node according to the sources of the map. Viewing the literature in the scoping review as analogous to a text in an exercise on linguistic meaning, a relationship present across multiple articles in the literature would thus be stronger than a relationship identified in fewer articles. Causal interpretation of the relationships in the map is restricted to the set of data from which the relative frequency was derived, they are not an exhaustive proof of causality.

Two researchers (IS and PC) inductively classified the factors emerging from the scoping review into categories in reiterative rounds,[35] and then condensed the factor level relationships into a category level map to facilitate visualization and interpretation.[34]

We used degree centrality measures in the free software yEd to further characterize the role of each factor.[36] Outdegree centrality calculated the total influence that each node has in the system, the sum of the absolute values of the weights for each node's outgoing edges. Indegree centrality indicated the total influence that each node receives using the same calculation with the incoming relationships.

Contextualising the evidence from the scoping review

The contextualization of available evidence combined three sources of information – traditional midwives,[37] intercultural researchers working on perinatal care[34] and the available literature – to identify the influences on maternal health in Indigenous communities in southern Mexico.

Traditional midwives contributed a cultural perspective grounded in Guerrero local conditions, and intercultural researchers shared their understanding of the issues, based on their years of bridging the relationships between Western institutions and Indigenous communities in their international work in America, Africa and Asia.

Dion's Weight of Evidence is a procedure for stakeholders to interpret, expand upon and prioritize findings from evidence syntheses.[21] We adapted this method by summarizing the scoping review evidence as a fuzzy cognitive map with operator-independent weights based on Harris' discourse analysis. As described elsewhere, traditional midwives and intercultural researchers generated cognitive maps of their knowledge of factors affecting maternal health in Indigenous communities.[34,37] We compared the literature with stakeholder knowledge using a pattern matching table, to identify agreement and differences across knowledge sources. This arranges each

map as a column and the factors or categories in each map that influence the outcome as rows. The factors or categories in the same row indicate patterns of agreement across knowledge sources.

Patient and public involvement

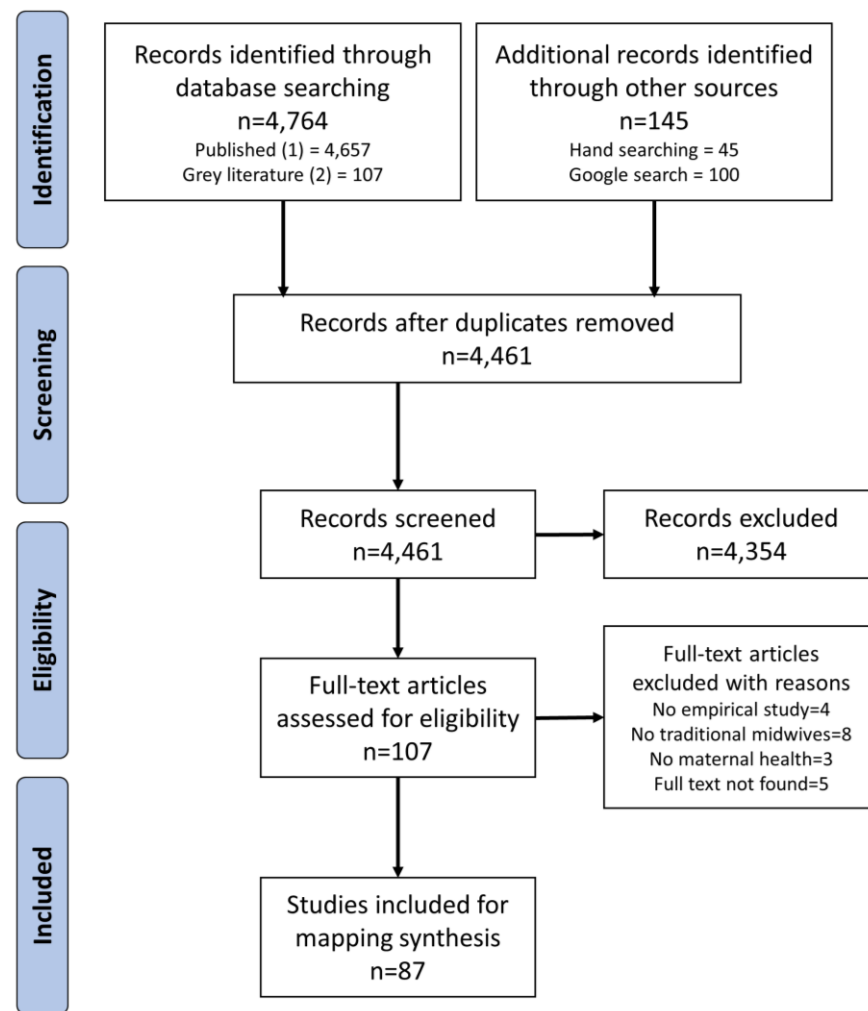
The study is part of a participatory research programme involving stakeholders in Guerrero. The scoping review did not directly involve patients or the public. We contextualised the findings from the scoping review using stakeholder perspectives already collected.

Results

Scoping review

Figure 5-1 provides an overview of the selection process for the scoping review. We examined 107 full texts and retained 87 documents including 62 published papers, 15 book chapters, 7 dissertations and 3 reports between 1989 and 2020 (see Appendix M3 - 1). Some 61% (53/87) of documents were published in the last ten years. The documents used English (60% or 52/87), Spanish (38% or 33/87) and Portuguese (2% or 2/87). Most studies were conducted in Mexico (38% or 33/87) and Guatemala (35% or 30/87), followed by Perú (7% or 6/87) and Ecuador (7% or 6/87). One multicounty study included contiguous communities in Mexico and Guatemala. Some 67% (58/87) were qualitative studies (mostly interviews, focus group discussions and observations), followed by 20% (17/87) quantitative and 14% (12/87) mixed methods. Cross-sectional surveys were the most common quantitative design. Three non-randomised studies used a pretest-posttest design to measure changes after training activities. Three pilot studies randomised an intervention, to test the involvement of traditional midwives as facilitators of women groups,[38] the use of mHealth technologies to encourage referrals,[39] or support for traditional midwifery.[40]

Figure 5-1. Flow diagram of the selection of sources of evidence (PRISMA-ScR)



Legend: (1) CINAHL, Scopus, LILACS, MEDLINE, Embase, Google Scholar. (2) CEPAL, Repositorio FLACSO, BVS, BVS MTCT, PAHO, PAHO IRIS, Red de repositorios Latinoamericanos, La referenica Dialnet, Redalyc, BDCOL, Biblioteca digital Bogotá, CLACSO, BRISA, WHO, WHO IRIS

Following MMAT criteria,[27] our main concern about the qualitative studies was soundness of data collection methods and the level at which the interpretation of the results was substantiated by data. The quantitative randomized controlled trials were non-blinded due to participation of communities in the interventions. Few quantitative studies clarified whether their samples were representative of the target population. The main limitation of mixed method studies was quality, particularly of quantitative components, and integration of the different components in the answer to the research question.

The studies addressed maternal health in different ways (Appendix M3 - 1), describing the practices of traditional midwifery or self-care customs, training programs for traditional midwives, barriers and facilitators of access to Western health care versus traditional services, or tensions in the interface of Indigenous communities and health care services. Four references reported on programs exclusively focussed on supporting traditional midwifery.[40–43]

Few studies were explicit about how they approached cultural differences and studies used different terminology and different interpretations of the same terminology. The terms included anthropologic or ethnographic, intercultural, integration of traditional midwives and strengthening of cultural traditions. The term intercultural, for example, was used to describe Western services adapted to cultural conditions of users,[44] integration of traditional practices in Western settings,[45,46] programs offering training,[46] programs valuing and recognizing cultural diversity,[47] or hybrid scenarios for the practice of traditional birthing,[48] among others.

Only one qualitative study focused specifically on traditional disease entities ("isihuayo" or "caída de matriz" (fallen womb) and "necaxantle" or "sobreparto" (postpartum illness)),[49] and eight studies mentioned traditional diseases.[50–59] The etiology, symptoms and treatment of these illnesses was rooted in the cosmovision of Indigenous groups and has been described as a result of imbalances of bodily and social equilibrium.[49] Some of them included imbalances of corporal humors (cold and hot or humid and dry),[53] others would include displacement of organs or parts of the body as described by Indigenous concepts of anatomy,[49] negative effects of environmental conditions,[56,58] postpartum complications of the mother,[51] among others. Six studies (7%) reported specifically on health outcomes such as maternal mortality, childbirth complications, perineal trauma and post-partum infection. Almost all (80/87) focused on aspects of childbearing management and mothers' experiences during the perinatal period. Most of these studies described traditional practices, explored barriers or facilitators for access to Western health care (for complications or routine), or described the quality of Western or traditional services (Appendix M3 - 1).

Studies in Canada,[60] the United States,[61] Chile[55] and Western Mexico[62] reported on memories of traditional birth practices no longer in use. In Perú and Chile, traditional midwives reported persecution by police due to their practice.[55,59] During the selection of articles, it was evident that some Indigenous groups have transitioned to mestizo traditions, which made it difficult to establish if traditional midwives identified as Indigenous.[63–65]

Characteristics of participating traditional midwives varied widely between studies. One set of studies referred to older women and men linked with traditional culture, with almost no access to Western school, exclusively speakers of Indigenous language and who combine their work with other subsistence activities. This type of midwife was characterized by a vocation to serve their community, often responding to a divine call or inspiration, and recognition by their communities. They usually offered additional services as healers (*curanderos*) for children and other family members.[46,49,57,59,66–68] The second set of studies referred to midwives similar to Western-trained birth attendants[23,69]. This included younger Indigenous women, sometimes family of older traditional midwives, who were fluent in Spanish and received external training in the use of Western techniques. This type of midwifery was typically more welcome at the health care facilities and closer to Western worldviews.[70] In some communities in Chile, Brazil and Mexico, the role of traditional midwives was less institutionalised because Indigenous women would give birth alone or with support of their families, and traditional midwives would be those who know how to help in case of complications.[55,62,71] The diversity of what could be considered traditional midwifery has generated several classifications,[40,72] although few of the selected studies used these classifications. Some 17 of the 87 studies report no details about their participants, most of them simply reporting that their participants were traditional midwives from an Indigenous community.

Influences on maternal health in the scoping review

The 87 studies identified between 2 and 33 factors, and between 1 and 39 relationships between those factors. Together the studies identified 264 unique factors, which we grouped into 20 categories, linked by 1538 relationships after transitive closure. Table 5-1 has a description of each category and Appendix M3 - 2 has the references for each of the maps that mentioned factors in these categories.

Table 5-1. Categories that emerged from the factors in the maps

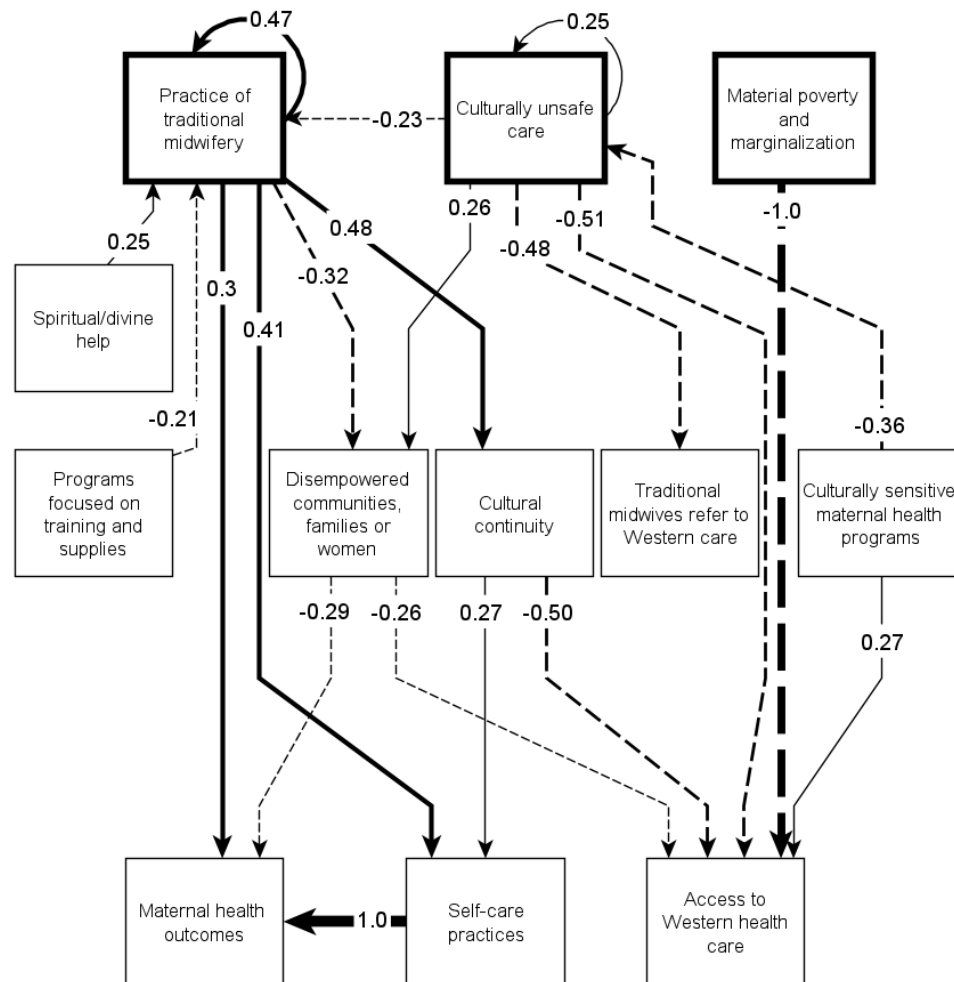
Category	Description
1. Positive maternal health outcomes	This category included reduced maternal mortality and pregnancy, childbirth or postpartum complications, such as bleeding, breech presentation, preeclampsia, eclampsia, premature rupture of membranes, prolonged labour, infections, perineal tear etc. This category also included prevention or control of traditional diseases, such as coldness, "matriz caída" (fallen womb), "sobrepardo" (postpartum illness), "antojo" (craving) etc. Other factors described mental health in terms of self-esteem and well-being of the mothers.
2. Adequate nutrition	Most of the studies that reported the importance of adequate mother nutrition did not offer additional details. Two studies mentioned increased intake of fish, vegetables or

	meat products during pregnancy. This category is different from dietary restrictions that are part of self-care practices.
3. Woman's comorbidities or physical weakness (before pregnancy)	Reports of women's weakness or poor health conditions that did not depend on the pregnancy, such as a history of hypertensive disorders, prior caesarean section and complications of other procedures.
4. Abortion and contraception	Use of modern (condoms, pills, etc.) or traditional methods (plants or massage of the umbilical cord) of family planning and pregnancy interruption.
5. Health of children and other family members	Positive infant health conditions such as treated diarrhoea or respiratory infections. This category included the cure or prevention of multiple traditional diseases such as "empacho" (gastrointestinal malaise), "susto" (fright), "mal de ojo" (evil eye) or the treatment of muscle- or bone-related conditions with "sobadas" (massages).
6. Casual/Family/No childbirth attendant	Childbirths in company of family (husband, mother-in-law, grandmother) or neighbours. This category could have overlap with traditional midwives who are family of the mother. This also included childbirths without any company.
7. Access to Western health care	This corresponds with the ideal scenario in which Western health services are available, affordable and accessible, with adequate infrastructure, supplies and personnel (enough providers and low turnover). Women go to these services for antenatal care, routine care or in case of complications. This category included institutional childbirths and postpartum institutional care.
8. Traditional midwives refer patients to Western care	Traditional midwives advise mothers to visit Western health care services for complications or routine care.
9. Culturally sensitive maternal health programs	Initiatives to adequate Western services to the cultural context of Indigenous groups but retaining the prominence of Western ways. This category included bringing traditional midwives to participate in institutional childbirths (mostly as an auxiliary, companion or translator), having translators, institutionalising vertical childbirths, offering Indigenous-led community centres to support mothers while they access institutional childbirths ("casas de la mujer indígena" or maternity houses), birthing facilities next to hospitals, allowing women to use their traditional clothes during childbirth, promoting circles of women, using mHealth technologies etc. One study reported the use of alternative/complementary therapies as part of these adaptations.[46]
10. Culturally unsafe care	At an individual level, it was expressed as racism in health institutions against Indigenous groups, lack of commitment of health providers, negative attitudes towards traditional midwifery and bad treatment to patients, family or traditional midwives at health care facilities. This also included lack of training to Western personnel on how to relate with other cultures, preference of colonial languages and Western worldviews in despise of Indigenous culture. In culturally unsafe care, patients had negative experiences or perceived risks of mistreatment, feared unnecessary c-section, episiotomy, surgery or sterilisation. At the system's level, this category included political or religious discrimination, lack of policies promoting intercultural care, implementation of policies that do not recognise the intercultural context or advise against Indigenous traditions and programs that use culturally inadequate communication strategies. In Mexico, cash transfers were vastly used to conditionate women's access to institutional childbirths.[83]
11. Disempowered communities, families or women	Communities divided by political or religious conflicts and without agency to act on health care services. Families could not contest the restrictions of Western providers to participate in childbirth, or they, and the mothers, were not aware of their rights. In Guatemala, Perú and México, limited access to birth certificates was an important barrier for traditional births.[46,59,68,84] Negative gender norms (machismo) reduced women's autonomy for decision making and increased violence against them. Indigenous women had strong feelings of modesty and shame during their interaction with Western practitioners.
12. Programs focused on training and supplies	Short courses offered by public authorities or NGOs focused on training traditional midwives on Western contents and bringing them supplies (kits) to put in practice these contents. There was a variety of formats for these courses, and some of them used translators, radio, visual aids etc., to communicate contents across cultural differences.

13. Cultural continuity	Groups that maintain traditional culture and knowledge use their traditional languages and respect traditional medicine, including traditional midwives. Cultural practices usually decreased with proximity to urban centres where these groups assimilated more mestizo identities. Cultural continuity included transmission of Indigenous practices and customs across younger generations.
14. Practice/Persistence of traditional midwifery	Traditional midwives were available and supported women during pregnancy, childbirth and the postpartum period, or even beyond. They had recognition from their communities and could be organised to support their practice (associations). In the main text we described the wide variability of participating traditional midwives.
15. Self-care practices	These included a wide range of cultural prescriptions for the prevention or early management of diseases. Mothers and their families would have the main responsibility to put these prescriptions into practice. These prescriptions involved many aspects of everyday life such as sexual behaviour, reduction of heavy work, dietary restrictions, spiritual routines or ritual, use of medicinal plants, preparation for childbirth etc. Particularly relevant was the care of the hot and cold balance of mothers' bodies.
16. Interest of traditional midwives in training or new roles	Traditional midwives expressed their interest in new roles (doulas, trainers of Western midwives, HIV prevention) or in participating in courses.
17. Material poverty and marginalisation	Most Indigenous groups included in the studies lived in communities with poor quality infrastructure (roads or institutional services) and lacked communication means. Transportation was a major challenge for these communities both in terms of availability and costs. In these communities, low income and food insecurity was a concern.
18. Positive experience with home childbirth	Mother's feelings of comfort, confidence and security. They described positive aspects of having company of their family, drinking teas or practising rituals. Mothers also valued the intimacy of their homes and not being exposed to unknown practitioners, particularly men.
19. Spiritual/divine help	Traditional midwives reported spiritual experiences as the origin of their practice, in the form of dreams or revelation. The spiritual dimension was also a source of help for the health of their patients either during routine care or in case of an emergency. Prayer was the main mechanism that traditional midwives used to obtain divine help.
20. External advocates and NGOs promoting maternal and reproductive health	Usually, international organisations or groups of professionals from bigger cities supporting Indigenous communities in the implementation of programs or advocacy of their rights. External aiders could work individually or in association with local authorities.

Based on discourse analysis weighting using relative frequency of relationships, Figure 5-2 shows the ten presumed most influential positive and negative relationships at the category level (Appendix M3 - 3). The categories with more and stronger outgoing relationships (higher outdegree centrality) were: practice of traditional midwifery, culturally unsafe care, and material poverty and marginalisation of remote communities. The main outcomes explored in the literature, as indicated by a higher indegree centrality, were access to Western health care, followed by maternal health outcomes and practice of traditional midwifery. The three categories in the map with the strongest influences on maternal health outcomes included the positive effects of self-care practices and practice of traditional midwifery followed by the negative effects of disempowered communities, families or women.

Figure 5-2. Fuzzy cognitive map of the most influential categories identified in the scoping review



Legend: To simplify the graph, we only included the ten strongest positive and negative relationships. Appendix M3 - 3 contains all the relationships on the map. Solid lines represent positive relationships and dashed lines negative ones. The numbers on the edges represent the cumulative influence of one category on another, where 1 is the strongest influence on the map. The three boxes with thicker lines also had the highest outdegree centrality or influence in the whole system.

The traditional midwifery category had a self pointing arrow denoting reinforcing cycles defined by commitment to their patients (community members), mentorship of apprentices and family heritage. Increasing age of traditional midwives had both positive and negative effects on their role: it impeded elderly traditional midwives from continuing their practice (negative) but it also brought more knowledge and esteem as they accumulated experience (positive). The spiritual dimension of traditional midwifery was reflected in mystic experiences signaling their professional call or

providing spiritual/divine help during their practice. The influence of traditional midwifery was decreased by culturally unsafe care and by programs focused on training and supplies.

The strongest outgoing arrows of traditional midwifery indicated most frequently reported positive effects on maternal health through adequate management of childbirth (even of some complicated cases) and the control of traditional diseases. Two additional arrows indicated positive effects of traditional midwives on cultural continuity and promotion of self-care practices, which in turn had the strongest positive effect on maternal health. More traditional care in the communities increased the sense of confidence and agency of mothers and levels of family and community involvement (decreased disempowerment). Both cultural continuity and disempowerment reduced access to Western care. Cultural continuity reflected in Indigenous people preferring traditional care (midwives or other traditional practitioners) and avoiding Western health services. Disempowerment was reflected in mothers not deciding about their care or having their decisions overruled by husbands or mothers-in-law.

Culturally unsafe care also showed reinforcing dynamics through the accumulation of negative experiences, fear and lack of trust among Indigenous mothers and community members. Programs that had a more sensitive approach to cultural differences contributed to decrease in culturally unsafe attitudes, particularly among care providers, and thus allowed for increased use of Western care. Lack of community trust in Western health personnel was an important barrier to accessing institutional care, either because women did not go or because traditional midwives did not advise their patients to visit Western providers.

Material poverty and marginalization often reduced access to Western health care, due to the geographical distance, poor-quality infrastructure, or lack of resources or transport to reach the services.

Contextualization of the scoping review with stakeholder perspectives

We compared results of the scoping review with the final category maps from two previously reported studies that used fuzzy cognitive mapping to describe stakeholder perspectives of factors affecting maternal health in Indigenous communities. A study in the south of Guerrero included 29 Indigenous traditional midwives from the *Me'phaa* (Tlapaneco) and *Nancue ñomndaa* (Amuzgo) groups.[37] These women and two men had de facto recognition as midwives in their communities, based on their decades of service and traditional knowledge. Most used only Indigenous languages

and the mapping session relied on trained intercultural brokers for translation. Traditional midwives drew their maps in group sessions, building one map of protective factors and another of risk factors.[40] The second study of stakeholder perspectives summarised the views of eight intercultural researchers (3 women and 5 men) with extensive experience in culturally safe health promotion (Mexico, Guatemala, Colombia, Canada, Nigeria, Botswana). All researchers had also contributed to the project that supported Indigenous traditional midwives (above), but none participated in the mapping sessions with the midwives. Researchers created individual maps with protective and risk factors on the same map.[34] The maps from these two sources are available in Figure 3-1, Figure 3-2 and Figure 4-2.

Table 5-2 shows the pattern matching table to compare the three categories of factors with the strongest influence on maternal health in the maps from each of the three sources. A pattern identified across all the maps was the positive effect of self-care practices, rituals and traditional midwifery. In the stakeholder and literature maps, these categories had reinforcing relationships between them.

Table 5-2. Pattern matching table to compare the maps from three different sources about factors influencing positive maternal health

Literature	Traditional midwives From the map of risks ^a	Traditional midwives From the map of protectors	Researchers	Pattern
Self-care practices (1)	The woman follows self-care practices (1)	The woman follows protective rituals (3)	Cultural continuity (1)	Pattern 1
Practice of traditional midwifery (2)		The woman has support of a traditional midwife or healer (2)		
Empowerment of communities, families or women (3) ^a	The woman does not suffer violence (3)	The woman has a loving and caring husband (1)	Physical and emotional safety of women (3)	Pattern 2
			Culturally safe health care (2)	Pattern 3
			Culturally safe environment (3) ^a	
	No traditional diseases (2) ^b			Pattern 4

Legend: The numbers in parenthesis indicate the relative position of the category in the map (1) strongest influence, (2) second strongest influence, (3) third strongest influence. ^a These categories appeared as risk factors in the maps. For comparison purposes, we adjusted the description in this table as the absence of the opposite of the risk factor to describe it in terms of protection. ^b This category came from the self-pointing loop in maternal health.

In another pattern across all the maps traditional midwives stressed the importance of reducing violence against women and promoting a supportive role for male partners, in their words: "a loving, working and caring husband". Researchers mentioned a broader category that included reduction of

violence and other aspects of women's well-being. In the literature review, the concern about control of gender violence and women's disempowerment was part of a broader category that included family and community empowerment. Traditional midwives mentioned their role in counselling partners to increase male engagement and reduce violence against mothers. The literature map (Figure 5-2) indicated that traditional midwifery could reduce disempowerment of communities, families or women, while culturally unsafe care would increase disempowerment.

The concern about culturally unsafe health care and, in general, a culturally unsafe institutional environment for Indigenous communities was prominent among intercultural researchers. Traditional midwives expressed a similar concern when they described the influence of hospital in the community on maternal health (Figure 3-2). Although, in their view, it had a modest protective effect, the maps also showed the presence of hospital reducing other protective factors. The literature also highlighted culturally unsafe care (Additional file 4), but its effect was stronger in reducing access to Western health care than on reducing maternal health. In contrast with the literature's main concern to increase access to Western health services, having a hospital in the community was not a priority for traditional midwives (Figure 3-2), and researchers conditioned importance of accessible health facilities to their level of cultural safety (Figure 4-2).

Finally, in the maps from traditional midwives the control of traditional diseases as positive for maternal health was prominent. The literature review also mentioned the importance of traditional diseases (Table 5-1), but with a lower level of influence.

Discussion

The contextualisation of the scoping review with the perspectives of traditional midwives and intercultural researchers indicated that all three knowledge sources considered self-care practices, rituals, and traditional midwifery as strong positive influences on maternal health in Indigenous communities. In the scoping review, access to Western health care was the primary outcome studied, followed by maternal health outcomes. For traditional midwives, a community-based hospital was less important and intercultural researchers conditioned its importance by its level of cultural safety. For traditional midwives, male support was the strongest protective factor; the researchers and the literature included male support in a category that comprised other aspects of women's well-being and empowerment. Control of traditional diseases was important for midwives, but less so in the literature.

The scoping review reveals an underdeveloped literature, with little quantitative evidence on traditional midwifery practices and their associated outcomes. Most of the studies in the scoping review were from two countries (Guatemala and Mexico) and published in English, a language not spoken in any of the countries reporting traditional midwifery. Three small randomised trials involved traditional midwives but only one tested the impact of their traditional practice. The studies had diverse approaches to cultural differences, ranging from assimilation of Indigenous cultures into Western ways, to recognition of diversity and co-design of interventions. The studies used a range of definitions of traditional midwifery.

Several literature reviews have explored the impact of programs involving traditional midwives (Indigenous and non-Indigenous) in maternal health.[9,10,12–15,73] All explored strategies to assimilate Indigenous communities into the Western health system. We restricted our review to Indigenous communities and traditions, thus focusing on the scope of their work and their knowledge, resources and technologies.

Our study offers a soft model that surfaces different potential starting points for interventions to improve maternal health. Previous work in Africa has shown that involving local perspectives can help to develop culturally respectful interventions for the promotion of reproductive health.[74,75] The literature map suggested that Western research has focused on understanding access to biomedical health care services as an outcome, as indicated by a higher indegree centrality in the map. Disrespect for Indigenous groups (cultural unsafety) and harsher material conditions accumulated to hinder Indigenous women's access to Western services and affected other factors in the literature map. Lack of understanding of the needs and practices of Indigenous communities, and not viewing cultural practices, including traditional midwifery, as a community strength, may limit the access of Indigenous communities to biomedical services (particularly if they require emergency obstetric care). A 2014 systematic global mapping[85] and a 2016 systematic review[86] explored interventions to address cultural factors that prevent access to Western maternity care. The reviews found that culturally congruent interventions can have a positive impact in use of professional care, although few studies have measured impact in low- and middle-income countries.

Contextualising this literature, both with local knowledge and international research expertise in culturally safe care, showed contrasting priorities in terms of both promotion of Western health care and the role of traditional diseases. Although the literature recognizes the existence of traditional concepts of diseases, more research is needed to understand them and their impact in terms of

maternal health. The three sources coincided in suggesting that Indigenous communities could contribute knowledge, skills and resources to promote maternal health (self-care practices, rituals and traditional healers, for example). The impact of traditional practices on maternal health outcomes remains a research priority. Communities with stronger traditions could be better positioned to protect the health of their mothers. Traditional healers in South America[76] and Indigenous communities in Canada[77] have suggested that cultural continuity has a positive effect in the health of Indigenous groups. Actions that promote ownership and sustained participation of Indigenous communities have shown positive changes in prenatal and child health outcomes in Canada.[78] A further challenge will be to define and to measure Indigenous cultural continuity and to establish its impact on healthy motherhood.

Particularly in Mexico, violence against Indigenous women is recognized as a risk factor for maternal and infant death with a structural dimension rooted in colonial history.[79,80] There is a paucity of research on the potential contribution of traditional midwives in reducing violence against women. In Guerrero, Mexico, and Africa, traditional midwives advise men and could engage them in providing support and an enabling environment for mothers.[37,81] Research on this topic could include discussing ways to improve the male role drawing on cultural strengths.

Strengths and limitations

Our application of Harris' discourse analysis permitted incorporation of qualitative and quantitative data on causal relationships from the studies in the scoping review, without depending on empirical measurement, mathematical transformations or researcher assumptions. The weights of the relationships in the operator-independent maps are best interpreted as grades of consensus about influence, not as pooled estimates of impact.[19,21] Harris' discourse analysis is more informative in maps of categories of factors.[34] These categories imply higher levels of abstraction with necessary losses in granularity for factor-level inference.[82] The stakeholder maps that we compared with the scoping review came from two specific groups purposively selected, and future research with other stakeholder groups could offer additional perspectives.

Conclusions

The literature and stakeholder maps showed maternal health in Indigenous communities resulting from complex interacting factors. Fuzzy cognitive mapping provided a practical way to compare and combine different sources of knowledge in a transparent and traceable way. The three knowledge

sources agreed that traditional practices could have positive effects on the health of mothers, highlighting the need for additional research on this topic.

Declarations

Competing interests

The authors declare that they have no competing interests.

Funding

The Graduate Research Excellence in Academics Award from the Department of Family Medicine at McGill University provided funding to support data extraction. The design, management, analysis, and reporting of the data are entirely independent from all sources of funding. Ceiba Foundation, the Centre of Intercultural Medical Studies in Colombia, and the Fonds de recherche du Québec Santé (255253) supported the work of Ivan Sarmiento.

Acknowledgements

Martin Morris at McGill University's library conducted the search strategy and contributed to drafting the protocol. Lorena Niño at Evidence Knowledge Brokering in Public Health developed the additional search of grey literature. The members of Participatory Research at McGill kindly discussed early versions of this work.

References

1. Koblinsky M, Moyer CA, Calvert C, et al. Quality maternity care for every woman, everywhere: a call to action. *Lancet* 2016;388:2307–20. doi:10.1016/S0140-6736(16)31333-2
2. Kennedy HP, Cheyney M, Dahlen HG, et al. Asking different questions: A call to action for research to improve the quality of care for every woman, every child. *Birth* 2018;45:222–31. doi:10.1111/birt.12361
3. Chalmers B. Cultural issues in perinatal care. *Birth* 2013;40:217–9. doi:10.1111/birt.12068
4. Jordan B. Birth in four cultures: A crosscultural investigation of childbirth in Yucatan, Holland, Sweden, and the United States. 4th ed. Long Grove, IL: : Waveland Press 1993.
5. United Nations. Department of Economic and Social Affairs. Permanent Forum on Indigenous Issues. State of the World's indigenous peoples. New York: : United Nations 2014.

- <http://www.un.org/esa/socdev/unpfii/documents/2015/sowip2volume-ac.pdf> (accessed 12 Apr 2021).
6. Mills L. The limits of trust: The Millennium Development Goals, maternal health, and health policy in Mexico. Montreal: : McGill-Queen's University Press 2017.
 7. Bohren MA, Hunter EC, Munthe-Kaas HM, et al. Facilitators and barriers to facility-based delivery in low- and middle-income countries: a qualitative evidence synthesis. *Reprod Health* 2014;11. doi:10.1186/1742-4755-11-71
 8. World Health Organization. General guidelines for methodologies on research and evaluation of traditional medicine. Geneva, Switzerland: 2000.
<http://apps.who.int/medicinedocs/en/d/Jwhozip42e/> (accessed 5 Apr 2019).
 9. Sibley LM, Sipe TA, Barry D. Traditional birth attendant training for improving health behaviours and pregnancy outcomes. *Cochrane Database Syst Rev* 2012;:CD005460.
doi:10.1002/14651858.CD005460.pub3
 10. Byrne A, Morgan A. How the integration of traditional birth attendants with formal health systems can increase skilled birth attendance. *Int J Gynecol Obstet* 2011;115:127–34.
doi:10.1016/j.ijgo.2011.06.019
 11. Kidney E, Winter HR, Khan KS, et al. Systematic review of effect of community-level interventions to reduce maternal mortality. *BMC Pregnancy Childbirth* 2009;9:2.
doi:10.1186/1471-2393-9-2
 12. Wilson A, Gallos ID, Plana N, et al. Effectiveness of strategies incorporating training and support of traditional birth attendants on perinatal and maternal mortality: meta-analysis. *BMJ Br Med J* 2012;344:16. doi:10.1136/bmj.d7102
 13. Lassi ZS, Das JK, Salam RA, et al. Evidence from community level inputs to improve quality of care for maternal and newborn health: interventions and findings. *Reprod Health* 2014;11:S2. doi:10.1186/1742-4755-11-S2-S2
 14. Darmstadt GL, Lee ACC, Cousens S, et al. 60 Million non-facility births: Who can deliver in community settings to reduce intrapartum-related deaths? *Int J Gynecol Obstet* 2009;107:S89–112. doi:10.1016/j.ijgo.2009.07.010

15. Kruske S, Barclay L. Effect of shifting policies on traditional birth attendant training. *J Midwifery Womens Health* 2004;49:306–11. doi:10.1016/j.jmwh.2004.01.005
16. World Health Organization. Department of Reproductive Health and Research. Making pregnancy safer: the critical role of the skilled attendant. A joint statement by WHO, ICM and FIGO. Geneva: 2004. <http://whqlibdoc.who.int/publications/2004/9241591692.pdf> (accessed 8 Nov 2018).
17. World Health Organization. WHO recommendations on maternal health: guidelines approved by the WHO Guidelines Review Committee. Geneva: 2017. http://who.int/tb/features_archive/factsheet_xpert.pdf (accessed 13 Dec 2019).
18. Jones E, Lattof SR, Coast E. Interventions to provide culturally-appropriate maternity care services: factors affecting implementation. *BMC Pregnancy Childbirth* 2017;17:267. doi:10.1186/s12884-017-1449-7
19. Peters MDJ, Marnie C, Tricco AC, et al. Updated methodological guidance for the conduct of scoping reviews. *JBIM Evid Synth* 2020;18:2119–26. doi:10.11124/JBIES-20-00167
20. Giles BG, Findlay CS, Haas G, et al. Integrating conventional science and aboriginal perspectives on diabetes using fuzzy cognitive maps. *Soc Sci Med* 2007;64:562–76. doi:10.1016/j.socscimed.2006.09.007
21. Dion A, Carini-Gutierrez A, Jimenez V, et al. Weight of Evidence: Incorporating stakeholder knowledge in evidence synthesis for health service improvement. *J Mix Methods Res* 2021;JMMR-19-03.
22. Kosko B. *Fuzzy Thinking: The New Science of Fuzzy Logic*. New York, NY: : Hyperion 1994. <https://books.google.ca/books?id=wIKRGQAACAAJ>
23. Sarmiento I, Paredes-Solís S, Morris M, et al. Factors influencing maternal health in indigenous communities with presence of traditional midwifery in the Americas: protocol for a scoping review. *BMJ Open* 2020;10:e037922. doi:10.1136/bmjopen-2020-037922
24. Arksey H, O'Malley L. Scoping studies: towards a methodological framework. *Int J Soc Res Methodol* 2005;8:19–32. doi:10.1080/1364557032000119616

25. Ouzzani M, Hammady H, Fedorowicz Z, et al. Rayyan-a web and mobile app for systematic reviews. *Syst. Rev.* 2016;5:1–10. doi:10.1186/s13643-016-0384-4
26. Clarivate Analytics. EndNote X9. <https://endnote.com/> (accessed 22 Sep 2018).
27. Hong QN, Gonzalez-Reyes A, Pluye P. Improving the usefulness of a tool for appraising the quality of qualitative, quantitative and mixed methods studies, the Mixed Methods Appraisal Tool (MMAT). *J Eval Clin Pract* 2018;24:459–67. doi:10.1111/jep.12884
28. Andersson N, Silver H. Fuzzy cognitive mapping: An old tool with new uses in nursing research. *J Adv Nurs* 2019;75:3823–30. doi:10.1111/jan.14192
29. Özesmi U, Özesmi SL. Ecological models based on people's knowledge: a multi-step fuzzy cognitive mapping approach. *Ecol Modell* 2004;176:43–64. doi:10.1016/j.ecolmodel.2003.10.027
30. Kosko B. Fuzzy cognitive maps. *Int J Man Mach Stud* 1986;24:65–75. doi:10.1016/S0020-7373(86)80040-2
31. Niesink P, Poulin K, Šajna M. Computing transitive closure of bipolar weighted digraphs. *Discret Appl Math* 2013;161:217–43. doi:10.1016/J.DAM.2012.06.013
32. Andersson N, Mitchell S. Epidemiological geomatics in evaluation of mine risk education in Afghanistan: introducing population weighted raster maps. *Int J Health Geogr* 2006;5:1. doi:10.1186/1476-072X-5-1.
33. Harris ZS. *Discourse Analysis. Language* (Baltim) 1952;28:1. doi:10.2307/409987
34. Sarmiento I, Cockcroft A, Dion A, et al. Combining conceptual frameworks on maternal health in indigenous communities -- Fuzzy cognitive mapping using participant and operator-independent weighting. *Field methods* 2022;34.
35. Saldaña J. *The coding manual for qualitative researchers*. Los Angeles, Calif.: : Sage Publications Inc. 2016. https://www.sagepub.com/sites/default/files/upm-binaries/24614_01_Saldana_Ch_01.pdf (accessed 26 Apr 2019).

36. Gray S, Zandre E, Gray SRJ. Fuzzy cognitive maps as representations of mental models and group beliefs. In: Papageorgiou EI, ed. Fuzzy cognitive maps for applied sciences and engineering. Berlin: Springer 2014. 29–48. doi:10.1007/978-3-642-39739-4_2
37. Sarmiento I, Paredes-Solís S, Loutfi D, et al. Fuzzy cognitive mapping and soft models of indigenous knowledge on maternal health in Guerrero, Mexico. BMC Med Res Methodol 2020;20:125. doi:10.1186/s12874-020-00998-w
38. Chomat AM, Menchú AI, Andersson N, et al. Women's circles as a culturally safe psychosocial intervention in Guatemalan indigenous communities: a community-led pilot randomised trial. BMC Womens Health 2019;19:53. doi:10.1186/s12905-019-0744-z
39. Martinez B, Ixen EC, Hall-Clifford R, et al. mHealth intervention to improve the continuum of maternal and perinatal care in rural Guatemala: a pragmatic, randomized controlled feasibility trial. Reprod Health 2018;15:120. doi:10.1186/s12978-018-0554-z
40. Sarmiento I, Paredes-Solís S, Andersson N, et al. Safe Birth and Cultural Safety in southern Mexico: study protocol for a randomised controlled trial. Trials 2018;19:354. doi:10.1186/s13063-018-2712-6
41. Paredes-Solís S, de Jesús-García A, Valtierra-Gil G, et al. Percepción de los cambios producidos por la enseñanza de parteras tradicionales experimentadas de Xochistlahuaca, Guerrero. In: Freyermuth G, Vega M, Tinoco A, et al., eds. Los caminos para parir en México en el siglo xxi: experiencias de investigación, vinculación, formación y comunicación. Ciudad de México, M: 2018. 194–203.
42. Icó M, Daniels S. Parteras Mayas tradicionales cuidando la salud de las mujeres. 2020. <https://www.culturalsurvival.org/news/parteras-mayas-tradicionales-cuidando-la-salud-de-las-mujeres> (accessed 18 Mar 2020).
43. Ministério da Saúde. Secretaria de Atenção à Saúde. Parto e nascimento domiciliar assistidos por parteiras tradicionais : o Programa Trabalhando com Parteiras Tradicionais e experiências exemplares. Brasília, BA: 2012.
44. Friesen L, Mazariegos C, Barrera A, et al. Atención del parto y del puerperio inmediato con pertinencia intercultural. Rev Méd (Col Méd Cir Guatem) 2017;156:67–70.

45. Gallegos CA, Waters WF, Kuhlmann AS. Discourse vs practice: are traditional practices and beliefs in pregnancy and childbirth included or excluded in the Ecuadorian health care system?: Table 1. *Int Health* Published Online First: 18 December 2016.
doi:10.1093/inthealth/ihw053
46. Mignone J, Bartlett J, O'Neil J, et al. Best practices in intercultural health: five case studies in Latin America. *J Ethnobiol Ethnomed* 2007;3:31. doi:10.1186/1746-4269-3-31
47. Rangel Flores YY, Hernández Ibarra LE, González Acevedo CE, et al. Agenciamientos y resistencias en el cuidado obstétrico comunitario tras la capacitación institucional. *Index de Enfermería*. 2017;26:250–4.http://scielo.isciii.es/scielo.php?script=sci_arttext&pid=S1132-12962017000300003&nrm=iso
48. Tucker K, Ochoa H, Garcia R, et al. The acceptability and feasibility of an intercultural birth center in the highlands of Chiapas, Mexico. *BMC Pregnancy Childbirth* 2013;13:94.
doi:10.1186/1471-2393-13-94
49. Smith-Oka V. An analysis of two indigenous reproductive health illnesses in a Nahua community in Veracruz, Mexico. *J Ethnobiol Ethnomed* 2012;8:33. doi:10.1186/1746-4269-8-33
50. Anderson BA, Anderson EN, Franklin T, et al. Pathways of decision making among Yucatan Mayan traditional birth attendants. *J Midwifery Women's Heal* 2004;49:312–9.
doi:10.1016/j.jmwh.2004.03.008
51. Ordinola Ramírez CM. Creencias y costumbres de madres y parteras para la atención del embarazo, parto y puerperio en el distrito de Huancas (Chachapoyas, Perú). *Arnaldoa* 2019;26. doi:10.22497/arnaldoa.261.26115
52. Paiva Dias-Scopel R, Scopel D. ¿Quiénes son las parteras munduruku? Pluralismo médico y autoatención en el parto domiciliario entre indígenas en Amazonas, Brasil. *Desacatos* 2018;:16–33.
53. Bayles B. Metaphors to cure by: Tojolab'al Maya midwifery and cognition. *Anthropol Med* 2008;15:227–38. doi:10.1080/13648470802357554

54. Lopez J. El fin de las comadronas tradicionales en el oriente de Guatemala. In: Fernandez-Juarez G, Gonzalez-Gonzalez I, García-Ortiz P, eds. *La diversidad frente al espejo. Salud, interculturalidad y contexto migratorio*. 2008. 101–12.
55. Salazar A. *El oficio de la püñeñelche: Memorias del parto en los relatos de tres mujeres mapuche de la comunidad Curaco Ranquil*. 2012.
56. Pérez-Pérez G, Godínez-Rodríguez M. Costumbres y prácticas ancestrales en el cuidado de la mujer tseltal embarazada. *Metas Enferm* 2019;22:49–55.
57. Castañeda Camey X, Garcia Barrios C, Romero Guerrero X, et al. Traditional birth attendants in Mexico: Advantages and inadequacies of care for normal deliveries. *Soc Sci Med* 1996;43:199–207. doi:10.1016/0277-9536(95)00362-2
58. Pelcastre B, Villegas N, De León V, et al. Embarazo, parto y puerperio: creencias y prácticas de parteras en San Luis Potosí, México. *Rev Esc Enferm USP* 2005;39:375–82.
59. Velarde L. "Las parteras sí saben, son importantes, solo que están olvidadas" Situación actual de las parteras en los Andes del sur del Perú (Ayacucho). 2007.
60. Pauktuutit Inuit Women's Association of Canada. *Pauktuutit Special Report Inuit Midwifery*, 1995. *Suvaguuq* 1995;10.
61. Kirsis LK. "She Taught Us How to Be": The Cultural Construction of Birth and Midwifery among the Koyukon Athabaskans of Interior Alaska. *Arctic Anthropol* 1996;33:62–76. <http://www.jstor.org/stable/40316412>
62. Gil-Veloz G. Partería entre las mujeres rarámuri y wixaritari. In: Freyermuth G, Vega M, Tinoco A, et al., eds. *Los caminos para parir en México en el siglo xxi: experiencias de investigación, vinculación, formación y comunicación*. Ciudad de México, M: 2018. 40–7.
63. Cardoso MA de S, Nascimento R. O dom e a dádiva entre parteiras do Amapá: uma abordagem etnográfica. *Saúde e Soc* 2019;28:235–49. doi:10.1590/s0104-12902019170010
64. Gonzalez-Liendo M. *Las parteras tradicionales como parte del sistema de salud pública intercultural de Bolivia*. 2010.

65. Hilgert NI, Gil GE. Reproductive medicine in northwest Argentina: traditional and institutional systems. *J Ethnobiol Ethnomed* 2007;3:19. doi:10.1186/1746-4269-3-19
66. Walsh L V. Beliefs and rituals in traditional birth attendant practice in Guatemala. *J Transcult Nurs* 2006;17:148–54. doi:10.1177/1043659605285412
67. Rodríguez-Flores L, Oviedo-Bautista S. Propuesta para la inclusión de las parteras tradicionales en el primer nivel de atención: el caso de Atoyac de Álvarez, Guerrero. In: Freyermuth G, Vega M, Tinoco A, et al., eds. *Los caminos para parir en México en el siglo xxi: experiencias de investigación, vinculación, formación y comunicación*. Ciudad de México, M: 2018. 116–23.
68. Rivas R. At highest risk: maternal health in the high Peruvian Andes. *MIDIRS Midwifery Dig* 2006;16:46–50.
69. Castañeda-Camey X. [Pregnancy, labor, and puerperium: concepts and practices of midwives in the state of Morelos]. *Salud Publica Mex* 1992;34:528–32.
70. Chary A, Díaz AK, Henderson B, et al. The changing role of indigenous lay midwives in Guatemala: New frameworks for analysis. *Midwifery* 2013;29:852–8. doi:10.1016/j.midw.2012.08.011
71. Gusman CR, Rodrigues DA, Villela WV. Paradoxos do programa de parteiras tradicionais no contexto das mulheres Krahô. *Cien Saude Colet* 2019;24:2627–36. doi:10.1590/1413-81232018247.09592017
72. Castañeda-Camey X. Embarazo, parto y puerperio: conceptos y prácticas de las parteras en el estado de Morelos. *Salud Publica Mex* 1992;34:528–32.
73. Miller T, Smith H. Establishing partnership with traditional birth attendants for improved maternal and newborn health: A review of factors influencing implementation. *BMC Pregnancy Childbirth* 2017;17:1–10. doi:10.1186/s12884-017-1534-y
74. Sarmiento I, Ansari U, Omer K, et al. Causes of short birth interval (kunika) in Bauchi State, Nigeria: systematizing local knowledge with fuzzy cognitive mapping. *Reprod Health* 2021;18:74. doi:10.1186/s12978-021-01066-2

75. Belaid L, Atim P, Atim E, et al. Communities and service providers address access to perinatal care in postconflict Northern Uganda: socialising evidence for participatory action. *Fam Med Community Heal* 2021;9:e000610. doi:10.1136/fmch-2020-000610
76. UMIYAC: Unión de Médicos Indígenas Yageceros de la Amazonía Colombiana. The Beliefs of the Elders, Code of Ethics for Indigenous Medicine of the Colombian Amazon. Colombia: : Amazon Conservation Team 2000. https://www.bialabate.net/wp-content/uploads/2008/08/code_of_ethics_umiyac.pdf (accessed 14 Apr 2021).
77. Mcivor O. Language and Culture as Protective Factors for At-Risk Communities. *J Aborig Heal* 2009;5:6–25.
78. Smylie J, Kirst M, McShane K, et al. Understanding the role of Indigenous community participation in Indigenous prenatal and infant-toddler health promotion programs in Canada: A realist review. *Soc Sci Med* 2016;150:128–43. doi:10.1016/j.socscimed.2015.12.019
79. Freyermuth-Enciso G, Argüello-Avendaño H. La muerte prematura de mujeres en Los Altos de Chiapas. Un análisis desde la violencia. *Rev Pueblos y Front Digit* 2011;6:181–216.
80. Gamlin JB. "You see, we women, we can't talk, we can't have an opinion...". The coloniality of gender and childbirth practices in Indigenous Wixárika families. *Soc Sci Med* 2020;252:112912. doi:10.1016/j.socscimed.2020.112912
81. Turinawe EB, Rwemisisi JT, Musinguzi LK, et al. Traditional birth attendants (TBAs) as potential agents in promoting male involvement in maternity preparedness: insights from a rural community in Uganda. *Reprod Health* 2016;13:24. doi:10.1186/s12978-016-0147-7
82. Harary F, Norman RZ, Cartwright D. Structural models: an introduction to the theory of directed graphs. New York SE - ix, 415 pages illustrations 24 cm: : Wiley 1965.
83. Sosa-Rubi SG, Walker D, Servan E, et al. Learning effect of a conditional cash transfer programme on poor rural women's selection of delivery care in Mexico. *Health Policy Plan* 2011;26:496–507. doi:10.1093/heapol/czq085

84. Vega RA. Racial i(nte)ridentification: The racialization of maternal health through the Oportunidades program and in government clinics in México. *Salud Colect* 2017;13:489. doi:10.18294/sc.2017.1114
85. Coast E, Jones E, Portela A, et al. Maternity care services and culture: A systematic global mapping of interventions. *PLoS One*. 2014;9. doi:10.1371/journal.pone.0108130
86. Coast E, Jones E, Lattof SR, et al. Effectiveness of interventions to provide culturally appropriate maternity care in increasing uptake of skilled maternity care: a systematic review. *Health Policy Plan* 2016;31:1479–91. doi:10.1093/heapol/czw065

SECTION 2.

TESTING THE IMPACT OF SUPPORTING TRADITIONAL MIDWIVES

Preface

In this section, I present the results of the full BMx RCT. Appendix 2, published with the co-authors of the study, presents the study protocol. The co-designed intervention was the product of three intersecting dynamics: the institutional commitment of CIET researchers to participatory approaches,[127] the prior development of participatory randomised trials[139] and the increasing adoption of culturally safe approaches in epidemiology.[142] The study set out to demonstrate non-inferiority of perinatal care provided by traditional midwives and found lower rates of perinatal deaths, childbirth complications or birth complications among intervention communities, in which the rates of traditional childbirths were higher. Notwithstanding the extremely difficult field conditions, the limitations imposed by the fixed size of participating populations and shortened intervention due to a restricted funding cycle, these results are compatible with positive effects of interventions in support of traditional midwifery.

The manuscript in Chapter 6 is currently under review in BMC Pregnancy and Childbirth. I presented and discussed the study protocol and its statistical analysis in the 4th Annual McGill Family Medicine Research Symposium, multiple meetings with members of Participatory Research at McGill and advanced statistical courses at the Department of Family Medicine. In 2020, I presented preliminary results and statistical analyses to senior researchers and students at CIET in Mexico.

Chapter 6: Safe birth in cultural safety in southern Mexico: a pragmatic non-inferiority cluster-randomised controlled trial (manuscript 4)

Iván Sarmiento^{1,2}, Sergio Paredes-Solís³, Abraham de Jesús García³, Nadia Maciel Paulino³, Felipe René Serrano de los Santos³, José Legorreta Soberanis³, Germán Zuluaga², Anne Cockcroft¹, Neil Andersson^{1,3}

1. CIET-PRAM, Faculty of Medicine, Department of Family Medicine, McGill University. Canada.

2. *Grupo de Estudios en Sistemas Tradicionales de Salud. Universidad del Rosario.* Colombia.

3. *Centro de Investigación de Enfermedades Tropicales. Universidad Autónoma de Guerrero.* Mexico.

Abstract

Background: Available research on the contribution of traditional midwifery to safe motherhood focuses on retraining and redefining traditional midwives assuming cultural prominence of Western ways. Our objective was to test if supporting traditional midwives on their own terms increases cultural safety (respect of Indigenous traditions) without worsening maternal health outcomes.

Methods: Pragmatic parallel-group cluster-randomised controlled noninferiority trial in four municipalities in Guerrero State, southern Mexico, with *Nabua*, *Na savi*, *Me'phaa* and *Nancue ñomndaa* Indigenous groups. The study included all pregnant women in 80 communities and 30 traditional midwives in 40 intervention communities. Between July 2015 and April 2017, traditional midwives and their apprentices received a monthly stipend and support from a trained intercultural broker, and local official health personnel attended a workshop for improving attitudes towards traditional midwifery. Forty communities in two control municipalities continued with usual health services. Trained Indigenous female interviewers administered a baseline and follow-up household survey, interviewing all women who reported pregnancy or childbirth in all involved municipalities in the last year. Primary outcomes included childbirth and neonatal complications, perinatal deaths, and postnatal complications, and secondary outcomes were traditional childbirth (at home, in vertical position, with traditional midwife and family), access and experience in Western healthcare, food intake, reduction of heavy work, and cost of health care (secondary).

Results: Among 872 completed pregnancies, women in intervention communities had lower rates of primary outcomes (perinatal deaths or childbirth or neonatal complications) (RD -0.06 95%CI -0.11--0.01) and reported more traditional childbirths (RD 0.10 95%CI 0.02-0.18). Among institutional childbirths, women from intervention communities reported more traditional management of placenta (RD 0.34 95%CI 0.21-0.48) but also more non-traditional cold-water baths (RD 0.10 95%CI 0.02-0.19). Among home-based deliveries, women from intervention communities had fewer postpartum complications (RD -0.12 95%CI -0.27-0.01).

Conclusions: Supporting traditional midwifery increased culturally safe childbirth without worsening health outcomes. The fixed population size restricted our confidence for inference of non-inferiority for mortality outcomes. Traditional midwifery could contribute to safer birth among Indigenous communities if, instead of attempting to replace traditional practices, health authorities promoted intercultural dialogue.

Trial registration: retrospectively registered ISRCTN12397283.

Trial status: concluded.

Plain English summary

In many Indigenous communities, traditional midwives support mothers during pregnancy, childbirth, and some days afterwards. Research involving traditional midwives have focused on training them in Western techniques and redefining their role to support Western care. In Guerrero state, Mexico, Indigenous mothers continue to trust traditional midwives. Almost half of these mothers still prefer traditional childbirths, at home, in the company of their families and following traditional practices. We worked with 30 traditional midwives to see if supporting their practice allowed traditional childbirth without worsening mothers' health. Each traditional midwife received an inexpensive stipend, a scholarship for an apprentice and support from an intercultural broker. The official health personnel participated in a workshop to improve their attitudes towards traditional midwives. We compared 40 communities in two municipalities that received support for traditional midwifery with 40 communities in two municipalities that continued to receive usual services. We interviewed 872 women with childbirth between 2016 and 2017. Mothers in intervention communities suffered fewer complications during childbirth and had fewer complications or deaths of their babies. They had more traditional childbirths and fewer perineal tears or infections across home-based childbirths. Among those who went to Western care, mothers

in intervention communities had more traditional management of the placenta and more non-traditional cold-water baths. Supporting traditional midwifery increased traditional childbirth without worsening health outcomes. The small size of participating populations limited our confidence about the size of this difference. Health authorities could promote better health outcomes if they worked with traditional midwives instead of replacing them.

Background

The contribution of traditional midwives to safe motherhood is the subject of ongoing debate.[1–3] Distinguishing them from Western midwives, traditional midwives have skills based on apprenticeships and "primarily on experience and knowledge acquired informally through the traditions and practices of the communities where they originated." [4] The dominant approach of Western health services to traditional midwives treats them as unskilled birth attendants. After decades of efforts to retrain them, the current focus is to redefine the role of traditional midwives as auxiliary to or in support of conventional obstetric care.[5, 6]

Several systematic reviews summarise the impact of retraining traditional midwives or involving them in intervention packages.[7–12] Low to moderate quality evidence shows improvement in "knowledge, attitude, behaviour, and advice";[11] more referrals to the formal health system;[13] small reductions in perinatal, intrapartum and postnatal mortality;[10, 11, 14–19] statistically significant reduction in maternal morbidity[13] and, with studies of limited size, non-significant reduction in maternal mortality.[10, 14, 20] Several authors have proposed retraining of traditional midwives to do Western childbirths as a cost-effective way to reduce perinatal mortality,[21, 22] with evidence less clear for reduction of maternal mortality. Our search of studies involving traditional midwives in Indigenous communities in the Americas between 1946 to 2020 (CINAHL, Scopus, LILACS, MEDLINE, Embase, Google Scholar and 15 additional web engines for grey literature) identified no published randomised controlled trial (RCT) that tested the value of traditional midwifery practices.

In response to a request from local Indigenous communities, researchers at the *Centro de Investigación de Enfermedades Tropicales* (CIET) at the *Universidad Autónoma de Guerrero* launched a participatory initiative to address poor maternal health outcomes. In this region, maternal mortality is ten times higher than in the rest of the state,[23] which has the highest maternal mortality rate in Mexico.[24, 25] A 2008 survey found Indigenous women in this area preferred home- over hospital-childbirths,

due to differences between their expectations and the available services.[26] Traditional midwives attended about one half of all childbirths, and women who gave birth attended by traditional midwives reported lower rates of perineal trauma.[26] A 2012 pilot randomised controlled trial found Indigenous women in communities where traditional midwives received support (to pay an apprentice, access a local birthing facility, and logistical assistance from a male community health worker) had reduced birth complications compared with their counterparts in control communities. It also suggested other contributions of the intervention, like reduced gender violence.[27]

The Safe Birth in Cultural Safety trial tests whether supporting traditional midwives on their own terms results in non-inferior maternal health outcomes while increasing cultural safety around childbirth.

Methods

This participatory research applies the principles of cultural safety and aims to promote intercultural dialogue between Indigenous and Western health care traditions. The study was part of a bigger initiative to foster intercultural dialogue,[27] in which parties with different cultural backgrounds converge to work out solutions around a shared concern of poorer maternal health outcomes[28, 29] by respecting Indigenous skills and ways and recognising the needs of scientific evidence.[30]

Trial design

This pragmatic parallel-group cluster-randomised controlled trial tested noninferiority of a co-designed intervention to support traditional midwifery in two intervention and two control municipalities between 2015 and 2017. Since ethnicity clusters and midwives serve a fixed community base, we used a cluster design. We describe the trial methods fully elsewhere.[27] The study included two levels of clustering: municipalities and communities within municipalities. Participating traditional midwives contributed to the design of the intervention by specifying what support they needed. We measured impact using an administered household survey, interviewing all women who reported pregnancy or childbirth in all involved municipalities during the study period. Trained bilingual Indigenous interviewers administered a baseline survey (February and March 2015) and a follow-up survey using the same procedure and questions (between April and May 2017).

Ethics

The study conformed to specific ethical principles of research with Indigenous communities [31, 32] and obtained ethical approval from the Ethics Committee of the *Centro de Investigación de Enfermedades*

Tropicales of the *Universidad Autónoma de Guerrero* (Reference 2013–014) and the Institutional Review Board of the Faculty of Medicine at McGill University (A06-B28-17B). The research team discussed the intervention with the leadership of all participating communities to get their approval to proceed in 2015. We obtained oral informed consent from Indigenous mothers during data collection and treated all responses from participants as confidential, with no identifying information recorded. Reporting follows the CONSORT Statement[33] and its extensions to cluster randomised trials,[34] noninferiority trials[35] and abstracts[36].

Participants

Located in the south of Guerrero State in Mexico, the four municipalities are home to four Indigenous groups (*Nabua*, *Na savi*/Mixteco, *Me'phaa*/Tlapaneco, and *Nancue ñomndaa*/ Amuzgo). These Indigenous groups have different degrees of acculturation to the Western economy in Mexico, most still living in nuclear families in rural areas or remote small villages. They subsist on small-scale agriculture and migrant labour, typically receiving less than the average wage in the region (about US\$40 per month).[37] The study included all Indigenous women in all 80 communities in the four municipalities who gave birth or who became pregnant during the study period (between 2015 and 2017) and their adult family members. There were no exclusions except people who left the municipalities, who were not followed.

The baseline survey identified 30 active traditional midwives (28 women and 2 men) whose communities recognized them based on the positive outcomes of their patients. They were mature adults with decades of practice, spoke almost exclusively Indigenous languages (*Me'phaa* and *Nancue ñomndaa*), used traditional techniques learned from a mentor traditional midwife, which included rituals and use of medicinal plants, and had strong connections with the community in which they lived.

Intervention

The co-designed intervention supported traditional midwifery with four components[27]: (i) Material support: Authentic traditional midwives received a small stipend to increase the time available for their practice and patient care. (ii) Apprentice support: The project paid a scholarship for one apprentice for each midwife. Midwives each appointed their own apprentices and defined their training. Apprentices supported tasks some midwives could no longer perform due to age. (iii) Sensitisation training for staff in the local government health centres: CIET researchers led a workshop in each intervention municipality to present evidence about the role of traditional

midwives and the importance of intercultural skills for Western medical practice. (iv) Intercultural health brokers: Community-appointed bilingual young community members received a two-month training (280 hours) as *técnicos interculturales de salud*. Training covered primary health care, recovery and protection of Indigenous culture, and conservation of their territory. After the course, intercultural brokers went back to their communities and supported traditional midwives to increase their reach in the communities and to bridge their interaction with Western health personnel.

Control municipalities continued with usual health services as described in the protocol.[27] Most of the communities in these municipalities also had traditional midwives but they were not supported by the project.

Primary outcomes

The questionnaire asked each household about household members, pregnancies and births. Women who had given birth in the last year, whether at home or in a health facility, responded to a questionnaire about their pregnancy and childbirth. Primary outcomes for comparison between intervention and non-intervention communities included: birth complications (breach position at birth, excessive bleeding, convulsions and retained placenta); perineal trauma (cut or tear) during childbirth; Caesarean section, and whether the wound became infected; and complications during birth affecting the health of the baby. We intended to ask about postpartum infection, but an error in administration of the questionnaire meant we did not collect this information.

Secondary outcomes

Secondary outcomes reflected cultural safety. This implies non-disruption of traditional ways of Indigenous groups, which include use of traditional midwives and childbirth at home, in the presence of family. The secondary outcomes included: the number of antenatal check-ups by traditional midwives (none vs any); place of birth (home or facility); intended place for future births (home or facility); presence of family members at the birth; and use of the traditional vertical position during labour.

Other secondary outcomes reflected interaction between traditional and Western care. We recorded the number of antenatal check-ups in Western care facilities (none vs any and up to four vs five or more). In Mexico, the recommendation is at least five antenatal care check-ups. We also recorded timing of the first antenatal care visit (whether during the first trimester or not) and asked if a traditional midwife had advised the pregnant woman to visit a health facility during their pregnancy

for routine antenatal care. We categorised attendance at the birth as skilled birth attendance by a traditional midwife or a Western-trained health worker (community health worker, nurse or doctor), non-skilled (for example neighbours or family members), or none.

We asked women who gave birth in institutions about their perinatal management to indicate respect of cultural practices. The women reported if they chose the birth position, availability of translators if required, bathing in cold water, handling of the placenta, retention of amulets, and how respectful they considered their management.

We asked specific questions to explore secondary outcomes of factors that could negatively affect maternal health like heavy work late in pregnancy and food intake during pregnancy. Women also reported the costs of transportation to reach Western health care facilities and if they paid for childbirth, either at home or elsewhere.

Sample size

The trial included the entire population of the participating communities for the duration permitted by the available funding. To establish the power of the study to detect a minimum margin of non-inferiority, we used the clusterPower package in R.[38] Across 80 communities in four municipalities, with a baseline rate of 30% for the occurrence of any of the primary outcomes (serious childbirth complications, perinatal deaths and neonatal complications), 420 births in each arm would permit a power of 89% to exclude a difference in favour of the control group of more than 15% as the upper limit of a 95% two-sided confidence interval.

Randomisation and masking

An epidemiologist not involved in the fieldwork (NA) generated the allocation sequence and assigned the four municipalities into two parallel groups. The CIET team led by SPS oversaw enrolment of clusters. There was no possibility to conceal intervention status from communities once the intervention began as supporting traditional midwifery was clearly different from pre-intervention status with unsupported traditional midwifery.

Statistical methods

The primary analysis reported outcomes as absolute event rates among intervention and control groups, risk difference (difference of exposed and control rates) with two-sided 95% confidence intervals (95%CI).[39] We also reported the equivalent odds ratios (OR) for the measures of effect. To calculate the intra-cluster correlation coefficient (ICC), the open-source software CIETmap 2.2

[40] divided the between-cluster variance by the variance within and between clusters. The primary analysis followed intention-to-treat principles (everyone included in each cluster, per allocation). A cluster-level analysis used the Welch modification of the t-test [39] to incorporate the variability across communities and baseline imbalances of the outcomes summarized at the cluster level[41] with the PRIOR function available in CIETmap 2.2.

Secondary analysis

We established cluster-level differences of primary and secondary outcomes with a multilevel analysis using generalised linear mixed modelling (GLMM) with community as a random effect.[42] The regression models to calculate the measures of effect included differences at baseline. For each model, we reported OR with 95%CI.

Sensitivity analysis

The intervention intended to implement all components in all intervention sites. In practice, community security in the face of narco-traffic activities and other factors led to a range of implementation fidelity. To establish the level of fidelity in each community, participating traditional midwives each scored the four intervention components in their communities before the analysis of the final survey (July 2018). The lead author analysed the results of the fidelity scores after the final survey but blind to the results of the survey. We used a classification tree available in rpart in R to identify baseline characteristics associated with differences in implementation fidelity.

A methodological concern in non-inferiority trials using an intention to treat analysis is the potential dilution of the effect measure simply because some participant might have not received the intervention.[43] We tested consistency across levels of fidelity.[35, 44] First, we compared outcomes in fully protocol-adherent communities with those in control communities, using GLMM with community as a random effect, adjusted by baseline characteristics. Second, we considered four categories of implementation: (1) communities with good performance in all four intervention components, (2) those with good performance in three components, (3) those with good performance in less than three components and (4) control communities. Finally, we used an instrumental variable analysis to establish the effect among compliers as the ratio of the ITT analysis estimate to the proportion of compliers.[45, 46]

Results

Figure 6-1 shows the participant flow of 18,389 women, 6168 of them aged 14-49 years in 8051 households in 80 community clusters through the trial. The intervention began in July 2015, with the final survey between April and May 2017, at which time there were 17,907 women (6188 aged 14-49 years) in 8174 households. All communities experienced in-migration and out-migration. We added new arrivals to the study but did not follow those leaving the clusters, many of whom migrated to the cities. The final survey included 1177 women who were pregnant during the last year, and 872 completed pregnancies, in the intervention and control municipalities. Nine households reported two pregnant women in the study period.

Figure 6-1. Flow diagram of progress of clusters and individuals through phases of the randomised trial

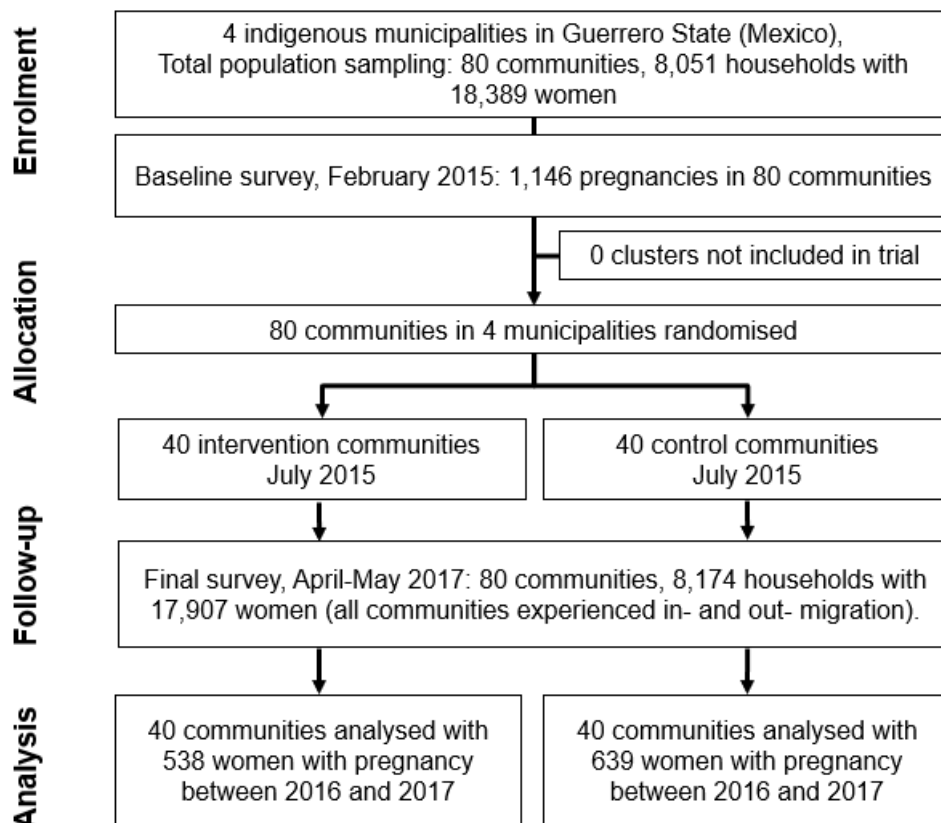


Table 6-1 shows 2015 baseline characteristics of included women in the intervention and control arms. Fewer women in the intervention communities used Spanish (they spoke only Indigenous languages). Women in intervention communities were also less likely to have attended school and

more likely to be single, to have had their last birth at home, without skilled attendance, and to have made payments related to the birth.

The baseline survey (Table 6-1) showed very similar rates of perinatal deaths and neonatal complications between intervention and control communities. It suggested more childbirth complications in communities that became the intervention arm, although this was not statistically significant at the 5% level.

Table 6-1. Baseline characteristics of intervention and control arms in 2015

Variable	ER% (n) Intervention (cluster n=40)	Control (cluster n=40)
Households (HH)	46.7 (3756/8051)	53.3 (4295/8051)
HH without tap water	14.0 (518/3704)	21.9 (928/4246)
Perinatal deaths	2.8 (11/386)	3.1 (14/448)
Neonatal complications	16.9 (61/362)	17.8 (76/427)
Childbirth serious complications	20.2 (74/366)	16.5 (72/437)
Any primary outcome ^a	32.9 (128/389)	31.0 (140/452)
Woman's age*	25.7 (0.4, n=528)	25.9 (0.4, n=599)
Woman speaks Spanish (p=0.00) ^b	69.3 (355/512)	86.4 (501/580)
Woman's education above primary (p=0.02) ^b	44.8 (237/529)	55.5 (329/593)
Women receives government aid	64.2 (337/525)	65.7 (388/591)
Woman has health insurance	93.2 (491/527)	92.4 (548/593)
Woman is main decision maker (alone or with partner)	66.7 (248/372)	74.3 (326/439)
Traditional midwife saw the woman at least once	74.6 (282/378)	71.0 (313/441)
Woman went to Western health care (WHC) for antenatal care	96.7 (357/369)	97.2 (422/434)
Gestational age of first recourse to WHC*	3.2 (0.1, n=380)	2.8 (0.1, n=441)
Childbirth at home (p=0.00) ^b	46.3 (171/369)	26.3 (115/438)
Unattended childbirth ^c (p=0.05) ^b	7.5 (28/375)	3.9 (17/439)
Childbirth with traditional midwife (p=0.02) ^b	36.5 (137/375)	22.6 (99/439)
Woman paid for childbirth (p=0.00) ^b	42.5 (141/332)	29.4 (121/412)
Company of family during childbirth (p=0.00) ^b	74.7 (275/368)	43.2 (189/437)
Traditional childbirth (p=0.01) ^b	26.1 (98/376)	13.2 (58/441)
Woman without a partner (p=0.05) ^b	6.6 (35/529)	9.9 (59/596)
Woman did not suffered violence during pregnancy	97.0 (361/372)	96.8 (427/441)
Infected wound after childbirth (p=0.03) ^b	6.1 (21/343)	2.6 (11/422)

Legend: * Average (standard deviation SD, n); ^a childbirth or neonatal complication or perinatal death; ^b cluster-level t-test; ^c Medical doctor, nurse or traditional midwife vs casual or unattended childbirth.

Table 6-2 shows the demographic characteristics of women in intervention and control communities in 2017. Women in the intervention communities were significantly less likely to have received formal education (RD -0.22 95%CI -0.31- -0.13) and to speak Spanish (RD -0.14 95%CI -0.23- -0.05).

Table 6-2. Demographic characteristics of intervention and control arms in 2017

Variable	ER% (n)	
	Intervention (cluster n=40)	Control (cluster n=40)
Households (HH)	46.9 (3836/8174)	53.1 (4338/8174)
Total population	46.5 (16321/35091)	53.5 (18770/35091)
People in each HH*	4.3 (2.0, n=3836)	4.3 (2.0, n=4338)
HH without tap water	88.0 (3351/3807)	81.4 (3518/4321)
Women parity*	2.0 (1.7, n=530)	1.9 (1.7, n=628)
Women age*	25.5 (6.6, n=530)	25.6 (6.6, n=627)
Women education above primary (p=0.00) ^a	46.5 (246/529)	59.8 (372/622)
Woman speaks Spanish (p=0.00) ^a	67.8 (353/521)	89.5 (556/621)
Woman without a partner	7.0 (37/527)	7.2 (45/623)
Women receives government aid	58.0 (304/524)	53.1 (329/620)
Woman has health insurance	94.0 (497/529)	93.9 (586/624)

Legend: * Average (SD, n); ^a cluster-level t-test.

Outcomes and estimation of the impact

Primary outcomes

We analysed event rates of perinatal deaths, mother's report of neonatal complications and serious birth complications between January 2016 and April 2017 on an intention-to-treat basis. There was a statistically significantly lower risk of having one or more of the three primary outcomes (perinatal deaths or childbirth or neonatal complications) in the intervention communities (RD -0.06 95%CI -0.09- -0.02) (Table 6-3).

Participants reported a total of 26 perinatal deaths in the households. There was a suggestion of reduced risk of perinatal deaths and neonatal complications in intervention communities compared with control communities, but the differences were not significant at the 5% level (Table 6-3). The risk of serious childbirth complications was significantly lower in intervention communities (RD -0.05 95%CI -0.08- -0.02). The analysis excluded parity in favour of the intervention with 95% confidence for childbirth complications (RD 95%CI -0.08- -0.02), 90% confidence for neonatal complications (RD 90%CI -0.07-0.00) and 70% confidence for perinatal mortality (RD 70%CI -0.02-0.00).

Table 6-3. Effect measures for the primary outcomes (intention to treat analysis)

Variable	Event rate (cluster n=40) % (n)	Event rate (cluster n=40) % (n)	RD 95%CI ^a	OR 95%CI ^b	ICC
	Intervention	Control			
Any primary outcomes ^c	12.4 (50/404)	18.2 (85/468)	-0.06 -0.09- -0.2	0.63 0.42-0.95	0.03
Perinatal deaths 2016 and 2017	2.5 (10/404)	3.4 (16/468)	-0.01 -0.04-0.02	0.73 0.31-1.75	0.04
Neonatal complications	5.9 (23/389)	7.1 (39/456)	-0.04 -0.08-0.01	0.59 0.30-1.18	0.05
Childbirth serious problems	4.8 (19/393)	7.7 (35/456)	-0.05 -0.08- -0.02	0.35 0.14-0.92	0.00
Caesarean section	13.1 (50/381)	15.0 (66/441)	-0.03 -0.10-0.04	0.78 0.47-1.31	0.11
Perineal trauma or wound infection	20.8 (81/389)	20.7 (94/455)	0.01 -0.07-0.08	1.06 0.70-1.61	0.07
Perineal trauma or wound infection in home childbirths	10.9 (17/156)	23.9 (27/116)	-0.12 -0.27-0.01	0.40 0.15-1.05	0.18

Legend: ^a Baseline-adjusted cluster-level analysis using t-test as presented by Campbell, 2014; ^b OR and confidence intervals calculated with a GLMM using lme4 package in R; ^c childbirth or neonatal complication or perinatal death. RD = risk difference; OR = odds ratio; ICC = Intraclass correlation coefficient.

Adjusted for baseline differences of the outcomes, a GLMM with intervention as a fixed effect and community as a random effect showed very similar measures of effect as the unadjusted analysis (Table 6-3).

Overall, women in intervention communities had almost identical rates of postpartum perineal trauma or wound infection (Table 6-3). However, among home childbirths, women in intervention communities had a lower risk of perineal trauma or wound infection compared with women in control communities, although this was not significant at 5% level.

Secondary outcomes

Analysis of secondary outcomes confirmed higher rates of traditional birth (at home, in company of family, with traditional midwife and mainly in vertical position) in intervention communities (RD 0.10 95%CI 0.02-0.18) (Table 6-4). More births were attended by traditional midwives in intervention than in control communities (RD 0.14 95% 0.03-0.25) (Table 6-4). In both intervention and control communities, traditional midwives saw more than 70% of all women during pregnancy, and almost 70% of those who gave birth in Western healthcare facilities (Table 6-4).

Table 6-4. Secondary outcomes (intention to treat analysis)

Secondary outcomes	Event rate (cluster n=40) Intervention % (n)	Event rate (cluster n=40) Control % (n)	RD 95%CI ^a	OR 95%CI ^b
<i>Traditional childbirth</i>				
Total traditional childbirths ^{c d}	19.0 (75/394)	10.5 (48/457)	0.10 0.02-0.18	2.95 1.27-6.84
Childbirth with traditional midwife	31.4 (123/392)	19.7 (90/456)	0.14 0.03-0.25	2.49 2.20-5.17
Childbirth at home	40.1 (158/394)	25.1 (114/454)	0.04 -0.11-0.19	1.13 0.52-2.45
Vertical childbirth ^c	28.6 (111/388)	17.8 (81/454)	0.12 0.03-0.22	2.38 1.26-4.47
Company of family during childbirth ^c	62.6 (244/390)	45.6 (205/450)	0.17 0.06-0.28	2.21 1.41-3.48
Intention of future childbirth at WHC ^c	64.4 (244/379)	79.9 (362/453)	-0.17 -0.26- -0.07	0.37 0.21-0.66
Traditional midwife saw the woman at least once	77.6 (406/523)	73.4 (458/624)	0.06 -0.02-0.14	1.47 0.93-2.33
<i>Access to health care services</i>				
Woman went to WHC for antenatal care	95.0 (497/523)	95.5 (590/618)	0.00 -0.04-0.03	1.04 0.49-2.22
At least 5 check-ups with WHC	70.9 (264/376)	73.9 (323/437)	-0.03 -0.12-0.05	0.88 0.57-1.36
Gestational age of first recourse to WHC*	3.0 (0.3, n=392)	3.0 (0.1, n=459)		
Traditional midwife advised visiting WHC	79.4 (246/310)	82.0 (292/356)	-0.06 -0.19-0.07	0.87 0.55-1.37
Childbirth with Western provider ^e	60.7 (238/392)	74.6 (340/456)	-0.01 -0.16-0.11	0.88 0.39-1.99
Antenatal care with traditional midwife and childbirth with Western provider	67.9 (161/237)	69.7 (237/340)	-0.02 -0.12-0.08	1.09 0.66-1.82
Unattended childbirths	7.9 (31/392)	5.7 (26/456)	0.02 -0.02-0.06	1.58 0.74-3.35
Paid for childbirth	37.6 (138/367)	23.9 (106/443)	0.12 -0.02-0.25	1.83 0.95-3.52
Paid for childbirth with Western provider	27.6 (62/225)	13.3 (44/331)	0.14 0.04-0.24	2.67 1.26-5.66
Average cost of childbirth (USD)*	68.6 (28.7, n=138)	84.3 (14.7, n=106)		
<i>Childbirth in Western facility</i>				
The woman chose childbirth position	60.2 (139/231)	61.0 (205/336)	-0.08 -0.24-0.08	0.97 0.57-1.66
Translator during childbirth (if needed)	41.7 (63/151)	31.7 (83/262)	0.04 -0.09-0.18	1.59 0.94-2.69
Woman had to bath with cold water*	59.7 (138/231)	45.2 (154/341)	0.10 0.02-0.19	1.72 0.99-3.00
The woman received the placenta*	56.0 (130/232)	20.6 (69/335)	0.34 0.21-0.48	6.15 3.24-11.7

Retention of amulets	29.7 (68/229)	26.6 (89/335)	0.03 -0.09-0.15	1.18 0.67-2.06
The woman felt she was treated with respect	88.6 (210/237)	92.3 (312/338)	-0.04 -0.12-0.03	0.67 0.31-1.42
<i>Behaviours</i>				
Woman eats same or more than usual during pregnancy	21.6 (85/394)	27.6 (125/453)	-0.05 -0.11-0.02	0.74 0.50-1.10
Woman works less than usual during pregnancy	36.5 (144/394)	38.7 (177/457)	-0.01 -0.10-0.09	0.90 0.62-1.30

Legend: ^a Baseline-adjusted cluster-level analysis using t-test as presented by Campbell, 2014; ^b OR and confidence intervals calculated with a GLMM using lme4 package in R; ^c significant differences at the 5% level; ^d at home, with traditional midwife and family and in preferred vertical position; ^e doctor, nurse or health promotor. WHC = Western health care facility; RD = risk difference; OR = odds ratio.

Women in intervention communities were also significantly less likely to say they intended to have future hospital-based childbirth (RD -0.17 95%CI -0.26- -0.07) (Table 6-4). This preference was associated with the place of the last childbirth. Within intervention communities, a woman who gave birth with traditional midwife was less likely to desire a future institutional childbirth (31.4% (38/121) compared with 80.5% (206/256), OR 0.13 95%CI 0.06-0.21). Among those who delivered in Western health facilities, women in intervention communities were significantly more likely to receive the placenta after childbirth, as required by custom, than did women in the control arm (RD 0.34 95% 0.21-0.48) (Table 6-4). There were no other positive differences in the experience in health care facilities of women in intervention communities, and they were more likely to report being forced to bath with cold water after childbirth (RD 0.10 95% 0.02-0.19) (Table 6-4). For childbirths with Western provider, more intervention women had to pay than did control women (RD 0.14 95%CI 0.04-0.24).

Sensitivity analysis

The traditional midwives reported that 13/40 communities performed well across the four intervention components, 9/40 performed well in three components, and 18/40 performed well in less than three components (Appendix M4 - 1).

Communities with a smaller number of births at home, remote communities with less Indigenous language speakers and communities with a Western health facility had lower intervention fidelity. Per-protocol analysis compared the communities with the highest level of intervention fidelity with the control communities. Women in protocol-adherent communities showed higher rates of traditional births than women in control communities (RD 0.23 95%CI 0.09-0.23) (Table 6-5). These communities also had fewer unattended childbirths than did control communities (difference

not significant at the 5% level, Table 6-5). Most of the unattended childbirths observed in the intervention arm happened in communities with less than three intervention components satisfactorily implemented (5.1% (10/197) compared with 10.8 (21/195), RD -0.06 95%CI -0.11- -0.01).

Table 6-5. Sensitivity analyses incorporating levels of fidelity to the intervention

	Event rate Intervention % (n)	Event rate Control % (n)	RD 95%CI ^a	OR 95%CI ^b
<i>Protocol-adherent communities vs control communities</i>	(cluster n=13)	(cluster n=40)		
Total traditional childbirths ^{c,d}	33.6 (40/119)	10.5 (48/457)	0.23 0.09-0.38	8.67 2.70-27.8
Unattended childbirths	3.4 (4/117)	5.7 (26/456)	-0.02 -0.08-0.03	0.69 0.18-2.72
Perinatal mortality	2.5 (3/122)	3.4 (16/468)	-0.02 -0.06-0.03	0.66 0.25-1.77
Neonatal complications	5.9 (7/118)	8.6 (39/456)	-0.03 -0.10-0.04	0.61 0.25-1.71
Childbirth complications ^c	2.5 (3/119)	7.7 (35/456)	-0.05 -0.08- -0.02	0.35 0.14-0.92
<i>As treated</i>	(cluster n=22)	(cluster n=40)		
Fear or good performance vs control ^c	3.0 (6/199)	7.7 (35/456)	-0.05 -0.08- -0.01	0.37 0.15-0.90
		(cluster n=58)		
Fear or good vs control and poor performance ^c	3.0 (6/199)	7.4 (48/650)	-0.04 -0.08- -0.01	0.39 0.16-0.93
<i>Instrumental variable</i>	(cluster n=40)	(cluster n=40)		
Perinatal mortality	2.5 (3/122)	3.4 (16/468)	-0.03 -0.12-0.06	
Neonatal complications	5.9 (7/118)	8.6 (39/456)	-0.11 -0.25-0.04	
Childbirth complications	2.5 (3/119)	7.7 (35/456)	-0.09 -0.18-0.00	

Legend: ^a Baseline-adjusted cluster-level analysis using t-test as presented by Campbell, 2014; ^b OR and confidence intervals calculated with a GLMM using lme4 package in R; ^c Significant differences at the 5% level; ^d at home, with traditional midwife and family and in preferred vertical position. WHC = Western health care facility; RD = risk difference; OR = odds ratio.

The measures of effect for primary outcomes confirmed the results from the intention to treat analysis with wider confidence intervals, due to a reduced number of participants involved in the calculation. When compared with control communities (Table 6-5), protocol-adherent communities had non significantly lower perinatal mortality, neonatal complications and significantly lower childbirth complications (RD -0.05 95%CI -0.08- -0.02).

Appendix M4 - 2 shows a comparison of groups as treated using GLMM. Serious complications were significantly lower in the communities with fair or good performance compared with control

communities (RD -0.05 95%CI -0.08- -0.01) or compared with control and poor performance communities together (RD -0.04 95%CI -0.08- -0.01) (Table 6-5).

The instrumental variable analysis confirmed the average protective effect among compliers although with increased confidence intervals for perinatal deaths and neonatal complications (Table 6-5). For serious childbirth complications, this analysis also indicated stronger protective effect and confirmed exclusion of the same or inferior performance of the intervention among compliers (RD -0.09 95%CI -0.18-0.00).

Discussion

The Safe Birth in Cultural Safety trial in Guerrero reduced perinatal deaths, neonatal complications and serious childbirth complications after 21 months of supporting traditional midwives on their own terms. Two-sided 95% confidence intervals indicated reduced risk of childbirth complications, and non-inferiority limits of 1% and 2% for neonatal complications and perinatal deaths, respectively. Consistent results for ITT and non-ITT analyses confirmed a protective effect in those communities with higher fidelity intervention.

The intervention also improved cultural safety as it increased traditional childbirths and, in communities where there was higher intervention fidelity, lowered rates of unattended births. The intervention improved handling of the placenta in institutional births to accommodate traditional norms, although other aspects of cultural safety in Western facilities failed to improve.

For almost a century,[47] engagement of traditional midwives has focused on their being re-trained and used as auxiliary health workers to extend the provision of Western health services.[3, 48–50] Apart from our pilot trial,[27] we could not identify any published trial of supporting traditional midwifery on its own terms.

Several studies report positive effects on peri-neonatal morbidity and mortality from working with traditional midwives,[10, 11, 13–15, 19, 51] some exploring cost-effective results.[21, 22] Traditional midwives in Guerrero described complex knowledge of risk factors and preventive practices, albeit framed in the terms of their traditional culture.[52] In a similar context in Guatemala, Austad [53] reported improvements in management of complications associated with support of obstetric care navigators, a role that intercultural brokers in Guerrero offered in coordination with the traditional midwives and their apprentices.[54]

For many Indigenous communities, place of birth and involvement with childbirth rituals are connected to identity, culture and territories, and even some roles in governance.[55, 56] In our study, women who delivered at home with a traditional midwife were less likely to intend to have an institutional childbirth in the future. Preference for home births in this region is closely linked to cultural values, and mistreatment or disrespect shown to Indigenous women in health institutions reinforces this preference.[26, 57] Beyond Indigenous communities, mistreatment,[58] disrespect,[59] and violence against women[60] during childbirth have gained increasing attention.[61, 62] Despite the controversy surrounding the safety of home births,[63–65] our study supports the argument that safe birth in places like Guerrero "needs a fully integrated comprehensive maternity care network that is supportive and responsive." [66] In a context like ours, where Indigenous women mostly deliver at home,[26] informed and principled interaction of the official health system with traditional midwives can pave the way for respectful and women-centred care.

Notwithstanding the well-documented benefits of modern obstetric care for the medical safety of mothers and children, there are also unintended side effects and iatrogenic illnesses.[67, 68] There are some procedures that women consider injurious but providers do not.[59, 61] Understanding what Indigenous women consider harmful practices requires interaction and mutual learning.[30] Rituals associated with handling of the placenta, for example, have profound implications for cultural identity in these communities and set the path for a healthy life of the child. Baths with cold water in the postpartum period, on the other hand, are regarded as violence, a source of coldness of the womb, and a cause of poor maternal health.[52] Promotion of cultural safety in Western institutions requires additional efforts and is an ongoing challenge for medical education.

Limitations and strengths

Sample size is a common limitation of research with small and remote Indigenous communities even including, as we did, all the women in the community. Accumulating numbers of events by increasing the duration of the study depends on availability of funding.

The difficult field conditions affected measurement of gender violence, a key ripple effect in the pilot study. Interviewers had to administer these questions, for security reasons, under conditions where the respondent could be seen and possibly overheard. We observed similar difficulties and attendant limits to interpretation earlier in Guerrero [69] and in Pakistan.[70]

Knowledge of intervention status could have affected some secondary outcomes (for example, intention of future home-based childbirths). The main outcome indicators (noninferiority for perinatal mortality, neonatal and serious childbirth complications) and other secondary outcomes would be less susceptible to this bias.

The cluster design avoided contamination that would occur if intervention traditional midwives attended women in control communities.[71] The clustered design reduced the power of the study, making it harder to demonstrate non-inferiority.

The study benefitted from decades of institutional commitment and experience of CIET researchers that cannot be assumed in other contexts. This community engagement generated the co-designed intervention. During the trial, the researchers also generated institutional support in government facilities, and established a favourable environment to discuss results with local authorities.

Conclusions

Supporting traditional midwives on their own terms can increase cultural safety without worsening birth outcomes. The small size of Indigenous populations and restricted funding for the intervention limits interpretation of this potentially important finding. Further research needs to explore the added benefit of increased collaboration with Western stakeholders. Traditional midwifery could contribute to safer birth among Indigenous communities if, instead of attempting to replace traditional practices, health authorities promoted intercultural dialogue.

Declarations

Ethics approval and consent to participate

The methods and procedures received prospective ethical approval from all participating communities (2015), the Ethics Committee of the Centro de *Investigación de Enfermedades Tropicales* of the *Universidad Autónoma de Guerrero* (reference 2013-014), and McGill's Faculty of Medicine Institutional Review Board (reference A06-B28-17B). All methods were performed in accordance with the relevant guidelines and regulations. We adopted the ethical principles for medical research in Indigenous communities proposed by the Research Group on Traditional Health Systems.[32] These principles incorporate the International Ethical Guidelines for Health-related Research Involving Humans (CIOMS, 2012 and maintain compliance with the version of 2016), Declaration of Helsinki (2013) and the Canadian Tri-Council Policy Statement: Ethical Conduct for Research

Involving Humans chapter 9. Participants provided oral consent using predefined formats authorised during the ethics reviews.

Consent for publication

Not applicable

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request. According to the agreements with participating communities, to ensure the protection of participants and governance of data, before the information can be shared, the requester will need to present a plan for data analysis. Also, the requester will need to complete the procedure for ethical approval of the secondary analysis in accordance with the procedures defined by the Ethics Board of the *Universidad Autónoma de Guerrero*.

Competing interests

The authors declare that they have no competing interests.

Funding

The pilot received support from UBS Optimus Foundation. The National Council of Science and Technology of Mexico funded the BMx2 randomised controlled trial (PDCPN-2013-214858). The Quebec Population Health Research Network and the Faculty of Medicine of McGill University provided support for fieldwork. CeiBA Foundation and the Center of Intercultural Medical Studies in Colombia, and the Fonds de recherche du Québec Santé (255253) supported the analysis of the randomised controlled trial. The design, management, analysis, and reporting of the data are entirely independent from all sources of funding.

Acknowledgements

Traditional midwives in Guerrero, the group of intercultural brokers and CIET team generously worked to implement the trial moved by a genuine concern with mother and child health. The Colombian team at the Center of Intercultural Medical Studies shared its experience in intercultural dialogue with Indigenous communities. The members of Participatory Research at McGill kindly discussed early versions of this work.

References

1. Harrison KA. Are traditional birth attendants good for improving maternal and perinatal health? No. *BMJ*. 2011;342 jun14 1:d3308–d3308. doi:10.1136/bmj.d3308.
2. Ana J. Are traditional birth attendants good for improving maternal and perinatal health? Yes. *BMJ*. 2011;342 jun14 1:d3310–d3310. doi:10.1136/bmj.d3310.
3. Gill CJ, Hamer DH, Knapp AB. Dispelling the myths surrounding traditional birth attendants. *BMJ*. 2011;343 jul19 3:d4481–d4481. doi:10.1136/bmj.d4481.
4. International Labour Office. International standard classification of occupations 2008 (ISCO-08): structure, group definitions and correspondence tables. Geneva, Switzerland: International Labour Office; 2012.
<http://ebookcentral.proquest.com/lib/mcgill/detail.action?docID=991922>. Accessed 10 May 2020.
5. Bergström S, Goodburn E. The role of traditional birth attendants in the reduction of maternal mortality. In: *Safe Motherhood Strategies: A Review of the Evidence*. Antwerp, Belgium: ITG Press; 2001. p. 77–96.
6. Bullough C, Meda N, Makowiecka K, Ronsmans C, Achadi EL, Hussein J. Review: Current strategies for the reduction of maternal mortality. *BJOG An Int J Obstet Gynaecol*. 2005;112:1180–8. doi:10.1111/j.1471-0528.2005.00718.x.
7. Sibley LM, Sipe TA, Koblinsky M. Does traditional birth attendant training increase use of antenatal care? A review of the evidence. *J Midwifery Women's Heal*. 2004;49:298–305.
8. Sibley L, Sipe TA, Koblinsky M. Does traditional birth attendant training improve referral of women with obstetric complications: A review of the evidence. *Soc Sci Med*. 2004;59:1757–68.
9. Kruske S, Barclay L. Effect of shifting policies on traditional birth attendant training. *J Midwifery Womens Health*. 2004;49:306–11.
10. Sibley LM, Sipe TA, Barry D. Traditional birth attendant training for improving health behaviours and pregnancy outcomes. *Cochrane Database Syst Rev*. 2012;:CD005460. doi:10.1002/14651858.CD005460.pub3.

11. Sibley L, Sipe TA. What can a meta-analysis tell us about traditional birth attendant training and pregnancy outcomes? *Midwifery*. 2004;20:51–60.
12. Wilson A, Gallos ID, Plana N, Lissauer D, Khan KS, Zamora J, et al. Effectiveness of strategies incorporating training and support of traditional birth attendants on perinatal and maternal mortality: meta-analysis. *BMJ Br Med J*. 2012;344:16.
13. Lassi ZS, Das JK, Salam RA, Bhutta ZA. Evidence from community level inputs to improve quality of care for maternal and newborn health: interventions and findings. *Reprod Health*. 2014;11 Suppl 2:S2. doi:10.1186/1742-4755-11-S2-S2.
14. Wilson A, Gallos ID, Plana N, Lissauer D, Khan KS, Zamora J, et al. Effectiveness of strategies incorporating training and support of traditional birth attendants on perinatal and maternal mortality: meta-analysis. *BMJ*. 2011;343 dec01 1:d7102.
15. Darmstadt GL, Lee ACC, Cousens S, Sibley L, Bhutta ZA, Donnay F, et al. 60 Million non-facility births: Who can deliver in community settings to reduce intrapartum-related deaths? *Int J Gynecol Obstet*. 2009;107 suppl:S89–112.
16. Lassi ZS, Middleton PF, Bhutta ZA, Crowther C. Strategies for improving health care seeking for maternal and newborn illnesses in low- and middle-income countries: A systematic review and meta-analysis. *Glob Health Action*. 2016;9:31408.
17. Carlo WA, Goudar SS, Jehan I, Chomba E, Tshefu A, Garces A, et al. Newborn-Care Training and Perinatal Mortality in Developing Countries. *N Engl J Med*. 2010;362:614–23. doi:10.1056/NEJMsa0806033.
18. Gill CJ, Phiri-Mazala G, Guerina NG, Kasimba J, Mulenga C, MacLeod WB, et al. Effect of training traditional birth attendants on neonatal mortality (Lufwanyama Neonatal Survival Project): randomised controlled study. *BMJ*. 2011;342 feb03 2:d346–d346. doi:10.1136/bmj.d346.
19. Manasyan A, Chomba E, Moore J, Wallace D, McClure EM, Koso-Thomas M, et al. Association between birth attendant type and delivery site and perinatal outcomes. *Int J Gynecol Obstet*. 2019;145:187–92. doi:10.1002/ijgo.12786.

20. Kidney E, Winter HR, Khan KS, Gülmezoglu AM, Meads CA, Deeks JJ, et al. Systematic review of effect of community-level interventions to reduce maternal mortality. *BMC Pregnancy Childbirth*. 2009;9:2. doi:10.1186/1471-2393-9-2.
21. Mangham-Jefferies L, Pitt C, Cousens S, Mills A, Schellenberg J. Cost-effectiveness of strategies to improve the utilization and provision of maternal and newborn health care in low-income and lower-middle-income countries: a systematic review. *BMC Pregnancy Childbirth*. 2014;14:243.
22. Sabin L, Knapp A, MacLeod W, Phiri-Mazala G, Kasimba J, Hamer D, et al. Costs and cost-effectiveness of training traditional birth attendants to reduce neonatal mortality in the Lufwanyama Neonatal Survival study (LUNESP). *PLoS One*. 2012;7:e35560.
23. Instituto Nacional de Estadística y Geografía de México. Mortalidad General. <https://www.inegi.org.mx/sistemas/olap/Proyectos/bd/continuas/mortalidad/MortalidadGeneral.asp>. Accessed 28 Mar 2019.
24. Observatorio de Mortalidad Materna de México. Boletín de mortalidad materna. Semana epidemiológica 52 información actualizada al 31 de diciembre de 2017. http://www.omm.org.mx/images/stories/Documentosgrandes/BOLETIN_52_2017_COMPLETO.pdf. Accessed 10 Jun 2018.
25. Pisanty-Alatorre J. Inequidades en la mortalidad materna en México: un análisis de la desigualdad a escala subestatal. *Salud Publica Mex*. 2017;59:639. doi:10.21149/8788.
26. de Jesús-García A, Paredes-Solís S, Valtierra-Gil G, los Santos FRS, Sánchez-Gervacio BM, Ledogar RJ, et al. Associations with perineal trauma during childbirth at home and in health facilities in indigenous municipalities in southern Mexico: A cross-sectional cluster survey. *BMC Pregnancy Childbirth*. 2018;18:198. doi:10.1186/s12884-018-1836-8.
27. Sarmiento I, Paredes-Solís S, Andersson N, Cockcroft A. Safe Birth and Cultural Safety in southern Mexico: study protocol for a randomised controlled trial. *Trials*. 2018;19:354. doi:10.1186/s13063-018-2712-6.
28. Dietz G. Interculturality. In: Callan H, editor. *The International Encyclopedia of Anthropology*. Oxford, UK: John Wiley & Sons, Ltd; 2018. p. 1–19. doi:10.1002/9781118924396.wbiea1629.

29. Argueta Villamar A, Pérez Ruiz ML. Los Saberes tradicionales y los desafíos para el Diálogo de conocimientos. *Desenvolv e Meio Ambient*. 2019;50. doi:10.5380/dma.v50i0.65438.
30. Sarmiento I, Zuluaga G, Paredes-Solís S, Chomat AM, Loutfi D, Cockcroft A, et al. Bridging Western and Indigenous knowledge through intercultural dialogue: lessons from participatory research in Mexico. *BMJ Glob Heal*. 2020;5:e002488. doi:10.1136/bmjgh-2020-002488.
31. Canadian Institutes of Health Research, Natural Sciences and Engineering Research Council of Canada, Social Sciences and Humanities Research Council of Canada. TCPS 2 - Chapter 9. In: Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans. 2014. p. 109–38. https://ethics.gc.ca/eng/tcps2-eptc2_2018_chapter9-chapitre9.html. Accessed 18 Jan 2021.
32. Zuluaga G. Una ética para la investigación médica con comunidades indígenas. In: Vélez A, Ruiz A, Torres M, editors. *Retos y dilemas de los comités de ética en investigación*. Colección. Bogotá: Editorial Universidad del Rosario; 2013. p. 259–81. http://media.wix.com/ugd/cb47c9_d790340d497847e58f5505518c122b24.pdf. Accessed 30 Apr 2014.
33. Moher D, Hopewell S, Schulz KF, Montori V, Gotzsche PC, Devereaux PJ, et al. CONSORT 2010 explanation and elaboration: updated guidelines for reporting parallel group randomised trials. *BMJ*. 2010;340 mar23 1:c869–c869. doi:10.1136/bmj.c869.
34. Campbell MK, Piaggio G, Elbourne DR, Altman DG. Consort 2010 statement: extension to cluster randomised trials. *BMJ*. 2012;345 sep04 1:e5661–e5661. doi:10.1136/bmj.e5661.
35. Piaggio G, Elbourne DR, Pocock SJ, Evans SJW, Altman DG, CONSORT Group for the. Reporting of noninferiority and equivalence randomized trials. *JAMA*. 2012;308:2594. doi:10.1001/jama.2012.87802.
36. Hopewell S, Clarke M, Moher D, Wager E, Middleton P, Altman DG, et al. CONSORT for reporting randomized controlled trials in journal and conference abstracts: explanation and elaboration. *PLoS Med*. 2008;5:e20. doi:10.1371/journal.pmed.0050020.
37. Meneses S, Pelcastre B, Vega M. Maternal mortality and the coverage, availability of resources, and access to women's health services in three indigenous regions of Mexico: Guerrero

- Mountains, Tarahumara Sierra, and Nayar. In: Schwartz DA, editor. Maternal death and pregnancy-related morbidity among indigenous women of Mexico and Central America. Cham: Springer International Publishing; 2018. p. 169–88.
38. Reich NG, Myers JA, Obeng D, Milstone AM, Perl TM. Empirical power and sample size calculations for cluster-randomized and cluster-randomized crossover studies. *PLoS One*. 2012;7:e35564. doi:10.1371/journal.pone.0035564.
 39. Campbell MJ, Walters SJ. How to design, analyse and report cluster randomised trials in medicine and health related research. Hoboken: John Wiley & Sons; 2014.
 40. Andersson N, Mitchell S. Epidemiological geomatics in evaluation of mine risk education in Afghanistan: introducing population weighted raster maps. *Int J Health Geogr*. 2006;5:1. doi:10.1186/1476-072X-5-1.
 41. Campbell MK, Mollison J, Steen N, Grimshaw JM, Eccles M. Analysis of cluster randomized trials in primary care: a practical approach. *Fam Pract*. 2000;17:192–6.
 42. Sommet N, Morselli D. Keep calm and learn multilevel logistic modeling: a simplified three-step procedure using stata, R, Mplus, and SPSS. *Int Rev Soc Psychol*. 2017;30:203–18. doi:10.5334/irsp.90.
 43. Shrier I, Steele RJ, Verhagen E, Herbert R, Riddell CA, Kaufman JS. Beyond intention to treat: What is the right question? *Clin Trials J Soc Clin Trials*. 2014;11:28–37. doi:10.1177/1740774513504151.
 44. Agbla SC, DiazOrdaz K. Reporting non-adherence in cluster randomised trials: A systematic review. *Clin Trials*. 2018;15:294–304. doi:10.1177/1740774518761666.
 45. Agbla SC, De Stavola B, DiazOrdaz K. Estimating cluster-level local average treatment effects in cluster randomised trials with non-adherence. *Stat Methods Med Res*. 2020;29:911–33. doi:10.1177/0962280219849613.
 46. Huang FL. Using instrumental variable estimation to evaluate randomized experiments with imperfect compliance. *Pract Assessment, Res Eval*. 2018;23:1–8.
 47. Leedam E. Traditional birth attendants. *Int J Gynecol Obstet*. 1985;23:249–274. doi:10.1186/1471-2458-10-570.

48. De Brouwere V, Tonglet RR, Van Lerberghe WW. Strategies for reducing maternal mortality in developing countries: what can we learn from the history of the industrialized West? *Trop Med Int Heal*. 1998;3:771–82. doi:10.1046/j.1365-3156.1998.00310.x.
49. Pigg SL. Authority in translation. Finding, knowing, naming, and training "traditional birth attendants" in Nepal. In: Davis-Floyd R, Sargent CF, editors. *Childbirth and authoritative knowledge: Cross-cultural perspectives*. Berkeley: University of California Press; 1997. p. 233–62.
50. World Health Organization. Working with individuals, families and communities to improve maternal and newborn health. Geneva: World Health Organization; 2010.
https://www.who.int/maternal_child_adolescent/documents/who_fch_rhr_0311/en/. Accessed 5 Apr 2019.
51. Carlo WA, McClure EM, Chomba E, Chakraborty H, Hartwell T, Harris H, et al. Newborn Care Training of Midwives and Neonatal and Perinatal Mortality Rates in a Developing Country. *Pediatrics*. 2010;126:e1064–71. doi:10.1542/peds.2009-3464.
52. Sarmiento I, Paredes-Solís S, Loutfi D, Dion A, Cockcroft A, Andersson N. Fuzzy cognitive mapping and soft models of indigenous knowledge on maternal health in Guerrero, Mexico. *BMC Med Res Methodol*. 2020;20:125. doi:10.1186/s12874-020-00998-w.
53. Austad K, Juarez M, Shryer H, Moratoya C, Rohloff P. Obstetric care navigation: results of a quality improvement project to provide accompaniment to women for facility-based maternity care in rural Guatemala. *BMJ Qual Saf*. 2020;29:169–78. doi:10.1136/bmjqs-2019-009524.
54. Paredes-Solís S, de Jesús-García A, Valtierra-Gil G, Gasga D, Legorreta-Soberanis J. Percepción de los cambios producidos por la enseñanza de parteras tradicionales experimentadas de Xochistlahuaca, Guerrero. In: Freyermuth G, Vega M, Tinoco A, Gil G, editors. *Los caminos para parir en México en el siglo xxi: experiencias de investigación, vinculación, formación y comunicación*. Ciudad de México, M; 2018. p. 194–203.
55. Berry NS. Kaqchikel midwives, home births, and emergency obstetric referrals in Guatemala: Contextualizing the choice to stay at home. *Soc Sci Med*. 2006;62:1958–69.

56. Jordan B. Birth in four cultures: A crosscultural investigation of childbirth in Yucatan, Holland, Sweden, and the United States. 4th edition. Long Grove, IL: Waveland Press; 1993.
57. Mills L. The limits of trust: The Millennium Development Goals, maternal health, and health policy in Mexico. Montreal: McGill-Queen's University Press; 2017.
58. Rosen HE, Lynam PF, Carr C, Reis V, Ricca J, Bazant ES, et al. Direct observation of respectful maternity care in five countries: A cross-sectional study of health facilities in East and Southern Africa. *BMC Pregnancy Childbirth*. 2015;15.
59. Freedman LP, Ramsey K, Abuya T, Bellows B, Ndwiga C, Warren CE, et al. Defining disrespect and abuse of women in childbirth: A research, policy and rights agenda. *Bull World Health Organ*. 2014;92:915–7.
60. Zacher Dixon L. Obstetrics in a Time of Violence: Mexican Midwives Critique Routine Hospital Practices. *Med Anthropol Q*. 2015;29:437–54. doi:10.1111/maq.12174.
61. Freedman LP, Kruk ME. Disrespect and abuse of women in childbirth: Challenging the global quality and accountability agendas. *The Lancet*. 2014;384:e42–4.
62. Bohren MA, Vogel JP, Hunter EC, Lutsiv O, Makh SK, Souza JP, et al. The Mistreatment of Women during Childbirth in Health Facilities Globally: A Mixed-Methods Systematic Review. *PLOS Med*. 2015;12:e1001847. doi:10.1371/journal.pmed.1001847.
63. Janssen PA, Saxell L, Page LA, Klein MC, Liston RM, Lee SK. Outcomes of planned home birth with registered midwife versus planned hospital birth with midwife or physician. *CMAJ*. 2009;181:377–83. doi:10.1503/cmaj.081869.
64. Wax JR, Lucas FL, Lamont M, Pinette MG, Cartin A, Blackstone J. Maternal and newborn outcomes in planned home birth vs planned hospital births: a metaanalysis. *Am J Obstet Gynecol*. 2010;203:243.e1-8. doi:10.1016/j.ajog.2010.05.028.
65. Olsen O. Meta-analysis of the Safety of Home Birth. *Birth*. 2008;24:4–13. doi:10.1111/j.1523-536X.1997.00004.pp.x.
66. Walker JJ. Planned home birth. *Best Pract Res Clin Obstet Gynaecol*. 2017;43:76–86. doi:10.1016/j.bpobgyn.2017.06.001.

67. Kennedy HP, Cheyney M, Dahlen HG, Downe S, Foureur MJ, Homer CSE, et al. Asking different questions: A call to action for research to improve the quality of care for every woman, every child. *Birth*. 2018;45:222–31.
68. Miller S, Abalos E, Chamillar M, Ciapponi A, Colaci D, Comande D, et al. Beyond "Too Little, Too Late" and Too Much, Too Soon": A pathway towards evidence-based, respectful maternity care worldwide. *Lancet*. 2016;388:2176–92.
69. Paredes-Solís S, Villegas-Arrizón A, Meneses-Rentería A, Rodríguez-Ramos I, Reyes-De Jesús L, Andersson N. Violencia física intrafamiliar contra la embarazada: un estudio con base poblacional en Ometepec, Guerrero, México. *Salud Publica Mex*. 2005;47:335–41.
http://www.scielo.org.mx/scielo.php?script=sci_arttext&pid=S0036-36342005000500003&nrm=iso. Accessed 17 Feb 2020.
70. Mhatre S, Andersson N, Ansari NM, Omer K. Access to justice for women of Karachi. 2002.
<https://www.ciet.org/wp-content/blogs.dir/20/files/2019/10/2006224174127.pdf>. Accessed 17 Feb 2020.
71. Andersson N, Lamothe G. Clustering and meso-level variables in cross-sectional surveys: an example of food aid during the Bosnian crisis. *BMC Health Serv Res*. 2011;11 Suppl 2:S15. doi:10.1186/1472-6963-11-S2-S15.

SECTION 3.

IMPLICATIONS OF THE EVIDENCE AND ENGAGEMENT

Preface

Non-Indigenous perspectives dominate research involving Indigenous people.[143] Study of the issues affecting these groups often fails to incorporate their world views, approaching them as vulnerable populations in need of external interventions.[143,144] International recognition of cultural diversity and the steady emergence of Indigenous scholarship have changed this landscape over the last three decades.[140] Sections 1 and 2 showed that Indigenous groups in Guerrero have knowledge and resources that could contribute to maternal and newborn health in their communities. One implication is that we should think of traditional midwifery as part of the solution instead of as the problem. The challenge is how to work with traditional midwives and their communities to achieve this potential.

Viewing the issue from the Western side of the cultural divide, I believe that recognising the sociocultural context[145] and valuing Indigenous perspectives[142] would increase the relevance of research with Indigenous people. Our experience in Guerrero could inform future intercultural research with concrete examples. Chapter 7, published in BMJ Global Health, describes how the project in Guerrero brought together Western and Indigenous knowledge for the promotion of safe birth. It spells out the practical steps in intercultural dialogue. Chapter 8 discusses my thesis findings in the context of the concepts of safe birth and intercultural research.

In 2018, I presented some of the reflections in this section at the McGill Family Medicine Research Seminar and the McGill Centre for Society, Technology and Development, together with Dr Juan Pimentel and his contribution to cultural safety in medical education. In 2019, I shared this content at Dawson College to help motivate young medical anthropology students.

Chapter 7: Bridging Western and Indigenous knowledge through intercultural dialogue: lessons from participatory research in Mexico (manuscript 5)

Iván Sarmiento^{1,2}, Germán Zuluaga², Sergio Paredes-Solís³, Anne Marie Chomat¹, David Loutfi¹, Anne Cockcroft¹, Neil Andersson^{1,3}

1. CIET-PRAM, Faculty of Medicine, Department of Family Medicine, McGill University. Canada.
2. Grupo de Estudios en Sistemas Tradicionales de Salud. Universidad del Rosario. Colombia.
3. Centro de Investigación de Enfermedades Tropicales. Universidad Autónoma de Guerrero. Mexico.

Abstract

Indigenous communities in Latin America and elsewhere have complex bodies of knowledge, but Western health services generally approach them as vulnerable people in need of external solutions. Intercultural dialogue recognises the validity and value of Indigenous standpoints, and participatory research promotes reciprocal respect for stakeholder input in knowledge creation. As part of their decades- long community-based work in Mexico's Guerrero State, researchers at the *Centro de Investigación de Enfermedades Tropicales* responded to the request from Indigenous communities to help them address poor maternal health. We present the experience from this participatory research in which both parties contributed to finding solutions for a shared concern. The aim was to open an intercultural dialogue by respecting Indigenous skills and customs, recognising the needs of health service stakeholders for scientific evidence. Three steps summarise the opening of intercultural dialogue. *Trust building and partnership* based on mutual respect and principles of cultural safety. This focused on understanding traditional midwifery and the cultural conflicts in healthcare for Indigenous women. A pilot randomised controlled trial was an opportunity to *listen and to adjust the lexicon* identifying and testing culturally coherent responses for maternal health led by traditional midwives. *Codesign, evaluation and discussion* happened during a full cluster randomised trial to identify benefits of supporting traditional midwifery on maternal outcomes. A narrative mid-term evaluation and cognitive mapping of traditional knowledge offered additional evidence to discuss with other stakeholders the benefits of intercultural dialogue. These steps are not mechanistic or invariable.

Other contexts might require additional steps. In Guerrero, intercultural dialogue included recovering traditional midwifery and producing high-level epidemiological evidence of the value of traditional midwives, allowing service providers to draw on the strengths of different cultures.

Summary box

- Modern economic development has resulted in cultural loss, marginalisation and worst health outcomes, including poorer maternal outcomes, for many Indigenous communities.
- Many Indigenous communities in Latin America still have traditional knowledge and potentially effective healthcare practices.
- Intercultural dialogue can improve functioning of Western health services for Indigenous communities, respecting cultural differences and leveraging local resources.
- This three-step approach strengthened traditional enabling environments for maternal health and contributed to positive outcomes among Indigenous women in Guerrero, Mexico.
- Building intercultural relationships takes time. Financial restrictions and changes in the internal dynamics of stakeholders can threaten the process.
- Promotion of intercultural dialogue by researchers is not a mechanistic recipe of predetermined steps; it hinges on their commitment and deep respect for communities.

Introduction

Indigenous communities in Latin America and elsewhere developed complex bodies of knowledge, know-how and practices over many generations.[1] These include ways, that are anchored in the worldview and territorial context of each culture, to address health needs.[2 3] Notwithstanding their diversity, most traditional medicine practitioners use local resources and approach health on multiple levels—physical, emotional, mental, spiritual and environmental—often all at once.[4]

Colonial history and the establishment of Western culture have increased political and economic marginalisation of Indigenous communities.[5] Disrespect of Indigenous cultures, implicit in this marginalisation, promotes a sense of inferiority and ignoring Indigenous knowledge.[6 7]

Acculturation, territorial loss, decay of healthcare traditions, socioeconomic conditions and conflictive interface with Western health institutions have negative effects on Indigenous health, including high burdens of obesity, diabetes and poor maternal health.[8–10]

Western health services generally approach Indigenous communities as at risk, vulnerable and lacking knowledge to solve their needs. This approach frames health promotion in Indigenous communities as new knowledge to be introduced by external service providers.[11,12] Damage-centred health research has been a source of distress for Indigenous communities,[13] who feel that focusing on their weaknesses and negative aspects reinforces a sense of inferiority.[11] Emerging Indigenous scholars have challenged hegemonic paradigms and methodologies in academic discourse and policies.[14–18] They have promoted particular ethical considerations for research involving Indigenous groups.[19–22] Indigenous scholarship and increasing international recognition of cultural diversity since the 1990s have revalued Indigenous knowledge and argued for a more active role of Indigenous peoples in defining health actions in their communities.[23] Emerging evidence suggests that active involvement of Indigenous participation in health promotion increases access to care and improves health outcomes in these communities.[24]

The practical consequence for contemporary healthcare is increased awareness and valuing of cultural diversity (cultural sensitivity) and the accommodation of strategies to provide health services in spite of cultural differences (cultural competence).[25,26] Although well intended, these adjustments nonetheless maintain Western cultural dominance in health decisions of what has to be done, how to do it and whether it is done at all.[26,27]

Indigenous movements in Latin America advocate for intercultural dialogue to open space for non-Western standpoints and to transform structures of exclusion and marginalisation.[5,28] Intercultural dialogue involves dynamic communication through which individuals, groups, or organisations with multiple cultural backgrounds converge to work out solutions around a shared concern, in our case, poor maternal health outcomes.[29–31] Modern participatory research recognises that knowledge creation is the result of a partnership in which stakeholder perspectives contribute at an equal level of respect.[32–33]

We present the experience of the *Centro de Investigación de Enfermedades Tropicales* (CIET) during participatory research to improve maternal health with Indigenous communities in Mexico's Guerrero State. This process aimed to open an intercultural dialogue by respecting Indigenous skills and customs and recognising the needs of service providers for scientific evidence of the value of traditional midwives. We describe three steps as examples of an ongoing effort to open the dialogue.

The setting

Guerrero is Mexico's second poorest state and one of five with the largest Indigenous populations.[34] Some 14% (456,774) of residents speak an Indigenous language, mainly *Nahua*, *Nasavi*/Mixteco, *Me'phaa*/Tlapaneco, or *Nancue ñomndaa*/Amuzgo.[35] Indigenous groups have different degrees of acculturation and most live in nuclear families in rural areas or small villages in the centre and south of the state. They subsist on migrant labour and small-scale agriculture, receiving less than the average regional wage (about US\$40 per month).[36] Government and private health services offer only Western birthing practices. Services are underfunded and poorly staffed.[37] Traditional Indigenous midwives (*parteras tradicionales*) are the providers of choice for most Indigenous women, particularly in remote villages where they are the only skilled practitioners available for antenatal and delivery care. But traditional Indigenous midwifery has become attenuated and does not on its own guarantee healthy childbirth in all cases. Official health policies in Guerrero have deliberately disrupted traditional birthing systems, preventing registration of births attended by traditional midwives (and thus withholding state child support triggered by birth registration) and providing cash incentives to women who use hospital-based services. Lack of collaboration between traditional midwives and Western health services now hinders timely referral to well resourced facilities with access to emergency and obstetrically indicated surgical interventions. Pregnant Indigenous women fall between two weakened systems, one weakened by poor resourcing and inefficiencies, the other by policies of acculturation.[38]

Indigenous birthing systems frame biological dimensions within a specific cultural background.[39] While Western science might focus first on access to obstetric services or routine diagnostic tests, Indigenous midwifery might begin with protective rituals of fertility or counselling the family on self-care practices. Indigenous women in Southern Guerrero prefer home deliveries and often shun Western obstetric care in fear of routine practices considered disrespectful in their culture.[37] In this context, maternal mortality is 10 times higher in Indigenous communities than it is in the rest of the state.[40]

Building trust and a safe space for partnership

Since the 1980s, cross-cultural approaches to safe birth have called for "fruitful accommodation" of traditional birthing systems.[41] The question is how to achieve this. CIET's experience can contribute to answering this question. As part of its decades-long relationship with *Nancue ñomndaa* (Amuzgo) communities in the municipality of Xochistlahuaca in Guerrero, researchers at CIET, in

the *Universidad Autónoma de Guerrero*, responded to a 2008 request from these communities to help them address poor maternal health. The research team philosophy included respect for Indigenous cultures as the starting point and absolute requirement for all activities in research. The consequent mutual respect facilitated building trust and establishing a safe space for exploring this complex issue, amidst the tense interface between the Western health system and Indigenous communities.

Respect is an essential condition allowing participants to feel they can open up and push the limits and certainties of their own system in the discussion of shared interests and goals.[42, 43] Building trust is ongoing and time consuming, and benefits from a clear framework for the dialogue.[44] In this case, like in others,[45] self-reflexivity guided our work under the principles of cultural safety.[33] Maori nurses developed the notion of *cultural safety* in the late 1980s in New Zealand.[46] It invited researchers to recognise the colonial and historical context of health disparities and the impact their own cultural identity and assumptions had in perpetuating these disparities.[47] Culturally safe healthcare would improve maternal health, while respecting or fortifying patient cultural identity.[48] In consequence, the project deviated from prevailing biomedical assumptions that attempted to replace or ban traditional practices.

After obtaining ethics approval in both Mexico and Canada, Indigenous participants and CIET researchers designed a baseline survey in participatory workshops. They adjusted standard epidemiological tools to the language and concepts of Indigenous communities, to better understand the role of authentic traditional midwives and birth experiences of Indigenous women. Trained Indigenous fieldworkers conducted a baseline survey in 2008 among 1723 women between the ages of 15 and 49 who were pregnant during the previous three years. They identified and interviewed 63 traditional midwives, respectfully titled *Nna'*, most of whom were over 50 years of age, and whose authority rested on proved service to their patients. The Indigenous midwives described part of their role as assisting women during pregnancy and homebirth; one half of them had personally taken their patients to the hospital when additional care was needed. All still conducted household visits as their age and health permitted. And their patients paid them what they could afford, which was most often nothing.

The survey revealed that 59% (938/1589) of pregnant Indigenous women received advice and care from traditional midwives, including those who delivered with Western doctors. Based on birth order analysis, Indigenous midwife-assisted home births had declined over the previous decade to around 48% (659/1378). During deliveries in hospital, most Indigenous mothers did not have

translation (68%, 468/692) and few could choose traditional positions for delivery (36%, 249/697). Birth complications such as self-reported perineal trauma were less frequent in traditional midwife-assisted births (24%, 120/656) than in births assisted by a doctor or nurse (39%, 210/543).[37]

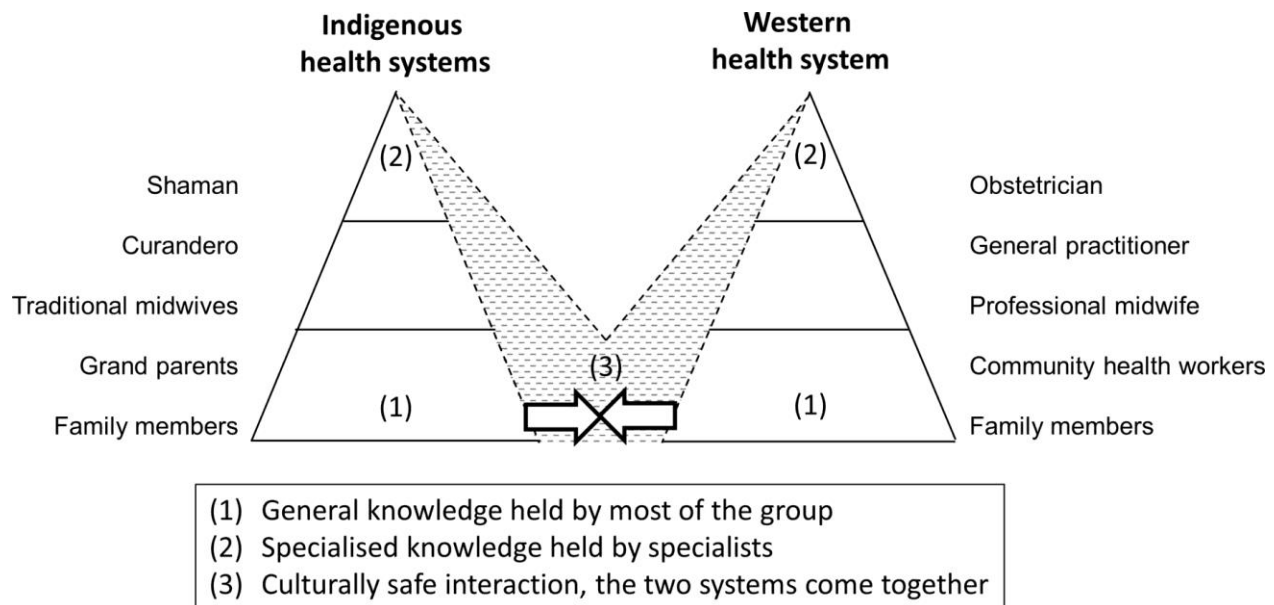
Women were more likely to attend for antenatal care in health units if a traditional midwife had told them to do so, and most women and their families accepted midwife advice to deliver in a Western healthcare unit.

The survey results confirmed the cultural alienation experienced by women in government health facilities. The evidence suggested that traditional midwifery could have a positive role in these communities. Indigenous participants felt encouraged to engage further in research, recognising researcher commitment to understand their traditions instead of attempting to replace their customs. Increased mutual trust set up the next step, which focused on a collaboration to support the role of traditional midwives.

Listen and adjust: the Xochistlahuaca pilot

Zuluaga described intercultural dialogue between Indigenous and Western healthcare as a bridge between two healthcare pyramids (Figure 7-1).[49] The biggest potential for interaction between health systems is at the family and primary healthcare levels, where individual's knowledge and practices are linked mostly to personal experiences (base of the pyramids). This can happen, for example, in the promotion of preventive practices or care for uncomplicated births by traditional midwives. Moving up through secondary to tertiary levels, knowledge becomes more specialised and is held by fewer practitioners with higher levels of formal training using increasingly complex technologies. CIET researchers, traditional midwives and Indigenous community health promoters together designed and piloted an intervention to support traditional midwives' role at the base of the pyramid.[50] Sixteen Indigenous traditional midwives requested facilities for simple birth centres, where they could train new apprentices, assist pregnant women and attend births. They also requested logistical support from a community health promoter linked with the project.

Figure 7-1. Scheme to represent the interaction between Indigenous and Western health systems.



The goal was to generate evidence that showed the potential of traditional concepts and practices, helping participants to go beyond the terminology and concerns of their Western counterparts while identifying opportunities and barriers for collaboration. The pilot was an opportunity to listen reflexively and to adjust lexicon around culturally safe maternal healthcare. Lexicon adjustment goes beyond a simple translation of words.[51] It requires listener reflexivity and experience to internalise the contents.[42] In this case, first understanding the concepts of traditional midwifery and positive birth experiences, and then incorporating and testing the meaning of culturally coherent responses for maternal health. Represented as a dashed shadow in Figure 7-1, these are opportunities for mutual learning and transformation in which both systems might expand their boundaries.

Data from a CIET survey after the intervention showed similar levels of *pregnancy* complications between women in exposed communities (24/94) and controls (65/252; OR 0.99, 95% CI 0.52 to 1.71), but substantially reduced *birth* complications (9/91 exposed and 57/248 controls; OR 0.37, 95% CI 0.11 to 0.73). The research team hypothesised that increased profile of traditional midwives led to reduced unattended deliveries and that improved logistical support in the intervention area improved referrals for high-risk women. This pilot study built local capacity to apply methods founded on a substantial history of pragmatic trials in the study of traditional midwifery.[50, 52]

Codesign, evaluate and discuss: the four-municipality trial

With the pilot data suggesting acceptability and safety of an intervention that strengthens traditional midwives, the team designed a cluster randomised controlled trial in which traditional midwives would extend further their authoritative role.[50] The goal of codesign was to allow each party to bring what they are best at, be it design a randomised control trial or manage spiritual content or counselling men. The cultural authorities of participating Indigenous communities and the ethics committees at CIET and McGill University approved this step.

In four predominantly Indigenous municipalities with access to usual healthcare, the trial compared maternal health outcomes of intervention (Xochistlahuaca and Acatepec) and control (San Luis Acatlán and Atlixac) communities. In the intervention communities, traditional midwives received support to recover and foster their traditional role. Intervention midwives received a small stipend, a bursary to train an apprentice and the support of an intercultural broker to facilitate interaction with Western health personnel. Additionally, two workshops for health personnel in intervention municipalities sought to improve their understanding of and attitudes towards traditional midwives.

Michie described intercultural brokerage as change agents placed between two cultures and with the ability to resolve the differences that keep them apart.[53] The training of 17 intercultural brokers drew on similar experience in Colombia.[54] In Guerrero, brokers were community-nominated young people who learnt about primary healthcare, recovery and protection of Indigenous culture, and conservation of their territory. After the course, intercultural brokers went back to their communities to collaborate with traditional midwives, increasing their presence in the communities and bridging the language and cultural gap with Western health services.

A mid-term evaluation used a narrative approach to illustrate positive changes described by participants.[55] Traditional midwives reported *hope in cultural continuity through their apprentices* and *renewed recognition of traditional midwifery among communities*. After the intervention finished in 2017, we used fuzzy cognitive mapping to portray traditional midwife knowledge on maternal health. The maps identified several birth risks including a web of Indigenous concepts of disease—"frío" (cold or coldness of the womb), "espanto" (fright), and "coraje" (anger)—abandonment of traditional practices of self-care, women's mental health and gender violence. Participants described culturally coherent responses to these risks including rituals, medicinal plants, massages, midwives counselling of husbands and other care practices connected with their culture.[56]

The final statistical analysis of the randomised controlled trial, to be reported in a separate publication, will incorporate traditional midwifery knowledge as described in the fuzzy cognitive maps as prior knowledge in the statistical models, in an extension of Bayesian procedures.[57] This allows a space for Indigenous voices even in the very technical matter of effect estimation and significance testing.

Limitations and challenges

Intercultural dialogue is context-specific and possible only with researcher attitudes of openness, engagement and commitment to local impact. Here, we recount three steps describing our progress: (1) trust building; (2) listener reflexivity and lexicon adjustment; and (3) codesign, evaluation and discussion. But these steps are not mechanistic or invariable, and other contexts might need additional steps.

The case we describe required long term commitment and took place over more than a full decade. Financial restrictions or changes in the internal dynamics of stakeholders can change relationships over this time. In our case, the researcher's strong institutional commitment to equity and partnership with Indigenous communities facilitated continuity.

Sustainability of change is hard to guarantee. Although intercultural dialogue opens the door to transformation, structural change of inequity and marginalisation rooted in historical causes might require time. Initial commitment with cultural safety attempts to have stronger autonomous communities able to foster these transformations.

The overall project attempts to increase respectful interaction between local health personnel and traditional midwives. We involved health personnel in an incremental way. Intercultural brokerage supported individual contacts, and workshops provided sensitisation training and a forum for discussion. In its role as a leading graduate health training institution in Guerrero, CIET also trains future health providers, managers and planners in the state. The randomised controlled trial will hopefully produce local evidence to show the health and social value of traditional midwives. It is too early to say something definitive about system change, but we can identify components recognised as contributors to this.[58] The project has increased understanding of the issues around maternal health using systems analysis (fuzzy cognitive maps) to incorporate community perspectives; it has developed a team of Indigenous and non-Indigenous people able to foster

action, and it has achieved "small wins" that can accumulate and embolden stakeholders to pursue bigger changes.

Our proposal of intercultural dialogue is not an Indigenous methodology. It reflects the experiences of a small group of researchers. It does align, however, with previous work of Indigenous elders and researchers who developed tools and procedures that fit with traditional concepts and values,[18, 59] and who have highlighted the need of "two eyed seeing." [24, 60] The commitment, approval and full participation of traditional midwives made the researchers feel confident that they considered this work appropriate.

The concept of cultural safety sometimes assumes one-way acculturation— overriding of Indigenous cultures by the dominant culture—and places the potential for disrespect on one side of the cultural divide.[61] We recognise it is possible to fall short of intercultural dialogue on both sides; therefore, there is a need for ongoing reflection. Shallow consultations, in which traditional contents are not made comprehensible in Western understanding, may be used as a way to justify external interventions.[28]

Conclusion

The experience of the CIET team shows that intercultural dialogue is feasible and contributes to improving maternal health outcomes. When the project began, Indigenous views and knowledge were generally ignored in Western health services. Support of traditional midwifery and intercultural brokerage initiated the interactions between traditional midwives and Western health services. The scientific evidence of positive impact of traditional midwives on maternal health focus on primary care and improved referral. Stronger traditional midwives are now in a better position to take their own steps towards further interactions with service providers. High-quality healthcare requires skilled and well-supplied facilities but also respectful practices that understand cultural strengths.

Intercultural dialogue moves away from almost a century of retraining traditional midwives to use them as accessory resources for Western healthcare in underserved areas. Our approach recognises that Indigenous midwives and their traditional knowledge can be agents of change. Although this approach will need to be tested in different contexts, intercultural dialogue offers an opportunity to improve health outcomes by combining the strengths of different cultures.

Declarations

Acknowledgments

The traditional midwives generously shared their knowledge throughout the research. Their commitment to women's health in their communities will remain an inspiration beyond the limits of this project. The apprentices and intercultural brokers represent our hopes for a new time in which the shadows of colonisation might fade or even disappear in the light of intercultural dialogue. The Indigenous communities participating in the project, led by their traditional authorities, contributed to systematising knowledge and to promoting action. Abraham de Jesús García and Nadia Maciel Paulino collaborated intensely as field coordinators during the intervention of the randomised controlled trial. Robert Ledogar advised the definition of the intervention to support Indigenous midwives in 2015. Alba Meneses, David Gazga, Alejandro Balanzar, Miguel Flores, José Legorreta and the research team at CIET greatly collaborated to make the work with traditional midwives in Guerrero possible. Germán Zuluaga, Carolina Amaya, Ignacio Giraldo and Juan Pimentel conducted the training program for intercultural brokers. The late Ascencio Villegas Arrizón was a tireless promoter of health and well-being in Indigenous groups of Guerrero State and he supported the dialogue with traditional midwives until his death in 2012.

Funding

The pilot received support from UBS Optimus Foundation. CONACyT, the National Council of Science and Technology of Mexico funded the BMx2 randomised controlled trial (PDCPN-2013-214858). The Quebec Population Health Research Network and the Faculty of Medicine of McGill University provided support for fieldwork. Ceiba Foundation and the Center of Intercultural Medical Studies in Colombia, and the Fonds de recherche du Québec Santé (255253) supported the analysis of the randomised controlled trial.

References

1. International Council for Science. ICSU series on science for sustainable development No. 4: science, traditional knowledge and sustainable development, 2002. Available: <http://unesdoc.unesco.org/images/0015/001505/150501eo.pdf> [Accessed 18 Oct 2018].
2. Abbott R. Documenting traditional medical knowledge, 2014. Available: http://www.wipo.int/export/sites/www/tk/en/resources/pdf/medical_tk.pdf [Accessed 30 Apr 2014].

3. World Health Organization. Regional office for the Western Pacific. A report of the consultation meeting on traditional and modern medicine: harmonizing the two approaches, 22-26 November 1999, Beijing, China. Manila, Phillipinas: 1999. Available: <http://iris.wpro.who.int/handle/10665.1/5573> [Accessed 19 Apr 2015].
4. National Agency for Drug and Food Control, World Health Organization. Trips, CBD and traditional medicines: concepts and questions. Report of an ASEAN workshop on the trips agreement and traditional medicine, 2001. Available: <http://apps.who.int/medicinedocs/en/d/Jh2996e/5.html> [Accessed 18 Oct 2018].
5. Walsh C. Interculturalidad, plurinacionalidad y decolonialidad: LAS insurgencias político-epistémicas de refundar El Estado. *Tabula Rasa* 2008;131–52.doi:10.25058/20112742.343
6. United Nations Department of Economic and Social AffairsDivision for Social Policy and Development Secretariat. Secretariat of the Permanent Forum on Indigenous Issues. State of the World's indigenous peoples. New York, 2017. Available: https://www.un.org/development/desa/indigenouspeoples/wp-content/uploads/sites/19/2017/12/State-of-Worlds-Indigenous-Peoples_III_WEB2018.pdf [Accessed 1 Jun 2018].
7. Restrepo E, Rojas A. Infelxión decolonial: fuentes, conceptos y cuestionamientos. Popayán, Colombia: Universidad del Cauca, 2010.
8. King M, Smith A, Gracey M. Indigenous health part 2: the underlying causes of the health gap. *Lancet* 2009;374:76–85.doi:10.1016/S0140-6736(09)60827-8pmid:<http://www.ncbi.nlm.nih.gov/pubmed/19577696>
9. Gracey M, King M. Indigenous health Part 1: determinants and disease patterns. *Lancet* 2009;374:65–75.doi:10.1016/S0140-6736(09)60914-4pmid:<http://www.ncbi.nlm.nih.gov/pubmed/19577695>
10. Lalonde AB, Butt C, Bucio A. Maternal health in Canadian Aboriginal communities: challenges and opportunities. *J Obstet Gynaecol Can* 2009;31:956–62.doi:10.1016/S1701-2163(16)34325-0pmid:<http://www.ncbi.nlm.nih.gov/pubmed/19941725>
11. Tuck E. Suspending damage: a letter to communities. *Harv Educ Rev* 2009;79:409–28.doi:10.17763/haer.79.3.n0016675661t3n15

12. World Health Organization. The regional strategy for traditional medicine in the Western Pacific (2011-2020), 2012. Available:
http://www.wpro.who.int/publications/2012/regionalstrategyfortraditionalmedicine_2012.pdf [Accessed 18 Oct 2018].
13. Cochran PAL, Marshall CA, Garcia-Downing C, et al. Indigenous ways of knowing: implications for participatory research and community. *Am J Public Health* 2008;98:22–7.
doi:10.2105/AJPH.2006.093641 pmid:<http://www.ncbi.nlm.nih.gov/pubmed/18048800>
14. McGregor D, Restoule J-P, Johnston R. Indigenous research: theories, practices, and relationships. Toronto, ON, Canada: Canadian Scholars, an imprint of CSP Books Inc, 2018.
15. Windchief S, San Pedro T. Applying Indigenous research methods. New York, United States: Routledge, 2019.
16. Smith LT. Decolonizing methodologies: research and indigenous peoples. 2 edn. London: Zed Books, 2012.
17. Denzin NK, Lincoln YS, Smith LT. Handbook of critical and indigenous methodologies. Los Angeles: Sage, 2008.
18. Williams M. Ngaa-bi-nya Aboriginal and Torres Strait Islander program evaluation framework. *Eval J Australas* 2018;18:6–20.
doi:10.1177/1035719X18760141
19. Canadian Institutes of Health Research Natural Sciences and Engineering Research Council of Canada Social Sciences and Humanities Research Council of Canada. TCPS 2 Chapter 9. In: Tri-Council policy statement: ethical conduct for research involving humans, 2014: 109–38.
<http://www.pre.ethics.gc.ca/eng/policy-politique/initiatives/tcps2-eptc2/Default/>
20. National Aboriginal Health Organization (NAHO). OCAP®: ownership, control, access and possession. OCAP® is a registered trademark of the first nations information governance centre (FNIGC, 2007. www.FNIGC.ca/OCAP
21. Zuluaga G. Una ética para la investigación médica con comunidades indígenas. In: Vélez A, Ruiz A, Torres M, eds. Retos Y dilemas de Los comités de ética en investigación. Bogotá: Editorial Universidad del Rosario, 2013: 259–81.
http://media.wix.com/ugd/cb47c9_d790340d497847e58f5505518c122b24.pdf

22. Macaulay AC, Delormier T, McComber AM, et al. Participatory research with native community of Kahnawake creates innovative code of research ethics. *Can J Public Health* 1998;89:105–8. doi:10.1007/BF03404399 pmid:<http://www.ncbi.nlm.nih.gov/pubmed/9583251>
23. Huria T, Palmer SC, Pitama S, et al. Consolidated criteria for strengthening reporting of health research involving Indigenous peoples: the consider statement. *BMC Med Res Methodol* 2019;19:173. doi:10.1186/s12874-019-0815-8 pmid:<http://www.ncbi.nlm.nih.gov/pubmed/31399058>
24. Allen L, Hatala A, Ijaz S, et al. Indigenous-led health care partnerships in Canada. *CMAJ* 2020;192:E208–16. doi:10.1503/cmaj.190728 pmid:<http://www.ncbi.nlm.nih.gov/pubmed/32122977> FREE Full Text
25. Aylett R, Hall L, Tazzyman S, et al. Werewolves, cheats, and cultural sensitivity. In: Lomuscio A, Scerri P, Bazzan A, et al., eds. *Proceedings of the 13th International Conference on autonomous agents and multi-agent systems (AAMAS 2014)*. Paris: International Foundation for Autonomous Agents and Multiagent Systems, 2014: 1085–92.
26. Kirmayer LJ. Rethinking cultural competence. *Transcult Psychiatry* 2012;49:149–64. doi:10.1177/1363461512444673 pmid:<http://www.ncbi.nlm.nih.gov/pubmed/22508634>
27. Pon G. Cultural competency as new racism: an ontology of forgetting. *J Progress Hum Serv* 2009;20:59–71. doi:10.1080/10428230902871173
28. Dietz G. Interculturality. In: Callan H, ed. *The International encyclopedia of anthropology*. Oxford, UK: John Wiley & Sons, Ltd, 2018: 1–19.
29. Council of Europe. White paper on Intercultural dialogue: living together as equals in dignity, 2008. Available: https://www.coe.int/t/dg4/intercultural/source/white_paper_final_revised_en.pdf [Accessed 1 Jun 2018].
30. Ganesh S, Holmes P. Positioning intercultural dialogue—Theories, pragmatics, and an agenda. *J Int Intercult Commun* 2011;4:81–6. doi:10.1080/17513057.2011.557482
31. Pérez Ruíz ML, Argueta AV. Saberes indígenas Y dialogo intercultural. *Cult y Represent Soc* 2011:31–56.

32. Andersson N. Participatory research-A modernizing science for primary health care. *J Gen Fam Med* 2018;19:154–
9.doi:10.1002/jgf2.187pmid:<http://www.ncbi.nlm.nih.gov/pubmed/30186727>
33. Cameron M, Andersson N, McDowell I, et al. Culturally safe epidemiology: oxymoron or scientific imperative.. *Pimatisiwin J Aborig Indig Community Heal*2010;8:89–116.
34. Consejo Nacional de Evaluación de la Política de Desarrollo Social. Indicadores de pobreza, 2008-2018 (nacional Y estatal), 2020. <https://datos.gob.mx/busca/dataset/indicadores-de-pobreza-2008-2018-nacional-y-estatal>
35. Instituto Nacional de Estadística y Geografía de México. Population aged 5 years and over who speaks some Indigenous language. Available: <http://en.www.inegi.org.mx/temas/lengua/> [Accessed 10 Jun 2018].
36. Meneses S, Pelcastre B, Vega M. Maternal mortality and the coverage, availability of resources, and access to women's health services in three indigenous regions of Mexico: Guerrero Mountains, Tarahumara Sierra, and Nayar. In: Schwartz DA, ed. *Maternal death and pregnancy-related morbidity among Indigenous women of Mexico and central America*. Cham: Springer International Publishing, 2018: 169–88.
37. de Jesús-García A, Paredes-Solís S, Valtierra-Gil G, et al. Associations with perineal trauma during childbirth at home and in health facilities in Indigenous municipalities in southern Mexico: a cross-sectional cluster survey. *BMC Pregnancy Childbirth* 2018;18:198.
doi:10.1186/s12884-018-1836-8pmid:<http://www.ncbi.nlm.nih.gov/pubmed/29855266>
38. Mills L. *The limits of trust: the millennium development goals, maternal health, and health policy in Mexico*. Montreal: McGill-Queen's University Press, 2017.
39. Chalmers B. *African birth: childbirth in cultural transition*, 1990. Available:
<http://www.popline.org/node/384026> [Accessed 19 Jan 2019].
40. Instituto Nacional de Estadística y Geografía de México. Mortalidad General. Available:
<https://www.inegi.org.mx/sistemas/olap/Proyectos/bd/continuas/mortalidad/MortalidadGeneral.asp> [Accessed 28 Mar 2019].

41. Jordan B. Birth in four cultures: a crosscultural investigation of childbirth in Yucatan, Holland, Sweden, and the United States. 4 edn. IL: Waveland Press, 1993.
42. Eberhard C. Rediscovering education through intercultural dialogue. In: Contribution to the international meeting of experts on cultural diversity and education. Brussels, 2008.
<http://www.dhdi.free.fr/recherches/horizonsinterculturels/articles/eberhardeducation.pdf>
43. Leeds-Hurwitz W, Dialogue I. Intercultural Dialogue. In: Tracy K, Ilie C, Sandel T, eds. The international encyclopedia of language and social interaction. Hoboken, NJ, USA: John Wiley & Sons, Inc, 2015: 1–8.
44. Jagosh J, Bush PL, Salsberg J, et al. A realist evaluation of community-based participatory research: partnership synergy, trust building and related ripple effects. BMC Public Health 2015;15:725. doi:10.1186/s12889-015-1949-1
pmid:<http://www.ncbi.nlm.nih.gov/pubmed/26223523>
45. Nicholls R. Research and Indigenous participation: critical reflexive methods. Int J Soc Res Methodol 2009;12:117–26. doi:10.1080/13645570902727698
46. Polaschek NR. Cultural safety: a new concept in nursing people of different ethnicities. J Adv Nurs 1998;27:452–7. doi:10.1046/j.1365-2648.1998.00547.x
pmid:<http://www.ncbi.nlm.nih.gov/pubmed/9543029>
47. Allan B, Smylie J, peoples F. First peoples, second class treatment. The role of racism in the health and well-being of Indigenous peoples in Canada. Toronto, ON, 2015.
<http://www.wellesleyinstitute.com/wp-content/uploads/2015/02/Summary-First-Peoples-Second-Class-Treatment-Final.pdf>
48. Papps E, Ramsden I. Cultural safety in nursing: the New Zealand experience. Int J Qual Health Care 1996;8:491–7. doi:10.1093/intqhc/8.5.491
pmid:<http://www.ncbi.nlm.nih.gov/pubmed/9117203>
49. Zuluaga G, Correal-Muñoz CA. Panorama actual de las medicinas tradicionales. In: Medicinas tradicionales: introducción al estudio de Los sistemas tradicionales de salud Y SU relación Con La medicina moderna. Bogotá: Universidad El Bosque, 2002: 13–28.

50. Sarmiento I, Paredes-Solís S, Andersson N, et al. Safe birth and cultural safety in southern Mexico: study protocol for a randomised controlled trial. *Trials* 2018;19:354.
doi:10.1186/s13063-018-2712-6pmid:http://www.ncbi.nlm.nih.gov/pubmed/29973241
51. Rubel AJ, O'Neill C. Dificultades para expresar al médico los trastornos que aquejan al paciente: La enfermedad del susto, como ejemplo. *Boletín la Of Sanit Panam* 1979;87:103–12.
52. Andersson N. Proof of impact and pipeline planning: directions and challenges for social audit in the health sector. *BMC Health Serv Res* 2011;11:S16. doi:10.1186/1472-6963-11-S2-S16pmid:http://www.ncbi.nlm.nih.gov/pubmed/22376386
53. Michie M. Understanding culture brokerage. In: *Working Cross-culturally: identity learning, border crossing and culture brokering*. Rotterdam: Sense Publishers, 2014: 83–106.
54. Amaya C. Gestores Comunitarios de Salud: Una experiencia pedagógica piloto en La Universidad del Rosario. *Rev Ciencias la Salud* 2006;4:33–40.
55. Dart J, Davies R. A dialogical, story-based evaluation tool: the most significant change technique. *Am J Eval* 2003;24:137–55.doi:10.1177/109821400302400202
56. Sarmiento I, Paredes-Solís S, Loutfi D, et al. Fuzzy cognitive mapping and soft models of Indigenous knowledge on maternal health in Guerrero, Mexico. *BMC Med Res Methodol* 2020;20:125. doi:10.1186/s12874-020-00998-wpmid:http://www.ncbi.nlm.nih.gov/pubmed/32429974
57. Dion A, Joseph L, Jimenez V, et al. Grounding evidence in experience to support people-centered health services. *Int J Public Health* 2019;64:797–802.doi:10.1007/s00038-018-1180-9pmid:http://www.ncbi.nlm.nih.gov/pubmed/30542753
58. Foster-Fishman PG, Watson ER. The able change framework: a conceptual and methodological tool for promoting systems change. *Am J Community Psychol* 2012;49:503–16.doi:10.1007/s10464-011-9454-xpmid:http://www.ncbi.nlm.nih.gov/pubmed/21735334
59. Kirkness VJ, Barnhardt R. First nations and higher education: the four R's – respect, relevance, reciprocity, responsibility. *J Am Indian Educ* 1991;30.

60. Bartlett C, Marshall M, Marshall A. Two-eyed seeing and other lessons learned within a co-learning journey of bringing together Indigenous and mainstream knowledges and ways of knowing. *J Environ Stud Sci* 2012;2:331–40.doi:10.1007/s13412-012-0086-8
61. Johnstone M-J, Kanitsaki O. An exploration of the notion and nature of the construct of cultural safety and its applicability to the Australian health care context. *J Transcult Nurs* 2007;18:247–56.doi:10.1177/1043659607301304pmid:http://www.ncbi.nlm.nih.gov/pubmed/17607062

Chapter 8: Discussion and conclusions

This dissertation presents my contribution to safe birth in Indigenous communities and, more broadly, to intercultural research. I did this through five manuscripts and two appendices exploring the role of traditional midwives in safe birth in cultural safety among indigenous women in Guerrero, Mexico. Section 1 addresses my first objective to contextualise safe birth in local indigenous cultures. Using FCM, a flexible and yet robust tool to map knowledge about influences on health issues, three pieces describe how stakeholder understanding of determinants of maternal health intersects with published evidence (Chapters 3 to 5).[10,146,147] Section 2 addresses my second objective to test the effect of supporting traditional midwifery on safe birth and cultural safety using original epidemiological data from a RCT in Guerrero (Chapter 6).[9] This section showed supporting traditional midwifery could benefit mothers and newborns and, to an extent, strengthen Indigenous birthing traditions. Section 3 addresses the third objective to share generalisable learnings of the process in Guerrero. This section contributed an example of how research can progress towards deeper intercultural dialogue for maternal health promotion and, in general, for constructive interaction between Western and Indigenous knowledge (Chapter 7).[148]

Safe birth in indigenous communities

My research followed a participatory research paradigm,[128] which valued local knowledge as a valid source of evidence. This contrasts with current international recommendations for promoting maternal health care which are largely focused on eradicating traditional midwifery or redefining it in favour of increased access to Western health care.[54] In the 1980s, Jordan published one of the earliest international contributions questioning the biomedical understanding of childbirth and its disconnection to cultural dimension.[38] Her work in Mexico proposed, possibly for the first time in the post-colonial literature, the need for mutual accommodation of Western and Indigenous perspectives and she highlighted the sociocultural importance of traditional midwives' authoritative knowledge.[50,55] Her work informed new directions in anthropological inquiry on childbirth that questioned the monopoly of the Western biomedical system,[56,149] opening space for other sources of knowledge to participate in the definition and practice of safe birth.[56,150–153]

My work with fuzzy cognitive mapping described the sophisticated knowledge that traditional midwives have about locally relevant concepts related to maternal health in Guerrero. In their maps, traditional midwives explained that, despite benefits for maternal health, a hospital in the community could have a disruptive impact on other protective factors such as fertility rituals or male

involvement.[147] This idea resonated with the experience of intercultural researchers, who saw the relevance of Western health care conditioned by its level of cultural safety.[146] The scoping review in Chapter 5 showed, in addition to a negative impact on Indigenous traditions, the strongest consequence of culturally unsafe care is reduced access to Western health services.

In Mexico, based on the premise that high quality Western health care is essential to manage birth complications,[14,15] application of International recommendations included the institutionalisation of birthing practices[33] through mechanisms like conditional cash transfers[117] or delaying access to birth certificates for babies born outside of an institutional environment.[154–157] Despite this official commitment to assimilate indigenous groups into the mainstream health system, the process is incomplete in many rural and marginalised areas of rural Guerrero, and its partial application has not achieved the expected benefits of Western medical practice.[111,149,158] Koblinsky argued decades ago that a model based on childbirth in a comprehensive essential obstetric care facility with the help of professionals might not be achievable in many countries.[159] A non-trivial consequence of this assimilationist approach is the loss of cultural traditions of indigenous groups, perpetuating the power asymmetry between them and the mainstream society.[38,160]

My scoping review (Chapter 5 and Annex 1) is the first systematic knowledge synthesis on the influence of traditional midwifery on maternal health in the Americas. The review identified a pattern of positive effects of culturally sensitive programs of access to Western health care. The last half of the 20th Century saw increasing international recognition of the value of health interventions that are sensitive of cultural differences and competent to deal with them.[161] A 2014 systematic global mapping[24] and a 2016 systematic review[162] explored interventions to address cultural factors that prevent access to Western maternity care. The reviews found that culturally congruent interventions can have a positive impact in the use of professional care, although few studies have measured the impact formally in low- and middle-income countries. A culturally sensitive approach would recognise that "knowing the opposition and understanding its views can be the key to successful negotiations on sensitive issues." [163] Yet, in indigenous settings, this is still in the context of prioritising Western contents and facilitating their assimilation.[79,164] Embracing cultural safety demands that health practitioners be prepared to critique the power asymmetries between Western and Indigenous cultures and their colonial origin and to challenge their own culture rather than prioritise themselves becoming "competent" in the cultures of others.[42]

My work in Guerrero confirmed and contributed to addressing the evidence gap on the impact of traditional practices, including traditional midwifery, on the health of mothers and children. Although the scoping review included positive accounts of traditional midwifery, self-care practices and rituals, almost no epidemiological studies addressed this. In response to this gap, the Safe Birth in Cultural Safety RCT in Guerrero extended high level epidemiological methods into intercultural research and contributed to dispelling concerns about the possible negative impact of traditional midwifery on maternal health. This study was a departure from the last century of inquiry focused on the assimilation of indigenous communities into Western culture and demonstrated an intervention adaptable to other intercultural settings. Epidemiology in a framework of intercultural dialogue is essential to disentangle the effects of traditional midwifery from the confounding intersectional factors, including scarce healthcare resources, isolation, poverty and marginalization.[39,64] In the words of the elders in the Amazon, it is not fair to judge the effectiveness of their medicine without considering the "distressing backdrop" that centuries of acculturation and colonialism have drawn.[165] In this thesis, I used modern epidemiology to allow the impact of traditional midwives to be evaluated clear of the distressing backdrop in Guerrero.

Traditional midwives in Guerrero reported, as their main protective role, accompanying women during pregnancy and taking care of the position of the baby using external massage.[147] The scoping review confirmed this role and highlighted the use of medicinal plants and rituals as additional components of their practice. The international literature included several examples of traditional practices in childbirth and maternal health.[166–170] Evaluation of potentially harmful practices is difficult because data are not always available and what is acceptable in one culture might be inappropriate or unacceptable in another .[171] In Guerrero, while practitioners at the health centers think that cold water baths are harmless, Indigenous women fear exposure to cold water because they see it as a cause of coldness of the womb.[147] Jordan showed that standards to define harmful practices are not static, they have changed even within Western biomedicine.[38] With the emergence of new evidence, some biomedical procedures that were previously considered safe have been shown to have deleterious effects in women and newborns.[172] Delays in updating routine practice mean such procedures can continue for some time. For example, some doctors in Guerrero continue to perform episiotomy routinely,[173] although international guidelines do not recommend this for women undergoing spontaneous vaginal birth.[122] Some procedures initially disregarded as based on traditional beliefs have been incorporated into biomedical practice, such as squatting and

moving during labour, continuous care giver support or delayed cord-cutting.[152] A model attempting mutual accommodation needs to include the indigenous perspective in the evaluation of harm.[38] This is a pillar of both cultural safety[66] and intercultural dialogue,[148] concepts that guided this doctoral project.

My argument is not that we should accept traditional practices blindly, even less that we should disregard Western perspectives. I tried to show we need to *and can* establish an adequate research framework to better understand what traditional practices can achieve. We need to and can establish mutually respectful collaboration that will ultimately reduce unhealthy practices everywhere and bring better health outcomes for indigenous and non-indigenous communities.

Intercultural Research

My doctoral project contributes examples and insights on how the process in Guerrero bridged the intercultural divide between Western and Indigenous perspectives in support of maternal health.[148] Despite increased international recognition of Indigenous groups, the methods to work *with* these communities are still underdeveloped.[27,37] My work offers a framework and methods for indigenous content to have a greater presence in shaping future research and decision making. I also showed how to apply tools that facilitate intercultural dialogue in Guerrero. The application of FCM in Section 1 shared contents and framed theories of what needs to change across the cultural divide.[10,147] Although it was not needed in Guerrero, the additional technique for operator-independent weighting will increase the relevance of FCM with groups with integrated concepts of causality that defy weighting of component causes.[146] The RCT of a midwife-centred intervention provided robust epidemiological evidence of the potential for increasing cultural safety while maintaining (or even improving) narrower health outcomes.[9]

Two concepts have been central to my proposal of intercultural research: cultural safety and intercultural dialogue. In the scoping review I found the most frequent approach to cultural differences was interculturality, with multiple and even contrasting meanings. Despite the increasing presence of cultural safety in Australia, New Zealand, the United States and Canada,[42] it was almost absent in the literature from Latin America. Preceding my thesis, adoption of cultural safety by the collaborating researchers in Guerrero allowed this project to deviate from prevailing biomedical assumptions that attempt to replace or ban traditional practices. This was part of what I described as the indispensable building of trust and safe space for partnership. In this case, cultural

safety was both a mechanism of change and an intended outcome. As a mechanism and research process, cultural safety promoted self-reflection on the impact that the colonial and socio-political context, including researcher assumptions, had in perpetuating power imbalances behind health disparities.[59] And as an outcome, cultural safety implied that improvements in biological health outcomes should not compromise the cultural identity of patients, allowing them feel spiritually, socially, emotionally and physically safe.[66,67] An enduring challenge is how to measure cultural safety.[42] My project used concrete indicators that might have wider applicability in other Indigenous contexts in Latin America – like respect for traditional birth (at home in company of family and traditional midwife), rituals associated with management of placenta, feelings of being respected and abandonment of practices considered harmful by Indigenous women such as bathing with cold water in the puerperium.

Building upon the recognition of and reflexivity about power imbalances and social injustice, *intercultural dialogue* proposes informed two-way communication in which individuals, groups or organisations with multiple interests converge to work out a way forward around a shared concern.[174] Intercultural dialogue recognises participants from both sides have strengths and bring value to the collaboration.[175] These multiple interests come from differences in cultural backgrounds and world views, and the interaction must be held in an attitudes of openness and respect.[176] In Western science, dialogue between different perspectives[177] has emerged as generative of deeper and broader understanding of the research issue, even accepting tension and contradiction of different views as valid knowledge.[129] In Guerrero, intercultural dialogue implied two additional steps. First, listen and adjust lexicon to identify contributions from traditional midwives, and, second, codesign, evaluate and discuss to identify benefits of supporting traditional practices.

The literature review (Chapter 5) confirmed Dietz' description of multiple interpretations of interculturality.[178] The Northern trend is to see interculturality as a functional strategy for smoothing over cultural interactions. Southern approaches see it as a transformative strategy to unveil, to question, and to change historically rooted inequities within society.[179] Some approaches to intercultural dialogue might use the interaction to extract useful knowledge without mutual benefit. Others might see it as a way to maintain the dominance of Western researchers in the definition of what is important or valid.[180] Adoption of cultural safety and focusing on the

solution of a concrete shared concern, in my experience, helps to maintain more horizontal interactions, an equal sharing of benefits and commitment to transformative approaches.

Limitations

Contextual limitations

Indigenous communities in Guerrero live in remote and hard-to-access territories affected by high levels of violence associated with illegal production and trafficking of drugs. The consequence for my work included higher costs of field work and restricted access to the communities. In securing financial support for the project, we had to face the limitations imposed by international disregard for traditional midwifery that restricts investment in work focusing on Indigenous ways. Funding and travel restrictions to work taking place in unsafe settings imposed an additional limitation to my presence in the field. A direct consequence of financial constraints was limitation of the length of the intervention and of the number of municipalities participating in the study, which had important implications for the measurement of impact (see below).

My access to the communities was one small element in the decades-long partnership between the Indigenous communities and the local team at CIET. My assigned role in analysis of the RCT reduced my presence in the field to research components before and after the RCT. Although my experience with intercultural dialogue facilitated trust building with Indigenous participants during my interaction, in this project I was challenged by having an external role and not being part of the dynamic on the field.

The advanced age of many traditional midwives, the many hours of difficult transportation that they needed to reach the towns and their dependence on subsistence farming for survival all reduced their participation in some project activities. We secured funding to reimburse a small part of their participation in the project, but participatory initiatives of this kind often underestimate the time participants need to commit. It seems plausible that, without these limitations, the RCT might have showed an even greater impact of support for traditional midwives on maternal and infant health.

Recognition of the scientific value and community linkages of CIET by state health authorities derived from decades of health promotion and training of health providers. This facilitated acceptance at policy level of an intervention focused on supporting traditional midwives. However, the broader environment of apprehension towards traditional practices among health care providers on the ground continued during the project, offset to a small degree by the workshops in the RCT's

intervention. Government and private health services providers in Guerrero continue to have negative attitudes towards traditional midwifery and this showed in the mixed results of the RCT in relation to cultural safety in institutional births.

Limitations of the methods and results

My research program used fuzzy cognitive maps based on group discussions, individual interviews and published evidence. I predefined protocols to standardise the process applied in each case, but facilitation of group sessions with traditional midwives faced language barriers. Bilingual intercultural brokers facilitated communication and, with support of other interpreters, helped to translate the contents of FCM and interviews. We always had more than one translator to confirm the flow of information in both directions. This increased the length of the sessions and might have reduced participant engagement.

Western research tools are poorly fitted to the complexity of indigenous concepts, notwithstanding the gains of fuzzy cognitive mapping sessions with traditional midwives (Chapter 3). Although participating traditional midwives named and confirmed the factors identified in each mapping sessions, the duration of the encounters was not enough for a full discussion about the meaning of some of these factors, especially culture-specific contents, such as traditional diseases.

Individual sessions with the intercultural researchers (Chapter 4) progressed faster because of shared language and concepts, but also because they had experience in expressing their knowledge about causal relationships. The group had different but not starkly contrasting perspectives from traditional midwives, as a more typical group of biomedical researchers might have. The main limitation of this component of the study was the small number of participants (eight people) and their specific characteristics as intercultural researchers in Guerrero, the main criterion for their selection to participate. This reduces generalisability of their maps to other researchers.

The literature map in the scoping review summarises studies of different quality, according to the MMAT tool. Because the revised MMAT tool does not generate quality measures for each study, I did not incorporate the quality assessment into the analysis of the maps.[181] There is space for further development of operator-independent weighting in the scoping review, considering some literature sources are more reliable than others.

Chapters 3, 4 and 5 present category maps to facilitate communication of very complex models with many factors and hundreds of relationships. We included map authors in the categorization process,

an option that might not always be available in other settings. As for any summary, category-level maps lose granularity and describe general characteristics that not necessarily translate back fully to the factor level. As explained in Chapter 5, categories helped to clarify the general picture, but outdegree centrality identified the most influential causal dynamics at factor level.

The first section of my thesis, contextualising safe birth in Guerrero, involved the two groups of stakeholders directly participating in intercultural dialogue (traditional midwives and intercultural researchers). The perspectives of other stakeholders, particularly government service providers, would expand the discussion and almost certainly identify topics in which traditional and non-traditional views have less agreement. In the part of the project reported in my thesis, engagement of government service providers happened in cultural awareness workshops and through intercultural brokers. The strategy behind this very gradual engagement recognises that, in a context of tension if not stand-off between traditional midwives and healthcare providers, there is space to strengthen the position and confidence of traditional midwives in relation to their Western counterparts before engaging in deliberation. I envisaged the RCT levelling slightly the playing field, providing high value epidemiological evidence of non-inferiority to offset, albeit in a partial way, the overwhelmingly negative attitudes of government service providers towards traditional midwives. As the larger project continues beyond the components in my thesis, this will provide a renewed basis for developing mutually respectful interaction between traditional midwives and health service providers.

There are also well recognised limitations of the tools I used. FCM produces soft models of causal understanding of the source of knowledge it represents, but an apparently causal relationship in the map does not guarantee it is causal or that it will be observed. We interpret the maps as reports of how each source sees the issue under study or as stakeholder theories to inform future research and discussion. Fuzzy cognitive maps in this thesis are not equivalent to a meta-analysis, although they clearly have some value in juxtaposing and sometimes combining different partial views of causality.

A related limitation is worth mention in the generation of operator-independent weights for fuzzy cognitive maps. The way I used Harris' discourse analysis is closer to contemporary content analysis[182] than it is to epidemiological risk analysis. Its objective was to identify the function of different parts of a text using only the information in the text.[6] I applied it to summarise the views of a specific group of sources into one map. The point at issue in this qualitative summary is whether a factor mentioned in a single map means the same as a factor mentioned in all maps in a

given set. Harris' premise was that the relative frequency of discourse parts (morphemes) indicates the function of that part in the discourse.[6] To implement this, I counted the frequency of causal relationships across the maps after transitive closure much as we would repeated content of multiple interviews or texts. The arrows in the map represented what participants consider causal relationships between nodes. Repetition of this consideration, applying the principles of Harris' discourse analysis, indicates importance within the context of causality represented by the map. Non-repetition, by axiom, indicates less importance in the overall set of maps. Comparing the operator-independent and participant weighting, I found reliability of the former is higher with the strongest relationships in the maps. These are the relationships most likely to inform action.

The RCT is a widely accepted epidemiological tool to measure impact. The study I report in this thesis used a clustered design in Guerrero across eighty communities in four municipalities. Masking and blinding were not possible because the intervention was obvious to residents in the intervention sites. Although some secondary outcomes (for example, intention of future home-based childbirths) might have been affected, the main outcome indicators (noninferiority for perinatal mortality, neonatal and serious childbirth complications) and other secondary outcomes would be less susceptible to this bias. The main limitation of the RCT was the fixed size of participating populations and limited time of the intervention. Clustered data requires bigger sample sizes to account for the variability within and across groups in the comparison of outcomes. Despite including all women in each community, the number of participants in the study was too small to allow inferences about maternal mortality. The shorter duration intervention with a fixed population meant less time to recruit pregnant women. A longer intervention would have increased the confidence in the effect.

An important ripple effect identified in the pilot that preceded my study was reduction in violence against women in communities where traditional midwives received support. In the 80-community RCT that I analysed and reported, interviewers had to administer the questions on violence under conditions where the respondent could potentially be seen and overheard, for security reasons. This meant respondents could not answer the sensitive questions about violence reliably and consequently I could not use these items in the analysis.

The RCT showed mixed results in terms of cultural safety of institutional births. The co-designed intervention featured the views of midwives. Inclusion of Western healthcare personnel at this stage would have helped to guarantee increased cultural safety in government health services, but it might

also have resulted in conflict and increased tensions. The analysis of the team was that a carefully managed RCT would increase the confidence of and the confidence in traditional midwives, a necessary step towards intercultural dialogue. The results in this thesis, therefore, are a step towards and not the full potential of intercultural dialogue.

Implications

The results of the RCT indicate that strengthening local capacities and knowledge results in positive health outcomes. Recognising the effects of five centuries of colonization and the consequent cultural and social disruption that they have brought, the intervention of the RCT in Guerrero focused the support in reverting this process. Direct support for traditional midwives helped to recover their self-esteem and animated their practice. Newly recruited apprentices reinforced cultural continuity and extended the workforce to provide care for mothers and babies. Intercultural brokers established a liaison with the non-Indigenous service providers, and the workshops with Western health personnel attempted to create a more respectful environment and interaction. The first lesson is that support for traditional midwives takes all this and more, and as soon as possible it is necessary to engage government healthcare providers in co-design of how their services might become more culturally safe.

Recognizing the strengths of Indigenous groups permits researchers and service providers to see them as more than vulnerable populations in need of external solutions to solve their problems. In addition to the potential benefits of self-care practices, rituals and traditional midwifery on health outcomes, the maps in Section 1 suggest traditional midwives can contribute to positive social dynamics within the family and the community (Chapter 5). For example, they could have a role in increasing male involvement in pregnancy and childbirth and in reducing interpersonal violence (Chapter 3).

Although the RCT found mixed effects on cultural safety of institutional births, the literature confirmed that increasing levels of cultural safety could increase access to health care services. Increased culturally safe health care will almost certainly lead indigenous women to think more highly of Western services and to use them more often and more appropriately.

This doctoral project offers knowledge of how to facilitate dialogue on safe birth in intercultural settings. I showed that mixed methods studies can produce the evidence needed for decision making, and they can engage stakeholders in discussions of solutions. I offered a concrete example

of how intercultural dialogue could facilitate the application of robust and high value research methods in identifying what Indigenous and Western birthing systems can contribute for maternal health and how to increase collaboration. Researchers and service providers could build on these synergies to reduce demands on resource constrained obstetric services, freeing up resources for those who need specialised interventions.

Future directions

The ongoing work on safe birth in cultural safety in Guerrero will continue to extend the knowledge about traditional midwifery in important ways. In the short term, a conversations protocol will probe important influences that traditional midwives reported in their maps: "frío" (cold or coldness of the womb), "espanto" (fright), "coraje" (anger) and traditional self-care practices.[183] A narrative evaluation involving participants in the trial will explore details about mechanisms of change, unexpected results or failures of the intervention. In the original trial protocol, we proposed additional statistical analysis including an economic evaluation of the study and the application of the fuzzy cognitive maps to inform Bayesian priors to formally incorporate stakeholder perspectives into statistical inference. An additional publication will explore the use of FCM in literature reviews, with an emphasis on analytical alternatives. Two fact sheets will share the results with other indigenous communities and health authorities in Guerrero to facilitate discussions of future actions. The next challenge will include engaging government health providers, if not in intercultural dialogue, at least in increasing the cultural safety of the services offered to Indigenous communities in the State.

The methods applied or developed in this thesis have already been applied in other settings.[2–5] As the next step in my journey, I will be applying these experiences with Inuit communities and service providers in Nunavik.

Summary and conclusions

Traditional midwives have detailed knowledge of what affects maternal health that complements published research and can inform culturally safe interventions in their communities. In the published literature, the positive effects of Western health care for Indigenous users seem to be conditioned by the levels of respect that Indigenous users perceive and receive. A paucity of studies addressing cultural safety and multiplicity of interpretations of interculturality identified in the literature review suggests that more discussion and dissemination of these concepts is still necessary.

Published literature and stakeholder perspectives indicated that safe birth in Indigenous communities is the result of complex interacting factors. Traditional midwives have a positive role in safe birth in Indigenous communities in Guerrero, Mexico. The full nature of these positive effects is partially understood and needs reliable epidemiological evidence.

Building on a participatory paradigm, our RCT in 80 communities in four predominantly Indigenous municipalities attempted to respond to the lack of evidence. Despite limitations of funding and the fixed small size of the communities, the trial found lower rates of perinatal deaths or childbirth or neonatal complications in communities where traditional midwives received support. Intervention communities also had higher levels of traditional childbirths. The effect on cultural safety of institutional births was mixed, with more respect for traditional management of placenta but also more non-traditional cold-water baths. This confirms the idea that future work should develop strategies to increase engagement of Western healthcare providers in improvement of cultural safety of their services. Additional research could seek to deepen understanding of traditional practices and the mechanisms through which supporting traditional midwifery can lead to positive change.

This project applied robust tools to facilitate participation. FCM compared and combined different sources of knowledge in a transparent and reproducible way. The knowledge base in Section 1 offers a starting point to incorporate and discuss the perspectives of other stakeholders using similar procedures. Additional tools for operator-independent weighting of causal knowledge expanded the usability of FCM across communities for whom participant weighting is not feasible. It also offered a tool to map and summarise published evidence, particularly when evidence is complex and heterogenous as it is often the case in scoping reviews. An RCT of a co-designed intervention produced epidemiological data about the benefits of support for traditional midwifery and a protocol of engagement reproducible in other indigenous communities. Per protocol, the intervention left space for participants to define specific actions relevant for the conditions in their own communities. This intervention could be adapted to other indigenous settings to test the replicability of the study findings.

The Safe Birth in Cultural Safety project in Guerrero was part of an intercultural dialogue between Western researchers and Indigenous communities. The project built on attitudes of respect and reflexivity. CIET's strong background in community engagement in the area favoured success. Nevertheless, cultural safety and intercultural dialogue might have wider relevance in a range of geographic and cultural settings. Embracing cultural safety, the project moved away from almost a

century of retraining traditional midwives to use them as accessory resources for Western healthcare in underserved areas. The consequence was trust building and partnership. Through self-reflexivity, the research team adjusted lexicon, opening space for traditional concepts and practices. The process extended through codesigned interventions and evidence to discuss their benefits. The experience of the CIET team shows that intercultural dialogue is feasible and can contribute to improving maternal health outcomes.

Thesis references

- 1 Andersson N, Silver H. Fuzzy cognitive mapping: An old tool with new uses in nursing research. *J Adv Nurs* 2019;**75**:3823–30. doi:10.1111/jan.14192
- 2 Sarmiento I, Ansari U, Omer K, *et al.* Causes of short birth interval (kunika) in Bauchi State, Nigeria: systematizing local knowledge with fuzzy cognitive mapping. *Reprod Health* 2021;**18**:74. doi:10.1186/s12978-021-01066-2
- 3 Belaid L, Atim P, Atim E, *et al.* Communities and service providers address access to perinatal care in postconflict Northern Uganda: socialising evidence for participatory action. *Fam Med Community Heal* 2021;**9**:e000610. doi:10.1136/fmch-2020-000610
- 4 Belaid L, Atim P, Ochola E, *et al.* Community views on short birth interval in Northern Uganda: a participatory grounded theory. *Reprod Health* 2021;**18**:88. doi:10.1186/s12978-021-01144-5
- 5 Tratt E, Sarmiento I, Gamelin R, *et al.* Fuzzy cognitive mapping with Inuit women: what needs to change to improve cervical cancer screening in Nunavik, northern Quebec? *BMC Health Serv Res* 2020;**20**:529. doi:10.1186/s12913-020-05399-9
- 6 Harris ZS. Discourse Analysis. *Language (Baltim)* 1952;**28**:1. doi:10.2307/409987
- 7 Giles BG, Findlay CS, Haas G, *et al.* Integrating conventional science and aboriginal perspectives on diabetes using fuzzy cognitive maps. *Soc Sci Med* 2007;**64**:562–76. doi:10.1016/j.socscimed.2006.09.007
- 8 Dion A, Carini-Gutierrez A, Jimenez V, *et al.* Weight of Evidence: Incorporating stakeholder knowledge in evidence synthesis for health service improvement. *J Mix Methods Res* 2021;**JMMR-19-03**.
- 9 Sarmiento I, Paredes-Solís S, Andersson N, *et al.* Safe Birth and Cultural Safety in southern Mexico: study protocol for a randomised controlled trial. *Trials* 2018;**19**:354. doi:10.1186/s13063-018-2712-6
- 10 Sarmiento I, Paredes-Solís S, Morris M, *et al.* Factors influencing maternal health in indigenous communities with presence of traditional midwifery in the Americas: protocol for a scoping review. *BMJ Open* 2020;**10**:e037922. doi:10.1136/bmjopen-2020-037922

- 11 Department of Economic and Social Affairs. Division for Social Policy and Development Secretariat. Secretariat of the Permanent Forum on Indigenous Issues. State of the World's indigenous peoples. New York: : United Nations 2009. doi:10.1016/S0140-6736(10)60721-0
- 12 Armenta-Paulino N, Sandín-Vázquez M, Bolúmar F. Indigenous language and inequitable maternal health care, Guatemala, Mexico, Peru and the Plurinational state of Bolivia. *Bull World Health Organ* 2019;**97**:59–67. doi:10.2471/BLT.18.216184
- 13 Freyermuth M, Luna M. Muerte materna y muertes evitables en exceso. Propuesta metodológica para evaluar la política pública en salud. Realidad, datos y espacio. *Rev Int estadística y Geogr* 2014;**5**:42–61.
- 14 Koblinsky M, Moyer CA, Calvert C, *et al.* Quality maternity care for every woman, everywhere: a call to action. *Lancet* 2016;**388**:2307–20. doi:10.1016/S0140-6736(16)31333-2
- 15 Merrick J. Global health: global strategy for women's, children's, and adolescents' health 2016-2030. *Int J Child Adolesc health* 2017;**10**:257–60. doi:10.1017/CBO9781107415324.004
- 16 Bar-Zeev S, Barclay L, Kruske S, *et al.* Use of maternal health services by remote dwelling aboriginal women in northern Australia and their disease burden. *Birth* 2013;**40**:172–81. doi:10.1111/birt.12053
- 17 Harvey S, Blandón Y, McCaw-Binns A, *et al.* Are skilled birth attendants really skilled? A measurement method, some disturbing results and a potential way forward. *Bull World Health Organ* 2007;**85**:783–90.
- 18 World Health Organization. The world health report 2005: make every mother and child count. Geneva: 2005. <http://www.who.int/whr/2005/en/> (accessed 16 Feb 2017).
- 19 Stephens C, Porter J, Nettleton C, *et al.* Disappearing, displaced, and undervalued: a call to action for Indigenous health worldwide. *Lancet* 2006;**367**:2019–28. doi:10.1016/S0140-6736(06)68892-2
- 20 Colombara D V., Hernández B, Schaefer A, *et al.* Institutional delivery and satisfaction among indigenous and poor women in Guatemala, Mexico, and Panama. *PLoS One* 2016;**11**:e0154388. doi:10.1371/journal.pone.0154388
- 21 Mills L. *The limits of trust: The Millennium Development Goals, maternal health, and health policy in*

Mexico. Montreal: : McGill-Queen's University Press 2017.

- 22 Bohren MA, Hunter EC, Munthe-Kaas HM, *et al.* Facilitators and barriers to facility-based delivery in low- and middle-income countries: a qualitative evidence synthesis. *Reprod Health* 2014;**11**. doi:10.1186/1742-4755-11-71
- 23 Canales Muñoz J, Almada Bay I, Narro Robles J. La mortalidad en una población rural de México y su relación con el uso de los servicios médicos antes de la muerte. *Salud Publica Mex* 1984;**26**:404–14.
- 24 Coast E, Jones E, Portela A, *et al.* Maternity care services and culture: A systematic global mapping of interventions. *PLoS One*. 2014;**9**. doi:10.1371/journal.pone.0108130
- 25 Gamlin JB. Shame as a barrier to health seeking among indigenous Huichol migrant labourers: An interpretive approach of the “violence continuum” and “authoritative knowledge”. *Soc Sci Med* 2013;**97**:75–81. doi:10.1016/j.socscimed.2013.08.012
- 26 International Council for Science. ICSU Series on science for sustainable development No. 4: Science, traditional knowledge and sustainable development. 2002.
<http://unesdoc.unesco.org/images/0015/001505/150501eo.pdf> (accessed 18 Oct 2018).
- 27 World Health Organization. WHO global report on traditional and complementary medicine 2019. Geneve, Switzerland: 2019. <https://apps.who.int/iris/handle/10665/312342> (accessed 6 May 2021).
- 28 United Nations. United Nations Declaration on the Rights of Indigenous Peoples. New York: 2007. <https://www.un.org/development/desa/indigenouspeoples/declaration-on-the-rights-of-indigenous-peoples.html> (accessed 21 Mar 2019).
- 29 International Labour Organization. Indigenous and Tribal Peoples Convention, 1989 (No. 169). Geneve, Switzerland: 1989.
https://www.ilo.org/dyn/normlex/en/f?p=NORMLEXPUB:12100:0::NO::P12100_ILO_CODE:C169 (accessed 5 May 2021).
- 30 World Health Organization. Primary health care. Report of the international conference on Primary Health Care. Alma-Ata: 1978. <http://apps.who.int/iris/handle/10665/39228> (accessed 6 May 2021).

- 31 World Health Organization. Declaration of Astana. Global Conference on Primary Health Car. Astana, Kazakhstan: 2018. <https://www.who.int/docs/default-source/primary-health/declaration/gcphc-declaration.pdf> (accessed 6 May 2021).
- 32 Estados Unidos Mexicanos. *Constitución Política de los Estados Unidos Mexicanos*. DOF11-03–2nd ed. Mexico: 1917.
http://www.diputados.gob.mx/LeyesBiblio/pdf_mov/Constitucion_Politica.pdf (accessed 6 May 2021).
- 33 Secretaría de Salud de los Estados Unidos Mexicanos. *Programa sectorial de salud 2020-2024*. Mexico: 2019. https://dof.gob.mx/nota_detalle.php?codigo=5598474&fecha=17/08/2020
- 34 Cámara de Diputados del Honorable Congreso de la Unión. *Ley General de salud*. DOF19-02–2nd ed. Mexico: 1984. http://www.diputados.gob.mx/LeyesBiblio/pdf/142_190221.pdf (accessed 6 May 2021).
- 35 Kruske S, Barclay L. Effect of shifting policies on traditional birth attendant training. *J Midwifery Womens Health* 2004;**49**:306–11. doi:10.1016/j.jmwh.2004.01.005
- 36 United Nations. Department of Economic and Social Affairs. Permanent Forum on Indigenous Issues. State of the World’s indigenous peoples. New York: : United Nations 2014. <http://www.un.org/esa/socdev/unpfii/documents/2015/sowip2volume-ac.pdf> (accessed 12 Apr 2021).
- 37 World Health Organization. General guidelines for methodologies on research and evaluation of traditional medicine. Geneva, Switzerland: 2000.
<http://apps.who.int/medicinedocs/en/d/Jwhozip42e/> (accessed 5 Apr 2019).
- 38 Jordan B. *Birth in four cultures: A crosscultural investigation of childbirth in Yucatan, Holland, Sweden, and the United States*. 4th ed. Long Grove, IL: : Waveland Press 1993.
- 39 Kennedy HP, Cheyney M, Dahlen HG, *et al*. Asking different questions: A call to action for research to improve the quality of care for every woman, every child. *Birth* 2018;**45**:222–31. doi:10.1111/birt.12361
- 40 Miller T, Smith H. Establishing partnership with traditional birth attendants for improved maternal and newborn health: A review of factors influencing implementation. *BMC Pregnancy*

- Childbirth* 2017;**17**:1–10. doi:10.1186/s12884-017-1534-y
- 41 Polaschek N. Cultural safety: a new concept in nursing people of different ethnicities. *J Adv Nurs* 1998;**27**:452–7. doi:10.1046/j.1365-2648.1998.00547.x
 - 42 Curtis E, Jones R, Tipene-Leach D, *et al.* Why cultural safety rather than cultural competency is required to achieve health equity: a literature review and recommended definition. *Int J Equity Health* 2019;**18**:174. doi:10.1186/s12939-019-1082-3
 - 43 Castañeda Camey X, Garcia Barrios C, Romero Guerrero X, *et al.* Traditional birth attendants in Mexico: Advantages and inadequacies of care for normal deliveries. *Soc Sci Med* 1996;**43**:199–207. doi:10.1016/0277-9536(95)00362-2
 - 44 Chalmers B. *African birth: childbirth in cultural transition*. South Africa: : Berv Publications 1990. <http://www.popline.org/node/384026> (accessed 19 Jan 2019).
 - 45 World Health Organization, The United Nations Children’s Emergency Fund, United Nations Population Fund. Traditional birth attendants: a joint WHO/UNFPA/UNICEF statement. Geneva: 1992. <http://www.who.int/iris/handle/10665/38994> (accessed 19 Jan 2019).
 - 46 Braine T. Mexico’s midwives enter the mainstream. *Bull World Health Organ* 2008;**86**:244–5. doi:10.2471/BLT.08.010408
 - 47 Flores-Hernández A, Espejel-Rodríguez A. *Nadie se muere por parir’ Muerte materna en Guerrero: un programa en perspectiva*. Tlaxcala, Mexico: : Universidad de Tlaxcala 2011.
 - 48 Pyone T, Adaji S, Madaj B, *et al.* Changing the role of the traditional birth attendant in Somaliland. *Int J Gynaecol Obstet* 2014;**127**:41–6. doi:10.1016/j.ijgo.2014.04.009
 - 49 Davis-Floyd R. Mutual accommodation or biomedical hegemony? Anthropological perspectives on global issues in midwifery. *Midwifery Today Int Midwife* 2000;**53**:12–6.
 - 50 Jordan B. Cosmopolitical obstetrics: some insights from the training of traditional midwives. *Soc Sci Med* 1989;**28**:925–37.
 - 51 Starrs A, editor. The safe motherhood action agenda: priorities for the next decade (English). In: *Safe Motherhood Technical Consultation, Sri Lanka, 18-23 October 1997*. Washington, DC: 1997.

107. <http://documents.worldbank.org/curated/en/403701468764711167/The-safe-motherhood-action-agenda-priorities-for-the-next-decade> (accessed 19 Jan 2019).
- 52 World Health Organization. Defining competent maternal and newborn health professionals. Geneva: 2018. <http://apps.who.int/iris/handle/10665/272817> (accessed 19 Jan 2019).
- 53 MacDonald M, Starrs A. Skilled care during childbirth. Information booklet. New York: 2002. [http://www.familycareintl.org/UserFiles/File/Skilled Care Info Kit PDFs/English/Information Booklet_English.pdf](http://www.familycareintl.org/UserFiles/File/Skilled%20Care%20Info%20Kit%20PDFs/English/Information%20Booklet_English.pdf) (accessed 19 Jan 2019).
- 54 World Health Organization. Department of Reproductive Health and Research. Making pregnancy safer: the critical role of the skilled attendant. A joint statement by WHO, ICM and FIGO. Geneva: 2004. <http://whqlibdoc.who.int/publications/2004/9241591692.pdf> (accessed 8 Nov 2018).
- 55 Jordan B. Technology and the social distribution of authoritative knowledge. In: Coreil J, Mull J, eds. *Anthropology and primary health care*. Boulder, USA: : Westview Press 1990.
- 56 Davis-Floyd R, Sargent C. Introduction: The anthropology of birth. In: Davis-Floyd R, Sargent C, eds. *Childbirth and authoritative knowledge: Cross-cultural perspectives*. Berkeley: : University of California Press 1997. 1–53.
- 57 Tritten J. International midwife: Global alliance of midwives. *Midwifery Today* 1999;46.
- 58 Fullerton JT, Thompson JB. International Confederation of Midwives core documents: Their added value for US Midwifery Associations. *J Midwifery Womens Health* 2013;58:130–2. doi:10.1111/jmwh.12037
- 59 Graham W, Bell J, Bullough C. Can skilled attendance at delivery reduce maternal mortality in developing countries? In: De Brouwere V, Van Lerberghe W, eds. *Safe motherhood strategies: A review of the evidence*. Antwerp, Belgium: : ITG Press 2001. 97–130.
- 60 Adegoke A, van den Broek N. Skilled birth attendance-lessons learnt. *BJOG An Int J Obstet Gynaecol* 2009;116:33–40.
- 61 Morgan A, Jimenez Soto E, Bhandari G, *et al.* Provider perspectives on the enabling environment required for skilled birth attendance: a qualitative study in western Nepal. *Trop Med Int Heal* 2014;19:1457–65. doi:10.1111/tmi.12390

- 62 Maclean GD. The challenge of preparing and enabling ‘skilled attendants’ to promote safer childbirth. *Midwifery* 2003;**19**:163–9. doi:10.1016/S0266-6138(03)00036-6
- 63 4th Global Midwifery Symposium, Women Deliver. In: *Empowered midwives, transformed communities. Midwives call for an enabling environment to transform maternal and newborn health outcomes*. 2019. 2.<https://www.unfpa.org/events/fourth-global-midwifery-symposium> (accessed 12 Aug 2021).
- 64 Sarmiento I, Zuluaga G, Andersson N. Traditional medicine used in childbirth and for childhood diarrhoea in Nigeria’s Cross River State: interviews with traditional practitioners and a statewide cross-sectional study. *BMJ Open* 2016;**6**:e010417. doi:10.1136/bmjopen-2015-010417
- 65 Allan B, Smylie J. First peoples, second class treatment. The role of racism in the health and well-being of indigenous peoples in Canada. Toronto, ON: 2015.
<http://www.wellesleyinstitute.com/wp-content/uploads/2015/02/Summary-First-Peoples-Second-Class-Treatment-Final.pdf> (accessed 29 Jan 2019).
- 66 Papps E, Ramsden I. Cultural safety in nursing: The New Zealand experience. *Int J Qual Heal care* 1996;**8**:491–7.
- 67 Williams R. Cultural safety - what does it mean for our work practice? *Aust N Z J Public Health* 1999;**23**:213–4. doi:10.1111/j.1467-842X.1999.tb01240.x
- 68 Johnstone M-J, Kanitsaki O. An exploration of the notion and nature of the construct of cultural safety and Its applicability to the Australian health care context. *J Transcult Nurs* 2007;**18**:247–56. doi:10.1177/1043659607301304
- 69 Graham WJ, Campbell OMR. Maternal health and the measurement trap. *Soc Sci Med* 1992;**35**:967–77. doi:10.1016/0277-9536(92)90236-J
- 70 Ana J. Are traditional birth attendants good for improving maternal and perinatal health? Yes. *BMJ* 2011;**342**:d3310–d3310. doi:10.1136/bmj.d3310
- 71 Harrison KA. Are traditional birth attendants good for improving maternal and perinatal health? No. *BMJ* 2011;**342**:d3308–d3308. doi:10.1136/bmj.d3308
- 72 United Nations Population Fund, International Confederation of Midwives, World Health

- Organization. The state of the world's midwifery 2014: A universal pathway. A woman's right to health. New York: 2014. <http://www.unfpa.org/sowmy> (accessed 16 Feb 2017).
- 73 Leedam E. Traditional birth attendants. *Int J Gynecol Obstet* 1985;**23**:249–274. doi:10.1186/1471-2458-10-570
 - 74 De Brouwere V, Tonglet RR, Van Lerberghe WW. Strategies for reducing maternal mortality in developing countries: what can we learn from the history of the industrialized West? *Trop Med Int Heal* 1998;**3**:771–82. doi:10.1046/j.1365-3156.1998.00310.x
 - 75 Pigg SL. Authority in translation. Finding, knowing, naming, and training 'traditional birth attendants' in Nepal. In: Davis-Floyd R, Sargent CF, eds. *Childbirth and authoritative knowledge: Cross-cultural perspectives*. Berkeley: : University of California Press 1997. 233–62.
 - 76 Gill CJ, Hamer DH, Knapp AB. Dispelling the myths surrounding traditional birth attendants. *BMJ* 2011;**343**:d4481–d4481. doi:10.1136/bmj.d4481
 - 77 World Health Organization. Working with individuals, families and communities to improve maternal and newborn health. Geneva: : World Health Organization 2010. https://www.who.int/maternal_child_adolescent/documents/who_fch_rhr_0311/en/ (accessed 5 Apr 2019).
 - 78 Lang J, Elkin E. A study of the beliefs and birthing practices traditional midwives in rural Guatemala. *J Nurse Midwifery* 1997;**42**:25–31. doi:10.1016/S0091-2182(96)00069-9
 - 79 World Health Organization. WHO recommendations on health promotion interventions for maternal and newborn health 2015. Geneva: 2015. https://www.who.int/maternal_child_adolescent/documents/health-promotion-interventions/en/ (accessed 29 Jan 2019).
 - 80 Vieira C, Portela A, Miller T, *et al*. Increasing the use of skilled health personnel where traditional birth attendants were providers of childbirth care: a systematic review. *PLoS One* 2012;**7**. doi:10.1371/journal.pone.0047946
 - 81 Byrne A, Morgan A. How the integration of traditional birth attendants with formal health systems can increase skilled birth attendance. *Int J Gynecol Obstet* 2011;**115**:127–34. doi:10.1016/j.ijgo.2011.06.019

- 82 Wilunda C, Dall'Oglio G, Scanagatta C, *et al.* Changing the role of traditional birth attendants in Yirol West County, South Sudan. *PLoS One* 2017;**12**:e0185726. doi:10.1371/journal.pone.0185726
- 83 Nsirim RO, Iyongo JA, Adekugbe O, *et al.* Integration of traditional birth attendants into prevention of mother-to-child transmission at primary health facilities in Kaduna, North-West Nigeria. *J Public Health Africa* 2016;**6**. doi:10.4081/jphia.2015.455
- 84 World Health Organization. WHO recommendations on maternal health: guidelines approved by the WHO Guidelines Review Committee. Geneva: 2017. http://who.int/tb/features_archive/factsheet_xpert.pdf (accessed 13 Dec 2019).
- 85 Sibley L, Sipe TA. What can a meta-analysis tell us about traditional birth attendant training and pregnancy outcomes? *Midwifery* 2004;**20**:51–60. doi:10.1016/S0266-6138(03)00053-6
- 86 Darmstadt GL, Lee ACC, Cousens S, *et al.* 60 Million non-facility births: Who can deliver in community settings to reduce intrapartum-related deaths? *Int J Gynecol Obstet* 2009;**107**:S89–112. doi:10.1016/j.ijgo.2009.07.010
- 87 Kidney E, Winter HR, Khan KS, *et al.* Systematic review of effect of community-level interventions to reduce maternal mortality. *BMC Pregnancy Childbirth* 2009;**9**:2. doi:10.1186/1471-2393-9-2
- 88 Wilson A, Gallos ID, Plana N, *et al.* Effectiveness of strategies incorporating training and support of traditional birth attendants on perinatal and maternal mortality: meta-analysis. *BMJ* 2011;**343**:d7102. doi:10.1136/bmj.d7102
- 89 Sibley LM, Sipe TA, Barry D. Traditional birth attendant training for improving health behaviours and pregnancy outcomes. *Cochrane Database Syst Rev* 2012;;CD005460. doi:10.1002/14651858.CD005460.pub3
- 90 Lassi ZS, Das JK, Salam RA, *et al.* Evidence from community level inputs to improve quality of care for maternal and newborn health: interventions and findings. *Reprod Health* 2014;**11**:S2. doi:10.1186/1742-4755-11-S2-S2
- 91 Lassi ZS, Middleton PF, Bhutta ZA, *et al.* Strategies for improving health care seeking for maternal and newborn illnesses in low- and middle-income countries: A systematic review

- and meta-analysis. *Glob Health Action* 2016;**9**:31408. doi:10.3402/gha.v9.31408
- 92 Carlo WA, Goudar SS, Jehan I, *et al.* Newborn-Care Training and Perinatal Mortality in Developing Countries. *N Engl J Med* 2010;**362**:614–23. doi:10.1056/NEJMsa0806033
 - 93 Carlo WA, McClure EM, Chomba E, *et al.* Newborn Care Training of Midwives and Neonatal and Perinatal Mortality Rates in a Developing Country. *Pediatrics* 2010;**126**:e1064–71. doi:10.1542/peds.2009-3464
 - 94 Gill CJ, Phiri-Mazala G, Guerina NG, *et al.* Effect of training traditional birth attendants on neonatal mortality (Lufwanyama Neonatal Survival Project): randomised controlled study. *BMJ* 2011;**342**:d346–d346. doi:10.1136/bmj.d346
 - 95 Manasyan A, Chomba E, Moore J, *et al.* Association between birth attendant type and delivery site and perinatal outcomes. *Int J Gynecol Obstet* 2019;**145**:187–92. doi:10.1002/ijgo.12786
 - 96 Sabin L, Knapp A, MacLeod W, *et al.* Costs and cost-effectiveness of training traditional birth attendants to reduce neonatal mortality in the Lufwanyama Neonatal Survival study (LUNESP). *PLoS One* 2012;**7**:e35560. doi:10.1371/journal.pone.0035560
 - 97 Mangham-Jefferies L, Pitt C, Cousens S, *et al.* Cost-effectiveness of strategies to improve the utilization and provision of maternal and newborn health care in low-income and lower-middle-income countries: a systematic review. *BMC Pregnancy Childbirth* 2014;**14**:243. doi:10.1186/1471-2393-14-243
 - 98 Bullough C, Meda N, Makowiecka K, *et al.* Review: Current strategies for the reduction of maternal mortality. *BJOG An Int J Obstet Gynaecol* 2005;**112**:1180–8. doi:10.1111/j.1471-0528.2005.00718.x
 - 99 Bergström S, Goodburn E. The role of traditional birth attendants in the reduction of maternal mortality. In: *Safe Motherhood Strategies: A Review of the Evidence*. Antwerp, Belgium: : ITG Press 2001. 77–96.
 - 100 Shea BJ, Grimshaw JM, Wells GA, *et al.* Development of AMSTAR: a measurement tool to assess the methodological quality of systematic reviews. *BMC Med Res Methodol* 2007;**7**:10. doi:10.1186/1471-2288-7-10
 - 101 Lee ACC, Lawn JE, Cousens S, *et al.* Linking families and facilities for care at birth: What

- works to avert intrapartum-related deaths? *Int J Gynecol Obstet* 2009;**107**:S65–88.
doi:10.1016/j.ijgo.2009.07.012
- 102 Nyamtema AS, Urassa DP, van Roosmalen J. Maternal health interventions in resource limited countries: A systematic review of packages, impacts and factors for change. *BMC Pregnancy Childbirth* 2011;**11**:11–30. doi:10.1186/1471-2393-11-30
 - 103 Lassi Z, Bhutta Z. Community-based intervention packages for reducing maternal and neonatal morbidity and mortality and improving neonatal outcomes. *Cochrane database Syst Rev* 2015;CD007754. doi:10.1002/14651858.CD007754.pub3. www.cochranelibrary.com
 - 104 Consejo Nacional de Evaluación de la Política de Desarrollo Social. Población en situación de pobreza por entidad federativa, 2016.
<http://sistemas.coneval.org.mx/InfoPobreza/Pages/wfrMapaPobreza?pAnio=2016&pTipoPobreza=1&pTipoIndicador=1> (accessed 8 Aug 2018).
 - 105 Instituto Nacional de Estadística y Geografía de México. Population aged 5 years and over who speaks some indigenous language. <http://en.www.inegi.org.mx/temas/lengua/> (accessed 10 Jun 2018).
 - 106 Cámara de Diputados. Honorable Congreso de la Unión. Anuarios Estatales.
http://www.diputados.gob.mx/sedia/biblio/usieg_anu_est16_gro.htm (accessed 10 Jun 2018).
 - 107 Paredes-Solís S, Villegas-Arrizón A, Meneses-Rentería A, *et al.* [Violence during pregnancy: a population based study in Ometepec, Guerrero, Mexico]. *Salud Publica Mex* 2005;**47**:335–41.
 - 108 Cárdenas R. Acciones y programas para la reducción de la mortalidad materna: ¿Qué necesitamos hacer? *Salud Publica Mex* 2007;**49**:231–3.
 - 109 Eternod Arámburu M. Metodología para calcular la razón de mortalidad materna: Un mejor registro y un indicador deficiente. *Real Datos y Espac Rev Int Estadística y Geogr* 2012;**3**:23–69. http://www.inegi.org.mx/rde/RDE_05/doctos/rde_05_art3.pdf (accessed 10 Jun 2018).
 - 110 Schmelkes S. Educación y pueblos indígenas: Problemas de medición. *Real Datos y Espac Rev Int Estadística y Geogr* 2013;**4**:5–13. http://www.inegi.org.mx/RDE/RDE_08/Doctos/RDE_08_Art1.pdf (accessed 10 Jun 2018).

- 2018).
- 111 Meneses S, Pelcastre B, Vega M. Maternal mortality and the coverage, availability of resources, and access to women's health services in three indigenous regions of Mexico: Guerrero Mountains, Tarahumara Sierra, and Nayar. In: Schwartz DA, ed. *Maternal death and pregnancy-related morbidity among indigenous women of Mexico and Central America*. Cham: : Springer International Publishing 2018. 169–88. doi:10.1007/978-3-319-71538-4_9
 - 112 Instituto Nacional de Estadística y Geografía de México. Estadísticas a Propósito del Día de la Madre (10 de mayo) 2017.
2017.http://www.inegi.org.mx/saladeprensa/aproposito/2017/madre2017_Nal.pdf (accessed 10 Jun 2018).
 - 113 Observatorio de Mortalidad Materna de México. Boletín de mortalidad materna. Semana epidemiológica 52 información actualizada al 31 de diciembre de 2017.
http://www.omm.org.mx/images/stories/Documentos grandes/BOLETIN_52_2017_COMPLETO.pdf (accessed 10 Jun 2018).
 - 114 Pisanty-Alatorre J. Inequidades en la mortalidad materna en México: un análisis de la desigualdad a escala subestatal. *Salud Publica Mex* 2017;**59**:639. doi:10.21149/8788
 - 115 Subsecretaría de Prevención y Promoción de la Salud. Informe semanal de vigilancia epidemiológica. Semana Epidemiológica 53. Mexico: 2021.
<https://www.gob.mx/salud/documentos/informes-semanales-para-la-vigilancia-epidemiologica-de-muertes-maternas-2020> (accessed 21 May 2021).
 - 116 Instituto Nacional de Estadística y Geografía de México. Tasa de mortalidad infantil por entidad federativa según sexo, 2016.
www.beta.inegi.org.mx/contenidos/temas/pob/mor/.../mdemo55.xls. (accessed 10 Aug 2018).
 - 117 Instituto Nacional de Estadística y Geografía de México. Anuario estadístico y geográfico de Guerrero 2016. México: 2016.
http://www.diputados.gob.mx/sedia/biblio/usieg/Anuarios_2016/Guerrero/A REFERENCIAS GENERALES.pdf (accessed 29 Jan 2019).
 - 118 Rouvier M, González-Block MA, Becerril-Montekio V, *et al.* Mapeo de problemas para la

- atención a la salud materna por actores estatales y federales. *Salud Pública de México* 2011;**53**:48–56. doi:10.1590/S0036-36342011000100008
- 119 Sanchez del Hierro G, Remmen R, Verhoeven V, *et al.* Are recent graduates enough prepared to perform obstetric skills in their rural and compulsory year? A study from Ecuador. *BMJ Open* 2014;**4**:e005759–e005759. doi:10.1136/bmjopen-2014-005759
 - 120 de Jesús-García A. *Complicaciones de parto atendido en casa y en instituciones de salud: un estudio transversal por conglomerados en municipios indígenas del sur de México*. 2013.
 - 121 World Health Organization. *WHO recommendations for prevention and treatment of maternal peripartum infections*. Geneva, Switzerland: 2015.
http://www.who.int/reproductivehealth/publications/maternal_perinatal_health/peripartum-infections-guidelines/en/ (accessed 19 Oct 2018).
 - 122 World Health Organization. *Who recommendations on intrapartum care for a positive childbirth experience*. Geneva, Switzerland: : World Health Organization 2018.
<https://www.who.int/reproductivehealth/publications/intrapartum-care-guidelines/en> (accessed 19 Oct 2018).
 - 123 Rodríguez-Aguilar R. Maternal mortality in Mexico, beyond millennial development objectives: An age-period-cohort model. *PLoS One* 2018;**13**:e0194607.
doi:10.1371/journal.pone.0194607
 - 124 Instituto Nacional de Estadística y Geografía de México. Mortalidad General.
<https://www.inegi.org.mx/sistemas/olap/Proyectos/bd/continuas/mortalidad/MortalidadGeneral.asp> (accessed 28 Mar 2019).
 - 125 Informe 2018 Grupo Estatal para la Prevención del Embarazo en Adolescentes. 2018.
https://www.gob.mx/cms/uploads/attachment/file/460824/Informe2018_GEPEA_Guerrero.pdf (accessed 12 Aug 2021).
 - 126 Barroso G, Sandoval A. Fecundidad indígena y salud reproductiva en La Montaña. In: *Estado del desarrollo económico y social de los pueblos indígenas de Guerrero*. Acapulco: : Programa Universitario México Nación Multicultural, Secretaría de Asuntos Indígenas de Guerrero 2009. 9–20.
http://www.nacionmulticultural.unam.mx/edespig/diagnostico_y_perspectivas/RECUA

DROS/CAPITULO 2/1 Fecundidad indigena y salud reproductiva en la Montana.pdf
(accessed 3 May 2018).

- 127 Andersson N. Building the community voice into planning: 25 years of methods development in social audit. *BMC Health Serv Res* 2011;**11 Suppl 2**:S1. doi:10.1186/1472-6963-11-S2-S1
- 128 Andersson N. Participatory research-A modernizing science for primary health care. *J Gen Fam Med* 2018;**19**:154–9. doi:10.1002/jgf2.187
- 129 Greene JC, Hall JN. Dialectics and Pragmatism: Being of Consequence. In: Tashakkori A, Teddlie C, eds. *SAGE Handbook of Mixed Methods in Social & Behavioral Research*. 2455 Teller Road, Thousand Oaks California 91320 United States: : SAGE Publications, Inc. 210AD. 119–44. doi:10.4135/9781506335193.n5
- 130 Gray S, Zanre E, Gray SRJ. Fuzzy cognitive maps as representations of mental models and group beliefs. In: Papageorgiou EI, ed. *Fuzzy cognitive maps for applied sciences and engineering*. Berlin: : Springer 2014. 29–48. doi:10.1007/978-3-642-39739-4_2
- 131 Glymour M, Greenland S. Causal Diagrams. In: Rothman K, Greenland S, Lash T, eds. *Modern Epidemiology*. Philadelphia: : Wolters Kluwer Health/Lippincott Williams & Wilkins 2008. 183–211.
- 132 Kosko B. Fuzzy cognitive maps. *Int J Man Mach Stud* 1986;**24**:65–75. doi:10.1016/S0020-7373(86)80040-2
- 133 Niesink P, Poulin K, Šajna M. Computing transitive closure of bipolar weighted digraphs. *Discret Appl Math* 2013;**161**:217–43. doi:10.1016/J.DAM.2012.06.013
- 134 Özesmi U, Özesmi SL. Ecological models based on people’s knowledge: a multi-step fuzzy cognitive mapping approach. *Ecol Modell* 2004;**176**:43–64. doi:10.1016/j.ecolmodel.2003.10.027
- 135 Giabbanelli PJ, Gray SA, Aminpour P. Combining fuzzy cognitive maps with agent-based modeling: Frameworks and pitfalls of a powerful hybrid modeling approach to understand human-environment interactions. *Environ Model Softw* 2017;**95**:320–5. doi:10.1016/j.envsoft.2017.06.040
- 136 Arksey H, O’Malley L. Scoping studies: towards a methodological framework. *Int J Soc Res*

- Methodol* 2005;**8**:19–32. doi:10.1080/1364557032000119616
- 137 Peters MDJ, Marnie C, Tricco AC, *et al.* Updated methodological guidance for the conduct of scoping reviews. *JBIM Evid Synth* 2020;**18**:2119–26. doi:10.11124/JBIES-20-00167
 - 138 Andersson N. Proof of impact and pipeline planning: Directions and challenges for social audit in the health sector. *BMC Health Serv Res* 2011;**11**:S16. doi:10.1186/1472-6963-11-S2-S16
 - 139 Andersson N. Community-led trials: Intervention co-design in a cluster randomised controlled trial. *BMC Public Health* 2017;**17**:397. doi:10.1186/s12889-017-4288-6
 - 140 Canadian Institutes of Health Research, Natural Sciences and Engineering Research Council of Canada, Social Sciences and Humanities Research Council of Canada. TCPS 2 - Chapter 9. In: *Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans*. 2014. 109–38. https://ethics.gc.ca/eng/tcps2-eptc2_2018_chapter9-chapitre9.html (accessed 18 Jan 2021).
 - 141 Zuluaga G. Una ética para la investigación médica con comunidades indígenas. In: Vélez A, Ruiz A, Torres M, eds. *Retos y dilemas de los comités de ética en investigación*. Bogotá: : Editorial Universidad del Rosario 2013. 259–81. http://media.wix.com/ugd/cb47c9_d790340d497847e58f5505518c122b24.pdf (accessed 30 Apr 2014).
 - 142 Cameron M, Andersson N, McDowell I, *et al.* Culturally safe epidemiology: oxymoron or scientific imperative. *Pimatisiwin J Aborig Indig Community Heal* 2010;**8**:89–116. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2962656/> (accessed 7 Apr 2020).
 - 143 Denzin NK, Lincoln YS, Smith LT. *Handbook of critical and indigenous methodologies*. Los Angeles: : Sage 2008.
 - 144 Tuck E. Suspending damage: A letter to communities. *Harv Educ Rev* 2009;**79**:409–28. doi:10.17763/haer.79.3.n0016675661t3n15
 - 145 Hersch-Martínez P. Epidemiología sociocultural: una perspectiva necesaria. *Salud Publica Mex* 2013;**55**:512–8. <http://www.medigraphic.com/pdfs/salpubmex/sal-2013/sal135i.pdf> (accessed 13 Dec 2013).
 - 146 Sarmiento I, Cockcroft A, Dion A, *et al.* Combining conceptual frameworks on maternal

- health in indigenous communities -- Fuzzy cognitive mapping using participant and operator-independent weighting. *Field methods* 2022;**34**.
- 147 Sarmiento I, Paredes-Solís S, Loutfi D, *et al.* Fuzzy cognitive mapping and soft models of indigenous knowledge on maternal health in Guerrero, Mexico. *BMC Med Res Methodol* 2020;**20**:125. doi:10.1186/s12874-020-00998-w
 - 148 Sarmiento I, Zuluaga G, Paredes-Solís S, *et al.* Bridging Western and Indigenous knowledge through intercultural dialogue: lessons from participatory research in Mexico. *BMJ Glob Heal* 2020;**5**:e002488. doi:10.1136/bmjgh-2020-002488
 - 149 Chalmers B. Changing childbirth in Eastern Europe. Which systems of authoritative knowledge should prevail? In: Davis-Floyd R, Sargent C, eds. *Childbirth and authoritative knowledge: Cross-cultural perspectives*. Berkeley: : University of California Press 1997. 263–83.
 - 150 Chalmers B. Childbirth across cultures: Research and practice. *Birth* 2012;**39**:276–80. doi:10.1111/birt.12000
 - 151 Kruske S, Kildea S, Barclay L. Cultural safety and maternity care for Aboriginal and Torres Strait Islander Australians. *Women Birth* 2006;**19**:73–7.
 - 152 Sadgopal M. Can maternity services open up to the indigenous traditions of midwifery? *Econ Polit Wkly* 2009;**44**:52–9.
 - 153 Barclay L, Aiavao F, Fenwick J. Midwives' tales: stories of traditional and professional birthing in Samoa. 2005.<http://site.ebrary.com/id/10360180>
 - 154 Mignone J, Bartlett J, O'Neil J, *et al.* Best practices in intercultural health: five case studies in Latin America. *J Ethnobiol Ethnomed* 2007;**3**:31. doi:10.1186/1746-4269-3-31
 - 155 Rivas R. At highest risk: maternal health in the high Peruvian Andes. *MIDIRS Midwifery Dig* 2006;**16**:46–50.
 - 156 Velarde L. “Las parteras sí saben, son importantes, solo que están olvidadas” *Situación actual de las parteras en los Andes del sur del Perú (Ayacucho)*. 2007.
 - 157 Vega RA. Racial i(nter)dentification: The racialization of maternal health through the Oportunidades program and in government clinics in México. *Salud Colect* 2017;**13**:489.

doi:10.18294/sc.2017.1114

- 158 Sesia P. “Women come here on their own when they need to” Prenatal care, authoritative knowledge and maternal health in Oaxaca. In: Davis-Floyd R, Sargent C, eds. *Childbirth and authoritative knowledge: Cross-cultural perspectives*. Berkeley: : University of California Press 1997. 397–420.
- 159 Koblinsky MA, Campbell O, Heichelheim J. Organizing delivery care: what works for safe motherhood? *Bull World Health Organ* 1999;**77**:399–406.<https://pubmed.ncbi.nlm.nih.gov/10361757>
- 160 Davis-Floyd R, Sargent CF, editors. *Childbirth and authoritative knowledge: Cross-cultural perspectives*. Berkeley: : University of California Press 1997.
- 161 Kirmayer LJ. Rethinking cultural competence. *Transcult Psychiatry* 2012;**49**:149–64. doi:10.1177/1363461512444673
- 162 Coast E, Jones E, Lattof SR, *et al*. Effectiveness of interventions to provide culturally appropriate maternity care in increasing uptake of skilled maternity care: a systematic review. *Health Policy Plan* 2016;**31**:1479–91. doi:10.1093/heapol/czw065
- 163 United Nations Population Fund. The state of world population 2008 Reaching Common Ground: Culture, Gender and Human Rights. New York: 2008. <https://www.unfpa.org/swp/2008/en/> (accessed 30 Apr 2014).
- 164 World Health Organization. Strategies toward ending preventable maternal mortality (EPMM). Geneva: 2015. https://www.who.int/reproductivehealth/topics/maternal_perinatal/epmm/en/ (accessed 29 Jan 2019).
- 165 UMIYAC: Unión de Médicos Indígenas Yageceros de la Amazonía Colombiana. *The Beliefs of the Elders, Code of Ethics for Indigenous Medicine of the Colombian Amazon*. Colombia: : Amazon Conservation Team 2000. https://www.bialabate.net/wp-content/uploads/2008/08/code_of_ethics_umiyac.pdf (accessed 14 Apr 2021).
- 166 Raman S, Nicholls R, Ritchie J, *et al*. Eating soup with nails of pig: thematic synthesis of the qualitative literature on cultural practices and beliefs influencing perinatal nutrition in low and

- middle income countries. *BMC Pregnancy Childbirth* 2016;**16**:192. doi:10.1186/s12884-016-0991-z
- 167 Raman S, Nicholls R, Ritchie J, *et al.* How natural is the supernatural? Synthesis of the qualitative literature from low and middle income countries on cultural practices and traditional beliefs influencing the perinatal period. *Midwifery* 2016;**39**:87–97. doi:10.1016/j.midw.2016.05.005
 - 168 Withers M, Kharazmi N, Lim E. Traditional beliefs and practices in pregnancy, childbirth and postpartum: A review of the evidence from Asian countries. *Midwifery* 2018;**56**:158–70. doi:10.1016/j.midw.2017.10.019
 - 169 Aziato L, Omenyo CN. Initiation of traditional birth attendants and their traditional and spiritual practices during pregnancy and childbirth in Ghana. *BMC Pregnancy Childbirth* 2018;**18**. doi:10.1186/s12884-018-1691-7 LK
 - 170 Selin H, Stone PK. Introduction. In: Selin H, ed. *Childbirth Across Cultures*. Dordrecht : Springer Netherlands 2009. 1. doi:10.1007/978-90-481-2599-9
 - 171 Chalmers B. Cultural issues in perinatal care. *Birth* 2013;**40**:217–9. doi:10.1111/birt.12068
 - 172 Chalmers I, Enkin M, Keirse MJ. *Effective care in pregnancy and childbirth*. Oxford: : Oxford University Press 1989.
 - 173 de Jesús-García A, Paredes-Solís S, Valtierra-Gil G, *et al.* Associations with perineal trauma during childbirth at home and in health facilities in indigenous municipalities in southern Mexico: A cross-sectional cluster survey. *BMC Pregnancy Childbirth* 2018;**18**:198. doi:10.1186/s12884-018-1836-8
 - 174 Council of Europe. White Paper on Intercultural Dialogue: Living together as equals in dignity. Strasbourg: 2008. https://www.coe.int/t/dg4/intercultural/source/white_paper_final_revised_en.pdf (accessed 1 Jun 2018).
 - 175 Pérez Ruíz ML, Argueta AV. Saberes indígenas y dialogo intercultural. *Cult y Represent Soc* 2011;**Año 5**:31–56.<http://www.journals.unam.mx/index.php/crs/article/view/24448>
 - 176 Leeds-Hurwitz W. Intercultural Dialogue. In: Tracy K, Ilie C, Sandel T, eds. *The international encyclopedia of language and social interaction*. Hoboken, NJ, USA: : John Wiley & Sons, Inc. 2015.

- 1–8. doi:10.1002/9781118611463.wbielsi061
- 177 Greene JC, Carecelli VJ. Making paradigmatic sense of mixed methods practice. In: Tashakkori A, Teddlie C, eds. *SAGE Handbook of Mixed Methods in Social & Behavioral Research*. Thousand Oaks, CA: : Sage Publications 2002. 119–44.
 - 178 Dietz G. Interculturality. In: Callan H, ed. *The International Encyclopedia of Anthropology*. Oxford, UK: : John Wiley & Sons, Ltd 2018. 1–19. doi:10.1002/9781118924396.wbiea1629
 - 179 Walsh C. *Interculturalidad, estado, sociedad: luchas (de)coloniales de nuestra época*. Quito, Ecuador: : Universidad Andina Simón Bolívar: Abya-Yala 2009.
 - 180 Argueta Villamar A, Pérez Ruiz ML. Los Saberes tradicionales y los desafíos para el Diálogo de conocimientos. *Desenvolv e Meio Ambient* 2019;**50**. doi:10.5380/dma.v50i0.65438
 - 181 Hong QN, Fàbregues S, Bartlett G, *et al*. The Mixed Methods Appraisal Tool (MMAT) version 2018 for information professionals and researchers. *Educ Inf* 2018;**34**:285–91. doi:10.3233/EFI-180221
 - 182 Hsieh H-F, Shannon SE. Three Approaches to Qualitative Content Analysis. *Qual Health Res* 2005;**15**:1277–88. doi:10.1177/1049732305276687
 - 183 Sarmiento I, de Jesús-García A, Paredes-Solís S, *et al*. Indigenous factors relevant for Safe Birth in Cultural Safety among Nancue ñomndaa communities in Guerrero, Mexico: Protocol of a qualitative study based on conversations. *Int J Indig Heal* 2019;**14**:7–18. doi:10.32799/ijih.v14i2.31946

APPENDICES

Appendix 1. Factors influencing maternal health in indigenous communities with presence of traditional midwifery in the Americas: protocol for a scoping review

Sarmiento^{1,2}, Sergio Paredes-Solís³, Martin Morris⁴, Juan Pimentel^{1,2}, Anne Cockcroft¹, Neil Andersson^{1,3}

1. CIET-PRAM, Faculty of Medicine, Department of Family Medicine, McGill University. Canada.
2. *Grupo de Estudios en Sistemas Tradicionales de Salud. Universidad del Rosario.* Colombia.
3. *Centro de Investigación de Enfermedades Tropicales. Universidad Autónoma de Guerrero.* Mexico.
4. Schulich Library of Physical Sciences, Life Sciences and Engineering, McGill University. Canada

Abstract

Introduction: Indigenous mothers often receive culturally unsafe services that do not fully respond to their needs. The objective of this scoping review is to collate and assess evidence that identifies factors, including the role and influence of traditional midwives, that affect maternal health in indigenous communities in the Americas. The results will map Western perspectives reflected in published and unpublished literature to indicate the complex network of factors that influence maternal outcomes. These maps will allow for comparison with local stakeholder knowledge and discussion to identify what needs to change to promote culturally safe care.

Methods and analysis: A librarian will search studies with iterative and documented adjustments in CINAHL, Scopus, Latin American and Caribbean Health Sciences Literature (LILACS), MEDLINE, Embase and Google Scholar without any time restrictions, and use Google search engine for grey literature. Included studies will be empirical (quantitative, qualitative or mixed); address maternal health issues among indigenous communities in the Americas; and report on the role or influence of traditional midwives. Two researchers will independently screen and blindly select the included studies. The quality assessment of included manuscripts will rely on the Mixed

Methods Appraisal Tool (MMAT). Two independent researchers will extract data on factors promoting or reducing maternal health in indigenous communities, including the role or influence of traditional midwives. Fuzzy cognitive mapping will summarise the findings as a list of relationships between identified factors and outcomes with weights indicating strength of the relationship and the evidence supporting this.

Ethics and dissemination: This review is part of a proposal approved by the ethics committees at McGill University and the Centro de Investigación de Enfermedades Tropicales in Guerrero. Participating indigenous communities in Guerrero State approved the study in 2015. The results of the scoping review will contribute to the field of cultural safety and intercultural dialogue for the promotion of maternal health in indigenous communities.

Strengths and limitations of this study

- Viewed from different standpoints, maternal health has multiple interpretations and multiple interacting factors that simple linear models cannot easily identify.
- Disentangling whether a study included traditional midwives or not will be challenging in times when retraining and professionalisation are becoming more prominent in Latin America.
- This scoping review uses fuzzy cognitive mapping to summarise results, generating soft models of causal relationships that require empirical testing.
- Heterogeneity of exposures and outcomes might require developing soft models generalised to a larger scale to allow for comparability.
- The review is part of a bigger initiative promoting intercultural dialogue between indigenous and Western perspectives, with a view to improving maternal health.

Introduction

Maternal morbidity and mortality are inequitable burdens for many indigenous women in the Americas.[1–3] Living as they do at the very periphery of the Western health system, indigenous mothers often receive low-quality care from attenuated health services that lack human and financial resources. Colonial history in the Americas has weakened indigenous cultures, including their traditions to promote safe motherhood.[4] Mutual mistrust between Western practitioners and traditional midwives creates additional distance and hampers collaboration.[5] While their traditional

and Western health providers largely ignore each other, indigenous mothers receive less appropriate Western services and they cannot rely solely on their weakened traditional resources.

Since 2004, no less than 18 literature reviews focussed on the effectiveness of *retraining* traditional midwives and redefining their traditional roles as auxiliary promoters of Western health services (Table A1-1). A recurring problem is the reduction of traditional midwife with *traditional birth attendant* (TBA), a term that refers to unskilled personnel providing limited support during the childbirth event.[6] Several interventions explored training birth attendants in Western birthing skills.

Table A1-1. List of systematic reviews related to the field of traditional midwifery in relation to maternal health

#	Review	Approach
1	Reference Sibley and Sipe [65] (2004) Time searched up to 1997 (inferred, not stated) Inclusion Studies involving training of TBAs (not stated).	Compares trained and untrained TBAs.
2	Reference Kruske and Barclay [7] (2004) Time 1970 to 2003 Inclusion 'A review of the health and sociological literature, and international policy documents that address TBA training'.	Documents studies that address TBA training.
3	Reference Sibley <i>et al</i> [66] (2004) Time January 1970 to June 1999 Inclusion Published and unpublished studies: Treatment was TBA training; treatment group data were derived from TBAs or mothers and neonates whose care was provided by TBAs or who were living in areas where more than 50% of births were attended by TBAs.	Effectiveness of TBA training to improve access to skilled birth attendance for obstetric emergencies.
4	Reference Sibley <i>et al</i> [67] (2004) Time 1970 to 2002 Inclusion Published and unpublished studies on the relationship between TBA training and increased use of professional ANC.	Effectiveness of TBA training to increase use of professional ANC.
5	Reference Sibley <i>et al</i> [68] (2007) Time up to 2006 Inclusion Published and unpublished randomised controlled trials, controlled before/after and interrupted time series studies comparing trained	Effects of TBA training on health behaviours and pregnancy outcomes.

	and untrained TBAs or women cared for/living in areas served by TBAs.	
6	Reference Lawn <i>et al</i> [69–74] (2009) Time up to 2002 (updated in 2009) Inclusion Interventions and strategies that avert intrapartum-related adverse outcomes.	Effect of community-based cadres—community-based skilled birth attendants, TBAs and community health workers—in improving perinatal and intrapartum-related outcomes.
7	Reference Kidney <i>et al</i> [75] (2009) Time From inception to 2006 Inclusion Maternity or childbearing-age women, comparative study designs with concurrent controls, community-level interventions and maternal death as an outcome.	Effectiveness of community-level interventions to reduce maternal mortality. Some interventions included traditional midwives.
8	Reference Byrne and Morgan [76] (2011) Time From inception to October 2010 Inclusion Interventions of integration between TBA and formal health systems.	Increase of skilled birth attendance after integration of TBAs with the health system.
9	Reference Wilson <i>et al</i> [77] (2011) Time From inception to April 2011 Inclusion Search terms were "birth attend*", "traditional midwife", "lay birth attendant", "dais" and "comadronas" in developing countries.	Effectiveness of training and support of TBAs on the outcomes of perinatal, neonatal and maternal death.
10	Reference Glenton <i>et al</i> [78] (2013) Time From inception to 2011 Inclusion Studies that used qualitative methods for data collection and analysis and that focussed on the experiences and attitudes of stakeholders.	Explores factors affecting the implementation of LHW programmes for maternal and child health. (In eight studies, LHWs were TBAs who had received additional training.)
11	Reference Vieira <i>et al</i> [79] (2012) Time From inception to June 2010 (additional materials received until 2012). Inclusion TBAs had been attending births prior to the intervention; and a transition to skilled health personnel was in progress or planned.	Effects of interventions to increase the use of skilled health personnel by women for childbirth care.
12	Reference Bohren <i>et al</i> [80] (2014) Time From inception to April 2013 Inclusion Study objectives related to barriers and/or facilitators to facility-based delivery and reporting qualitative data.	Facilitators and barriers to increase the use of skilled health personnel by women for childbirth care.
13	Reference Lassi <i>et al</i> [81] (2014)	Effectiveness of care delivered through community level inputs for improving maternal

	Time From inception to April 2013 Inclusion Systematic reviews	and newborn health outcomes. (Interventions involving TBAs focussed on training.)
14	Reference Mangham-Jefferies <i>et al</i> [82] (2014) Time January 1990 to October 2016 Inclusion Peer-reviewed and grey literature reporting cost-effectiveness measures based on primary data.	Assess cost-effectiveness of strategies to improve the demand and supply of maternal and newborn healthcare in low-income and lower-middle-income countries.
15	Reference WHO recommendations on health promotion interventions for maternal and newborn health 2015.[83,84] Time up to 2015 (not indicated) Inclusion Not explained.	Effects of health interventions during pregnancy, childbirth and the postnatal period. Effects of health behaviours of women during these periods to care for themselves and their babies. (Interventions involving TBAs included training, promotion of skilled attendance and promotion of partnership and linkage.)
16	Reference Lassi <i>et al</i> [85] (2016) Time From inception to January 2015 Inclusion All experimental studies from LMICs that assessed the healthcare-seeking behaviour or pattern for maternal and newborn healthcare and illnesses.	Impact of different strategies to improve maternal and neonatal healthcare-seeking. (Interventions involving TBAs focussed on training.)
17	Reference Miller and Smith [86] (2017) Time 2000 to 2012 (updated 2015? not indicated) Inclusion Secondary analysis of studies identified in previous reviews[76,78] and a mapping of maternal health literature.[87]	Effectiveness of interventions to find new roles for TBAs on maternal and newborn health outcomes.
18	Reference Blanchard <i>et al</i> [31] (2019) Time Studies conducted after 1990 and published between January 1996 and August 2017. Inclusion Studies examining the effects of CHW interventions in LMIC on maternal and newborn health outcomes across socioeconomic groups.	CHW include trained lay workers, health volunteers, community health agents, TBAs and community midwives.

Legend: ANC, antenatal care ; CHW, community health workers; LHW, lay health workers; LMIC, low-income and middle-income countries; TBA, traditional birth attendants.

In indigenous communities with traditional health systems, with particularities across different cultural groups, traditional midwives accompany women from childhood and through motherhood; their role is much wider (including family and other social relations) and deeper (including counselling and emotional support from menarche to menopause) than can be summarised as "birth

attendance".[7,8] Traditional midwives usually have their own hierarchy, defined by capacity to deal with complex health problems.[9] There is little research on interventions that support traditional midwives and recognises their knowledge, and even less research on adjusting the Western health system to work with traditional midwives.[7]

Maternal health is a capacious concept that incorporates complex sociocultural mechanisms affecting the well-being of women, their offspring and communities.[10] Existing literature reviews (Table A1-1) focus on biomedical outcomes like maternal morbidity and mortality, neonatal survival or uptake of Western health services. A scoping review allows us to address broader questions, including what the outcomes are.[11] The approach allows incorporation of intersectional factors in a general landscape that can improve understanding of the full role of traditional midwifery. This is central to services that are respectful of indigenous cultures where women still use this resource, improving interactions between indigenous and Western health services.[12] More culturally safe health services increase patient perceptions of physical, spiritual, social and emotional safety.[13] Another benefit of a mutually respectful environment is the concerting of traditional and Western services together to improve maternal health.[14]

Part of a larger initiative project to understand the role that traditional midwifery has in safe birth in cultural safety, this scoping review aims to contribute to intercultural dialogue between traditional and Western health systems.[15] Our objective is to collate and assess evidence that identifies factors, including the role and influence of traditional midwives, that affect maternal health in indigenous communities in the Americas. The larger project will develop a composite theory of change from three knowledge bases: (1) the scoping review described in this protocol; (2) the research team's understanding of the intercultural dialogue dynamics as these relate to safe birth; and (3) traditional midwives' understanding of safe birth. Representing each knowledge set as a fuzzy cognitive map, we will adapt the *Weight of Evidence*[16] approach to combine the three sources into one model to inform decision making and a stakeholder-led analysis of a cluster randomised controlled trial.[15] In this protocol, we focus on the procedures to conduct the scoping review and mention the additional use of the review results. A full description of the procedure to combine the three knowledge sources is the subject of an additional report.

Methods

This protocol follows the PRISMA-P (Preferred Reporting Items for Systematic Reviews and Meta-Analyses Protocols) guidelines and the Joanna Briggs Institute Reviewer's Manual to assure transparency, accuracy and completeness.[17,18] It follows Arksey and O'Malley's methodological framework consisting of six stages.[19] All members of the research team developed, reviewed and agreed with the protocol.

Stage 1: identify the research question

A convergent mixed studies review[20,21] will address the question: What factors, including the role and influence of traditional midwives, promote or reduce maternal health in indigenous settings in the Americas and, based on available qualitative and quantitative evidence, what is the relative weight of their influence?

Secondary questions of the included studies are:

- What are the indicators of maternal health?
- How are the concepts of cultural safety and intercultural dialogue considered?
- What is the influence of traditional midwifery on maternal health?
- What is the effect on maternal health of interventions supporting traditional midwives?

Stage 2: identifying relevant studies

A health librarian (MM) developed the comprehensive search strategy to explore the following databases: CINAHL Nursing Journal Databases, Scopus, Latin American and Caribbean Health Sciences Literature (LILACS), MEDLINE/PubMed, Embase and Google Scholar. The review will include studies in human populations reported in English, Spanish, French or Portuguese published at any time up to the date of the search.

The strategy applies a targeted, iterative searching technique that documents new keywords emerged from screened articles.[22] This strategy consists of two steps: (1) an initial search in MEDLINE/PubMed to analyse the text words in the titles and abstracts retrieved, and the index terms used to describe the article; and (2) using the updated terms, conduct a second search and translate the search to run across the other databases and grey literature. The final report of the review will document in detail these two steps. Appendix A1 - 1 presents a draft literature search strategy for step 1.

Using the Google (Google LLC) search engine, we will identify unpublished studies and grey literature, such as institutional and advocacy reports. In the advanced search section, we will use consistent search terms identified during the screening stage of published literature. To increase precision, each search will use the Google versions for the country of interest and limit the results for that country. We will use the computer of the leading author to guarantee that the personal filters of Google are in favour of academic information about traditional midwives. The screening process will be limited to the first 100 results returned for reasons of feasibility. We will use the title and short text underneath for initial screening.[23] To facilitate the transparency of web searching, for each website, we will report the URL, dates searched, search terms and the citation details of any included literature. To document specific searches of government information and reports that are not published commercially, we will complete hand searches of the websites following the procedure of the Canadian Agency for Drugs and Technologies for Health checklist.[24]

We will search the reference list of included references for additional studies, but we do not propose to contact authors for further information.

Stage 3: study selection

After completing the search and excluding duplicated records using EndNote (X9.3.1, Clarivate Analytics), we will digitise the list of references in Rayyan (Qatar Computing Research Institute)[25] to support the selection process, and two independent researchers will select the studies. The independent researchers will reconcile the differences, and if they do not reach consensus, a third party will decide the inclusion or exclusion. The first selection round will use title and abstract as criteria, and a second round will use full content to support the decision.

In scoping reviews, the selection process can be iterative. When the research team engages in study selection and more deeply explore the literature, they may get new information to enhance the identification phase.[22] We will document any adjustment to the search strategy occurring after the selection process has already started. Included studies will satisfy the following four criteria:

The study addresses maternal health issues in indigenous populations

The concept of maternal health is a broad term without a common definition and standard identification criteria. Part of the challenge is the extended debate on defining health, which is even deeper across different cultural backgrounds.[8] For example, traditional midwives in Guerrero, Mexico, included in their definition of a healthy mother, those with a healthy baby and a healthy

husband. The World Health Organization (WHO) focusses the definition on the mother and uses a time period to circumscribe the concept as "the health of women during pregnancy, childbirth and the postpartum period".[26] In the negative interpretation of the concept of maternal health, maternal mortality has usually been used as a critical measure. But it only represents a small fraction of the problem when compared with the occurrence of maternal morbidity, understood as "any health condition attributed to and/or aggravated by pregnancy and childbirth that has a negative impact on the woman's well-being".[27]

According to Graham, maternal health is commonly conceptualised as a discrete state of negative outcomes in terms of morbidity and mortality, characterised by physical rather than social or mental manifestations, and by a narrow time perspective.[28] Especially in the context of indigenous communities, spiritual and environmental domains can have strong relevance. Graham suggested the need for flexible interpretations to recognise that "maternal health encompasses positive or negative outcomes—physical, social or mental, in a woman from any cause related to childbearing or its management".[28]

Our review will therefore include studies that report on maternal health irrespective of the definition of this concept. The review will include studies on positive or negative outcomes from any cause related to childbearing or its management.

The study reports on the role or influence of traditional midwives

Birth traditions in most indigenous cultures involve someone attending women throughout pregnancy and delivery, many of them including support from menarche to menopause.[10] To clarify terminology, we distinguish between three categories of birth attendants in indigenous contexts: (1) casual or coincidental birth helpers, who might help in a family or neighbourhood emergency; (2) trained birth attendants (different to TBAs, but conflated by the acronym TBA), are individuals who receive training in Western birth practices and who might have received an official certification; and (3) authentic traditional midwives, whose recognition by their communities is reflected in the number of births they attend each year, the outcomes for their patients and the traditional knowledge they hold. Traditional midwives "provide basic healthcare and advice before, during and after pregnancy and childbirth (...) based primarily on experience and knowledge acquired informally through the traditions and practices of the communities where they originated".[29] With significant cultural particularities in their knowledge, training and practice

between and within indigenous groups, traditional midwives have their own hierarchy defined by their capacity to deal with complex health problems.[9]

We will only include studies of authentic traditional midwives. However, this concept receives multiple interpretations in the literature, which are reflected in the use of apparently equivalent terms such as community midwives, lay midwives or TBAs.[30] These terms are often conflated under the broader concept of community health worker,[31,32] which, although it recognises the community roots of traditional midwives, neglects the culture specific roots of their practice. In a similar way, the appellation of lay midwives is used to suggest lack of professional qualification or expert knowledge. Extensive use of the term TBA[33,34] in the literature suggests limiting the role of traditional midwives to the actual delivery, ignoring their experience, cultural relevance and social role, and that they usually accompany women throughout pregnancy and even from the menarche.[6,35]

Contemporary distortions or misunderstandings of traditional health practitioner roles have reinforced mistrust in official health personnel. This has not been helped by charlatans and health entrepreneurs who mimic the traditional healer role on a fee-for-service basis, but who lack the training and spiritual foundations to play this role.[32] An additional layer of complexity is that mainstream Western medicine often bundles indigenous health systems, anchored in specific cultures and history, with alternative or complementary therapies,[36] which are abstracted from cultural identities and might not have proven effectiveness or safety.[37] We will accept reports of traditional midwifery assuming authenticity, but the hierarchy and genuineness of participants will be discussed in the final report.

The review will distinguish traditional midwives from professional midwives. The main difference between these categories is the origin of their knowledge and practice. The appellation of traditional recognises the link with traditional knowledge and worldviews of indigenous cultures, whereas professional situates midwives in an institutional context of Western biomedicine and international standards.[38] Professionalisation of midwifery started in Europe after the replacement of traditional midwives[39,40] and has expanded since the 19th century mainly through colonial education.[41] Professional midwives receive formal education to perform their role, either through direct entry or after basic nursing, with diverse cadres and appellations.[42] Their practice has a wide scope that includes primary care of woman and newborns, less biomedical interventions and more humanised interaction with patients.[38,43] An essential difference between traditional and professional

midwives is that the latter enjoy official accreditation and licensing according to global guidelines. A practical consequence is higher esteem for professional midwives in biomedical contexts.[44] Promoters of this category of health worker often equate it with the concept of skilled attendant, assuming that compliance with international regulations and standards assures a higher level of competency and quality of care.[45]

Yet there is no unanimously accepted international definition of what constitutes "skilled". Among professional (licensed) midwives, for example, there is a discussion on whether practitioners should conform to a restrictive Western definition or celebrate the diversity of cultural perspectives.[46,47] It is becoming increasingly common for licensed midwives to adopt and apply indigenous techniques learnt from traditional midwives.[48] And at the same time, more indigenous people and even traditional midwives are receiving formal training, accreditation and permission to practice.[49] This landscape becomes even more complex if we consider emerging roles such as doulas, who provide continuous, one-on-one emotional and informational support during the perinatal period but do not provide medical services.[50,51] Non-indigenous doulas sometimes apply practices learnt from indigenous traditions, and indigenous doulas usually accompany other indigenous mother in navigating Western services in countries where traditional midwifery is forbidden.[52]

To address the multiple interpretations expressed in terminology referring to traditional midwives, we will consider the study as including authentic traditional midwives if the report explicitly uses this term or TBAs, or if it describes the link of their practice to the traditional culture of the community and refers to a traditional locally recognised role helping women during pregnancy, delivery or postpartum, even if the traditional midwives have received some informal training. The review will exclude studies reporting on professional midwives even if they come from an indigenous community. Appendix A1 - 2 presents a list of terms that could be referring to traditional midwives. To allow for a comprehensive search, we will not restrict the search strategy using these terms, but the list will guide the screening process.

It is an empirical study

The review will include qualitative, quantitative or mixed-methods studies, observational or experimental, that address maternal health outcomes. We will not include ethnographic descriptions of traditional midwifery that do not report on its effects on maternal health outcomes.

The study setting is in the Americas

Given the variability in traditions and cultural practices, we will restrict the review to studies in indigenous communities in the Americas.

Exclusion criteria

The review will exclude theoretical models without empirical support. The final report will contain a list of the studies excluded and the reasons for doing so. We will document the process in a diagram according to the PRISMA guidelines.[53]

Quality appraisal

Although some scoping reviews do not conduct quality appraisal,[22] we consider it is necessary in this study to determine the strength of the current evidence. Quality assessment of the included studies will follow the MMAT,[54] the results from the quality assessment will contribute to interpret the weights in the fuzzy cognitive maps described in Stage 5.

Stage 4: charting the data

Based on the reading of full texts, two independent authors will extract concepts related to safe birth using an electronic form with the following items:

- a. Study (title, year of the study, publication type (published/unpublished), year of publication, country, type of study (qualitative/ quantitative/mixed), study design and population).
- b. Study citation details.
- c. Quality according to the MMAT.
- d. Maternal health outcomes reported in the study.
- e. Characteristics of traditional midwives involved in the study.
- f. Approach of the study to cultural differences.
- g. Factors related to maternal health studied and reported (complete h to j for all relationships).
- h. If quantitative: what is the measure? And what is the value of the relationship with maternal health? (Include confidence intervals - CIs.)
- i. If qualitative: what is the argument or insight about the importance of this relationship with safe birth (copy and paste)?
- j. Does the study report other relations among factors? If yes, identify all the relationships and complete h or i for all of them.

- k. To ensure consistency and to test the data abstraction format, a data abstraction pilot will include five randomly selected articles. The pilot will identify necessary changes prior to abstracting the remaining articles. The data extractors will compare results and a third party will resolve irreconcilable discrepancies.

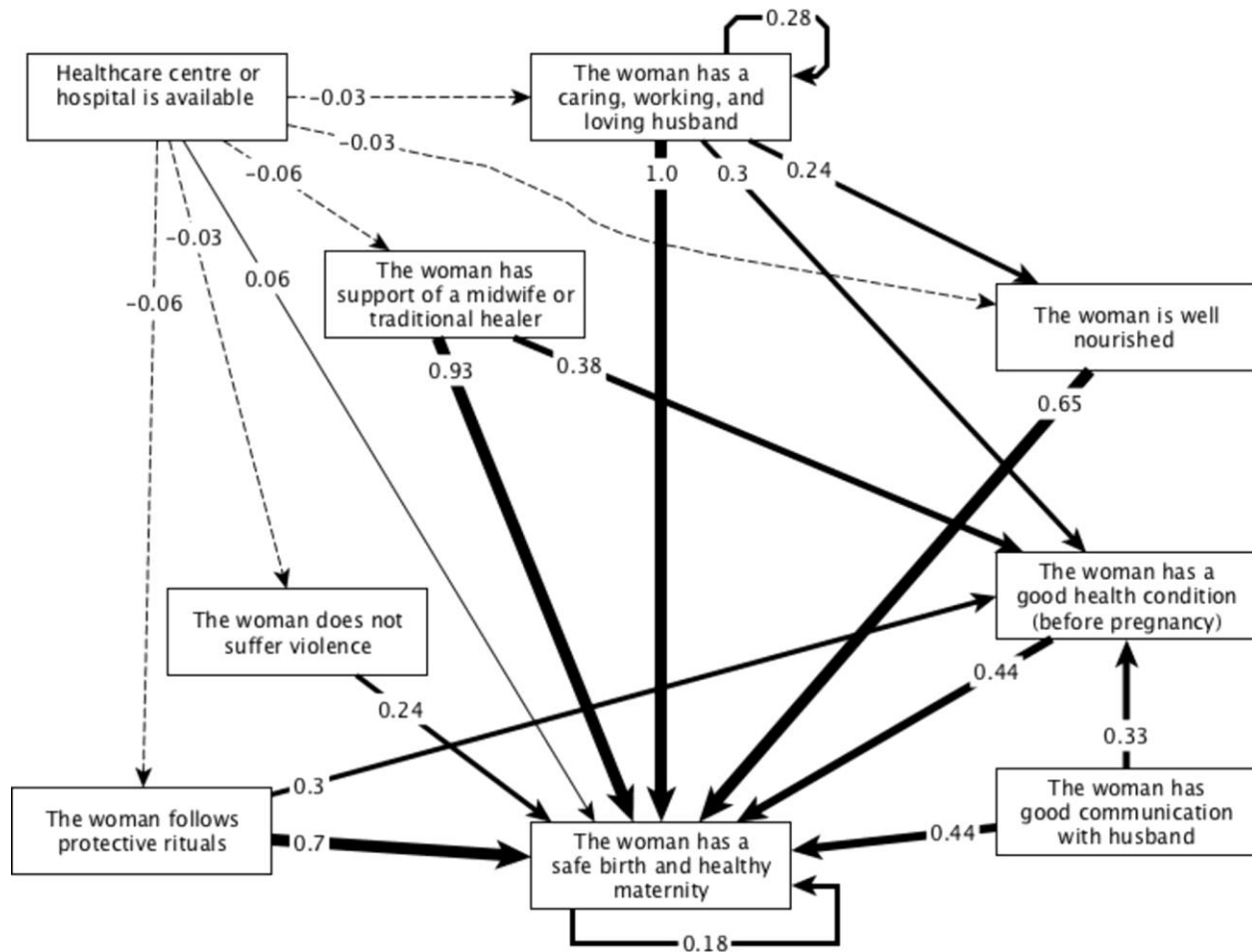
Stage 5: collating, summarising and reporting the results

The reporting will follow the PRISMA Scoping Reviews (PRISMA-ScR) guidelines.[53] Reporting will produce tables and charts of the geographic and population distribution of studies; the factors included in the review; the cultural approach to traditional midwifery of each study; the research methods adopted; and the measures of maternal health used. The report will present an illustrative fuzzy cognitive map, as a logic framework for convergent synthesis[21] of the literature and the interpretation of its weights in terms of the influence that each factor might have on maternal health according to the model.

Fuzzy cognitive mapping

The pivotal tool for summarising the results of this review is fuzzy cognitive mapping (FCM). This is a graphic representation of soft models composed of elements or concepts and relations between elements. Each element is a node (factors identified in point g of the data extraction form), and each relationship is represented as an edge (arrow) linking nodes together. These graphics represent assumptions on causal relations and can be based on data or unwritten knowledge.[55] The edges represent causal relations, so the direction of the arrows matters.[56] The relations or edges can be assigned different values to quantify their strength in a relative way (hence the term fuzzy). As the causal knowledge is often uncertain, or at least different from the viewpoints of different stakeholders (for each of whom it might feel certain), fuzzy models allow us to understand "hazy degrees of causality between hazy causal concepts" using fuzzy causal algebra.[57] Figure A1-1 illustrates a fuzzy cognitive map from traditional midwives in Guerrero state, describing their views about protective factors for maternal health.[58]

Figure A1-1. Fuzzy cognitive map of protective factors for maternal health from *Me'Phaa* and *Nancue ñomda* traditional midwives in Guerrero



Legend: Solid arrows represent excitatory relationships and dashed arrows represent inhibitory relationships. The thickness of the arrows varies according to the weight of the relationships. The numbers on the arrows represent the weight of the influence of one factor on another, with 1 being the highest influence.

An edge list is a tabular format to represent the relationships in a fuzzy cognitive map. An edge list consists of a table with two initial columns, the first to indicate the origin factor (from) and the second to indicate the consequence factor (to). Additional columns will indicate the supporting evidence of the relationship (items h or i of the data extraction form) and the corresponding reference. Each relationship corresponds to a row.

Based on extracted data, we will plot a fuzzy cognitive map using yEd graphical tools, scaling the effect measures into a range (−1 to 1) assigning negative and positive signs for inhibitory and

excitatory relationships, respectively. Adapting the Weight of Evidence approach proposed by Dion et al,[59] it is possible to calculate common effect estimates to summarise quantitative data on the influence between factors. Wherever ORs are available, the formula proposed by Šajna will transform the values into a measure of the weight (w) in the symmetric range (−1 to 1):

$$w = 1 - \left(\frac{2}{OR + 1} \right)$$

When multiple effect estimates describe the same relationship between factors, we will calculate a summary measure using standard approaches to meta-analysis. If the studies provide statistics other than ORs, such as χ^2 or mean differences, we will convert them to the standardised mean difference (d) and then convert d to an OR using the following formula.[60]

$$OR = \exp \left(\frac{\pi d}{\sqrt{3}} \right)$$

Where π is the mathematical constant (approximately 3.14159).

For qualitative relationships, based on their reading of the context and report, two independent researchers will propose a value in the range (−1 to 1) to indicate their interpretation of the weight and direction of the influence of each factor. They will propose these weights for qualitative relationships, considering all the qualitative and quantitative relationships in the map. They will reconcile differences by consensus (both agreeing on a new value after discussion), resolving discrepancies with the intervention of a third reviewer. To facilitate weighting using an ordered scale between 1 and 5,[61] researchers will answer two if-then questions for each relationship.[62] First, if (the origin factor) increases, then (the resulting factor) would increase or decrease? Weights will be positive for the former and negative for the latter. Second, if (the origin factor) increases, then (the resulting factor) would rarely change or very often change? In a scale between one if the resulting factor rarely changes and five if it changes very often. Researchers will review all the weights that they assigned in a second round to guarantee that the weights are comparable across all the relationships in the map. We will contrast the results of the classification with a technique for operator-independent weighting based on Harris's method for discourse analysis[63] that assigns the weight of the relationship based on the number of times a relationship was identified. We do not use it as the primary method because it is still under development.

In the final map, with all relationships identified in the scoping review, the transitive closure algorithm will calculate the weights of the relationships considering the entire system.[13] This procedure is available in CIETmap, an open-source Windows-like interface with the R programming language.[64]

Stage 6: consultation exercise

Arksey and O'Malley recognise the benefit of discussing the final results of a scoping review with experts.[19] The *Weight of Evidence*[16] approach goes further, recognising that the literature review presents a valuable side of the story to be contrasted and expanded with the views and experiences of those affected by the issue. We will use this to generate a composite model incorporating two additional sources, the knowledge of traditional midwives in Guerrero and the views of the research team involved in a cluster-randomised controlled trial supporting traditional midwifery.[15] This will be completed and reported separately.

Patient and public involvement

This research involves no direct patient or public involvement, but the design of the study is the result of participatory research involving traditional midwives from Guerrero State, Mexico.

Conclusion

This protocol describes a scoping review to map factors, including the roles of traditional midwives who can contribute to or detract from maternal health in indigenous communities. The review will contribute to the understanding of maternal health in a complex interaction of variables where indigenous cultures meet Western medicine. It reflects a shift in approach to traditional midwifery, recognising its influence on health outcomes cannot be understood in isolation. FCM offers a systematic and visual way to deal with heterogeneity and uncertainty of epidemiological data, as well as a common language to juxtapose Western knowledge with other sources of knowledge such as indigenous wisdom and experience.

Fuzzy cognitive maps are conceptual models depicting causal assumptions and prior beliefs. The maps expand the realm of possible improvement strategies by identifying factors from multiple knowledge bases and, in each knowledge base reflect direct or indirect interactions. The influences between factors, however, do not translate as probabilities as they might from some meta-analyses. The map generated by the scoping review will inform a participatory process to update currently

available knowledge with additional evidence from the experience of traditional midwives and experimental data.

Declarations

Acknowledgments

Participatory Research at McGill, particularly Anna Dion, contributed valuable insights on the use of fuzzy cognitive mapping. Genevieve Gore offered initial ideas to adjust the search strategy. German Zuluaga and Anne Marie Chomat read and commented on the initial version of this protocol.

Collaborators

Anna Dion, Participatory Research at McGill University's Department of Family Medicine.

Contributors

IS is the guarantor. IS, NA, and AC drafted the manuscript. All authors contributed to the development of the selection criteria, the risk of bias assessment strategy and data extraction criteria. MM developed the search strategy and the compliance with quality standards for scoping reviews. NA provided statistical expertise as a coauthor of the *Weight of Evidence*. AC adjusted the manuscript for dissemination. SP is the sponsor of the work with traditional midwives in Guerrero. JP contributed to define procedures for data collection. All authors read, provided feedback and approved the final manuscript.

Funding

This scoping review is funded by CIETCanada and the Center of Intercultural Medical Studies in Colombia. IS and JP are scholars of the Fonds de la Recherche en Sante du Quebec and CeIBA Foundation. The *Centro de Investigación de Enfermedades Tropicales* at the *Universidad Autónoma de Guerrero* is the sponsor of the study.

Competing interests

None declared.

Patient consent for publication

Not required.

Provenance and peer review

Not commissioned; externally peer-reviewed.

References

1. Department of Economic and Social Affairs. Division for social policy and development secretariat. Secretariat of the permanent forum on indigenous issues. State of the world's indigenous peoples. New York: United Nations, 2009.
2. Armenta-Paulino N, Sandín-Vázquez M, Bolúmar F. Indigenous language and inequitable maternal health care, Guatemala, Mexico, Peru and the Plurinational state of Bolivia. *Bull World Health Organ* 2019;97:59–67.doi:10.2471/BLT.18.216184pmid:<http://www.ncbi.nlm.nih.gov/pubmed/30618466>
3. Lalonde AB, Butt C, Bucio A. Maternal health in Canadian Aboriginal communities: challenges and opportunities. *J Obstet Gynaecol Can* 2009;31:956–62.doi:10.1016/S1701-2163(16)34325-0pmid:<http://www.ncbi.nlm.nih.gov/pubmed/19941725>
4. King M, Smith A, Gracey M. Indigenous health part 2: the underlying causes of the health gap. *Lancet* 2009;374:76–85.doi:10.1016/S0140-6736(09)60827-8pmid:<http://www.ncbi.nlm.nih.gov/pubmed/19577696>
5. Ohaja M, Murphy-Lawless J. Unilateral collaboration: the practices and understandings of traditional birth attendants in southeastern Nigeria. *Women Birth* 2017;30:e165–71.doi:10.1016/j.wombi.2016.11.004pmid:<http://www.ncbi.nlm.nih.gov/pubmed/27889258>
6. Pigg SL. Acronyms and effacement: traditional medical practitioners (TMP) in international health development. *Soc Sci Med* 1995;41:47–68.doi:10.1016/0277-9536(94)00311-Gpmid:<http://www.ncbi.nlm.nih.gov/pubmed/7667673>
7. Kruske S, Barclay L. Effect of shifting policies on traditional birth attendant training. *J Midwifery Womens Health* 2004;49:306–11.doi:10.1016/j.jmwh.2004.01.005pmid:<http://www.ncbi.nlm.nih.gov/pubmed/15236710>
8. Jordan B. Birth in four cultures: a crosscultural investigation of childbirth in Yucatan, Holland, Sweden, and the United States. 4th edn. Long Grove, IL: Waveland Press, 1993.
9. Sesia P. "Women come here on their own when they need to" Prenatal care, authoritative knowledge and maternal health in Oaxaca. In: Davis-Floyd R, Sargent C, eds. Childbirth and authoritative knowledge: cross-cultural perspectives. Berkeley: University of California Press, 1997: 397–420.

10. Kennedy HP, Cheyney M, Dahlen HG, et al. Asking different questions: a call to action for research to improve the quality of care for every woman, every child. *Birth* 2018;45:222–31.doi:10.1111/birt.12361pmid:<http://www.ncbi.nlm.nih.gov/pubmed/29926965>
11. Colquhoun HL, Levac D, O'Brien KK, et al. Scoping reviews: time for clarity in definition, methods, and reporting. *J Clin Epidemiol* 2014;67:1291–4.doi:10.1016/j.jclinepi.2014.03.013pmid:<http://www.ncbi.nlm.nih.gov/pubmed/25034198>
12. Cameron M, Andersson N, McDowell I, et al. Culturally safe epidemiology: oxymoron or scientific imperative. *Pimatisiwin J Aborig Indig Community Heal* 2010;8:89–116.
13. Kruske S, Kildea S, Barclay L. Cultural safety and maternity care for Aboriginal and Torres Strait Islander Australians. *Women Birth* 2006;19:73–7.doi:10.1016/j.wombi.2006.07.001pmid:<http://www.ncbi.nlm.nih.gov/pubmed/16911880>
14. United Nations Educational Cultural and Scientific Organization. Investing in cultural diversity and intercultural dialogue. Paris, France, 2009. Available: <https://unesdoc.unesco.org/ark:/48223/pf0000184755> [Accessed 30 Apr 2014].
15. Sarmiento I, Paredes-Solís S, Andersson N, et al. Safe birth and cultural safety in southern Mexico: study protocol for a randomised controlled trial. *Trials* 2018;19:354. doi:10.1186/s13063-018-2712-6pmid:<http://www.ncbi.nlm.nih.gov/pubmed/29973241>
16. Dion A, Joseph L, Jimenez V, et al. Grounding evidence in experience to support people-centered health services. *Int J Public Health* 2019;64:797–802.doi:10.1007/s00038-018-1180-9pmid:<http://www.ncbi.nlm.nih.gov/pubmed/30542753>
17. Shamseer L, Moher D, Clarke M, et al. Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015: elaboration and explanation. *BMJ* 2015;350:g7647. doi:10.1136/bmj.g7647pmid:<http://www.ncbi.nlm.nih.gov/pubmed/25555855>
18. Peters M, Godfrey C, McInerney P, et al. Scoping reviews. In: Aromataris E, Munn Z, eds. Joanna Briggs institute reviewer's manual. The Joanna Briggs Institute, 2017. <https://reviewersmanual.joannabriggs.org/>
19. Arksey H, O'Malley L. Scoping studies: towards a methodological framework. *Int J Soc Res Methodol* 2005;8:19–32.doi:10.1080/1364557032000119616

20. Pluye P, Hong QN. Combining the power of stories and the power of numbers: mixed methods research and mixed studies reviews. *Annu Rev Public Health* 2014;35:29–45.doi:10.1146/annurev-publhealth-032013-182440pmid:<http://www.ncbi.nlm.nih.gov/pubmed/24188053>
21. Harden A, Thomas J, Cargo M, et al. Cochrane qualitative and implementation methods group guidance series-paper 5: methods for integrating qualitative and implementation evidence within intervention effectiveness reviews. *J Clin Epidemiol* 2018;97:70–8.doi:10.1016/j.jclinepi.2017.11.029pmid:<http://www.ncbi.nlm.nih.gov/pubmed/29242095>
22. Morris M, Boruff JT, Gore GC. Scoping reviews: establishing the role of the librarian. *J Med Libr Assoc* 2016;104:346–54.doi:10.3163/1536-5050.104.4.020pmid:<http://www.ncbi.nlm.nih.gov/pubmed/27822163>
23. Godin K, Stapleton J, Kirkpatrick SI, et al. Applying systematic review search methods to the grey literature: a case study examining guidelines for school-based breakfast programs in Canada. *Syst Rev* 2015;4:138. doi:10.1186/s13643-015-0125-0pmid:<http://www.ncbi.nlm.nih.gov/pubmed/26494010>
24. CADTH. Grey matters: a practical tool for searching health-related grey literature, 2018. Available: <https://www.cadth.ca/resources/findings-evidence> [Accessed 7 May 2020].
25. Ouzzani M, Hammady H, Fedorowicz Z, et al. Rayyan—a web and mobile APP for systematic reviews. *Syst Rev* 2016;5:1–10.doi:10.1186/s13643-016-0384-4
26. World Health Organization. WHO-Europe maternal and newborn health., 2019. Available: <http://www.euro.who.int/en/health-topics/Life-stages/maternal-and-newborn-health/maternal-and-newborn-health#> [Accessed 18 Dec 2019].
27. Firoz T, Chou D, von Dadelszen P, et al. Measuring maternal health: focus on maternal morbidity. *Bull World Health Organ* 2013;91:794–6.doi:10.2471/BLT.13.117564pmid:<http://www.ncbi.nlm.nih.gov/pubmed/24115804>
28. Graham WJ, Campbell OM. Maternal health and the measurement trap. *Soc Sci Med* 1992;35:967–77.doi:10.1016/0277-9536(92)90236-Jpmid:<http://www.ncbi.nlm.nih.gov/pubmed/1411704>

29. International Labour Office. International standard classification of occupations 2008 (ISCO-08) : structure, group definitions and correspondence tables. Geneva, Switzerland: International Labour Office, 2012.
<http://ebookcentral.proquest.com/lib/mcgill/detail.action?docID=991922>
30. Schwartz DA. A glossary for anthropological research referring to indigenous peoples of Mexico and Central America BT - maternal death and pregnancy-related morbidity among indigenous women of Mexico and Central America: an anthropological, epidemiological, and biome. Cham: Springer International Publishing, 2018: 743–74.
31. Blanchard AK, Prost A, Houweling TAJ. Effects of community health worker interventions on socioeconomic inequities in maternal and newborn health in low-income and middle-income countries: a mixed-methods systematic review. *BMJ Glob Health* 2019;4:e001308.
doi:10.1136/bmjgh-2018-001308pmid:<http://www.ncbi.nlm.nih.gov/pubmed/31275619>
32. World Health Organization. District health systems unit. traditional healers as community health workers, 1991. Available: <http://apps.who.int/iris/handle/10665/60375> [Accessed 16 Aug 2017].
33. Leedam E. Traditional birth attendants. *Int J Gynaecol Obstet* 1985;23:249–74.doi:10.1016/0020-7292(85)90020-7pmid:<http://www.ncbi.nlm.nih.gov/pubmed/2866113>
34. World Health OrganizationThe United Nations Children's Emergency FundUnited Nations Population Fund. Traditional birth attendants: a joint WHO/UNFPA/UNICEF statement. Geneva, 1992. Available: <http://www.who.int/iris/handle/10665/38994> [Accessed 19 Jan 2019].
35. Hinojosa SZ. Authorizing tradition: vectors of contention in highland Maya midwifery. *Soc Sci Med* 2004;59:637–51.doi:10.1016/j.socscimed.2003.11.011pmid:<http://www.ncbi.nlm.nih.gov/pubmed/15144771>
36. World Health Organization. WHO traditional medicine strategy 2014-2023. Geneva, Switzerland, 2013. Available: <http://apps.who.int/iris/handle/10665/92455> [Accessed 8 Apr 2014].

37. National Agency for Drug and Food ControlWorld Health Organization. Trips, CBD and traditional medicines: concepts and questions. Report of an ASEAN workshop on the TRIPS agreement and traditional medicine. Jakarta, Indonesia, 2001.
38. Jefford E, Alonso C, Stevens JR. Call us midwives: critical comparison of what is a midwife and what is midwifery. *Int J Childbirth* 2019;9:39–50.doi:10.1891/2156-5287.9.1.39
39. Högberg U. The decline in maternal mortality in Sweden: the role of community midwifery. *Am J Public Health* 2004;94:1312.
doi:10.2105/ajph.94.8.1312pmid:http://www.ncbi.nlm.nih.gov/pubmed/15284032
40. De Brouwere V, Tonglet R, Van Lerberghe W. Strategies for reducing maternal mortality in developing countries: what can we learn from the history of the industrialized West? *Trop Med Int Health* 1998;3:771–82.doi:10.1046/j.1365-3156.1998.00310.xpmid:http://www.ncbi.nlm.nih.gov/pubmed/9809910
41. United Nations Population Fund. The State of the World's Midwifery 2011. New York, 2011.
Available: <https://www.unfpa.org/publications/state-worlds-midwifery-2011> [Accessed 22 Apr 2020].
42. United Nations Population FundInternational Confederation of MidwivesWorld Health Organization. The state of the world's midwifery 2014: a universal pathway. a woman's right to health. New York, 2014. Available: <http://www.unfpa.org/sowmy> [Accessed 16 Feb 2017].
43. Kennedy HP, Shannon MT, Chuahorm U, et al. The landscape of caring for women: a narrative study of midwifery practice. *J Midwifery Womens Health* 2004;49:14–23.doi:10.1016/j.jmwh.2003.09.015pmid:http://www.ncbi.nlm.nih.gov/pubmed/14710136
44. World Health Organization. Department of reproductive health and research. making pregnancy safer: the critical role of the skilled attendant. A joint statement by WHO, ICM and FIGO. Geneva, 2004. Available: <http://whqlibdoc.who.int/publications/2004/9241591692.pdf> [Accessed 8 Nov 2018].
45. World Health Organization. Defining competent maternal and newborn health professionals. Geneva, 2018. Available: <http://apps.who.int/iris/handle/10665/272817> [Accessed 19 Jan 2019].

46. Tritten J. International midwife: global alliance of midwives. *Midwifery Today* 1999;46.
47. Fullerton JT, Thompson JB. International confederation of midwives core documents: their added value for us midwifery associations. *J Midwifery Womens Health* 2013;58:130–2. doi:10.1111/jmwh.12037 pmid:<http://www.ncbi.nlm.nih.gov/pubmed/23590484>
48. Foster J, Alonso C. Contemporary issues in the training, practice, and implementation of midwifery for indigenous women in Mexico BT. In: Schwartz DA, ed. *Maternal death and pregnancy-related morbidity among indigenous women of Mexico and Central America: an anthropological, epidemiological, and biomedical approach*. Cham: Springer International Publishing, 2018: 313–26.
49. Braine T. Mexico's midwives enter the mainstream. *Bull World Health Organ* 2008;86:244–5. doi:10.2471/BLT.08.010408 pmid:<http://www.ncbi.nlm.nih.gov/pubmed/18438508>
50. Kozhimannil KB, Attanasio LB, Jou J, et al. Potential benefits of increased access to doula support during childbirth. *Am J Manag Care* 2014;20:e340–52. pmid:<http://www.ncbi.nlm.nih.gov/pubmed/25295797>
51. Bohren MA, Hofmeyr GJ, Sakala C, et al. Continuous support for women during childbirth. *Cochrane Database Syst Rev* 2017;7:CD003766. doi:10.1002/14651858.CD003766.pub6 pmid:<http://www.ncbi.nlm.nih.gov/pubmed/28681500>
52. Ireland S, Montgomery-Andersen R, Geraghty S. Indigenous Doulas: a literature review exploring their role and practice in Western maternity care. *Midwifery* 2019;75:52–8. doi:10.1016/j.midw.2019.04.005 pmid:<http://www.ncbi.nlm.nih.gov/pubmed/31003022>
53. Tricco AC, Lillie E, Zarin W, et al. PRISMA extension for scoping reviews (PRISMA-ScR): checklist and explanation. *Ann Intern Med* 2018;169:467. doi:10.7326/M18-0850 pmid:<http://www.ncbi.nlm.nih.gov/pubmed/30178033>
54. Hong QN, Gonzalez-Reyes A, Pluye P. Improving the usefulness of a tool for appraising the quality of qualitative, quantitative and mixed methods studies, the mixed methods appraisal tool (MMAT). *J Eval Clin Pract* 2018;24:459–67. doi:10.1111/jep.12884 pmid:<http://www.ncbi.nlm.nih.gov/pubmed/29464873>

55. Gray S, Zatre E, Gray SRJ. Fuzzy cognitive maps as representations of mental models and group beliefs. In: Papageorgiou EI, ed. Fuzzy cognitive maps for applied sciences and engineering. Berlin: Springer, 2014: 29–48.
56. Glymour M, Greenland S. Causal Diagrams. In: Rothman K, Greenland S, Lash T, eds. Modern epidemiology. Philadelphia: Wolters Kluwer Health/Lippincott Williams & Wilkins, 2008: 183–211.
57. Kosko B. Fuzzy cognitive maps. *Int J Man Mach Stud* 1986;24:65–75.doi:10.1016/S0020-7373(86)80040-2
58. Sarmiento I. Fuzzy cognitive mapping and soft models of Indigenous knowledge on maternal health in Guerrero, Mexico.. *BMC Med Res Methodol* 2020;20:125.
59. Dion A, Robert É, Sarmiento I, et al. A guideline for the weight of evidence, 2019CIET-PRAM, Department of Family Medicine, McGill University. Available: https://ciet.org/weight_of_evidence/ [Accessed 2020/10/22].
60. Borenstein M, Hedges LV. Effect size for meta-analysis. In: Cooper HM, Hedges LV, Valentine J, eds. Handbook of research synthesis and meta-analysis. New York: Russell Sage Foundation, 2019: 208–43. <https://muse.jhu.edu/book/65827/>
61. Papageorgiou EI, Kontogianni A. Using fuzzy cognitive mapping in environmental decision making and management: a methodological primer and an application. *International Perspectives on Global Environmental Change*, 2012.
62. Stylios D, Groumpos PP, Georgopoulos VC, et al. Fuzzy cognitive MAP approach to process control systems Chrysostomos. *J Adv Comput Intell Intell Inform* 1999;3:409–17.doi:10.20965/jaciii.1999.p0409
63. Harris ZS. Discourse analysis. *Language* 1952;28:1. doi:10.2307/409987
64. Andersson N, Mitchell S. Epidemiological geomatics in evaluation of mine risk education in Afghanistan: introducing population weighted raster maps. *Int J Health Geogr* 2006;5:1. doi:10.1186/1476-072X-5-1pmid:<http://www.ncbi.nlm.nih.gov/pubmed/16390549>

65. Sibley L, Ann Sipe T, Sipe TA. What can a meta-analysis tell us about traditional birth attendant training and pregnancy outcomes? *Midwifery* 2004;20:51–60.doi:10.1016/S0266-6138(03)00053-6pmid:http://www.ncbi.nlm.nih.gov/pubmed/15020027
66. Sibley L, Sipe TA, Koblinsky M. Does traditional birth attendant training improve referral of women with obstetric complications: a review of the evidence. *Soc Sci Med* 2004;59:1757–68.doi:10.1016/j.socscimed.2004.02.009pmid:http://www.ncbi.nlm.nih.gov/pubmed/15279931
67. Sibley LM, Sipe TA, Koblinsky M. Does traditional birth attendant training increase use of antenatal care? A review of the evidence. *J Midwifery Womens Health* 2004;49:298–305.doi:10.1016/j.jmwh.2004.03.009pmid:http://www.ncbi.nlm.nih.gov/pubmed/15236709
68. Sibley LM, Sipe TA, Brown CM, et al. Traditional birth attendant training for improving health behaviours and pregnancy outcomes. *Cochrane Database Syst Rev* 2007:CD005460. doi:10.1002/14651858.CD005460.pub2pmid:http://www.ncbi.nlm.nih.gov/pubmed/17636799
69. Darmstadt GL, Lee ACC, Cousens S, et al. 60 million non-facility births: who can deliver in community settings to reduce intrapartum-related deaths? *Int J Gynaecol Obstet* 2009;107:S89–112.doi:10.1016/j.ijgo.2009.07.010pmid:http://www.ncbi.nlm.nih.gov/pubmed/19815200
70. Lawn JE, Lee ACC, Kinney M, et al. Two million intrapartum-related stillbirths and neonatal deaths: where, why, and what can be done? *Int J Gynaecol Obstet* 2009;107:S5–19.doi:10.1016/j.ijgo.2009.07.016pmid:http://www.ncbi.nlm.nih.gov/pubmed/19815202
71. Lawn JE, Kinney M, Lee ACC, et al. Reducing intrapartum-related deaths and disability: can the health system deliver? *Int J Gynaecol Obstet* 2009;107:S123–42.doi:10.1016/j.ijgo.2009.07.021pmid:http://www.ncbi.nlm.nih.gov/pubmed/19815205
72. Hofmeyr GJ, Haws RA, Bergström S, et al. Obstetric care in low-resource settings: what, who, and how to overcome challenges to scale up? *Int J Gynaecol Obstet* 2009;107:S21–45.doi:10.1016/j.ijgo.2009.07.017pmid:http://www.ncbi.nlm.nih.gov/pubmed/19815204

73. Wall SN, Lee ACC, Niermeyer S, et al. Neonatal resuscitation in low-resource settings: what, who, and how to overcome challenges to scale up? *Int J Gynaecol Obstet* 2009;107:S47–64.doi:10.1016/j.ijgo.2009.07.013pmid:http://www.ncbi.nlm.nih.gov/pubmed/19815203
74. Lee ACC, Lawn JE, Cousens S, et al. Linking families and facilities for care at birth: what works to AVERT intrapartum-related deaths? *Int J Gynaecol Obstet* 2009;107:S65–88.doi:10.1016/j.ijgo.2009.07.012pmid:http://www.ncbi.nlm.nih.gov/pubmed/19815201
75. Kidney E, Winter HR, Khan KS, et al. Systematic review of effect of community-level interventions to reduce maternal mortality. *BMC Pregnancy Childbirth* 2009;9:2. doi:10.1186/1471-2393-9-2pmid:http://www.ncbi.nlm.nih.gov/pubmed/19154588
76. Byrne A, Morgan A. How the integration of traditional birth attendants with formal health systems can increase skilled birth attendance. *Int J Gynaecol Obstet* 2011;115:127–34.doi:10.1016/j.ijgo.2011.06.019pmid:http://www.ncbi.nlm.nih.gov/pubmed/21924419
77. Wilson A, Gallos ID, Plana N, et al. Effectiveness of strategies incorporating training and support of traditional birth attendants on perinatal and maternal mortality: meta-analysis. *BMJ* 2011;343:d7102. doi:10.1136/bmj.d7102pmid:http://www.ncbi.nlm.nih.gov/pubmed/22134967
78. Glenton C, Colvin CJ, Carlsen B, et al. Barriers and facilitators to the implementation of lay health worker programmes to improve access to maternal and child health: qualitative evidence synthesis. In: Glenton C, ed. *Cochrane database of systematic reviews*. Chichester, UK: John Wiley & Sons, Ltd, 2013.
79. Vieira C, Portela A, Miller T, et al. Increasing the use of skilled health personnel where traditional birth attendants were providers of childbirth care: a systematic review. *PLoS One* 2012;7:e47946. doi:10.1371/journal.pone.0047946pmid:http://www.ncbi.nlm.nih.gov/pubmed/23110138
80. Bohren MA, Hunter EC, Munthe-Kaas HM, et al. Facilitators and barriers to facility-based delivery in low- and middle-income countries: a qualitative evidence synthesis. *Reprod Health* 2014;11:71. doi:10.1186/1742-4755-11-71pmid:http://www.ncbi.nlm.nih.gov/pubmed/25238684

81. Lassi ZS, Das JK, Salam RA, et al. Evidence from community level inputs to improve quality of care for maternal and newborn health: interventions and findings. *Reprod Health* 2014;11:S2. doi:10.1186/1742-4755-11-S2-S2
82. Mangham-Jefferies L, Pitt C, Cousens S, et al. Cost-effectiveness of strategies to improve the utilization and provision of maternal and newborn health care in low-income and lower-middle-income countries: a systematic review. *BMC Pregnancy Childbirth* 2014;14:243. doi:10.1186/1471-2393-14-243pmid:<http://www.ncbi.nlm.nih.gov/pubmed/25052536>
83. World Health Organization. WHO recommendations on health promotion interventions for maternal and newborn health 2015. Geneva, 2015. Available: https://www.who.int/maternal_child_adolescent/documents/health-promotion-interventions/en/ [Accessed 29 Jan 2019].
84. World Health Organization. WHO recommendations on maternal health: guidelines approved by the WHO guidelines review Committee. Geneva, 2017. Available: http://who.int/tb/features_archive/factsheet_xpert.pdf [Accessed 13 Dec 2019].
85. Lassi ZS, Middleton PF, Bhutta ZA, et al. Strategies for improving health care seeking for maternal and newborn illnesses in low- and middle-income countries: a systematic review and meta-analysis. *Glob Health Action* 2016;9:31408. doi:10.3402/gha.v9.31408pmid:<http://www.ncbi.nlm.nih.gov/pubmed/27171766>
86. Miller T, Smith H. Establishing partnership with traditional birth attendants for improved maternal and newborn health: a review of factors influencing implementation. *BMC Pregnancy Childbirth* 2017;17:1–10.doi:10.1186/s12884-017-1534-y
87. World Health Organization. Department for maternal, newborn C and a health (WHO/MCA). MASCOT/Wotro map of maternal health research (database), 2013. Available: <http://epi.ioe.ac.uk/webdatabases4/Intro.aspx?ID=11> [Accessed 12 Dec 2019].

Manuscript 6. Appendices

Appendix A1 - 1. Search strategy (2nd version)

Online supplementary file 1.

Search strategy (2nd version)

May 4, 2020

Developed for Ovid MEDLINE(R) and Epub Ahead of Print, In-Process & Other

Non-Indexed Citations

Librarian: Martin Morris

McGill University

1. exp Maternal Health/

2. exp Maternal Welfare/

3. exp Maternal Health Services/

4. exp Pregnancy/

5. exp Pregnancy Complications/

6. exp Midwifery/

7. (maternal or maternity or mother? or midwif* or (birth adj1 attendant?) or doula?).tw,kf.

8. pregnan*.ti.

9. or/1-8

10. exp American Native Continental Ancestry Group/

11. exp Health Services, Indigenous/

12. (aborigine? or aboriginal?).tw,kf.

13. indigenous.tw.

14. natives.tw.

15. (tribe* or tribal*).tw.

16. autochton*.tw.

17. or/11-16

18. **** COMMENT: North America ****.sm.

19. native american?.tw.

20. american indian?.tw.

21. first nation?.tw.

22. alaska* native*.tw.

23. (athabascan or ahtna or aleut* or alutor or chelkancy or chukchi or chulymcy or chuvancy or koryak or nanaicy or manci or kumadincy or negidalcu or nenets or orocho or nganasan or nivkhy or oroki or sa?mi or selkup or shorcy or soioty or tazy or telengity or teleuty or tofolar or tubolar or tuvin-todjin or udege or ukagiry or ulchi or veps or "deg hit?an" or dena?ina or holikachuk or kolchan or koyukon or tanacross or eyak or haida or tlingit or tsimshian* or inupiat or yup?ik or cup?ik or sugpiaq or alutiiq or alutiqu or chugach or koniag or unanga? or yup?ik or cree or mohawk or salish or nuxalk or kimsquit or tallheo or stuie or kwatna or shishalh or sechelt or squamish or Skwxwu7mesh or qualicum or comox or sliammon or comos or klahoose or halkomelem or cowichan or somena or s?amuna? or quw?utsun or quamichan or clemclemalut* or l?uml?umulut* or comiakem or qwum?yiqu? or khenipsen or hinupsum or kilpahla* or ti?ulpalu* or koksilah or hwulqwselu or penelakut or lamalcha or musqueam or snuneymuxw or tsleil-waututh or ts?ailes or chehali* or sto?lo or aitchellitz or matsqui or popkum or skway or skawahlook or skowkale or squiala or sumas or tzeachten or yakweakwioose or chawathil or cheam or kawaw-kawaw-apilt or scowlitz or scaulit* or shxw?ow?hamel or soowahlie or katzie or kwantlen or kwikwetlem or tsawwassen or songhee* or t?souke or sooke or semiahmoo or malahat or tsartlip or tsawout or esquimalt or tsimshian* or gitxsan or niska?a or haida or nuu-chah-nulth or nootka or mowachaht* or ahousaht or ehattesaht or hesquiaht or cheklesahht or kyuquot

or nuchatlaht or huu-ay-aht or ohiaht or hupacasath or opetchesaht or toqaht or tseshaht or uchucklesaht or ucluelet or ditidaht or pacheedaht or kwakwaka?wakw or laich-kwil-tach or euclataws or yuculta or weewaikai or wewaykum or koskimo or namgis or haisla or kiamaat or henaksiala or heiltsuk or wuikinuxv or owekeeno or tlingit or ("aa tlein" or deisleen) adj2 kwaan) or athapaskan or dakelh or wet?suwet?en or dene-thah or denethah or slavey or tsilhqot?in or chilcotin or sekani or dunne-za or tahlitan

or "kaska dena" or nlaka?pamux or okanagan or secwepemc or shuswap or sinixt or st?at?imc or lillooet or lil?wat or stl?atl?imx or skatin or semahquam or xa?xtsa or nequatque or ktunaxa or kootenay or ashinaabe or plains_ojibwa or blackfoot or kainai or peigan or siksika or dene or chipewyan or nakoda or assiniboine or ((plains or oji or "james bay") adj1 cree) or "eeyou istchee" or tastine or "tsuu t?ina" or ktunaxa or sahtu or "tli cho" or yellowknives or dunne?za or gwich?in or kutchin or loucheaux or han or kaska or tagish or tutchone or anishinaabe or algonquin or nipissing or ojibwa or mississaugas or saulteaux or potawatomi or cree or innu or montagnais or naskapi or beothuk or maliseet or mi?kmaq or passamaquoddy or iroquois or haudenosaunee or cayuga or guyohkohnyo or kanien?kehaka or oneida or onayotekaono or on?ndaga* or tuscarora or wyandot or huron or onondowahgah or ganonsyoni or seneca).tw.

24. or/19-23

25. **** COMMENT: Central and Meso- America ****.sm.

26. ("chichimeca jonaz" or "huastec teenek" or achi or amuzgo or tzjon or tzotyio or nanncue or aztecan or bokota or boruca or bribri or cabecar or chorti or chatino or chibchan or chinantec or choc?o or ngiwai or ixcatec or chontal or chorotega or mangue or mankeme or chuj or cora or naayarite or corachol or cuicatec or guaymi or waimi or huave or huichol or wixarita* or itza or ixil or jakalteki or popti or kiche or kaqchikel or kuna or dule or tule or lacandon or "hach winik" or lenca or maleku or mamean or manguean or matlatzinca or maya? or mazahua or tetjo or mazatec or miskit? or misumalpan or ayuukjaay or mixtec* or mopan or nahua* or teribe or "tjer di" or ngabe-bugle or oto-manguean or oto-pamean or otomi or popoloca? or poqom* or qanjob* or qeqchi or qichea* or sumalpan or mayangna or talamancal or tarascan or tequistlatecan or "chontal de oaxaca" or tlapanec or tojolabal or tolupan or jicaque or totonac* or tutunacu or trique or tzutujil or tzeltal or tzotzil or uto-aztecan or votic or xin?a or yucatec* or zambo or cafuso or zapotec* or zoque).tw,kf.

27. **** COMMENT: South America ****.sm.

28. (abip?n or achagua or achuar or aguano or aguaruna or akawaio or akurio or amahuaca or amany? or amorua or andaqu? or andoque or araona or arawak or arhuacos or ijka or ash?ninka or atacama or atacame?o or atikum or atorada or auak? or av? guaran? or aw?-guaj? or aymara or ayoreo or baniwa or bara or barasana or motilon or baure or betoye or bora or bor?ro or botocudo or cabiyar? or callawalla or ca?ari or candoshi or canelos-quichua or canichana or caranqui or carapana or carib or carijona or cashibo or cat?o or cavine?a or cayambi or cayubaba or ch?cobo or chamacoco or chanka or charr?a or chimbuelo or chimila or chinchu or chipaya or chiquitano or chiricoa or chirip? or cholones or chorote or chulupi or ?ocama or cocamilla or coconuco or cof?n or kof?n or comeching?n or coreguaje or cubeo or cuiba or curripaco or desano or diaguita or ebytosos or ember? or "enawene nawe" or "ese ejja" or guahibo or guambiano or misak or guana or guane or guaran? or guarayu or guat? or guayabero or guayupe or harakmbut or huambisa or huanca or huarpe or hupda or ignaciano or inga or ingarik? or itene or itonama or jaoi or jibito or jivaro or jor? or kadiw?u or kaingang or kali?na or kalina or kamayur? or kams? or kankuamo or karaj? or kawaskhar or kaxinaw? or kayapo or kogui or k?ggaba or kokama or kolla or

korubo or kubeo or kulina or kuna or leco or letuama or lokono or machiguenga or machinere or macushi or maimar? or maina or makaguaje or makuna or makuxi or mapidian or mapuche or "mapuches aymara" or mashco-piro or masiguare or matap? or mats?s or mawayana or mayoruna or mbay? or mbya* or mira?a or mocov? or mokan? or "motilone bar?" or movima or muinane or muisca or munduruku or nambikwara or nepuyo or nivac? or nonuya or nukak or oca?na or ofay? or omaguaca or orealla or otavale?os or pacabuy or pacahuara or p?ez or nasa or "pai tavytera" or pai-tavyter or paiter or pampa or panar? or panche or pankararu or panzaleo or patamona or patax? or paunaka or pauserna or pemon or piapoco or piaroa or pichincha or pijao or pilag? or piraha or piratapuyo or pitsamira or potiguara or puinave or puruh? or q?ero or qu?chua or querand? or quijos-quichua or rankulche or "rapa nui" or reyesano or salasacan or s?liba or sanapan? or sanavir?n or saraguro or saraveca or "sater? maw?" or secoya or shapra or shinabo or shipibo-conibo or shuar or sikiana or siona or siriano or sirion? or "suru? do par?" or sutagao or tacana or taiwano or tanimuka or tapiet? or tapirape or tariano or tatuyo or tehuelche or terena or ti?una or tiri? or toba or tom?raho or tonocote or toromona or totor? or trememb? or trinitario or tsiman? or tugua or tukano or tungurahua or tupi or "tup? guaran?" or tuyuca or u?wa or tunebo or umbr? or urarina or uru or vilela or waiwai or wanano or waorani or wapishana or wapixana or waranka or warao or wauja or wayana or wayu? or wich? or witoto or huitoto or uitoto or wiwa or sanh? or wounaan or xakriab? or xavante or xukuru or ya?nomam? or yaghan or yagua or yaminaw? or yanacona or yanesha? or yanomami or yarigui or yaruro or ye?kuana or yine or yukpa or yuko or yukuna* or yuqui or yuracare or yuri or yurut? or zamuco or zaparo or zenu).tw,kf.

29. exp Qualitative Research/

30. (qualitative adj (research or stud\$3)).ti,ab,kf.

31. (mixed adj (method* or studies)).ti,ab,kf.

32. "Surveys and Questionnaires"/

33. exp Interviews as Topic/

34. interview*.ti,ab,kf.

35. focus groups/

36. focus group*.ti,ab,kf.

37. self report/

38. ((action or participatory) and research).ti,ab,kf.

39. exp Community-Based Participatory Research/

40. grounded theory/

41. grounded theory.ti,ab,kf.

42. phenomenolog*.ti,ab,kf.

43. exp Narration/

44. narrat*.ti,ab,kf.

45. conversation*.ti,ab,kf.

46. discourse*.ti,ab,kf.

47. (ethnograph* or ethnomethodolog* or ethno methodolog* or autoethnograph*).ti,ab,kf.

48. hermeneutic*.ti,ab,kf.

49. constructivis*.ti,ab,kf.

50. ((case or field) adj (study or studies)).ti,ab,kf.

51. ((participant* or field) adj observ*).ti,ab,kf.

52. ((purpos* or theoretical or judg?ment or "maximum variation" or convenience or "critical case" or "deviant case" or "key informant" or snowball or cluster) adj sampl*).ti,ab,kf.

53. (experience* or perspective* or perception* or meaning* or view? or viewpoint*).ti.

54. ((lived or life or personal* or patient? or survivor*) adj3

(experience* or perspective* or perception* or meaning* or view? or viewpoint*)).ti,ab,kf.
 55. ((thematic or content) adj analys*).ti,ab,kf.
 56. "group discussion*".ti,ab,kf.
 57. (cope or copes or coping or thrive or thrives or thriving).ti,ab,kf.
 58. finding?.ti,ab,kf.
 59. or/29-58
 60. 17 or 24 or 26 or 28
 61. 9 and 59 and 60
 62. (traditional* adj3 (birth adj1 (attendant? or midwi* or doula?))).tw,kf.
 63. 60 and 62
 64. ((randomized controlled trial or controlled clinical trial).pt. or randomized.ab. or randomised.ab. or placebo.ab. or drug therapy.fs. or randomly.ab. or trial.ab. or groups.ab.) not (exp animals/ not humans.sh.)
 65. Epidemiologic studies/ or exp case control studies/ or exp cohort studies/ or (Case control or (cohort adj (study or studies)) or cohort analy\$ or (Follow up adj (study or studies)) or (observational adj (study or studies)) or longitudinal or retrospective or cross sectional).tw.
 66. 9 and (59 or 64 or 65) and 60

Appendix A1 - 2. Terms potentially referring to traditional midwives and their implications for the search strategy

Term	Action
Traditional midwife <i>Püñeñelche</i> (Mapuche). Partera tradicional (SP). Parteira Tradicional (PR). Comadrona (SP).	Include.
Trained birth attendants Training programs for traditional midwives are frequent, but not all the trained birth attendants are traditional midwives. We are not interested in just trained community members but in the traditional part of their practice.	Does the reference link their practice to the traditional culture of the community and refers to a traditional locally recognized role helping women during pregnancy, delivery or postpartum? If yes, then include. Else, exclude.
Casual or coincidental birth helpers. They do not have the required years of experience and traditional training; therefore, they should be excluded	Exclude.
Midwife (midwives). Partera/partero (SP). Matrona/Matrón (SP). Sages-femmes (FR). Accoucheuse/accoucheur (FR). Parteiras/obstetrix (PT). This term is often used to indicate professional/licenced midwives and to delimitate authoritative knowledge of Western cadres with international accreditation. In Canada, indigenous professional midwives are also called Aboriginal midwives or Indigenous midwives. But their role is not necessarily part of traditional midwifery.	Does the reference link their practice to the traditional culture of the community and refers to a traditional locally recognized role helping women during pregnancy, delivery or postpartum? If yes, then include. Else, exclude.
Traditional birth attendants. Comadrona/matrona (SP). Parteras empíricas (SP). Partera rural (SP). Although inherently disrespectful of the role and practice of traditional midwives, the term has been used since 1920's to describe them.	Does the reference link their practice to the traditional culture of the community and refers to a traditional locally recognized role helping women during pregnancy, delivery or postpartum? If yes, then include. Else, exclude.
Community midwives. Recognizes the community aspect, but it does not distinguish if the practice is framed within the traditional knowledge of the group.	Does the reference link their practice to the traditional culture of the community and refers to a traditional locally recognized role helping women during pregnancy, delivery or postpartum? If yes, then include. Else, exclude.
Lay midwives (<i>parteras empíricas</i> – SP). The term refers to practitioners without accreditation or professional status. But it is not necessarily a synonym of traditional practices.	Does the reference link their practice to the traditional culture of the community and refers to a traditional locally recognized role helping women during pregnancy, delivery or postpartum? If yes, then include. Else, exclude.
Doula. This is a recent term that does not correspond to the practice of traditional midwives. Doulas accompany women to prepare for delivery and to navigate health services. Some people have proposed that traditional midwives could transition towards a	Exclude.

doula-like role to exclude them from the participation in health care practice.	
Skilled birth attendant. Often used to exclude traditional midwives based on cadres with international recognition.	Does the reference link their practice to the traditional culture of the community and refers to a traditional locally recognized role helping women during pregnancy, delivery or postpartum? If yes, then include. Else, exclude.
Midwifery associate Professionals. This is one of the applicable names in the List of health-related occupations according to International Standard classification of Occupations (ISCO-08).	Does the reference link their practice to the traditional culture of the community and refers to a traditional locally recognized role helping women during pregnancy, delivery or postpartum? If yes, then include. Else, exclude.
Traditional or complementary medicine associate professional. This is another category from the ISCO-08 that include traditional practitioners.	Does the reference link their practice to the traditional culture of the community and refers to a traditional locally recognized role helping women during pregnancy, delivery or postpartum? If yes, then include. Else, exclude.
Nurses with obstetrical/perinatal experience. Closer to professional midwife, sometimes this term could include indigenous midwives, often without traditional background.	Exclude.
Complementary or alternative providers. The roles of these providers are abstract from cultural identities.	Exclude.

Legend: SP: Spanish, FR: French, PT: Portuguese

Appendix 2. Safe Birth and Cultural Safety in southern Mexico: study protocol for a randomised controlled trial

Sarmiento^{1,2}, Sergio Paredes-Solís³, Anne Cockcroft¹, Neil Andersson^{1,3}

1. CIET-PRAM, Faculty of Medicine, Department of Family Medicine, McGill University. Canada.

2. *Grupo de Estudios en Sistemas Tradicionales de Salud. Universidad del Rosario.* Colombia.

3. *Centro de Investigación de Enfermedades Tropicales. Universidad Autónoma de Guerrero.* Mexico.

Abstract

Background: Indigenous women in the southern Mexican state of Guerrero face poor maternal health outcomes. Living as they do at the very periphery of the Western health system, they often receive low-quality care from health services that lack human and financial resources. Traditional health systems remain active in indigenous communities where traditional midwives accompany women through motherhood. Several interventions have explored training birth attendants in Western birthing skills, but little research has focussed on supporting traditional midwives by recognising their knowledge. This trial supports traditional midwifery in four indigenous groups and measures its impact on maternal health outcomes.

Methods: The study includes four indigenous populations in the State of Guerrero (*Nahua, Nahuatl/Mixteco, Me'phaa/Tlapaneco* and *Nancue ñomndaa/Amuzgo*), covering approximately 8000 households. A parallel-group cluster-randomised controlled trial will compare communities receiving usual care with communities where traditional midwives received support in addition to the usual care. The intervention was defined in collaboration with participants in a 2012 pilot study. Supported midwives will receive a small stipend, a scholarship to train one apprentice, and support from an intercultural broker to deal with Western health personnel; additionally, the health staff in the intervention municipalities will participate in workshops to improve understanding and attitudes towards authentic traditional midwives. A baseline and a final survey will measure changes in birth and pregnancy complications (primary outcomes), and changes in gender violence, access to

healthcare, and engagement with traditional cultural activities (secondary outcomes). The project has ethical approval from the participating communities and the *Universidad Autónoma de Guerrero*.

Discussion: Indigenous women at the periphery of Western health services do not benefit fully from the attenuated services which erode their own healthcare traditions. Western health service providers in indigenous communities often ignore traditional knowledge and resources, inadvertently or in ignorance, disrespecting indigenous cultures. Improved understanding between midwives and the official healthcare system can contribute to more appropriate referral of high-risk cases, improving the use of scarce resources while lowering costs of healthcare for indigenous families.

Trial registration: ISRCTN12397283. Retrospectively registered on 6 December 2016.

Background

Maternal mortality and morbidity remain inequitable burdens for indigenous women in Mexico, as in many other countries [1, 2]. Modern obstetric care, especially in emergencies, can be key to survival [3, 4] and, in remote indigenous communities where the needs might be more pressing, women almost invariably receive poorer-than-average health services [5, 6]. Inappropriate allocation of state resources and weakness of local governments are part of the problem on the supply side [7]. On the demand side, lack of interaction with traditional knowledge systems in Western medical facilities has led many indigenous women to shun Western health services [8]. One consequence, in many remote indigenous communities, is that traditional midwives are the only source of care available for maternal health [9].

Much of the research to address this state of affairs focusses on short-term training of non-traditional task-oriented birth attendants, and training of traditional midwives in Western birthing concepts and practices [9,10,11,12]. A systematic review summarising 60 experimental and quasi-experimental studies of training traditional birth attendants (TBAs) found a small reduction of perinatal and postnatal mortality, and that trainees remembered the content of their training ("improvement in knowledge") [13]. A 2011 meta-analysis synthesised six cluster-randomised controlled trials (RCTs) of training and support of TBAs [14]. All six RCTs found a reduction in perinatal death (Number Needed to Treat (NNT) 35, 95%CI 24–70) and neonatal death (NNT 98, 95%CI 66–170). Three of the RCTs reported on maternal mortality and showed a non-significant reduction.

A 2009 systematic review found "low/moderate-quality evidence" suggesting that training TBAs "may improve linkages with facilities and improve perinatal outcomes", and meta-analysis showed an 11% reduction in intrapartum and intrapartum-related neonatal mortality [12]. A synthesis of systematic reviews published in 2014 concluded that in low- and middle-income countries training TBAs, "as a part of community-based intervention packages showed significant improvement in referrals (RR 1.4, 95%CI 1.19–1.65)", "significant reductions in maternal morbidity (RR 0.75, 95%CI 0.61–0.92), neonatal mortality (RR 0.76, 95%CI 0.68–0.84) and perinatal mortality (RR 0.80, 95%CI 0.71–0.91)" [15]. The success of programmes was found to be context specific [16], and related to better communication with formal healthcare systems [16,17,18].

Throughout the academic literature, the term "birth attendant" instead of "midwife" ignores cultural issues and the experience and full social role of traditional midwives [19]. The research focus on training assumes the inferiority of traditional midwifery, or their lack of competence in birthing techniques [20]. The emphasis is on compliance with Western midwifery, rather than on the strengths of traditional midwifery [10]. The World Health Organisation (WHO) excludes traditional midwives from the category of skilled birth attendants, reserving this term for those midwives with formal Western training [7, 9]. We have not found any published RCT that tests the value of supporting the original practices of traditional midwives.

Terminology: authentic traditional midwives

Birth traditions in most indigenous cultures involve the support of a traditional practitioner, frequently called in the academic literature untrained traditional birth attendants (TBAs) [9, 21]. To clarify terminology, we distinguish between (1) authentic traditional midwives, whose recognition by their communities is reflected in the number of births they attend each year and the traditional knowledge they hold, (2) casual or coincidental birth helpers, who might help in a family or neighbourhood emergency and (3) skilled or trained birth attendants, often conflated by acronym with TBAs, who attend courses in Western birth practices and who might receive official certification.

Our concern in this trial is exclusively authentic traditional midwives, recognised in their own cultures and accessed by their communities. We prefer not to abbreviate the term, in order to avoid confusion with Western concepts of trained birth attendant or TBA. For economy of words we refer to them as traditional midwives.

Traditional midwives are part of the traditional health system of their communities [22]. Beyond their technical role in pregnancy and birth, traditional midwives are counsellors and indigenous knowledge bearers, transmitters of culture and cultural values [23]. Some traditional midwives take government training courses, similarly to the "skilled" or trained birth attendants, when these courses allow traditional midwives to obtain birth certificates for the children they deliver. Some traditional midwives might incorporate aspects of Western obstetrics; for example, cutting of the umbilical cord, into their practice [24]. What distinguishes traditional midwives is their rootedness in community and culture, and this is confirmed by the confidence placed in them by their communities. Usually female – the *Me'phaa* or Tlapaneco of Guerrero also have male parteros – they accompany the pregnancy, attend the birth and advise on care of the newborn [25, 26].

The pilot study

A pilot cluster-RCT tested the feasibility and acceptability of an intervention to support authentic traditional midwives between 2008 and 2012 [27]. The pilot was not powered to determine the effect of the intervention, but it did measure outcomes in the intervention and control group, in order to establish that the intervention was not likely to have an adverse effect on maternal morbidity and mortality.

The pilot study was conducted in Xochistlahuaca municipality with *Nancue ñomndaa* (Amuzgo) communities and included 16 indigenous women clearly considered to be traditional midwives by the communities. These traditional midwives were randomly assigned into two groups, one of which received a co-designed intervention [28].

Each intervention midwife received financial support to pay an apprentice (about US\$8 per month); had access to a local birthing centre (purpose-built, rented or loaned); and received logistical support from a male community health worker who could arrange transport for women referred to the local hospital and who could interact with the hospital staff on behalf of the traditional midwives, many of whom could not speak Spanish. Control communities continued receiving usual care, provided mainly by the healthcare centre (*hospital básico comunitario*) located in the municipal capital of Xochistlahuaca and by traditional midwives without external support. An unknown proportion of indigenous women in the rural areas of the municipality did not receive healthcare either from Western health staff or from traditional midwives.

The pilot showed that a larger trial would be feasible. It allowed us to adjust the intervention, to design and test questionnaires, to establish the local capacity needed to conduct a larger study, and to identify costs of the intervention. The pilot established the acceptability of the intervention according to three criteria. First, the intervention was safe; the groups with midwives receiving support did not have worse health outcomes and did not report complicated cases related to the intervention (see below). Second, the communities did not react against the recovery of traditions; some previous experience had suggested that some community members, particularly the younger ones, might interpret an intervention to support traditional midwives as an attempt to reduce the services provided by the Government. Third, the staff at the local healthcare centres accepted an increased involvement of midwives with no conflicts which would make the health authorities stop the intervention.

The pilot found similar levels of pregnancy complications between women in exposed communities (24/94) and controls (65/252) (OR 0.99, 95%CI 0.52–1.71). It was not intended to measure mortality but, in the event, results were compatible with a positive effect of supporting traditional midwives on reducing birth complications (9/91 exposed and 57/248 controls reported birth complications, OR 0.37, 95%CI 0.11–0.73). Women living in the intervention area did not report any neonatal deaths during the last year of the intervention (0/93, compared with 6/254 in control area, chi-square = 2.2, $p = 0.13$). The pilot also suggested advantages for women in terms of skilled birth attendance (92/94 among exposed and 233/253 among controls were assisted by a traditional midwife or physician, OR 3.95, 95%CI 1.0–15.59).

The significantly lower birth complications in intervention communities were likely due to two factors: (1) improved referrals as a result of the intercultural brokerage; and (2) increased use of traditional midwives in the intervention area, resulting in fewer women giving birth without a skilled birth attendant. The pilot demonstrated acceptability of the intervention among the communities and the economical and logistical feasibility of supporting traditional midwifery. The pilot also built local capacity for intercultural and multi-disciplinary research that is scientifically valid and also takes full account of the local cultural context.

Objectives

The overall objective is to reduce maternal morbidity and mortality in indigenous communities without further marginalising or undermining their cultures. The overall hypothesis is that recovery and strengthening of traditional healthcare have a positive impact on indigenous people's health. An explicit intention is to develop an intercultural approach that reduces the dependence on external resources and promotes the cultural assets of indigenous communities.

Specific objectives of the study are: (1) to assess the impact on maternal health outcomes of a co-designed intervention to support traditional midwives in four municipalities of Guerrero; (2) to assess the secondary or social outcomes of this intervention, including gender violence against pregnant women and behaviours related to traditional midwives; and (3) to evaluate the economic cost of the intervention.

Research question: Among the four main indigenous groups in Guerrero, does support for authentic traditional midwives lead to non-inferior maternal health outcomes and improved social outcomes within the study period, when compared with usual care?

Theory of change: Intercultural brokers increase effective contact with Western health services; this improved referral generates better maternal outcomes by allowing obstetric attention to focus on those who need it most. Better maternal outcomes, along with the apprentices and economic support provided by the intervention, increase prestige of traditional midwives within the communities. Midwives' prestige promotes cultural continuity and strengthens the social fabric. Additionally, this prestige expands their services among women who do not need specialist obstetric intervention, thus decreasing pressure on poorly funded healthcare services. The no-longer-overloaded healthcare services are then better able to deal with emergency cases and those in need of Western obstetric care, which further improves maternal outcomes.

Methods

Design of the study

A parallel-group pragmatic cluster-RCT will test the non-inferiority of maternal health outcomes of an intervention to support authentic traditional midwives in four indigenous groups (*Me'phaa*, *Nabua*, *Na savi* and *Nancue ñomndaa*) in four municipalities (Atlixac, San Luis Acatlán, Acatepec and Xochistlahuaca) in Guerrero State (Figure A2-1) [28].

Figure A2-1. Map of the participating municipalities



The setting

Indigenous people make up one third of the world's poorest rural people, and this is also true of indigenous people living in Guerrero, currently Mexico's third poorest state [29, 30]. Of the 481,000 indigenous people in the state, *Nahua* make up 40%, *Na savi* (Mixteco) 28%, *Me'phaa* (Tlapaneco) 22% and *Nancue ñomndaa* (Amuzgo) about 9%. They live in scattered and often remote communities with poor access to government services and rely mainly on subsistence agriculture. Most speak their traditional languages and self-identify as indigenous. Government-conditional cash-transfer programmes give a monthly US\$15 incentive to indigenous women for improving attendance to official healthcare services and food consumption. Indigenous people in Mexico have less than

average access to the country's main health insurance system, and indigenous peoples of Guerrero state have the lowest access among indigenous groups nationally [31].

Where they are available outside of the cities, health services are often poorly staffed and of poor quality. In part, this is due to lack of qualified medical personnel. In the Montaña region of Guerrero, home to the *Na savi* and *Me'phaa* peoples, there are no obstetric services within 1 days' travel for the population of several hundred thousand. Only one in four of Mexico's indigenous women has completed secondary education, a requirement for training as a "skilled birth attendant" in government programmes.

In Mexico, as elsewhere in Latin America, maternal and perinatal mortality among indigenous peoples is poorly documented. Indicators of indigenous maternal and child health in Guerrero State are below the national average, and maternal deaths are three times more common than in the non-indigenous population [2, 32]. Maternal mortality is five to six times the national average (281/100,000 in Zona Centro de Guerrero, compared with 51 in Mexico at large) and infant mortality three to four times higher (89 compared with 28 per 1000) [32, 33].

Participants

Eighty indigenous communities in four municipalities with a total of around 8000 households. The study will include all indigenous women who give birth or become pregnant during the study period, and their adult family members.

The intervention

The intervention has four components that incorporate the co-design exercise from the pilot study and subsequent discussions with the midwives in the four indigenous groups. The intervention comprises activities to invigorate the practice of traditional midwifery and increase the interaction of traditional midwives with the Western healthcare system. The intervention does not define a protocol for the management of motherhood in these communities; thus, Western physicians and traditional midwives remain autonomous in their own practice.

Component 1. Material support for 30 authentic traditional midwives. Each traditional midwife in the intervention group will receive a monthly stipend of US\$20. This small financial support is meant to allow the traditional midwives access to basic goods and increase the time that they have available for their practice and patient care; most of these traditional practitioners are low-income elderly depending on their own work or on support from their families. Additionally, the small

monthly payment will be a symbol of external esteem for the role of these traditional midwives, thus increasing their recognition among community members. Field coordinators will be in charge of the payments to the traditional midwives in the intervention municipalities.

Component 2. Scholarship support of one apprentice for each midwife. The midwives in the intervention group will each appoint one apprentice to receive a monthly stipend of US\$10; the midwife will decide on the training programme and the criteria to evaluate the achievements of her apprentice. The midwife will authorise the payment for the apprentice, while the field coordinators will be in charge of the disbursement. The apprentices will support the practice of the traditional midwives, particularly in tasks that the midwives can no longer perform due to their age. This component will foster the intergenerational transfer of traditional midwifery practice and increase its recognition by community members.

Component 3. Improving understanding and attitudes of staff in the local government health centres towards traditional midwives. In this component, senior researchers from the *Centro de Investigación de Enfermedades Tropicales* in the *Universidad Autónoma de Guerrero* (CIET) will lead a workshop in each municipality to present evidence about the role of traditional midwives and the importance of intercultural skills for Western medical practice. The workshop participants will be the personnel from two primary healthcare centres and ten rural health posts in the intervention municipalities. The workshops will focus on presenting technical data to the staff and will not include traditional midwives, to avoid potential confrontation during this initial stage. Although we expect changes in the attitudes of the staff in the intervention municipalities, their clinical practice remains independent of the project.

Component 4. Training of intercultural brokers (*técnicos interculturales de salud*). A total of 17 community-appointed people will receive training. Inclusion criteria are: being a member of the relevant ethnic group and having basic understanding of traditional culture and Western health services. Each community will follow their own customs to select the candidates.

The training programme will build on previous experiences from Colombia tailored to local conditions of Guerrero [34], and its content will be organised into three thematic lines: culture, nature and health (Table A2-1). This triple thematic approach reflects a concept of health promotion that seeks to implement actions with positive impact not only on individual health but also on the cultural and environmental domains. Each thematic line comprises theoretical and practical sessions

totalling 280 hours of class in 2 months. The training will take place in Acapulco, under the supervision of CIET and with support from Colombian instructors from the Centre for Intercultural Medical Studies. The project will provide accommodation and food for the trainees in Acapulco.

Table A2-1. Content of the course for training intercultural brokers in Guerrero State (May to June 2015)

Content	Thematic line
<i>Introductory module</i>	
Western medicine, biomedical model and traditional health	Health
Memory, will, and concepts about medicinal plants	
Traditional concept of heat and cold	
Self-care	
Nature and environment	Nature
Culture and intercultural dialogue	Culture
Traditional knowledge	
<i>Module of applied concepts</i>	
Cultural context and identity in Mexico	Culture
National and international legislation on behalf of indigenous peoples	
Internet, accounting basics and management	
Cultural diversity	
Oral tradition	
Traditional values and principles	
Indigenous education	
Basics of ecology	Nature
Soils and organic fertiliser	
Participatory mapping	
Tools for nature observation	
Biological diversity and its relation with cultural diversity	
Territories conserved by indigenous communities	
Food sovereignty and local food	
The health system of Mexico and official health programmes	Health
The human body	
Vital signs	
Nutrition	
First aid and injections	
Management of emergencies	
Wound care	
Most prevalent health problems in Guerrero (dengue, chikungunya, skin disorders, scorpion sting, diabetes, violence and oral health)	
Healthcare of a healthy child	
Healthcare of a sick child (undernourishment, acute diarrhoea, acute respiratory infection, intestinal parasitic infections)	
<i>Final cross-cutting module</i>	
Women's health	
Self-care promotion	
Support of traditional midwifery	
<i>Practices and fieldwork</i>	
Practice: building a planting bed	
Fieldwork: nature observation and planting bed	
Fieldwork: botanical garden	
Fieldwork: archaeological sites	

Another guiding principle of the training programme for the intercultural brokers is the promotion of intercultural dialogue between indigenous and Western cultures [35]. This principle is the basis for the intercultural brokerage that the trainees will undertake when they return to their communities [36].

Once in their communities, the brokers will design a work plan applying the course contents to the specific needs that they identify for their communities. Each broker will support one to two midwives, and together they will cover two to three contiguous enumeration areas. The brokers will define these plans in consultation with the traditional midwives supported by them. The plan will consist of two linked components: activities to accompany the traditional midwives and actions for health promotion with an emphasis on women's and maternal health. These activities will follow a pattern of implementation where the brokers will start with activities applying the contents learned during the training upon themselves, then they will involve their families and, finally, with increasing confidence, they will involve other members of their communities.

The intervention will be coordinated by a local team based at CIET. The local team has more than 30 years of experience working in the rural areas of Guerrero. The intervention begins immediately after the training of intercultural brokers (component 4) and will continue for 2 years. Any change in the protocol will be notified to the registry of the trial (Figure A2-2).

Figure A2-2. Schedule of enrolment, interventions and assessments for the study Safe Birth and Cultural Safety

Months	STUDY PERIOD							
	Enrolment	Allocation	Post-allocation					Close-out
	-t ₆	0	t ₁₋₄	t ₅₋₈	t ₉₋₁₂	t ₁₃₋₁₆	t ₁₇₋₂₀	t ₂₁
ENROLMENT:								
Ethics approval (October 2013)	X							
Eligibility screen, selection of clusters (January 2015)	X							
Informed consent from communities (February 2015)	X							
Baseline survey (February - March 2015)	X							
Random allocation (March 2015)		X						
Communities appoint midwives (March 2015)	X							
Comm. appoint Intercultural Brokers (March 2015)	X							
Training of Intercultural Brokers (May – June 2015)	X							
INTERVENTIONS:								
<i>Inexpensive support for traditional midwives</i>			◆────────────────◆					
<i>Scholarship for one apprentice for each midwife</i>			◆────────────────◆					
<i>Intercultural brokers supporting midwives</i>			◆────────────────◆					
<i>Supporting staff in the public health centres</i>					X	X		
ASSESSMENTS:								
Women pregnant in the past year (May 2017)								
Maternal mortality	X							X
Neonatal mortality	X							X
Birth problems among survivors	X							X
Infection postpartum	X							X
Women were seen by midwife for pregnancy	X							X
Births at home attended by midwives	X							X
Births at home attended without external assistance	X							X
Recourse to midwife in case of pregnancy complications	X							X
Recourse to midwife for complications with new-borns	X							X
Women intending to have future births at home	X							X
Cost of birthing	X							X
Woman pregnant in past year (delivery: health facility)								
Birth position	X							X
Respect of traditions and of the woman	X							X
Another person accompanying	X							X
Secondary outcomes								
Social disruption (violence against pregnant women)								X
Engagement in their culture of origin (CASCADA)								X
Qualitative middle-term evaluation (November 2016)							X	

Control communities receive usual healthcare services. Usual perinatal care for indigenous women in the Montaña region of Guerrero is provided by Western physicians (54.6%), nurses (4.2%) and traditional midwives without external support (20.7%); however, some 20.5% of these women do

not have any antenatal care. Among those who received antenatal care, more than 3 out of ten women received less than five antenatal check-ups, the minimum indicated by Mexican standards [37].

In this region, Western physicians (36%), nurses (8%) and traditional midwives without external support (47.9%) provide usual care for childbirth. Some 8.1% of the indigenous women had other or no source of care [37]. Control municipalities have a healthcare centre (*hospital básico comunitario*) in San Luis Acatlán as well as two rural posts (*centro de salud rural* and *unidad de consulta externa*) in Atlixac. In both cases, healthcare facilities are located in the population centres and provide services for the entire municipality. Women in remote areas need several hours' walking or travel by gravel road to reach the closest healthcare facility. Regional general hospitals (Ometepec and Tlapa) attend the complicated cases remitted from these communities [38].

The intervention will become obvious to residents in the intervention sites, and some outcomes (particularly social cohesion) could be influenced by knowledge of intervention status. The main outcome indicators (non-inferiority for morbidity and maternal mortality) and other secondary outcomes would be less susceptible to this bias.

Outcome measures

For objective (1), the central concern is the added benefit of supporting traditional midwives in a context of non-inferior maternal and neonatal mortality. The limited size of the populations involved hinders mortality estimates and increases reliance on intermediate outcomes: birth problems among survivors of pregnancy in the past year. We will measure maternal mortality and morbidity and neonatal mortality through direct questions in each household.

Secondary outcomes (objective (2)) include (a) reduction of social disruption, indicated by gender violence against pregnant women and (b) improvement in intermediate outcomes towards more engagement of women in their culture of origin. The CASCADA model describes these intermediate outcomes in a results chain based on the theory of planned behaviour, overcoming the well-documented limitations of the Knowledge, Attitude and Practices (KAP) model [39, 40]: Conscious knowledge, Attitudes, positive deviation from Subjective norms, intentions to Change behaviour, Agency (individual and collective), Discussion/socialisation of possible action and, finally, Action or change of practice [41]. Two randomised trials in Pakistan and Mexico, a cross-sectional study in

Southern Africa, and a qualitative analysis of narratives in three Southern African countries have used the CASCADA model [42,43,44,45,46].

In this case, the CASCADA model will reflect conscious knowledge of the traditional midwife, a positive attitude about using her services, a positive deviation from a negative subjective norm about traditional midwifery, intention to change in a future pregnancy, the agency to implement these choices, discussion of the choices with partners and, ultimately, interaction with the supported traditional midwife.

The economic outcome measures (objective (3)) are described below under "Economic analysis".

The study will have two measurement points: a baseline survey administered by trained bilingual indigenous interviewers (February and March 2015) and a follow-up survey using the same procedure and questions about pregnancy experiences and outcomes to women pregnant during the past year (May 2017). The period of inquiry for the final survey is defined to avoid any overlap with the pre-intervention period. Given the extent of the region, logistical constraints mean it is not feasible to have continuous or mid-term data collection.

The surveys will use instruments tested during the pilot study and will include questions about: maternal deaths, neonatal deaths, number of times women are seen by the traditional midwife during pregnancy, proportion of births at home attended by midwives or without external assistance, frequency of recourse to the traditional midwife in case of pregnancy complications, frequency of recourse to the traditional midwife in case of complications with newborns, proportion of women intending to have future births at home, infection postpartum, and cost of birthing. Among women who gave birth in health institutions, we also will ask questions about their treatment, including birth position, availability of translators, presence of family members at the birth, presence of the traditional midwife at the birth, bathing in cold water, treatment of the placenta, retention of amulets, and how respectful they consider their treatment to have been.

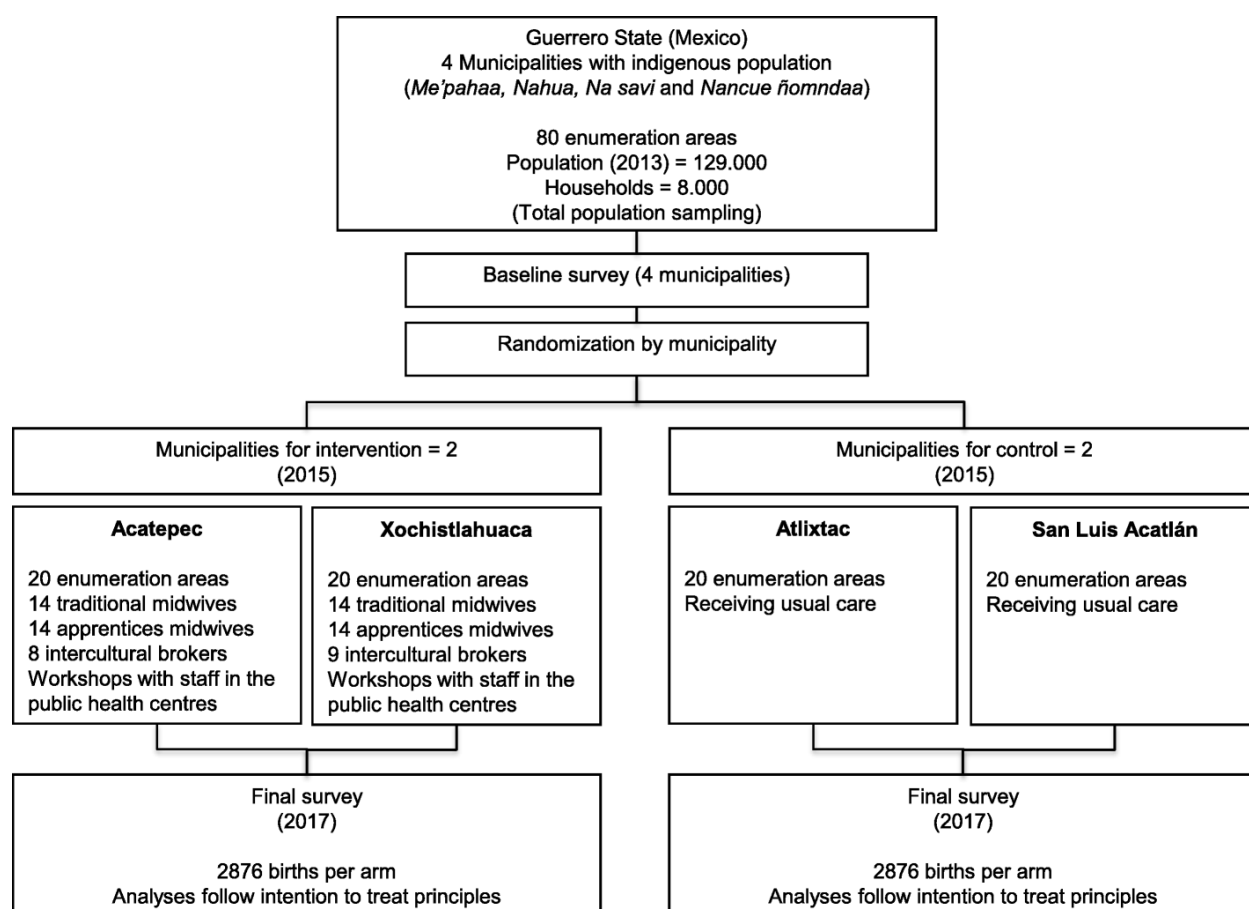
Secondary outcomes measured in the follow-up survey will include: prevalence of violent acts towards pregnant women, opinion as to whom the woman should consult first when she learns that she is pregnant, opinion of who should attend to the woman first if she has complications during pregnancy, opinion as to who should decide whether to take the woman to the hospital if there are complications during childbirth, perception of neighbours' preferences as to who should provide antenatal care, perception of neighbours' preferences as to home vs institutional birth.

A qualitative mid-course peer evaluation using the Most Significant Change technique with local stakeholders will provide information about progress and the relevance of secondary outcomes regarding cultural safety [47]. This technique is a participatory method for monitoring and evaluation of complex projects in which participants narrate stories describing the most significant changes they attribute to the intervention, and implementers review the stories. This will provide information about change dynamics, identify issues in implementation and provide moral support for the intercultural brokers.

Random allocation of the intervention

The total of 80 enumeration areas in the four municipalities are home to the four main indigenous groups (Figure A2-3). If we allocated the intervention at the level of enumeration areas, we would expect a substantial contamination effect within each municipality (mothers from control enumeration areas going to authentic traditional midwives in the intervention enumeration areas) with strong spill-over influence within the same indigenous group served by the intervention midwives; through schools; and through local government or non-governmental organisations (NGOs) taking up the emerging evidence to guide interventions in control enumeration areas. This contamination would reduce the measured difference between control and intervention enumeration areas. To avoid this, the study will centrally randomise the intervention to two of the four municipalities (40 enumeration areas, 20 in each municipality).

Figure A2-3 Flow diagram of the study Safe Birth and Cultural Safety



Analysis

Data entry and security

Independent operators will enter questionnaire responses twice, with verification of discordant entries from the original questionnaires. Researchers will check digitised data for logical errors. We will handle questionnaires from intervention and control sites in exactly the same way, with data technicians unaware of the intervention status of clusters.

Principal analysis

With 80 communities allocated evenly between the intervention and control arms, the principal analysis of primary outcomes will follow intention-to-treat principles using a cluster t-test (everyone included in each cluster, per allocation). We will report outcomes as absolute event rates among intervention and control groups, risk difference with two-sided 95% confidence intervals (95% CIs).

and one-sided 97.5% confidence intervals for the non-inferiority analysis, and relative risk reduction (RRR) with 95%CI [48]. The intraclass correlation coefficient (ICC) will be calculated by dividing the between-cluster variance by the variance within and between clusters.

Sensitivity analysis will focus on the different ethnic groups and their accompanying government health services. It will also examine the four intervention components separately because, although all components are available for all participating midwives, we expect a range of implementation in practice.

Secondary analysis

In each cluster, we will collect relevant data from the local government to determine rates of reported local crime and level of engagement in civic affairs. Individual-level data in a multilevel/hierarchical regression modelling technique will take into account group characteristics.

Planned subgroup analysis and reporting include a focus on the gender of the offspring. Age of the traditional midwife is also of interest because it is a core issue in the recovery of traditional healing and care practices.

The statistical analysis of data will rely on CIETmap, an open-source interface with the R programming language [49].

Economic analysis

The economic dimension is not trivial. Intercultural dialogue can lead to new solutions for health promotion based on adequate use of local resources [50]. Evaluation of the work of traditional midwives should recognise that far fewer official resources support their work than support Western-trained birth attendants. Finally, cultural loss and depletion of natural resources around indigenous communities mean that some authentic traditional midwives cannot work at full capacity and in these cases we may need to implement some actions to strengthen traditional health systems or at least take into account this imbalance in the measurement process.

In 2 years, the intervention might change some population-based maternity outcomes, allowing aggregated costs to be compared between intervention and control municipalities. The concern is to quantify the somewhat increased cost of adding the intervention and the much-increased access this affords to indigenous women. A starting point is an assessment of site-specific maternal health services available to indigenous women from a societal perspective, based on (1) the implementation

costs of these services and (2) the implementation costs of the Safe Birth and Cultural Safety project. Site visits and in-person interviews with representatives of services and of the project will assess local implementation costs. We will measure costs in Mexican pesos and convert into US\$ to allow for international comparison.

From the results of the final survey, we will identify direct benefits in terms of maternal mortality and morbidity indicators, particularly birth complications. Additional benefits we expect to evaluate are (1) change in access/uptake of services and (2) secondary effects like increases in social capital, health literacy, or community planning skills in maternal health services. Finally, we will identify the completeness and timing of implementation to provide a context. We will express the relation between benefits and differences in costs using cost-effectiveness ratios [51].

A third component of the economic analysis will project the costs and effectiveness of implementing the project using alternative models of intervention to enhance sustainability. The specific objectives of this component will be to predict the most cost-effective strategy for wider implementation of Safe Birth and Cultural Safety. It will also help to identify the resources (including local government funding and community participation) needed for rollout.

Missing data

All communities experience in-migration and out-migration. We will add new arrivals to the study but will not follow those leaving the clusters. We do not have reason to expect differential out-migration between intervention and control clusters. Self-selection (decision not to participate or not to answer certain questions) in the surveys is a concern. Those who opt not to respond may be less involved with safe motherhood initiatives – thus affecting the measured effect. Therefore, we will characterise subjects with missing data as far as possible and analyse the effect of missing data using the multiple imputation method in the Amelia II programme [52].

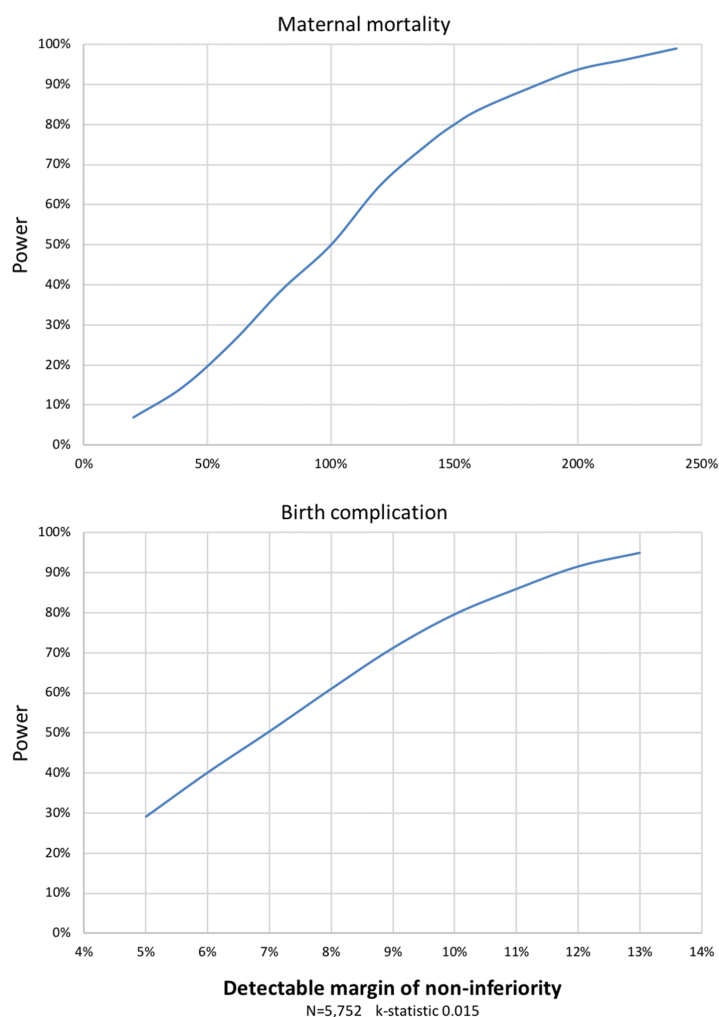
Sample size calculation

Borrowing from the field of bioequivalence, equivalency trials and their statistical testing procedures focus on non-inferiority margins [53]. We expect that supporting traditional midwives does not result in worse primary outcomes of maternal health than does the available usual care in the region, principally because so few indigenous women in the study area access available services. Under the non-inferiority hypothesis, the trial might show equivalent or superior effects of the intervention [54]. The pilot study suggested additional benefits that secondary outcomes accrue from a culturally

safe intervention. In the absence of previous studies in similar settings, we established a practical margin for non-inferiority-based discussion of findings with local authorities and indigenous communities. The resulting computation of study power illustrates the possibilities of demonstrating non-inferiority in these small communities of fixed size.

Based on 2013 data, we expected 5752 births across the four municipalities [55]. This study size is too small to use maternal mortality as an outcome over the funded duration of the trial, using 150% as the minimum non-inferiority margin to be detected. For birth complications as primary outcome, this study size can detect differences within a practical margin for non-inferiority of 15%, with 80% power at a significance level of 5% (Figure A2-4).

Figure A2-4. Power of the sample in relation to the margin of non-inferiority for maternal mortality and birth complications



For the secondary outcome of improved skilled birth attendance (birth assisted by traditional midwife or physician), the pilot study suggested a rate of 92% in control communities (k-statistic 0.011). Follow-up of 1438 births in each cluster (two clusters per arm) would detect a 6.2% increase in skilled attendance (92.1% to 97.8%) with 80% power at a significance level of 5% (allowing us to set the non-inferiority margin at 15%).

These calculations assume no interaction effects with cluster as unit of primary analysis in unmatched parallel groups and relied on the trial simulator devised by Taylor and Bosch [56].

Implications for health services

Strengthening traditional healthcare practices can lead to better maternal health outcomes for at least three reasons: a better use of local resources owned by communities; healthcare actions take into account the culture of the people and the environmental characteristics of the territory; and an increased level of cultural safety in obstetric care.

For many indigenous communities, place of birth and engagement in childbirth are deeply connected to their identity, viability of their cultures and territories, and their systems of governance [57, 58]. Some link the impositions associated with hospital births with marginalisation of their knowledge systems, and this can have serious social and cultural consequences [59, 60].

Traditional midwives hold detailed knowledge of each woman during her pregnancy, placing them in an ideal position to refer those who need specialised care like caesarean section to Western obstetricians [61, 62]. A system built on these synergies could result in less demand on already overloaded obstetric services, higher-quality care for those who need it and, with more resources available for those requiring surgical interventions, fewer post-delivery complications [16, 63].

Ethical considerations

We do not anticipate adverse events or side effects. As communities in the pilot project adopted traditional midwives supported by the project, they continued to use government services for complications that traditional midwives do not deal with. In the pilot study significantly lower complication rates and infection rates among those using traditional midwives suggest improved referral and self-referral. There were no negative reactions from the government health services, which received increased referrals of high-risk cases.

The Ethics Committee of the *Centro de Investigación de Enfermedades Tropicales* of the *Universidad Autónoma de Guerrero* approved the trial on 22 October 2013 (Reference 2013–014). Community assemblies representing the indigenous peoples involved in the trial approved the project between January and February 2015. We adopted the ethical principles for medical research in indigenous communities proposed by the Research Group on Traditional Health Systems [64].

Informed consent: After clarification of the catchment area of each midwife, field coordinators from the project will identify a suitable community leader able to speak on behalf of the community. They will explain the proposed study and that the community might or might not be allocated to receive the intervention; then, they will seek their permission to include the community. This community leader will follow the traditional ways of the indigenous communities to reach the final decision about participation.

Informed consent for interviews: Trained interviewers will explain to respondents the nature of the study and the voluntary nature of their participation using suitable local language. They will explain that participants may decline to answer any questions that they do not wish to answer, may refuse to participate in the activity, and may end the interview at any time. Interviewers will clarify the procedures to ensure confidentiality. They will then ask respondents for oral informed consent for the interview. The informed consent is oral because of the high rates of illiteracy among the participants.

There will be no biological samples taken.

Ensuring confidentiality: Fieldworker and data operator training will emphasise their responsibility for maintaining confidentiality of all information accessed during the work. We will report grouped findings in a way that does not allow identification of any individuals or communities. No names or identifiers will be recorded next to individual questionnaire responses and reports of findings will not identify individual communities.

Protection of emotional well-being: It is possible that questions about infant and maternal deaths could awaken distressing memories. If this happens, the interviewer will stop the interview, assess the condition of the respondent, use words of support, and immediately inform the field coordinator. The field coordinator will inform the project coordinator (an experienced researcher and physician) to decide the actions needed to ensure the welfare of the participant. The field coordinator will be responsible for ensuring that these actions are completed. Our experience

suggests that the opportunity to engage in household and community protection to be uplifting and a self-affirmation for participants. We will provide specific training for interviewers about asking sensitive questions.

Normative pressure within communities: The pilot revealed no pressure on women to seek help from the traditional midwives in intervention communities. However, government conditional cash transfer programmes may have a strong influence towards choosing to use government supported health centres. The clinical practice of the staff in the government health centres in the intervention municipalities will remain independent of the project.

Data security: Digital records will be secure and accessible only to the principal investigators. Original paper records will be securely transported, stored, retained and finally destroyed in accordance with CIET guidelines for security, storage and eventual destruction of paper records.

Discussion

Recent studies in indigenous communities confirm the importance of sociocultural dimensions of safe motherhood [57, 60, 65, 66]. Most indigenous communities face a transition from ancient traditions to Western culture, implying dual healing resources and a complex process of health choices [67]. This cultural transition involves changes in education and service delivery but is an incomplete process in many places, leaving important gaps [68]. For example, indigenous people shun Western services as a reaction to feeling that their culture and values are ignored [20, 57, 59, 69]. Women in these settings fall between the two cultures, where traditional services are attenuated if not actively undermined, but where there is not full access to Western services [70]. Therefore, promotion of intercultural dialogue could open a way for indigenous women to think more highly of Western services and to use them more efficiently [68].

The support requested by the traditional midwives during co-design of the intervention in the pilot study included an apprenticeship programme. In this important sense, authentic traditional midwives represent renewal of their communities and the intergenerational transfer of traditional midwifery skills. Traditional midwives might be a factor in social cohesion, in marital harmony or in the socialisation of young people. Support for traditional midwives means support of recovery and reinforcement of authoritative indigenous knowledge.

Most recent research follows the convention of "upgrading" the skills of traditional midwives in Western concepts of safe motherhood [63, 71, 72, 73]. Often, these approaches rely on ill-suited

methods and often inappropriate teachers – a young Western nurse who is supposed to "teach" women three times her age – and who might dismiss or discourage indigenous practices [20, 61]. This limited understanding of tradition and culture has had deleterious effects on traditional midwifery roles [19, 72]. This trial shifts the focus to support for, rather than replacement or reinvention of traditional midwives. We are not aware of accounts of other trials taking this approach.

Training local community leaders as intercultural brokers (*técnicos interculturales*) to bridge the intercultural gap is the centrepiece of the trial. Our approach is to foster intercultural dialogue in support of both the traditional midwife and the Western obstetrician, each to do what they do best. The argument has never been that traditional midwives might carry out caesarean sections, nor that Western obstetricians are well placed to support indigenous women on issues like work in pregnancy or intimate partner violence. It makes sense to combine primary, secondary and tertiary prevention of maternal morbidity and mortality through an adequate interaction between the two health systems.

Community health workers have long been recognised as "relevant to most service delivery priorities at the primary healthcare level, particularly in under-served areas" [74]. The intervention does not seek to train community workers to deliver clinical services, but rather to train intercultural brokers to liaise between communities and health services, especially for promoting prevention strategies for maternal and child morbidity [75]. This will be the first trial providing information about the value of this sort of training of intercultural brokers in improving maternal outcomes.

This trial might contribute to the discipline of intercultural epidemiology by adapting high-value epidemiological methods to study traditional medical practices in remote indigenous settings. Safe motherhood in cultural safety must go beyond simply classifying indigenous women as high risk, and beyond the degrading concept of "otherness" implicit in cultural sensitivity and cultural competence [76]. A culturally safe approach recognises traditional culture as an asset and the damaging effect that cultural loss and disempowerment have on health status of individuals and communities [77]. Although traditional health systems remain in widespread use [78], evidence about their health impact is scarce and we need attuned epidemiological methods to understand them [79]. We plan to disseminate our results in academic settings as well as to communicate evidence to communities through the intercultural brokers.

Advances of this protocol include use of the pragmatic RCT design, with large clusters (entire municipalities) reducing the contamination of control communities. The involvement of traditional midwives in designing the intervention is likely to be crucial to its success. This is an example of developing better practices of intercultural health based on a respectful intercultural dialogue [35, 80].

Declarations

Acknowledgements

Germán Zuluaga, Carolina Amaya, Juan Pablo Pimentel and Ignacio Giraldo trained the team of Intercultural brokers and offered intercultural advice for the definition of the intervention. Abraham de Jesus García and Nadia Maciel Paulino gave valuable support for fieldwork. The Centro de Investigación de Enfermedades Tropicales of the Universidad Autónoma de Guerrero is the sponsor of the project, its team in Acapulco have been actively involved in the intervention.

Funding

The National Council of Science and Technology of Mexico (CONACyT, PDCPN-2013-214858) is funding the cluster-RCT. McGill University is funding fieldwork for middle-term evaluation of the intervention (T244294C0G). The authors thank The Quebec Population Health Research Network (QPHRN) for its contribution to the financing of this publication. The design, management, analysis and reporting of the study are entirely independent from the sources of funding.

References

1. World Health Organization. Trends in maternal mortality 1990 to 2015: estimates by WHO, UNICEF, UNFPA, World Bank Group and the United Nations Population Division. World Health Organization; 2015.
<http://www.who.int/reproductivehealth/publications/monitoring/maternal-mortality-2015/en/>. Accessed 8 May 2018.
2. United Nations, Department of Economic and Social Affairs. State of the world's indigenous peoples, 2nd volume: indigenous peoples' access to health services. 2013.
<http://www.un.org/esa/socdev/unpfii/documents/2015/sowip2volume-ac.pdf>. Accessed 8 May 2018.

3. Koblinsky M, Moyer CA, Calvert C, Campbell J, Campbell OMR, Feigl AB, et al. Quality maternity care for every woman, everywhere: a call to action. *Lancet*. 2016;388:2307–20.
4. World Health Organization. Every Woman Every Child. The global strategy for women's, children's and adolescents' health, 2016–2030. <http://www.who.int/life-course/partners/global-strategy/en/>. Accessed 8 May 2016.
5. Bar-Zeev S, Barclay L, Kruske S, Bar-Zeev N, Gao Y, Kildea S. Use of maternal health services by remote dwelling aboriginal women in northern Australia and their disease burden. *Birth*. 2013;40:172–81.
6. Harvey S, Blandón Y, McCaw-Binns A, Sandino I, Urbina L, Rodríguez C, et al. Are skilled birth attendants really skilled? A measurement method, some disturbing results and a potential way forward. *Bull World Health Organ*. 2007;85:783–90.
7. World Health Organization. World health report 2005: make every mother and child count. World Health Organization; 2005. <http://www.who.int/whr/2005/en/>. Accessed 8 May 2018.
8. Stephens C, Porter J, Nettleton C, Willis R. Disappearing, displaced, and undervalued: a call to action for indigenous health worldwide. *Lancet*. 2006;367:2019–28.
9. World Health Organization. Making pregnancy safer: the critical role of the skilled attendant. A joint statement by WHO, ICM and FIGO. WHO; 2004. <http://whqlibdoc.who.int/publications/2004/9241591692.pdf>. Accessed 8 May 2018.
10. De Brouwere V, Tonglet R, Van Lerberghe W. Strategies for reducing maternal mortality in developing countries: what can we learn from the history of the industrialized West? *Tropical Med Int Health*. 1998;3:771–82.
11. United Nations Population Fund, International Confederation of Midwives, World Health Organization. The state of the world's midwifery 2014: a universal pathway—a woman's right to health. 2014. https://www.unfpa.org/sites/default/files/pub-pdf/EN_SoWMy2014_complete.pdf. Accessed 8 May 2018.

12. Darmstadt GL, Lee ACC, Cousens S, Sibley L, Bhutta ZA, Donnay F, et al. 60 million non-facility births: who can deliver in community settings to reduce intrapartum-related deaths? *Int J Gynecol Obstet.* 2009;107(Suppl):S89–S112.
13. Buekens P. Averting maternal death and disability. Review of: "traditional birth attendant training effectiveness: a meta-analysis": L.M. Sibley, T.A. Sipe. *Int J Gynecol Obstet.* 2003;83:121–2.
14. Wilson A, Gallos ID, Plana N, Lissauer D, Khan KS, Zamora J, et al. Effectiveness of strategies incorporating training and support of traditional birth attendants on perinatal and maternal mortality: meta-analysis. *BMJ.* 2011;343:d7102.
15. Lassi ZS, Das JK, Salam RA, Bhutta ZA. Evidence from community level inputs to improve quality of care for maternal and newborn health: interventions and findings. *Reprod Health.* 2014;11(Suppl 2):S2. <https://doi.org/10.1186/1742-4755-11-S2-S2>. Accessed 8 May 2018.
16. Byrne A, Morgan A. How the integration of traditional birth attendants with formal health systems can increase skilled birth attendance. *Int J Gynecol Obstet.* 2011;115:127–34.
17. Nyamtema AS, Urassa DP, van Roosmalen J. Maternal health interventions in resource limited countries: a systematic review of packages, impacts and factors for change. *BMC Pregnancy Childb.* 2011;11:30. <https://doi.org/10.1186/1471-2393-11-30>. Accessed 8 May 2018.
18. Lee AC, Lawn JE, Cousens S, Kumar V, Osrin D, Bhutta ZA, et al. Linking families and facilities for care at birth: what works to avert intrapartum-related deaths? *Int J Gynecol Obstet.* 2009;107(Suppl):S65–88.
19. Hinojosa SZ. Authorizing tradition: vectors of contention in highland Maya midwifery. *Soc Sci Med.* 2004;59:637–51.
20. Lang J, Elkin E. A study of the beliefs and birthing practices traditional midwives in rural Guatemala. *J Nurse Midwifery.* 1997;42:25–31.
21. Leedam E. Traditional birth attendants. *Int J Gynecol Obstet.* 1985;23:249–74.
22. International Council for Science and UNESCO. Science, Traditional Knowledge and Sustainable Development. Series on Science for Sustainable Development, No. 4. ICSU; 2002.

- <http://allafrica.com/download/resource/main/main/يداتس/00010039:b3887f9f75e062e63cd568b202469b15.pdf>. Accessed 8 May 2018.
23. Chalmers B. African birth: childbirth in cultural transition. River Club, South Africa: Berev Publications; 1990. <http://www.popline.org/node/384026>. Accessed 8 May 2018.
 24. Davis-Floyd R. Mutual accommodation or biomedical hegemony? Anthropological perspectives on global issues in midwifery. *Midwifery Today Int Midwife*. 2000;53:12–6.
 25. Pigg SL. Acronyms and effacement: traditional medical practitioners (TMP) in international health development. *Soc Sci Med*. 1995;41:47–68.
 26. Saravanan S, Turrell G, Johnson H, Fraser J. Birthing practices of traditional birth attendants in South Asia in the context of training programmes. *J Health Manag*. 2010;12:93–121.
 27. Andersson N. Neonatal survival, cultural safety and traditional midwifery in indigenous communities of Guerrero State, Mexico. ISRCTN80090228. 2009. p. 7. <https://doi.org/10.1186/ISRCTN80090228>. Accessed 8 May 2018.
 28. Andersson N. Proof of impact and pipeline planning: directions and challenges for social audit in the health sector. *BMC Health Serv Res*. 2011;11(Suppl 2):S16. <https://doi.org/10.1186/1472-6963-11-S2-S16>. Accessed 8 May 2018.
 29. United Nations. Department of Economic and Social Affairs. State of the world's indigenous peoples. New York: United Nations; 2009. http://www.un.org/esa/socdev/unpfii/documents/SOWIP/en/SOWIP_web.pdf . Accessed 8 May 2018.
 30. Programa de las Naciones Unidas para el Desarrollo. Informe sobre Desarrollo Humano de los Pueblos Indígenas en México: El reto de la desigualdad de oportunidades. 2010. http://www.cdi.gob.mx/idh/informe_desarrollo_humano_pueblos_indigenas_mexico_2006.pdf. Accessed 14 June 2018.
 31. Fernández Ham P, Tuirán Gutiérrez A, Ordorica Mellado M, Salas Y, Villagómez G, Camarena Córdova RM, Serrano Carreto E. Informe sobre desarrollo humano de los pueblos indígenas de México 2006 (Versión electrónica base 2000). 2006. Available from:

- http://www.cdi.gob.mx/idh/informe_desarrollo_humano_pueblos_indigenas_mexico_2006.pdf. Accessed 8 May 2018.
32. Senado de la República (Mexico). BOLETÍN-0257 Pide Ramírez Hernández otro hospital en montaña de Guerrero. 2012.
<http://comunicacion.senado.gob.mx/index.php/informacion/boletines/4346-boletin-0257-pide-ramirez-hernandez-otro-hospital-en-montana-de-guerrero.html>. Accessed 14 June 2018.
33. Amaro-Cordero A. Diagnóstico en materia de salud pública en el estado de Guerrero. Encrucijada Rev Electrónica del Cent Estud en Adm Pública la Fac Ciencias Políticas y Soc Univ Nac Autónoma México. 2010; Mayo – Ago.
<http://www.revistas.unam.mx/index.php/encrucijada/article/download/58522/51751>. Accessed 14 June 2018.
34. Amaya C. Gestores Comunitarios de Salud: una experiencia pedagógica piloto en la Universidad del Rosario. Rev Ciencias la Salud [Internet]. 2006;4:33–40. Available from:
<http://revistas.urosario.edu.co/index.php/revsalud/article/view/541/465>. Accessed 8 May 2018
35. Pérez Ruíz ML, Argueta AV. Saberes indígenas y dialogo intercultural. Cult y Represent Soc. 2011;Año 5:31–56. Available from:
<http://www.journals.unam.mx/index.php/crs/article/view/24448>. Accessed 8 May 2018.
36. Michie M. Understanding culture brokerage. In: Working cross-culturally. Rotterdam: SensePublishers; 2014. p. 83–106.
37. Barroso G, Sandoval A. Fecundidad indígena y salud reproductiva en La Montaña. In: Programa Universitario México Nación Multicultural, Secretaría de Asuntos Indígenas de Guerrero. Acapulco: Estado del Desarro. económico y Soc. los pueblos indígenas Guerr; 2009.
http://www.nacionmulticultural.unam.mx/edespig/diagnostico_y_perspectivas/RECUADROS/CAPITULO%202/1%20Fecundidad%20indigena%20y%20salud%20reproductiva%20en%20la%20Montana.pdf. Accessed 8 May 2018.
38. Directorio hospitales, clínicas y consultorios en México. <https://hospitalesmexico.com/>. Accessed 8 May 2018.
39. Bentler PM, Speckart G. Models of attitude-behavior relations. Psychol Rev. 1979;86:452–64.

40. Baranowski T, Cullen KW, Nicklas T, Thompson D, Baranowski J. Are current health behavioral change models helpful in guiding prevention of weight gain efforts? *Obes Res.* 2003;11:23S–43S.
41. Andersson N, Ledogar RJ. The CIET aboriginal youth resilience studies: 14 years of capacity building and methods development in Canada. *Pimatisiwin.* 2008;6:65.
42. Andersson N, Cockcroft A, Ansari NM, Omer K, Baloch M, Foster AH, et al. Evidence-based discussion increases childhood vaccination uptake: a randomised cluster controlled trial of knowledge translation in Pakistan. *BMC Int Health Hum Rights.* 2009;9:S8.
43. Andersson N, Nava-Aguilera E, Arosteguí J, Morales-Perez A, Suazo-Laguna H, Legorreta-Soberanis J, et al. Evidence based community mobilization for dengue prevention in Nicaragua and Mexico (Camino Verde, the green way): cluster randomised controlled trial. *BMJ.* 2015;35:h3267.
44. Andersson N, Beauchamp M, Nava-Aguilera E, Paredes-Solís S, Šajna M. The women made it work: fuzzy transitive closure of the results chain in a dengue prevention trial in Mexico. *BMC Public Health.* 2017;17(Suppl 1):408. <https://doi.org/10.1186/s12889-017-4301-0>. Accessed 8 May 2018.
45. Cameron M, Cockcroft A, Waichigo GW, Marokoane N, Laetsang D, Andersson N. From knowledge to action: participant stories of a population health intervention to reduce gender violence and HIV in three southern African countries. *AIDS Care.* 2014;26:1534–40.
46. Mitchell S, Cockcroft A, Lamothe G, Andersson N. Equity in HIV testing: evidence from a cross-sectional study in ten Southern African countries. *BMC Int Health Hum Rights.* 2010;10:23.
47. Dart J, Davies R. A dialogical, story-based evaluation tool: the most significant change technique. *Am J Eval.* 2003;24(2):137–55. <https://doi.org/10.1177/109821400302400202>.
48. Röhm J. Therapeutic equivalence investigations: statistical considerations. *Stat Med.* 1998;17:1703–14.

49. Andersson N, Mitchell S. Epidemiological geomatics in evaluation of mine risk education in Afghanistan: introducing population weighted raster maps. *Int J Health Geogr.* 2006;5(1) <https://doi.org/10.1186/1476-072X-5-1>.
50. Howitt P, Darzi A, Yang GZ, Ashrafi H, Atun R, Barlow J, et al. Technologies for global health. *Lancet.* 2012;380:507–35.
51. Owens D. Interpretation of cost-effectiveness analyses. *J Gen Intern Med.* 1998;13:716–7.
52. Honaker J, King G, Blackwell M. Amelia II: A program for missing data. <https://gking.harvard.edu/amelia>. Accessed 9 May 2018.
53. Hauck WW, Anderson S. Some issues in the design and analysis of equivalence trials. *Drug Inf J.* 1999;33(1):109–18.
54. Walker E, Nowacki AS. Understanding equivalence and noninferiority testing. *J Gen Intern Med.* 2011;26:192–6.
55. Instituto Nacional de Estadística y Geografía (México). Anuario estadístico y geográfico de Guerrero 2015. In: Internet Content INEG; 2015. http://www.datatur.sectur.gob.mx/ITxEF_Docs/GRO_ANUARIO_PDF15.pdf. Accessed 10 May 2018.
56. Taylor DW, Bosch EG. CTS: A clinical trials simulator. *Stat Med.* 1990;9:787–801. <http://doi.wiley.com/10.1002/sim.4780090708>. Accessed 8 May 2018.
57. Berry NS. Kaqchikel midwives, home births, and emergency obstetric referrals in Guatemala: contextualizing the choice to stay at home. *Soc Sci Med.* 2006;62:1958–69.
58. Davis-Floyd R, Sargent C. Introduction: the anthropology of birth. In: Davis-Floyd R, Sargent C, editors. *Childbirth authoritative knowledge: cross-cultural perspectives*. Berkeley: University of California Press; 1997. p. 1–53.
59. Jasen P. Race, culture, and the colonization of childbirth in northern Canada. *J Soc Soc Hist Med.* 1997;10:383–400.
60. Chapman RR. Endangering safe motherhood in Mozambique: prenatal care as pregnancy risk. *Soc Sci Med.* 2003;57:355–74.

61. Kruske S, Barclay L. Effect of shifting policies on traditional birth attendant training. *J Midwifery Womens Health*. 2004;49:306–11. <https://doi.org/10.1016/j.jmwh.2004.01.005>. Accessed 8 May 2018.
62. Walraven G, Weeks A. The role of (traditional) birth attendants with midwifery skills in the reduction of maternal mortality. *Tropical Med Int Health*. 1999;4:527–9.
63. Sibley L, Sipe TA, Koblinsky M. Does traditional birth attendant training improve referral of women with obstetric complications: a review of the evidence. *Soc Sci Med*. 2004;59:1757–68.
64. Zuluaga G. Una ética para la investigación médica con comunidades indígenas. In: Vélez A, Ruiz A, Torres M, editors. *Retos y dilemas los Com ética en Investig*. Bogotá: Editorial Universidad del Rosario; 2013. p. 259–81. http://media.wix.com/ugd/cb47c9_d790340d497847e58f5505518c122b24.pdf. Accessed 8 May 2018.
65. Sesia PM. "Women come here on their own when they need to": prenatal care, authoritative knowledge, and maternal health in Oaxaca. *Med Anthropol Q*. 1996;10:121–40.
66. Castañeda-Camey X. Embarazo, parto y puerperio: conceptos y prácticas de las parteras en el estado de Morelos. *Salud Publica Mex*. 1992;34:528–32.
67. Chukwuneke FN, Ezeonu CT, Onyire BN, Ezeonu PO. Culture and biomedical care in Africa: the influence of culture on biomedical care in a traditional African society, Nigeria, West Africa. *Niger J Med*. 2012;21:331–3.
68. Chomat AM, Solomons NW, Montenegro G, Crowley C, Bermudez OI. Maternal health and health-seeking behaviors among indigenous mam mothers from Quetzaltenango, Guatemala. *Rev Panam Salud Pública*. 2014;35:113–20.
69. Castaneda Camey X, Garcia Barrios C, Romero Guerrero X, Nunez-Urquiza RM, Gonzalez Hernandez D, Langer Glass A. Traditional birth attendants in Mexico: advantages and inadequacies of care for normal deliveries. *Soc Sci Med*. 1996;43:199–207.
70. Chalmers B. Childbirth across cultures: research and practice. *Birth*. 2012;39:276–80.

71. Jokhio A, Winter H, Cheng K. An intervention involving traditional birth attendants and perinatal and maternal mortality in Pakistan. *N Engl J Med*. 2005;352:2091–9.
72. Jenkins GL. Burning bridges: policy, practice, and the destruction of midwifery in rural Costa Rica. *Soc Sci Med*. 2003;56:1893–909.
73. Douglas VK. Childbirth among the Canadian Inuit: a review of the clinical and cultural literature. *Int J Circumpolar Health*. 2006;65:117–32.
74. Maher D, Cometto G. Research on community-based health workers is needed to achieve the sustainable development goals. *Bull World Health Organ*. 2016;94:786.
<https://doi.org/10.2471/BLT.16.185918>. Accessed 8 May 2018.
75. Lassi ZS, Middleton PF, Bhutta ZA, Crowther C. Strategies for improving health care seeking for maternal and newborn illnesses in low- and middle-income countries: a systematic review and meta-analysis. *Glob Health Action*. 2016;9:1–13.
76. Pon G. Cultural competency as new racism: an ontology of forgetting. *J Prog Hum Serv*. 2009;20:59–71.
77. King M, Gracey M. Indigenous health part 2: the underlying causes of the health gap. *Lancet*. 2009;374:76–85.
78. World Health Organization. WHO traditional medicine strategy 2014–2023. Geneva: WHO; 2013. http://www.who.int/medicines/publications/traditional/trm_strategy14_23/en/. Accessed 14 June 2018.
79. World Health Organization. General guidelines for methodologies on research and evaluation of traditional medicine. Geneva: WHO; 2000. Report No.: WHO/EDM/TRM/2000.1.
<http://apps.who.int/medicinedocs/en/d/Jwhozip42e/>. Accessed 9 May 2018
80. Mignone J, Bartlett J, O'Neil J, Orchard T. Best practices in intercultural health: five case studies in Latin America. *J Ethnobiol Ethnomed*. 2007;3:31. <https://doi.org/10.1186/1746-4269-3-31>.

Appendices of Chapter 3 (manuscript 1)

Appendix M1 - 1. Adjacency matrix of the final map showing categories of risk factors for maternal health in the South of Guerrero

Adjacency matrix for the map of risk categories after combination of *Me'phaa* and *Nancue ñomndaa* perspectives.

	R1	R1a	R1b	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14
R1 The woman does not have a healthy maternity (nor a healthy delivery)	0.76	0.53	0.39	0.01												
R1a The woman dies			0.01													
R1b The baby dies																
R2 Abnormal position of baby	0.08	0.03	0.01													
R3 Abortion	0.02	0.06	0.03													
R4 The woman suffers violence	0.34	0.07	0.07		0.03											
R5 Unsupportive family environment	0.07	0.02	0.05		0.02	0.02					0.02					
R6 The woman does not follow protective rituals	0.07	0.02	0.02													
R7 The woman does not follow self-care practices	1.00	0.23	0.29	0.18	0.01	0.01										
R8 Accidents	0.02	0.05	0.05													
R9 Intended spiritual attacks from others	0.12	0.05		0.05							0.02					
R10 Physical or spiritual imbalance	0.15	0.03	0.01													
R11 Primigravida	0.02	0.02	0.02													
R12 The woman has poor health condition (before pregnancy)	0.04	0.01	0.01													
R13 The woman is poorly nourished	0.08	0.01	0.01											0.01		
R14 The woman has worries, feels disgust or nervous during pregnancy	0.30	0.05	0.09													
R15 Unwanted pregnancy	0.02	0.03	0.03		0.03											

Legend: The numbers in the cells represent the cumulative net influence of one category on another, where 1 is the highest influence in the map. Positive and negative signs represent excitatory and inhibitory relationships respectively.

Appendix M1 - 2. Adjacency matrix of the final map showing categories of protective factors for maternal health in the South of Guerrero

Adjacency matrix for the map of protective categories after combination of *Me'phaa* and *Nancue ñomndaa* perspectives

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12
P1 The woman has a safe birth and healthy maternity	0.18											
P2 The woman has support of a midwife or traditional healer	0.93	0.15		0.03		0.15		0.15	0.15	0.38		0.15
P3 Healthcare center or hospital is available (= 5)*	0.16	-0.06		-0.06		-0.03		-0.03		0.12		-0.03
P3 Healthcare center or hospital is available (= 0)*	0.11	-0,06		-0,06		-0,03		-0,03		0,03		-0,03
P4 The woman follows protective rituals	0.70					0.15		0.06		0.30		0.06
P5 The woman follows self-care practices	0.22									0.09		
P6 The woman does not suffer violence	0.24									0.12		
P7 The woman lives without worries	0.22											
P8 The woman has a caring, working, and loving husband	1.00					0.09	0.18	0.28		0.30	0.04	0.24
P9 The woman has good communication with husband	0.44								0.09	0.33		
P10 The woman has a good health condition (before pregnancy)	0.44											
P11 The woman has economic stability	0.20						0.07					0.06
P12 The woman is well nourished	0.65					0.09				0.15		

Legend: The numbers in the cells represent the cumulative net influence of one category on another, where 1 is the highest influence in the map. Positive and negative signs represent excitatory and inhibitory relationships respectively.

* Calculated for the two extreme values discussed in Xochistlahuaca.

Appendices of Chapter 4 (manuscript 2)

Appendix M2 - 1. Profile of researchers who contributed their fuzzy cognitive maps

Participant	Profession and studies	Experience with indigenous groups (countries)	Experience with indigenous groups (decades)	Relation to the project in South Guerrero
Female#1	MD, Master of Public Health (MPH) PhD in parasitology and environmental sciences	Mexico, Canada, Guatemala	Over a decade	Advisor on women involvement
Female#2	MD, Fellow of the Royal College of Physicians (FRCP) Fellow of the Faculty of Occupational Medicine (FFOM)	Mexico, Canada, Guatemala, Botswana, Nigeria, Lesotho, South Africa, Pakistan	Over three decades	Advisor on participatory research
Female#3	MD, MSc in epidemiology, PhD in rural development	Mexico, Canada	Over three decades	Researcher
Male#1	Doctor of medicine (MD), Master of science (MSc) in Epidemiology Master of Philosophy (MPhil) Doctor of Philosophy (PhD) in Public Health	Mexico, Canada, Guatemala, Colombia, Botswana, Nigeria, Lesotho, South Africa, Pakistan	Over three decades	Principal epidemiologist and investigator
Male#2	MD, MPH	Mexico	Member of the <i>Nancue ñomndaa</i> indigenous group in Guerrero, Mexico	Field coordinator
Male#3	MD, MSc in epidemiology	Mexico	Over two decades	Advisor on maternal health interventions
Male#4	MD, MSc in epidemiology, DSc in epidemiology	Mexico, Canada, Botswana	Over two decades	Field manager and principal investigator
Male#5	MD, MSc in epidemiology, DSc in epidemiology	Mexico, Ecuador, Colombia	Over three decades	Advisor on intercultural dialogue

Appendix M2 - 2. Pattern matching table of factors and categories across all the maps

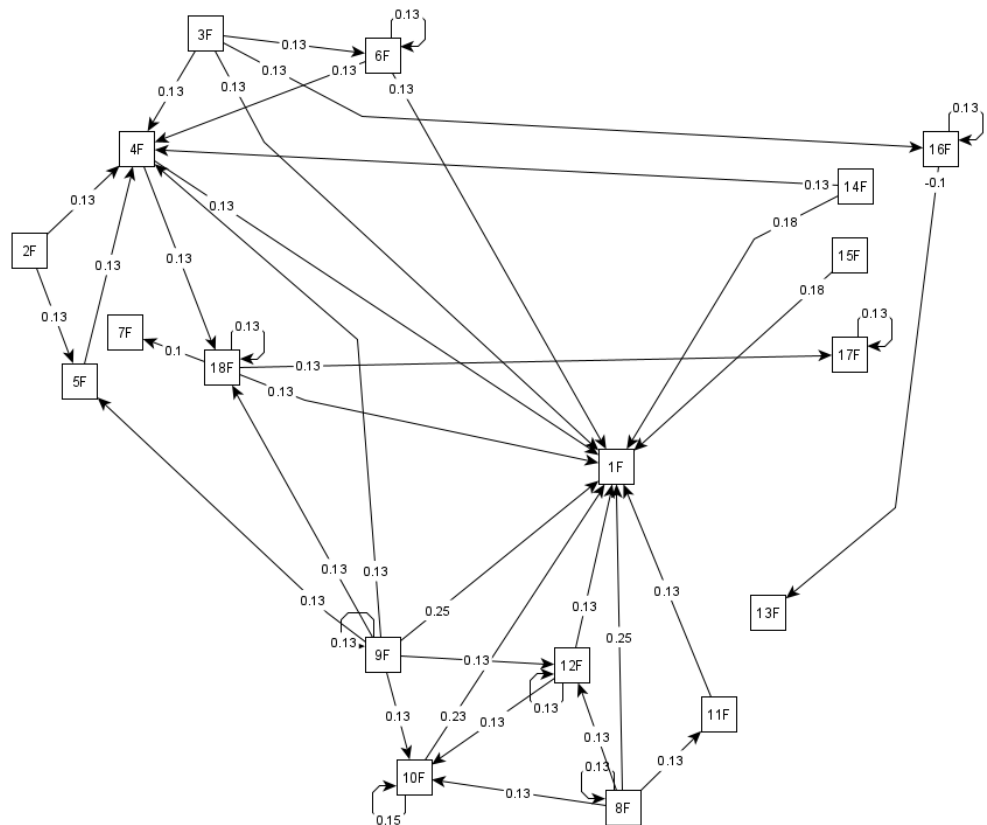
Female#1	Female#2	Female#3	Male#1	Male#2	Male#3	Male#4	Male#5	Category
Maternal health	Maternal health	Maternal health Less complication of pregnancy or childbirth	Maternal health Less complication of pregnancy or childbirth	Maternal health	Maternal health	Maternal health	Maternal health	1C The woman has a safe birth and healthy maternity
Access to formal health services staffed by a doctor Care for childbirth Malpractice and poor quality of health services (inverted)	Access to Western health care Western health care for complications of pregnancy and childbirth Cultural competence of health providers Willingness of women to go to western health services	Availability and access to Western health services Reduced burden on health services Coordination between traditional midwives and Western services	Western health services	Availability and access to Western health services Western health care for complications of pregnancy and childbirth Willingness of women to go to western health services	Availability and access to Western health services (public and private) Improved Health Service Performance (4 WHO functions) Cultural competencies of health care providers Utilisation of quality health services Delays in receiving services in a timely manner with quality and respect while at the services (hospital or health centre) (inverted) Collaboration between midwives and health services (only if there are horizontal relations with services)	Western health services Antenatal care within an intercultural framework	Western health services within an intercultural framework	2C Access to culturally safe Western health care
Geographical context and weather Transport restrictions			Geographical context and isolation of women. Transport restrictions		Delays in getting to health services (distance/transport, infrastructure or services)			3C Geographic or social isolation
Supportive partner Social cohesion within the community and the family	Supportive partner	Family support Ability to seek and obtain health services Community support for traditional medicine	Good relationship with partner	Family support The community supports the pregnant woman	Family support	Family/partner support The community supports the pregnant woman	Good relationship with partner A cultural environment that allows women to take care of their menstruation	4C Support from partner family or community
Access to informal or traditional health services (traditional midwives, etc.) Maintaining cultural identity Traditional health care knowledge Alcoholism and drug abuse (inverted)	Midwives' unity and strength Maintaining cultural identity Following other traditional believes (other than food) Following traditional believes with food (hot/cold food) Alcohol and drugs in the partner (inverted) Alcohol and drugs in the women (inverted) Culture of violence or violence in the community (inverted)	Access to informal or traditional health services (traditional midwives, etc.) Maintaining cultural identity Alcohol and drugs in the partner (inverted) Pressure from other mothers or from women with higher levels of education Mothers' and midwives' fear of complications, illness or death (risk strategy) (inverted)	Traditional midwives (strong and enough) Maintaining cultural identity (includes spiritual dimension)	Access to informal or traditional health services (traditional midwives, etc.) Continuity of traditional midwifery Appropriate management of traditional diseases	Traditional midwives provide care for pregnancy, delivery and post-partum Midwives' unity and strength Traditional midwives in the community	Antenatal care with traditional midwife Traditional midwives in the community Following cultural traditions/rituals	Good relationship with the spiritual or transcendental dimension Traditional care (diet, purging and other traditional practices) Traditional menstrual care	5C Cultural continuity

Reproductive health: spacing and planning			Many children appropriately spaced	Wanted pregnancies Intentional pregnancies to receive more government subsidies			Wanted pregnancies	6C Wanted pregnancy
Culturally unsafe/racist environment Machismo and gender inequity	Land insecurity / loss of territory Previous negative experiences in Western institutions	Inconsistency between policies that recognise cultural diversity and institutional practices Government programmes that follow international policies Western education contrary to traditional culture	Culturally unsafe political and social environment Western education contrary to traditional culture	Poor communication between government programs and communities Women's access to Western education	Previous negative experiences in Western institutions Inconsistency between policies that recognise cultural diversity and institutional practices Government programmes Women's access to Western education	Machismo and gender inequity Government programmes Partner's / Women's access to Western education	Catholic and Christian missionaries Western education contrary to traditional culture	7C Political and institutional culturally unsafe environment
			Risk awareness		Woman recognises/decides that she needs to go to a health service The woman receives adequate information	The woman receives adequate information		8C The woman knows about risks for maternal health
Good nutrition for women	Woman good nutritional status Good diet	Good nutrition for women Adoption of lower quality foods in the diet and abandonment of traditional diets Healthy diets		Good nutrition for women		Good nutrition for women Food security Vitamins and nutritional supplements		9C The woman is well nourished
Poor previous health condition of the woman	Diabetes	Poor previous health condition of the woman	Comorbidities (obesity, diabetes etc.)	Illegal abortions		Comorbidities (obesity, diabetes etc.)		10C The woman has comorbidities
Economic security	Economic security (opposite to poverty)	Financial resources to pay for or access services. Adequate laboral environment	Adequate laboral environment	Economic security	Higher income	Economic security Adequate laboral environment Reduce heavy work during pregnancy		11C The woman has economic stability and adequate laboral environment
Women's mental and emotional health The woman does not suffer violence (physical, psychological and sexual)	The woman does not suffer violence (physical, psychological and sexual) Women's positive emotional and psychological state The woman has adequate rest. She is cared for Emotional well-being of the partner		Women's physical, mental and emotional security	The woman does not suffer violence (physical, psychological and sexual)		The woman does not suffer violence (physical, psychological and sexual)		12C Physical and emotional safety of the women

Appendix M2 - 3. Step by step explanation of the condensation process

To facilitate reproducibility of the condensation process, we prepared a graphical step by step explanation of the condensation of fuzzy cognitive maps into category maps. For this demonstration we used a map with 18 nodes and 40 relationships, as presented below in graphical and tabular formats.

Factor From	Factor To	Weight
8F	1F	0.25
9F	1F	0.25
10F	1F	0.23
14F	1F	0.18
15F	1F	0.18
10F	10F	0.15
8F	8F	0.13
18F	1F	0.13
16F	16F	0.13
8F	10F	0.13
8F	11F	0.13
11F	1F	0.13
18F	18F	0.13
2F	4F	0.13
9F	9F	0.13
9F	4F	0.13
9F	16F	0.13
3F	1F	0.13
3F	18F	0.13
4F	1F	0.13
4F	18F	0.13
18F	17F	0.13
2F	5F	0.13
5F	4F	0.13
9F	5F	0.13
17F	17F	0.13
14F	4F	0.13
6F	6F	0.13
6F	4F	0.13
6F	1F	0.13
3F	6F	0.13
3F	4F	0.13
9F	12F	0.13
9F	10F	0.13
16F	13F	0.1
8F	12F	0.13
18F	7F	0.1
12F	1F	0.13
12F	10F	0.13
12F	12F	0.13

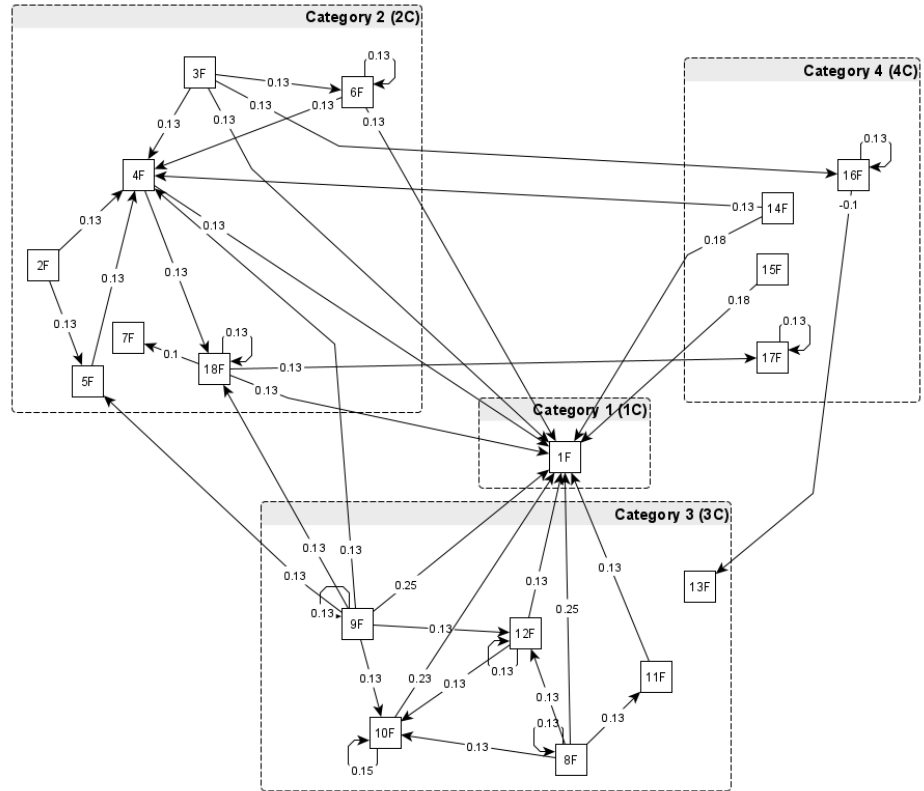


Step 1. Create a list of unique factors in the map and the corresponding category to which they belong. For this example, we have a list of 18 unique factors arranged into four categories. In our paper this table corresponds to **Error! Reference source not found.**.

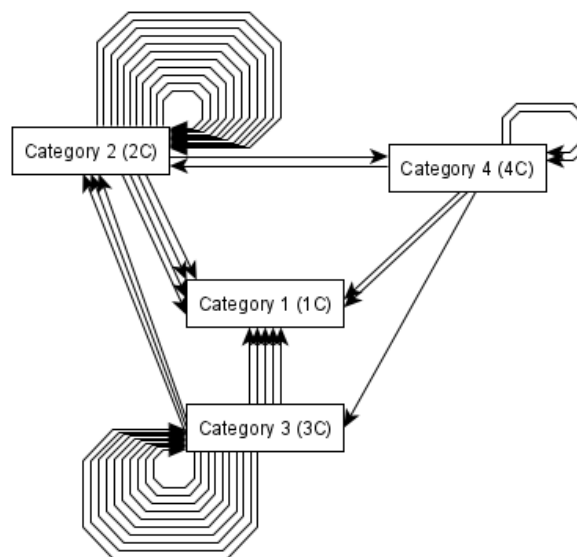
Name of unique the factor	Corresponding category
1F	1C
2F	2C
3F	2C
4F	2C
5F	2C
6F	2C
7F	2C
8F	3C
9F	3C
10F	3C
11F	3C
12F	3C
13F	3C
14F	4C
15F	4C
16F	4C
17F	4C
18F	2C
21F	4C
23F	4C
24F	4C
25F	4C

Step 2. Rename the factors in the map with the corresponding category to which they belong. The result will be a map with four nodes, each representing one category.

Factor-level view of the map (18 nodes and 40 relationships)



Category-level view of the map (4 nodes and 40 relationships)



Category from	Category to	Weight
3C	1C	0.25
3C	1C	0.25
3C	1C	0.23
4C	1C	0.18
4C	1C	0.18
3C	3C	0.15
3C	3C	0.13
2C	1C	0.13
4C	4C	0.13
3C	3C	0.13
3C	3C	0.13
3C	1C	0.13
2C	2C	0.13
2C	2C	0.13
3C	3C	0.13
3C	2C	0.13
3C	2C	0.13
2C	1C	0.13
2C	2C	0.13
2C	1C	0.13
2C	2C	0.13
2C	4C	0.13
2C	2C	0.13
2C	2C	0.13
3C	2C	0.13
4C	4C	0.13
4C	2C	0.13
2C	2C	0.13
2C	2C	0.13
2C	1C	0.13
2C	2C	0.13
2C	2C	0.13
3C	3C	0.13
3C	3C	0.13
4C	3C	0.1
3C	3C	0.13
2C	2C	0.1
3C	1C	0.13
3C	3C	0.13
3C	3C	0.13

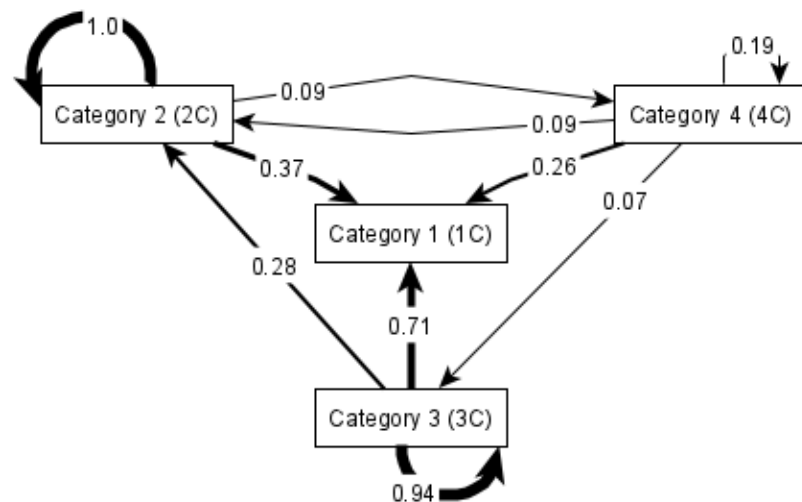
Step 3. Calculate the category level weights by aggregating all the relationships with the same category names. Normalise the weights to put them in the range 0 to 1.

List of category-level relationships

Category relationship	Weight
3C-1C	0.25
3C-1C	0.25
3C-1C	0.23
4C-1C	0.18
4C-1C	0.18
3C-3C	0.15
3C-3C	0.13
2C-1C	0.13
4C-4C	0.13
3C-3C	0.13
3C-3C	0.13
3C-1C	0.13
2C-2C	0.13
2C-2C	0.13
3C-3C	0.13
3C-2C	0.13
3C-2C	0.13
2C-1C	0.13
2C-2C	0.13
2C-1C	0.13
2C-2C	0.13
2C-4C	0.13
2C-2C	0.13
2C-2C	0.13
2C-2C	0.13
3C-2C	0.13
4C-4C	0.13
4C-2C	0.13
2C-2C	0.13
2C-2C	0.13
2C-2C	0.13
3C-3C	0.13
3C-3C	0.13
4C-3C	0.1
3C-3C	0.13
2C-2C	0.1
3C-1C	0.13
3C-3C	0.13
3C-3C	0.13

Unique relationship	Category weight	Normalised
3C-1C	0.99	0.71
4C-1C	0.36	0.26
3C-3C	1.32	0.94
2C-1C	0.52	0.37
4C-4C	0.26	0.19
2C-2C	1.4	1.00
3C-2C	0.39	0.28
2C-4C	0.13	0.09
4C-2C	0.13	0.09
4C-3C	0.1	0.07
Maximum	1.4	1.0

Category map (4 nodes and 10 relationships)



Appendix M2 - 4. Adjacency matrices of the category maps

a) The adjacency matrix of the participant-weighted category map

Participant	1C	2C	3C	4C	5C	6C	7C	8C	9C	10C	11C	12C	Outd.
1C- Healthy maternity	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2C-Access to culturally safe Western Health Care	0.4	0.6	-0.1	0.0	0.1	0.0	-0.1	0.0	0.1	0.0	0.0	0.0	0.4
3C-Geographic or social isolation	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
4C-Support from partner, family or community	0.1	0.2	0.0	0.1	0.2	0.1	0.0	0.0	0.2	0.0	0.1	0.1	0.3
5C-Cultural continuity	0.4	0.6	-0.1	0.3	1.0	0.1	-0.1	0.1	0.4	0.0	0.2	0.3	1.0
6C-Wanted pregnancy	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
7C-Culturally unsafe environment	-0.2	-0.3	0.0	-0.1	-0.4	0.0	0.1	0.0	0.0	0.0	0.0	-0.3	0.4
8C-Woman knows about risks for maternal health	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
9C-Woman is well nourished	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
10C-Woman has comorbidities	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
11C-Woman's economic stability and adequate labor environment	0.1	0.2	0.0	0.0	0.1	0.0	0.0	0.0	0.2	0.0	0.1	0.1	0.3
12C-Physical and emotional safety of the women	0.2	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2

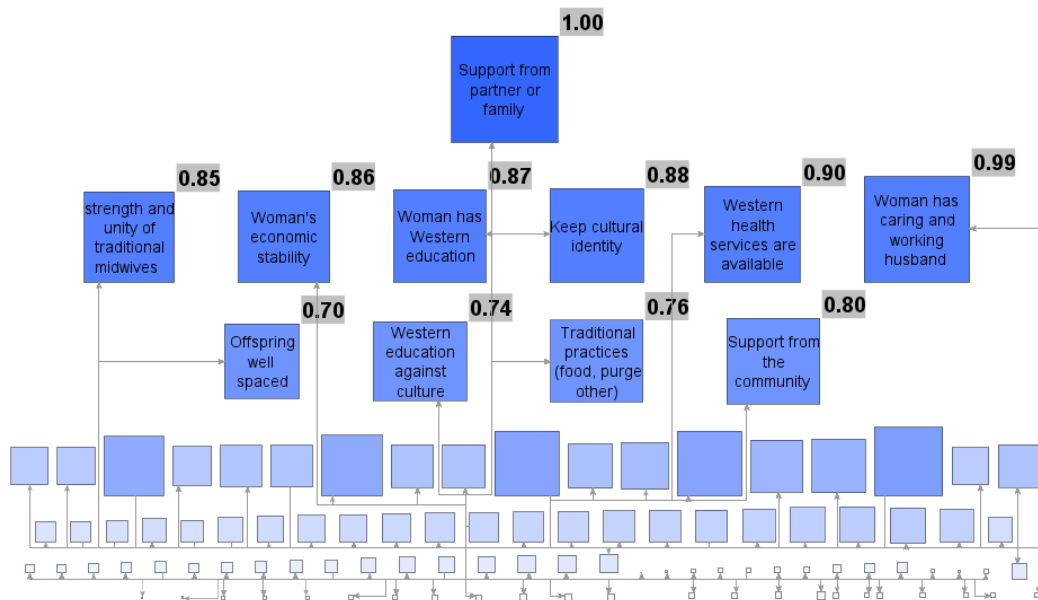
b) The adjacency matrix of the category map using operator-independent weighting

Participant	1C	2C	3C	4C	5C	6C	7C	8C	9C	10C	11C	12C	Outd.
1C- Healthy maternity	0.1	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
2C-Access to culturally safe Western Health Care	0.3	0.7	-0.1	0.0	0.1	0.0	-0.1	0.0	0.1	0.1	0.1	0.0	0.4
3C-Geographic or social isolation	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
4C-Support from partner, family or community	0.1	0.2	0.0	0.2	0.2	0.1	0.0	0.0	0.2	0.0	0.1	0.1	0.3
5C-Cultural continuity	0.4	0.6	0.0	0.4	1.0	0.1	-0.1	0.1	0.4	0.0	0.2	0.4	1.0
6C-Wanted pregnancy	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
7C-Culturally unsafe environment	-0.1	-0.2	0.0	0.0	-0.3	0.0	0.1	0.0	0.0	0.0	0.0	-0.2	0.3
8C-Woman knows about risks for maternal health	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
9C-Woman is well nourished	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
10C-Woman has comorbidities	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
11C-Woman's economic stability and adequate labor environment	0.1	0.3	0.0	0.0	0.1	0.0	0.0	0.0	0.2	0.0	0.1	0.2	0.3
12C-Physical and emotional safety of the women	0.2	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2

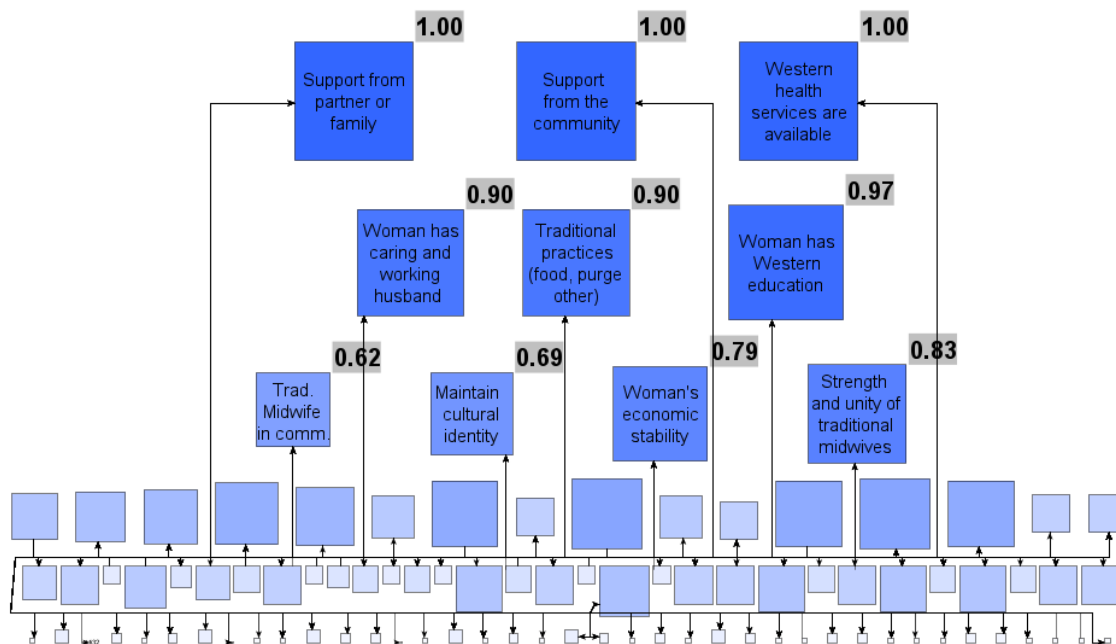
Legend: Each cell in the table corresponds to one relationship in the map. The relationships go from the category in the row to the category in the column. Bold numbers were the strongest levels of influence on the map according to the absolute value of the weights. The last column is the outdegree centrality (Outd.) of the category in its relative order of importance with one being the strongest.

Appendix M2 - 5. Comparison of factor-level outdegree centrality

a) Outdegree centrality of the factors in the map using the original weights assigned by the mappers



b) Outdegree centrality of the factors in the maps using the frequency-based weights



Legend: Figures present the then factors with higher outdegree centrality. The size of the boxes is proportional to the outdegree centrality in a scale between 0 for the lowest (no outgoing edges) and 1 for the highest (very strong outgoing edges). Higher outdegree centrality would imply a higher influence in the system.

Appendices of Chapter 5 (manuscript 3)

Appendix M3 - 1. Study characteristics and list of references

Table 1. Study characteristics

Ref.	Year	Author	Country	Language	Design	Publication type	Study participants ^a	Emphasis in maternal health	Main topic
[1]	1989	Jordan	Mexico	English	Ethnography	Article	# TM	Childbearing management	Training and supplies
[2]	1994	Bastien	Bolivia	English	Interviews	Article	# TM	Childbearing management	Interface of Western and traditional care
[3]	1995	Pauktuutit, Inuit Women's Association of Canada	Canada	English	Interviews	Article	76 CM	Childbearing management	Traditional practices
[4]	1996	Castañeda et al.	Mexico	English	Cross-sectional, interviews, observation	Article	35 TM 243 W	Experience of care	Safety of practices
[5]	1996	Kirsis	United States	English	Interviews	Article	# CM	Childbearing management	Traditional practices
[6]	1997	Lang et al.	Guatemala	English	Interviews	Article	24 TM	Childbearing management	Traditional practices
[7]	2000	Glei et al.	Guatemala	English	Cross-sectional	Article	3,253 births	Childbearing management	Access to Western vs traditional care
[8]	2003	Glei et al.	Guatemala	English	Cross-sectional	Article	2020 PW	Childbearing management	Access to Western vs traditional care
[9]	2003	Goldman et al.	Guatemala	English	Cross-sectional	Article	2872 PW	Childbearing management	Access to Western vs traditional care
[10]	2004	Anderson et al.	Mexico	English	Interviews	Article	6 TM	Childbearing management	Management of complications
[11]	2004	Fonseca-Becker et al.	Guatemala	English	Case study	Report	2 PW	Childbearing management	Management of complications
[12]	2004	Foster et al.	Guatemala	English	Interviews, observation	Article	93 TM, # WP, # CM	Childbearing management	Training and supplies

[13]	2004	Hinojosa	Guatemala	English	Interviews	Article	15 TM	Childbearing management	Interface of Western and traditional care
[14]	2005	Brentlinger et al.	Mexico	English	Cross-sectional	Article	1227 W	Health outcomes	Maternal or perinatal mortality
[15]	2005	DeBroe	Guatemala	English	Cross-sectional	Article	109 PW	Childbearing management	Access to Western vs traditional care
[16]	2005	Pelcastre et al.	Mexico	Spanish	Interviews	Article	25 TM	Childbearing management	Traditional practices
[17]	2006	Berry	Guatemala	English	Multiple methods	Article	No indicated	Childbearing management	Access to Western vs traditional care
[18]	2006	Herrera et al.	Mexico	Spanish	Interviews, focus groups, cross-sectional	Article	# TM, # CM, 158 HH	Health outcomes	Maternal or perinatal mortality
[19]	2006	Rivas	Perú	English	Ethnography	Article	# TM, # W, # CM	Childbearing management	Interface of Western and traditional care
[20]	2006	Walsh	Guatemala	English	Ethnography	Article	10 TM	Childbearing management	Traditional practices
[21]	2007	Chavez et al.	Perú	Spanish	Interviews	Article	4 TM, 12 PW	Experience of care	Traditional practices
[22]	2007	Mignone	Guatemala and Ecuador	English	Case study	Article	No indicated	Childbearing management	Training and supplies, Integration of TM
[23]	2007	Velarde	Perú	Spanish	Interviews, observation	Dissertation	8 TM, 2 W, 2 WP	Childbearing management	Traditional practices, Interface of Western and traditional care
[24]	2008	Coe	Nicaragua	English	Ethnobotany	Article	8 TM	Childbearing management	Traditional practices
[25]	2008	Bayles	Mexico	English	Ethnography	Article	7 TM	Childbearing management	Traditional practices
[26]	2008	Lopez	Guatemala	Spanish	Interviews	Book chapter	# TM	Childbearing management	Interface of Western and traditional care
[27]	2008	Maupin	Guatemala	English	Ethnography, interviews	Article	36 TM	Childbearing management	Training and supplies
[28]	2009	Gabrysch et al.	Perú	English	Program evaluation	Article	801 births	Childbearing management	Cultural adaptation of Western care
[29]	2009	Schooley et al.	Guatemala	English	Interviews, focus groups, observations	Article	21 W, 29 CM	Childbearing management	Access to Western vs traditional care

[30]	2010	Smid et al.	Mexico	English	Interviews, focus groups	Article	65 TM, 24 WP	Childbearing management	New roles of traditional midwives
[31]	2011	Flores et al.	Mexico	Spanish	Interviews, cross-sectional	Book chapter	7 TM, 7 AD, 4 WP	Experience of care	Programs to promote maternal health
[32]	2011	Ramos	Colombia	Spanish	Interviews	Dissertation	10 PW	Childbearing management	Traditional practices
[33]	2011	Sosa-Rubí et al.	Mexico	English	Cross-sectional	Article	5051 W	Childbearing management	Access to Western vs traditional care
[34]	2011	Veizaga-Fernández	Bolivia	Spanish	Interviews	Dissertation	3 TM	Childbearing management	Interface of Western and traditional care
[35]	2012	Amaya et al.	Mexico	Spanish	Interviews	Article	14 W	Childbearing management	Community involvement
[36]	2012	Ministério de Saude	Brazil	Portuguese	Case study	Book chapter	No indicated	Childbearing management	Training and supplies, Support of traditional midwifery
[37]	2012	Salazar	Chile	Spanish	Interviews	Dissertation	3 W	Childbearing management	Traditional practices
[38]	2012	Smith-Oka	Mexico	English	Interviews, observation	Article	5 TM, 8 WP, 48 W	Traditional diseases	Traditional practices
[39]	2013	Chary et al.	Guatemala	English	Interviews	Article	44 TM	Childbearing management	Role of traditional midwives
[40]	2013	Espinel	Ecuador	Spanish	Interviews, cross-sectional	Dissertation	161 TM	Childbearing management	Traditional practices
[41]	2013	Ruiz et al.	Guatemala	English	Interviews	Article	7 TM, 4 PW, 14 W, 9 CM, 14 WP	Childbearing management	Access to Western vs traditional care
[42]	2013	Torri	Ecuador	English	Ethnography	Article	20 TM, 35 W, 7 WP	Childbearing management	Traditional practices
[43]	2013	Tucker et al.	Guatemala	English	Interviews, focus groups	Article	7 TM, # W, 11 WP	Childbearing management	Access to Western vs traditional care
[44]	2013	Van Dijk et al.	Guatemala	English	Interviews	Article	45 TM, 18 W, 44 WP,	Childbearing management	Interface of Western and traditional care

[45]	2013	Avellaneda-Yajahuanca et al.	Perú	English	Ethnography	Article	Not indicated	Childbearing management	Access to Western vs traditional care
[46]	2014	Chomat et al.	Guatemala	English	Cross-sectional	Article	100 W	Childbearing management	Access to Western vs traditional care
[47]	2015	Amat et al.	Mexico	English	Cross-sectional	Report	451 TM	Childbearing management	Training and supplies
[48]	2015	Gusman et al.	Brazil	Portuguese	Interviews	Article	39 TM	Childbearing management	Training and supplies
[49]	2015	Ibañez et al.	Mexico	English	Interviews	Article	12 TM, 13 W	Childbearing management	Access to Western vs traditional care
[50]	2016	Santana	Ecuador	Spanish	Cross-sectional	Dissertation	24 TM, 20 WP	Childbearing management	Interface of Western and traditional care
[51]	2016	Stollak et al.	Guatemala	English	Cross-sectional, interviews, focus groups	Article	# TM, 275 W, # CM, # WP	Childbearing management	Access to Western vs traditional care
[52]	2017	Austard et al.	Guatemala	English	Program evaluation	Article	45 TM, 800 W	Childbearing management	Care navigation
[53]	2017	Friesen et al.	Guatemala	Spanish	Interviews, focus groups	Article	# TM, 10 W, 13 WP	Experience of care	Interface of Western and traditional care
[54]	2017	Gallegos et al.	Ecuador	English	Interviews, focus groups, workshops, observation	Article	19 TA, 13 WP	Childbearing management	Interface of Western and traditional care
[55]	2017	Laureano et al.	Mexico	Spanish	Interviews	Article	84 TM	Childbearing management	Traditional practices
[56]	2017	Rangel et al.	Mexico	Spanish	Focus groups	Article	24 TM, 18 WP	Childbearing management	Interface of Western and traditional care
[57]	2017	Roberts et al.	Guatemala	English	Pretest-Posttest, interviews	Article	26 TM	Childbearing management	Training and supplies
[58]	2017	Vega	Mexico	Spanish	Ethnography	Article	2069 people	Childbearing management	Interface of Western and traditional care
[59]	2018	Gil Veloz	Mexico	Spanish	Interviews	Book chapter	# PW	Experience of care	Traditional practices
[60]	2018	Paredes-Solis et al.	Mexico	Spanish	Interviews, cross-sectional	Book chapter	1723 W, 4 TM	Experience of care	Support of traditional midwifery
[61]	2018	Vega-Macedo et al.	Mexico	Spanish	Interviews	Book chapter	# W, #TM	Childbearing management	Access to Western vs traditional care
[62]	2018	Uicab-Pool et al.	Mexico	Spanish	Interviews	Book chapter	7 W	Childbearing management	Access to Western vs traditional care

[63]	2018	Acero-Vidal et al.	Mexico	Spanish	Interviews	Book chapter	6 TM	Experience of care	Community participation
[64]	2018	Rodríguez-Flores et al.	Mexico	Spanish	Interviews	Book chapter	30 TM	Childbearing management	Integration of traditional midwives in primary care
[65]	2018	Martínez-Villarruel	Mexico	Spanish	Interviews	Book chapter	# TM, # WP	Childbearing management	Integration of traditional midwives in primary care
[66]	2018	Velázquez-Gutiérrez et al.	Mexico	Spanish	Interviews, cross-sectional	Book chapter	821 TM or WP	Childbearing management	Training and supplies
[67]	2018	Vázquez-Gómez et al.	Mexico	Spanish	Interviews, focus groups	Book chapter	109 TM	Childbearing management	Trained birth attendants
[68]	2018	Herrera-Torres et al.	Guatemala, Mexico	Spanish	Interviews	Book chapter	No indicated	Childbearing management	Training and supplies
[69]	2018	Ramírez-Pérez	Mexico	Spanish	Interviews	Book chapter	13 W	Childbearing management	Access to Western vs traditional care
[70]	2018	Garcia et al.	Guatemala	English	Pretest-Posttest	Article	191 TM	Childbearing management	Training and supplies
[71]	2018	Hernandez et al.	Guatemala	English	Pretest-Posttest	Article	13 TM	Childbearing management	Training and supplies
[72]	2018	De Jesus-García et al.	Mexico	English	Interviews, cross sectional	Article	4 TM, 2 W, 2 PW, 3 CM, 13 WP, 1238 births	Health outcomes	Perineal trauma
[73]	2018	Jimenez et al.	Mexico	Spanish	Interviews	Article	9 TM	Childbearing management	Traditional practices
[74]	2018	Llamas et al.	Ecuador	English	Interviews	Article	4 TM, 35 WP, 7 CM	Childbearing management	Interface of Western and traditional care
[75]	2018	Martinez	Guatemala	English	Pragmatic feasibility trial - pilot	Article	44 TM, 799 births	Childbearing management/Health outcomes	Access to Western vs traditional care
[76]	2018	Paiva et al.	Brazil	Spanish	Ethnography	Article	33 W, # WP, # CM	Childbearing management	Traditional practices
[77]	2018	Poaquiza	Ecuador	Spanish	Interviews	Dissertation	3 TM, 45 W	Childbearing management	Traditional practices

[78]	2018	Sarmiento et al.	Mexico	English	Parallel randomised pilot trial	Article	16 TM, 346 births	Health outcomes	Support of traditional midwifery
[79]	2019	Chomat et al.	Guatemala	English	Parallel group pilot randomised	Article	6 TM, 10 CM, 84 W	Health outcomes	New roles of traditional midwives
[80]	2019	Gusman et al.	Brazil	English	Ethnography	Article	10 W	Experience of care	Programs to promote maternal health
[81]	2019	Ordinola et al.	Perú	Spanish	Interviews, focus groups	Article	6 TM, 24 PW	Childbearing management	Traditional practices
[82]	2019	Orrego et al.	Guatemala	English	Interviews, focus groups, observation	Article	22 TM, 1 WP	Childbearing management	New roles of traditional midwives
[83]	2019	Perez	Mexico	Spanish	Ethnography	Article	7 PW	Childbearing management	Traditional practices
[84]	2019	Sousa et al.	Guatemala	English	Program evaluation	Article	Not indicated	Childbearing management	Training and supplies
[85]	2020	Austard et al.	Guatemala	English	Program evaluation	Article	847 births, 41 TM	Childbearing management	Care navigation
[86]	2020	Dixon	Mexico	English	Ethnography	Book chapter	3 TM	Experience of care	Traditional practices
[87]	2020	Ico et al.	Mexico	Spanish	Interviews	Report	1 TM	Childbearing management	Support of traditional midwifery

Legend: a # = Unreported number of; TM = Traditional midwives; W = Women; PW = Pregnant women; CM = Community members; WP = Western healthcare personnel; HH = Household; AD = Advocate or volunteer.

List of References

- [1] Jordan. 1989. Cosmopolitical obstetrics: some insights from the training of traditional midwives. *Social Science & Medicine*;28(9):925-37
- [2] Bastien. 1994. Collaboration of doctors and nurses with ethnomedical practitioners. *World Health Forum*;15 (2):133-7
- [3] Pauktuutit, Inuit Women's Association of Canada. 1995. Pauktuutit Special Report Inuit Midwifery, 1995. *Suvaguuq*;10:1
- [4] Castañeda et al. 1996. Traditional birth attendants in Mexico: Advantages and inadequacies of care for normal deliveries. *Social Science & Medicine*;43(2):199-207

- [5] Kirsis. 1996. "She Taught Us How to Be": The Cultural Construction of Birth and Midwifery among the Koyukon Athabaskans of Interior Alaska. *Arctic Anthropology*;33(2):62–76
- [6] Lang et al. 1997. A study of the beliefs and birthing practices of traditional midwives in rural Guatemala. *Journal of Nurse-Midwifery*;42(1):25-31
- [7] Gleit et al. 2000. Understanding ethnic variation in pregnancy-related care in rural Guatemala. *Ethnicity & Health*;5(1):5-22
- [8] Gleit et al. 2003. Utilization of care during pregnancy in rural Guatemala: does obstetrical need matter?. *Social Science & Medicine*;57(12):2447
- [9] Goldman et al. 2003. Evaluation of midwifery care: results from a survey in rural Guatemala. *Social Science & Medicine*;56(4):685
- [10] Anderson et al. 2004. Pathways of decision making among Yucatan Mayan traditional birth attendants. *Journal of Midwifery & Women's Health*;49(4):312-9
- [11] Fonseca-Becker et al. 2004. Impact Evaluation: Community Mobilization and Behavior Change, Maternal and Neonatal Health Component, Ministry of Health and Public Assistance. Johns Hopkins Bloomberg School of Public Health Center for Communication Programs
- [12] Foster et al. 2004. A report of a midwifery model for training traditional midwives in Guatemala. *Midwifery*;20(3):217-25
- [13] Hinojosa. 2004. Authorizing tradition: vectors of contention in Highland Maya midwifery. *Social Science & Medicine*;2004(59):637-51
- [14] Brentlinger et al. 2005. Pregnancy outcomes, site of delivery, and community schisms in regions affected by the armed conflict in Chiapas, Mexico. *Social Science & Medicine*;61(5):1001-14
- [15] DeBroe. 2005. Diversity in the use of pregnancy-related care among ethnic groups in Guatemala. *Journal of Family Planning & Reproductive Health Care*;31(3):199-205

- [16] Pelcastre et al. 2005. Embarazo, parto y puerperio creencias y prácticas de parteras en San Luis Potosí, México. *Rev Esc Enferm*;39(4):75-82
- [17] Berry. 2006. Kaqchikel midwives, home births, and emergency obstetric referrals in Guatemala: Contextualizing the choice to stay at home. *Social Science & Medicine*;62:1958–69
- [18] Herrera et al. 2006. La economía del grupo doméstico: determinante de muerte materna entre mujeres indígenas de Chiapas, México. *Rev. panam. salud pública*;19(2):69-78
- [19] Rivas. 2006. At highest risk: maternal health in the high Peruvian Andes. *MIDIRS Midwifery Digest*;16(1):46-50
- [20] Walsh. 2006. Beliefs and rituals in traditional birth attendant practice in Guatemala. *Journal of Transcultural Nursing*;17(2):148-54
- [21] Chavez et al. 2007. Rescuing the self-care of health during pregnancy, the delivery and to the newborn: social representations from women of a native community in Peru. *Texto & Contexto Enfermagem*;16(4):680-7
- [22] Mignone. 2007. Best practices in intercultural health: five case studies in Latin America. *Journal of Ethnobiology & Ethnomedicine*;3:31
- [23] Velarde. 2007. Las parteras sí saben, son importantes, solo que están olvidadas". Situación actual de las parteras en los Andes del sur del Perú (Ayacucho). Thesis. Pontificia Universidad Católica del Perú, Perú
- [24] Coe. 2008. Rama midwifery in eastern Nicaragua. *Journal of Ethnopharmacology*;117:136-57
- [25] Bayles. 2008. Metaphors to cure by: Tojolab'al Maya midwifery and cognition. *Anthropology & Medicine*;15(3):227-38
- [26] Lopez. 2008. El fin de las comadronas tradicionales en el Oriente de Guatemala. In: Fernández-Juárez et al. (Eds). *La diversidad frente al espejo. Salud, interculturalidad y contexto migratorio*.

- [27] Maupin. 2008. Remaking the Guatemalan midwife: Health care reform and midwifery training programs in highland Guatemala. *Medical Anthropology*;27(4):353-82
- [28] Gabrysch et al. 2009. Cultural adaptation of birthing services in rural Ayacucho, Peru. *Bulletin of the World Health Organization*;87(9):724-9
- [29] Schooley et al. 2009. Factors influencing health care-seeking behaviours among Mayan women in Guatemala. *Midwifery*;25(4):411-21
- [30] Smid et al. 2010. Bringing two worlds together: exploring the integration of traditional midwives as doulas in Mexican public hospitals. *Health Care Women Int*;31(6):475-98
- [31] Flores et al. 2011. Nadie se muere por parir: Muerte Materna en Guerrero. Universidad Autónoma de Tlaxcala
- [32] Ramos. 2011. Prácticas culturales de cuidado de gestantes indígenas que viven en el Resguardo Zenú ubicado en la Sabana de Córdoba. Thesis. Universidad Nacional de Colombia, Colombia
- [33] Sosa-Rubí et al. 2011. Learning effect of a conditional cash transfer programme on poor rural women's selection of delivery care in Mexico. *Health Policy and Planning*;26:496–507
- [34] Veizaga-Fernández. 2011. Articulación de parteras tradicionales al sistema de salud, Chimeo Villamontes - Tarija 2011. Thesis. Universidad Mayor de San Andrés, Bolivia
- [35] Amaya et al. 2012. Gender and work: The experience of providers of health services to indigenous women from Guerrero and Oaxaca. *Ciencia e Saude Coletiva*;17(3):731-9
- [36] Ministério de Saude. 2012. Parto e nascimento domiciliar assistidos por parteiras tradicionais: o programa trabalhando com parteiras tradicionais e experiências exemplares.

- [37] Salazar. 2012. El oficio de la puñenelchefe: memorias del parto en los relatos de tres mujeres mapuche de la comunidad curaco ranquil. Thesis. Universidad de Chile, Chile
- [38] Smith-Oka. 2012. An analysis of two indigenous reproductive health illnesses in a Nahua community in Veracruz, Mexico. *Journal of Ethnobiology and Ethnomedicine*;8:33
- [39] Chary et al. 2013. The changing role of indigenous lay midwives in Guatemala: new frameworks for analysis. *Midwifery*;29(8):852-8
- [40] Espinel. 2013. Modelo de certificación social y formal con énfasis en la partería en la medicina tradicional indígena en la provincia de Napo 2010 TT - Model of social and formal certification with emphasis on midwifery in traditional indigenous medicine in Napo provin. Thesis. Universidad técnica del Norte, Ecuador
- [41] Ruiz et al. 2013. Barriers to the use of maternity waiting homes in indigenous regions of Guatemala: a study of users' and community members' perceptions. *Culture, Health & Sexuality*;15(2):205-18
- [42] Torri. 2013. Perceptions and uses of plants for reproductive health among traditional midwives in Ecuador: moving towards intercultural pharmacological practices. *Midwifery*;29(7):809-17
- [43] Tucker et al. 2013. The acceptability and feasibility of an intercultural birth center in the highlands of Chiapas, Mexico. *BMC Pregnancy and Childbirth*;13:94
- [44] Van Dijk et al. 2013. Ensuring intercultural maternal health care for Mayan women in Guatemala: a qualitative assessment. *Culture, Health & Sexuality*;15(sup3):S365-82
- [45] Avellaneda-Yajahuanca et al. 2013. Birth at the health center or at home: an analysis of birthing care among the Kukamas Kukamirias women of Peru. *Rev. bras. crescimento desenvolv. Hum*;23(3):322-30

- [46] Chomat et al. 2014. Maternal health and health-seeking behaviors among indigenous Mam mothers from Quetzaltenango, Guatemala. *Rev Panam Salud Publica*;35(2):113–20
- [47] Amat et al. 2015. Traditional Midwives working within the Mexican health system. Exploratory study in Central Mexico. <https://www.researchgate.net/publication/334416554>. Accessed 2021/03/19
- [48] Gusman et al. 2015. Inclusão de parteiras tradicionais no Sistema Único de Saúde no Brasil: reflexão sobre desafios. *Rev. panam. salud pública*;37(4):365-70
- [49] Ibañez et al. 2015. Labor and delivery service use: indigenous women's preference and the health sector response in the Chiapas Highlands of Mexico. *International Journal for Equity in Health*;14:156
- [50] Santana. 2016. Estrategia de Integración al Sistema de Salud Pública Ecuatoriano de Parteras/Os, Parroquia Quisapincha, Ambato, 2016. Thesis. Universidad Técnica de Ambato, Ecuador
- [51] Stollak et al. 2016. Casas Maternas in the Rural Highlands of Guatemala: A Mixed-Methods Case Study of the Introduction and Utilization of Birthing Facilities by an Indigenous Population. *Global Health: Science and Practice*;4(1):114-31
- [52] Austard et al. 2017. Obstetric care navigation: a new approach to promote respectful maternity care and overcome barriers to safe motherhood. *Reproductive Health*;14:148
- [53] Friesen et al. 2017. Atención del parto y del puerperio inmediato con pertinencia intercultural. *Rev. Col. Méd. Cir. Guatem*;156(2):67-70
- [54] Gallegos et al. 2017. Discourse versus practice: are traditional practices and beliefs in pregnancy and childbirth included or excluded in the Ecuadorian health care system?. *International Health*;9(2):105-11

- [55] Laureano et al. 2017. Perspectiva de las parteras en Jalisco, México, frente al embarazo de alto riesgo: estudio cualitativo. *Rev. colomb. obstet. Ginecol*;68(1):49-61
- [56] Rangel et al. 2017. Agenciamientos y resistencias en el cuidado obstétrico comunitario: tras la capacitación institucional. *Index de Enfermería*;26(4):250-4
- [57] Roberts et al. 2017. Simulation Learning Among Low Literacy Guatemalan Traditional Birth Attendants. *International Journal of Childbirth*;7(2):67-76
- [58] Vega. 2017. Racial i(nter)dentification: The racialization of maternal health through the Oportunidades program and in government clinics in Mexico. *Salud Colectiva*;13(3):489-505
- [59] Gil Veloz. 2018. Partería entre las mujeres rarámuri y wixaritari. In: Freyermuth G (Ed). *Los caminos para parir en México en el siglo XXI*.
- [60] Paredes-Solís et al. 2018. Percepción de los cambios producidos por la enseñanza de parteras tradicionales experimentadas de Xochistlahuaca, Guerrero (In Freyermuth, 2018). In: Freyermuth G (Ed). *Los caminos para parir en México en el siglo XXI*.
- [61] Vega-Macedo et al. 2018. Salud materna: retos y oportunidades en el acceso a una atención de calidad. El papel de las parteras tradicionales en comunidades indígenas de Chiapas. In: Freyermuth G (Ed). *Los caminos para parir en México en el siglo XXI*.
- [62] Uicab-Pool et al. 2018. Factores que determinan que las mujeres embarazadas de bajos recursos elijan el modelo de partería tradicional. In: Freyermuth G (Ed). *Los caminos para parir en México en el siglo XXI*.
- [63] Acero-Vidal et al. 2018. Participación comunitaria en la atención de la salud. Grupo de parteras tradicionales de Carmen Yalchuch, Chiapas. In: Freyermuth G (Ed). *Los caminos para parir en México en el siglo XXI*.

- [64] Rodríguez-Flores et al. 2018. Propuesta para la inclusión de las parteras tradicionales en el primer nivel de atención: el caso de Atoyac de Álvarez, Guerrero. In: Freyermuth G (Ed). Los caminos para parir en México en el siglo XXI.
- [65] Martínez-Villarruel. 2018. La partería en el modelo intercultural de salud. El caso de la sierra Norte de Puebla. In: Freyermuth G (Ed). Los caminos para parir en México en el siglo XXI.
- [66] Velázquez-Gutiérrez et al. 2018. La capacitación en partería y su incidencia en la calidad de la atención. Experiencias de éxito en San Luis Potosí. In: Freyermuth G (Ed). Los caminos para parir en México en el siglo XXI.
- [67] Vázquez-Gómez et al. 2018. Lo que dicen las parteras tradicionales sobre su participación en la formación de parteras profesionales. In: Freyermuth G (Ed). Los caminos para parir en México en el siglo XXI.
- [68] Herrera-Torres et al. 2018. La voz de las parteras. El compartir sabiduría a través de la radio, en Chiapas. In: Freyermuth G (Ed). Los caminos para parir en México en el siglo XXI.
- [69] Ramírez-Pérez. 2018. El parto en los modelos público institucional y partería tradicional: motivaciones de las mujeres del istmo oaxaqueño. In: Freyermuth G (Ed). Los caminos para parir en México en el siglo XXI.
- [70] Garcia et al. 2018. Teaching Guatemalan traditional birth attendants about obstetrical emergencies. *Midwifery*;61:36-38
- [71] Hernandez et al. 2018. Impact of Standardized Prenatal Clinical Training for Traditional Birth Attendants in Rural Guatemala. *Healthcare*;6(2):9
- [72] De Jesus-García et al. 2018. Associations with perineal trauma during childbirth at home and in health facilities in indigenous municipalities in southern Mexico: a cross-sectional cluster survey. *BMC Pregnancy & Childbirth*;18(1):198
- [73] Jimenez et al. 2018. Costumbres y prácticas ancestrales en el cuidado de la mujer tseltal embarazada. *Cultura de los Cuidados*;23:53

- [74] Llamas et al. 2018. Five hundred years of medicine gone to waste? Negotiating the implementation of an intercultural health policy in the Ecuadorian Andes. *BMC Public Health*;18(1):686
- [75] Martinez. 2018. mHealth intervention to improve the continuum of maternal and perinatal care in rural Guatemala: a pragmatic, randomized controlled feasibility trial. *Reproductive Health*;15(1):120
- [76] Paiva et al. 2018. ¿Quiénes son las parteras munduruku? Pluralismo médico y autoatención en el parto domiciliario entre indígenas en Amazonas, Brasil. *Desacatos*;58:16-33
- [77] Poaquiza. 2018. Uso de plantas medicinales en la labor de parto en la parroquia de Salasaca. Thesis. Universidad Técnica de Ambato, Ecuador
- [78] Sarmiento et al. 2018. Safe Birth and Cultural Safety in southern Mexico: study protocol for a randomised controlled trial. *Trials*;19(1):354
- [79] Chomat et al. 2019. Women's circles as a culturally safe psychosocial intervention in Guatemalan indigenous communities: a community-led pilot randomised trial. *BMC Women's Health*;19(1):53
- [80] Gusman et al. 2019. Paradoxes of the traditional midwives program in the context of Kraho women. *Ciencia & Saude Coletiva*;24(7):2627-36
- [81] Ordinola et al. 2019. Creencias y costumbres para la atención del embarazo, parto y puerperio en madres y parteras del distrito de huancas, chachapoyas - 2014. *Arnaldoa*;26(1):325-38
- [82] Orrego et al. 2019. Engaging the capacity of comadronas as HIV prevention providers in rural Guatemala. *Health Care for Women International*;41:5
- [83] Perez. 2019. Costumbres y prácticas ancestrales en el cuidado de la mujer tseltal embarazada. *Metas Enferm*;22(7):49-55

- [84] Sousa et al. 2019. Building Capacity to Provide Maternal Health Care in an Indigenous Guatemalan Community Through Ultrasound and Skills Training. *Journal of Radiology Nursing*;38:123-30
- [85] Austard et al. 2020. Obstetric care navigation: Results of a quality improvement project to provide accompaniment to women for facility-based maternity care in rural Guatemala. *BMJ Qual Saf*;29:169–178
- [86] Dixon. 2020. *Delivering Health: Midwifery and Development in Mexico*. Chapter 5. Vanderbilt University Press. muse.jhu.edu/book/78557. Accessed 2021/03/19
- [87] Ico et al. 2020. Parteras Mayas tradicionales cuidando la salud de las mujeres. <https://www.culturalsurvival.org/news/parteras-mayas-tradicionales-cuidando-la-salud-de-las-mujeres>. Accessed 2021/03/20

Appendix M3 - 2. References of the studies that mentioned factors in each of the categories used to condense the maps

Category	Code	Outgoing relationships	Incoming relationships
Positive maternal health outcomes	C1	[4], [10], [12], [13], [14], [16], [17], [18], [25], [26], [37], [38], [54], [57], [66], [75], [76], [81], [83], [85]	[3], [4], [5], [6], [10], [11], [14], [16], [17], [18], [19], [21], [22], [23], [25], [26], [27], [29], [31], [32], [34], [37], [38], [39], [42], [43], [45], [47], [51], [54], [55], [56], [57], [60], [61], [63], [66], [69], [70], [71], [72], [74], [76], [77], [78], [79], [81], [82], [83], [85], [86]
Adequate nutrition	C2	[3], [10], [16], [21], [23], [32], [81]	[23], [46], [82]
Woman's comorbidities or physical weakness (before pregnancy)	C3	[5], [14], [31], [38], [72], [76], [85]	
Abortion and contraception	C4		[6], [16], [21], [37], [41], [64], [82]
Health of children and other family members	C5		[22], [23], [26], [47], [64], [76]
Casual/Family/No childbirth attendant	C6	[13], [18]	[3], [13], [18], [59], [76], [78], [80], [81]
Access to Western health care	C7	[3], [5], [8], [10], [11], [13], [14], [15], [17], [18], [19], [23], [31], [34], [37], [40], [43], [48], [49], [52], [53], [56], [59], [60], [62], [64], [65], [66], [68], [69], [76], [81]	[5], [7], [8], [9], [11], [13], [14], [15], [16], [17], [18], [19], [22], [23], [28], [29], [31], [33], [36], [41], [43], [46], [47], [49], [50], [51], [53], [56], [57], [58], [59], [60], [61], [62], [64], [66], [69], [72], [74], [75], [76], [80], [84], [85]
Traditional midwives refer patients to Western care	C8	[12], [17], [23], [57], [76], [86]	[2], [4], [6], [7], [9], [10], [16], [17], [19], [22], [23], [27], [28], [30], [39], [41], [44], [47], [48], [50], [51], [53], [54], [56], [57], [60], [61], [63], [65], [66], [67], [70], [71], [75], [76], [82], [85], [86]
Culturally sensitive maternal health programs	C9	[2], [11], [12], [13], [19], [22], [27], [28], [29], [31], [36], [41], [43], [44], [49], [51], [60], [61], [63], [65], [66], [74], [75], [79], [85]	[13], [18], [19], [28], [29], [31], [34], [36], [43], [44], [49], [51], [52], [54], [74], [78], [79]
Culturally unsafe care	C10	[1], [2], [4], [5], [10], [11], [13], [14], [15], [16], [17], [19], [23], [27], [30], [31], [33], [34], [35], [37], [39], [41], [43], [44], [49], [50], [53], [54], [56], [59], [62], [63], [64], [65], [66], [69], [72], [74], [76], [81], [86]	[4], [6], [11], [12], [13], [16], [17], [18], [19], [22], [23], [27], [28], [29], [31], [36], [37], [39], [41], [44], [49], [53], [54], [56], [57], [59], [60], [61], [62], [63], [66], [69], [74], [86]
Disempowered communities, families or women	C11	[7], [11], [14], [17], [19], [21], [22], [23], [27], [29], [31], [35], [38], [39], [41], [43], [49], [53], [55], [56], [57], [58], [59], [60], [66], [67], [75], [80], [81]	[3], [5], [8], [11], [12], [13], [14], [18], [19], [22], [23], [27], [28], [29], [31], [35], [36], [37], [39], [41], [51], [53], [58], [60], [62], [63], [64], [66], [68], [69], [76], [79], [82], [86], [87]
Programs focused on training and supplies	C12	[1], [2], [9], [10], [12], [16], [19], [22], [26], [27], [31], [39], [47], [56], [57], [58], [65], [66], [68], [70], [71], [79], [80], [82], [84], [86]	[1], [2], [12], [36], [47], [61], [65], [68]

Indigenous identity	C13	[3], [4], [6], [7], [8], [9], [10], [11], [13], [14], [15], [16], [18], [19], [21], [23], [26], [28], [31], [33], [37], [40], [41], [43], [45], [46], [49], [55], [57], [59], [60], [61], [62], [64], [65], [66], [67], [68], [69], [70], [72], [75], [76], [77], [80], [82], [83], [86]	[3], [10], [13], [16], [18], [23], [26], [27], [31], [32], [34], [37], [40], [46], [57], [58], [59], [60], [66], [68], [80], [82], [83], [87]
Practice/Persistence of traditional midwifery	C14	[3], [4], [6], [9], [10], [11], [12], [14], [16], [17], [19], [21], [22], [24], [23], [26], [27], [31], [32], [34], [35], [37], [38], [39], [40], [42], [45], [47], [48], [49], [54], [57], [60], [61], [63], [64], [66], [67], [69], [70], [71], [72], [73], [74], [76], [78], [81], [82], [83], [86], [87]	[2], [3], [4], [5], [6], [9], [10], [11], [12], [13], [16], [17], [18], [19], [20], [24], [22], [23], [26], [27], [31], [32], [33], [34], [36], [37], [39], [40], [43], [47], [48], [56], [57], [60], [61], [62], [63], [64], [65], [66], [67], [68], [69], [73], [76], [80], [81], [82], [83], [84], [86], [87]
Self-care practices	C15	[3], [4], [10], [13], [16], [17], [19], [20], [21], [23], [25], [32], [37], [38], [42], [45], [55], [76], [77], [81], [82], [83], [86]	[3], [4], [11], [16], [18], [19], [21], [23], [26], [28], [29], [36], [37], [39], [42], [45], [57], [59], [61], [63], [73], [76], [77], [79], [81], [83], [87]
Interest in training or new roles	C16	[39], [82]	[1], [12], [27], [30], [39], [57], [58], [63], [66], [68], [71], [80], [82]
Material poverty and marginalization	C17	[4], [7], [8], [9], [10], [11], [13], [14], [15], [16], [17], [18], [19], [22], [23], [27], [31], [32], [35], [36], [37], [40], [41], [43], [46], [47], [48], [49], [50], [51], [53], [57], [59], [61], [62], [64], [66], [67], [68], [69], [75], [76], [80], [81], [82], [83], [84], [86]	[7], [8], [11], [13], [14], [18], [23], [31], [46], [50], [70], [75], [82]
Positive experience with home childbirth	C18	[19], [43]	[4], [6], [21], [23], [26], [45], [54], [60], [66], [74]
Spiritual/divine help	C19	[10], [17], [20], [26], [27], [31], [37], [39], [61], [67], [76], [82], [86], [87]	[17], [22], [26]
External advocates and NGOs promoting maternal and reproductive health	C20	[12], [19], [22], [30], [36], [51], [78], [84], [86]	[12], [65]

References

- [1] Jordan. 1989. Cosmopolitical obstetrics: some insights from the training of traditional midwives. *Social Science & Medicine*;28(9):925-37
- [2] Bastien. 1994. Collaboration of doctors and nurses with ethnomedical practitioners. *World Health Forum*;15 (2):133-7
- [3] Pauktuutit, Inuit Women's Association of Canada. 1995. Pauktuutit Special Report Inuit Midwifery, 1995. *Suvaguuq*;10:1

- [4] Castaneda et al. 1996. Traditional birth attendants in Mexico: Advantages and inadequacies of care for normal deliveries. *Social Science & Medicine*;43(2):199-207
- [5] Kirsis. 1996. "She Taught Us How to Be": The Cultural Construction of Birth and Midwifery among the Koyukon Athabaskans of Interior Alaska. *Arctic Anthropology*;33(2):62–76
- [6] Lang et al. 1997. A study of the beliefs and birthing practices of traditional midwives in rural Guatemala. *Journal of Nurse-Midwifery*;42(1):25-31
- [7] Glei et al. 2000. Understanding ethnic variation in pregnancy-related care in rural Guatemala. *Ethnicity & Health*;5(1):5-22
- [8] Glei et al. 2003. Utilization of care during pregnancy in rural Guatemala: does obstetrical need matter?. *Social Science & Medicine*;57(12):2447
- [9] Goldman et al. 2003. Evaluation of midwifery care: results from a survey in rural Guatemala. *Social Science & Medicine*;56(4):685
- [10] Anderson et al. 2004. Pathways of decision making among Yucatan Mayan traditional birth attendants. *Journal of Midwifery & Women's Health*;49(4):312-9
- [11] Fonseca-Becker et al. 2004. Impact Evaluation: Community Mobilization and Behavior Change, Maternal and Neonatal Health Component, Ministry of Health and Public Assistance. Johns Hopkins Bloomberg School of Public Health Center for Communication Programs
- [12] Foster et al. 2004. A report of a midwifery model for training traditional midwives in Guatemala. *Midwifery*;20(3):217-25
- [13] Hinojosa. 2004. Authorizing tradition: vectors of contention in Highland Maya midwifery. *Social Science & Medicine*;2004(59):637-51

- [14] Brentlinger et al. 2005. Pregnancy outcomes, site of delivery, and community schisms in regions affected by the armed conflict in Chiapas, Mexico. *Social Science & Medicine*;61(5):1001-14
- [15] DeBroe. 2005. Diversity in the use of pregnancy-related care among ethnic groups in Guatemala. *Journal of Family Planning & Reproductive Health Care*;31(3):199-205
- [16] Pelcastre et al. 2005. Embarazo, parto y puerperio creencias y prácticas de parteras en San Luis Potosí, México. *Rev Esc Enferm*;39(4):75-82
- [17] Berry. 2006. Kaqchikel midwives, home births, and emergency obstetric referrals in Guatemala: Contextualizing the choice to stay at home. *Social Science & Medicine*;62:1958–69
- [18] Herrera et al. 2006. La economía del grupo doméstico: determinante de muerte materna entre mujeres indígenas de Chiapas, México. *Rev. panam. salud pública*;19(2):69-78
- [19] Rivas. 2006. At highest risk: maternal health in the high Peruvian Andes. *MIDIRS Midwifery Digest*;16(1):46-50
- [20] Walsh. 2006. Beliefs and rituals in traditional birth attendant practice in Guatemala. *Journal of Transcultural Nursing*;17(2):148-54
- [21] Chavez et al. 2007. Rescuing the self-care of health during pregnancy, the delivery and to the newborn: social representations from women of a native community in Peru. *Texto & Contexto Enfermagem*;16(4):680-7
- [22] Mignone. 2007. Best practices in intercultural health: five case studies in Latin America. *Journal of Ethnobiology & Ethnomedicine*;3:31
- [23] Velarde. 2007. Las parteras sí saben, son importantes, solo que están olvidadas". Situación actual de las parteras en los Andes del sur del Perú (Ayacucho). Thesis. Pontificia Universidad Católica del Perú, Perú

- [24] Coe. 2008. Rama midwifery in eastern Nicaragua. *Journal of Ethnopharmacology*;117:136-57
- [25] Bayles. 2008. Metaphors to cure by: Tojolab'al Maya midwifery and cognition. *Anthropology & Medicine*;15(3):227-38
- [26] Lopez. 2008. El fin de las comadronas tradicionales en el Oriente de Guatemala. In: Fernández-Juárez et al. (Eds). *La diversidad frente al espejo. Salud, interculturalidad y contexto migratorio*.
- [27] Maupin. 2008. Remaking the Guatemalan midwife: Health care reform and midwifery training programs in highland Guatemala. *Medical Anthropology*;27(4):353-82
- [28] Gabrysch et al. 2009. Cultural adaptation of birthing services in rural Ayacucho, Peru. *Bulletin of the World Health Organization*;87(9):724-9
- [29] Schooley et al. 2009. Factors influencing health care-seeking behaviours among Mayan women in Guatemala. *Midwifery*;25(4):411-21
- [30] Smid et al. 2010. Bringing two worlds together: exploring the integration of traditional midwives as doulas in Mexican public hospitals. *Health Care Women Int*;31(6):475-98
- [31] Flores et al. 2011. Nadie se muere por parir: Muerte Materna en Guerrero. Universidad Autónoma de Tlaxcala
- [32] Ramos. 2011. Prácticas culturales de cuidado de gestantes indígenas que viven en el Resguardo Zenú ubicado en la Sabana de Córdoba. Thesis. Universidad Nacional de Colombia, Colombia
- [33] Sosa-Rubí et al. 2011. Learning effect of a conditional cash transfer programme on poor rural women's selection of delivery care in Mexico. *Health Policy and Planning*;26:496–507

- [34] Veizaga-Fernández. 2011. Articulación de parteras tradicionales al sistema de salud, Chimeo Villamontes - Tarija 2011. Thesis. Universidad Mayor de San Andrés, Bolivia
- [35] Amaya et al. 2012. Gender and work: The experience of providers of health services to indigenous women from Guerrero and Oaxaca. *Ciencia e Saude Coletiva*;17(3):731-9
- [36] Ministério de Saude. 2012. Parto e nascimento domiciliar assistidos por parteiras tradicionais: o programa trabalhando com parteiras tradicionais e experiências exemplares.
- [37] Salazar. 2012. El oficio de la puñenelchefe: memorias del parto en los relatos de tres mujeres mapuche de la comunidad curaco ranquil. Thesis. Universidad de Chile, Chile
- [38] Smith-Oka. 2012. An analysis of two indigenous reproductive health illnesses in a Nahua community in Veracruz, Mexico. *Journal of Ethnobiology and Ethnomedicine*;8:33
- [39] Chary et al. 2013. The changing role of indigenous lay midwives in Guatemala: new frameworks for analysis. *Midwifery*;29(8):852-8
- [40] Espinel. 2013. Modelo de certificación social y formal con énfasis en la partería en la medicina tradicional indígena en la provincia de Napo 2010 TT - Model of social and formal certification with emphasis on midwifery in traditional indigenous medicine in Napo provin. Thesis. Universidad técnica del Norte, Ecuador
- [41] Ruiz et al. 2013. Barriers to the use of maternity waiting homes in indigenous regions of Guatemala: a study of users' and community members' perceptions. *Culture, Health & Sexuality*;15(2):205-18
- [42] Torri. 2013. Perceptions and uses of plants for reproductive health among traditional midwives in Ecuador: moving towards intercultural pharmacological practices. *Midwifery*;29(7):809-17

- [43] Tucker et al. 2013. The acceptability and feasibility of an intercultural birth center in the highlands of Chiapas, Mexico. *BMC Pregnancy and Childbirth*;13:94
- [44] Van Dijk et al. 2013. Ensuring intercultural maternal health care for Mayan women in Guatemala: a qualitative assessment. *Culture, Health & Sexuality*;15(sup3):S365-82
- [45] Avellaneda-Yajahuanca et al. 2013. Birth at the health center or at home: an analysis of birthing care among the Kukamas Kukamirias women of Peru. *Rev. bras. crescimento desenvolv. Hum*;23(3):322-30
- [46] Chomat et al. 2014. Maternal health and health-seeking behaviors among indigenous Mam mothers from Quetzaltenango, Guatemala. *Rev Panam Salud Publica*;35(2):113–20
- [47] Amat et al. 2015. Traditional Midwives working within the Mexican health system. Exploratory study in Central Mexico. <https://www.researchgate.net/publication/334416554>. Accessed 2021/03/19
- [48] Gusman et al. 2015. Inclusão de parteiras tradicionais no Sistema Único de Saúde no Brasil: reflexão sobre desafios. *Rev. panam. salud pública*;37(4):365-70
- [49] Ibañez et al. 2015. Labor and delivery service use: indigenous women's preference and the health sector response in the Chiapas Highlands of Mexico. *International Journal for Equity in Health*;14:156
- [50] Santana. 2016. Estrategia de Integración al Sistema de Salud Pública Ecuatoriano de Parteras/Os, Parroquia Quisapincha, Ambato, 2016. Thesis. Universidad Técnica de Ambato, Ecuador
- [51] Stollak et al. 2016. Casas Maternas in the Rural Highlands of Guatemala: A Mixed-Methods Case Study of the Introduction and Utilization of Birthing Facilities by an Indigenous Population. *Global Health: Science and Practice*;4(1):114-31

- [52] Austard et al. 2017. Obstetric care navigation: a new approach to promote respectful maternity care and overcome barriers to safe motherhood. *Reproductive Health*;14:148
- [53] Friesen et al. 2017. Atención del parto y del puerperio inmediato con pertinencia intercultural. *Rev. Col. Méd. Cir. Guatem*;156(2):67-70
- [54] Gallegos et al. 2017. Discourse versus practice: are traditional practices and beliefs in pregnancy and childbirth included or excluded in the Ecuadorian health care system?. *International Health*;9(2):105-11
- [55] Laureano et al. 2017. Perspectiva de las parteras en Jalisco, México, frente al embarazo de alto riesgo: estudio cualitativo. *Rev. colomb. obstet. Ginecol*;68(1):49-61
- [56] Rangel et al. 2017. Agenciamientos y resistencias en el cuidado obstétrico comunitario: tras la capacitación institucional. *Index de Enfermería*;26(4):250-4
- [57] Roberts et al. 2017. Simulation Learning Among Low Literacy Guatemalan Traditional Birth Attendants. *International Journal of Childbirth*;7(2):67-76
- [58] Vega. 2017. Racial i(nte)ridentification: The racialization of maternal health through the Oportunidades program and in government clinics in Mexico. *Salud Colectiva*;13(3):489-505
- [59] Gil Veloz. 2018. Partería entre las mujeres rarámuri y wixaritari. In: Freyermuth G (Ed). *Los caminos para parir en México en el siglo XXI*.
- [60] Paredes-Solís et al. 2018. Percepción de los cambios producidos por la enseñanza de parteras tradicionales experimentadas de Xochistlahuaca, Guerrero (In Freyermuth, 2018). In: Freyermuth G (Ed). *Los caminos para parir en México en el siglo XXI*.

- [61] Vega-Macedo et al. 2018. Salud materna: retos y oportunidades en el acceso a una atención de calidad. El papel de las parteras tradicionales en comunidades indígenas de Chiapas. In: Freyermuth G (Ed). Los caminos para parir en México en el siglo XXI.
- [62] Uicab-Pool et al. 2018. Factores que determinan que las mujeres embarazadas de bajos recursos elijan el modelo de partería tradicional. In: Freyermuth G (Ed). Los caminos para parir en México en el siglo XXI.
- [63] Acero-Vidal et al. 2018. Participación comunitaria en la atención de la salud. Grupo de parteras tradicionales de Carmen Yalchuch, Chiapas. In: Freyermuth G (Ed). Los caminos para parir en México en el siglo XXI.
- [64] Rodríguez-Flores et al. 2018. Propuesta para la inclusión de las parteras tradicionales en el primer nivel de atención: el caso de Atoyac de Álvarez, Guerrero. In: Freyermuth G (Ed). Los caminos para parir en México en el siglo XXI.
- [65] Martínez-Villarruel. 2018. La partería en el modelo intercultural de salud. El caso de la sierra Norte de Puebla. In: Freyermuth G (Ed). Los caminos para parir en México en el siglo XXI.
- [66] Velázquez-Gutiérrez et al. 2018. La capacitación en partería y su incidencia en la calidad de la atención. Experiencias de éxito en San Luis Potosí. In: Freyermuth G (Ed). Los caminos para parir en México en el siglo XXI.
- [67] Vázquez-Gómez et al. 2018. Lo que dicen las parteras tradicionales sobre su participación en la formación de parteras profesionales. In: Freyermuth G (Ed). Los caminos para parir en México en el siglo XXI.
- [68] Herrera-Torres et al. 2018. La voz de las parteras. El compartir sabiduría a través de la radio, en Chiapas. In: Freyermuth G (Ed). Los caminos para parir en México en el siglo XXI.
- [69] Ramírez-Pérez. 2018. El parto en los modelos público institucional y partería tradicional: motivaciones de las mujeres del istmo oaxaqueño. In: Freyermuth G (Ed). Los caminos para parir en México en el siglo XXI.

- [70] Garcia et al. 2018. Teaching Guatemalan traditional birth attendants about obstetrical emergencies. *Midwifery*;61:36-38
- [71] Hernandez et al. 2018. Impact of Standardized Prenatal Clinical Training for Traditional Birth Attendants in Rural Guatemala. *Healthcare*;6(2):9
- [72] De Jesus-García et al. 2018. Associations with perineal trauma during childbirth at home and in health facilities in indigenous municipalities in southern Mexico: a cross-sectional cluster survey. *BMC Pregnancy & Childbirth*;18(1):198
- [73] Jimenez et al. 2018. Costumbres y prácticas ancestrales en el cuidado de la mujer tseltal embarazada. *Cultura de los Cuidados*;23:53
- [74] Llamas et al. 2018. Five hundred years of medicine gone to waste? Negotiating the implementation of an intercultural health policy in the Ecuadorian Andes. *BMC Public Health*;18(1):686
- [75] Martinez. 2018. mHealth intervention to improve the continuum of maternal and perinatal care in rural Guatemala: a pragmatic, randomized controlled feasibility trial. *Reproductive Health*;15(1):120
- [76] Paiva et al. 2018. ¿Quiénes son las parteras munduruku? Pluralismo médico y autoatención en el parto domiciliario entre indígenas en Amazonas, Brasil. *Desacatos*;58:16-33
- [77] Poaquiza. 2018. Uso de plantas medicinales en la labor de parto en la parroquia de Salasaca. Thesis. Universidad Técnica de Ambato, Ecuador
- [78] Sarmiento et al. 2018. Safe Birth and Cultural Safety in southern Mexico: study protocol for a randomised controlled trial. *Trials*;19(1):354
- [79] Chomat et al. 2019. Women's circles as a culturally safe psychosocial intervention in Guatemalan indigenous communities: a community-led pilot randomised trial. *BMC Women's Health*;19(1):53

- [80] Gusman et al. 2019. Paradoxes of the traditional midwives program in the context of Kraho women. *Ciencia & Saude Coletiva*;24(7):2627-36
- [81] Ordinola et al. 2019. Creencias y costumbres para la atención del embarazo, parto y puerperio en madres y parteras del distrito de huancas, chachapoyas - 2014. *Arnaldoa*;26(1):325-38
- [82] Orrego et al. 2019. Engaging the capacity of comadronas as HIV prevention providers in rural Guatemala. *Health Care for Women International*;41:5
- [83] Perez. 2019. Costumbres y prácticas ancestrales en el cuidado de la mujer tseltal embarazada. *Metas Enferm*;22(7):49-55
- [84] Sousa et al. 2019. Building Capacity to Provide Maternal Health Care in an Indigenous Guatemalan Community Through Ultrasound and Skills Training. *Journal of Radiology Nursing*;38:123-30
- [85] Austard et al. 2020. Obstetric care navigation: Results of a quality improvement project to provide accompaniment to women for facility-based maternity care in rural Guatemala. *BMJ Qual Saf*;29:169–178
- [86] Dixon. 2020. Delivering Health: Midwifery and Development in Mexico. Chapter 5. Vanderbilt University Press. muse.jhu.edu/book/78557. Accessed 2021/03/19
- [87] Ico et al. 2020. Parteras Mayas tradicionales cuidando la salud de las mujeres. <https://www.culturalsurvival.org/news/parteras-mayas-tradicionales-cuidando-la-salud-de-las-mujeres>. Accessed 2021/03/20

Appendix M3 - 3 Adjacency matrix of the category map

		C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16	C17	C18	C19	C20
Positive maternal health outcomes	C1	0.14				-0.03	0.02	0.04	-0.03	0.02	-0.03	0.02		-0.03	-0.10	-0.03	-0.02	-0.02	-0.01	-0.01	
Adequate nutrition	C2	0.14																			
Woman's comorbidities or physical weakness (before pregnancy)	C3	-0.12						-0.04	0.04												
Abortion and contraception	C4																				
Health of children and other family members	C5																				
Casual/Family/No childbirth attendant	C6	0.02						0.02		0.02	-0.01			-0.02	-0.02			-0.02			
Access to Western health care	C7	0.05			0.02	0.02	0.02	0.06	0.03	0.03	0.05	0.11	0.02	-0.06	-0.14	-0.04					
Traditional midwives refer patients to Western care	C8	-0.02				0.02		0.02			-0.03	-0.04									
Culturally sensitive maternal health programs	C9	0.06				0.02		0.27	0.18	0.14	-0.36	-0.20	0.07	0.02	0.11	0.12	0.02		-0.02	0.02	
Culturally unsafe care	C10	-0.11			0.02	-0.04		-0.51	-0.48	-0.15	0.25	0.26	-0.02	-0.07	-0.23	-0.09	-0.05	0.02	-0.05		
Disempowered communities, families or women	C11	-0.29				-0.04		-0.26	-0.03	-0.02	0.09	-0.02		-0.02	-0.18	-0.08	-0.01	0.02	-0.01	-0.02	
Programs focused on training and supplies	C12	0.24				-0.02		0.04	0.08	0.02	-0.02	-0.03	-0.02	-0.01	-0.21	0.04	0.01			-0.02	
Indigenous identity	C13	0.02	-0.01	-0.02	0.04	0.04	-0.50	-0.04	0.01	-0.05	-0.10			0.16	0.02	0.27	0.02	0.16	0.06	0.02	0.02
Practice/Persistence of traditional midwifery	C14	0.30			-0.11	0.22	-0.02	-0.04	0.07		-0.15	-0.32	-0.04	0.48	0.47	0.41	0.09	0.04	0.24	0.08	
Self-care practices	C15	1.00			0.02		0.02			0.02	-0.01			-0.01	-0.01	0.02				-0.02	
Interest in training or new roles	C16								0.02		-0.02	0.04			-0.01	0.02	0.02				
Material poverty and marginalization	C17	-0.16	-0.06	-0.06	0.06	0.08	-1.00	-0.16	-0.03	0.01	-0.05	-0.04	0.11	-0.03	0.14	-0.08	0.17	0.06	0.02		
Positive experience with home childbirth	C18							-0.04			-0.04										
Spiritual/divine help	C19	0.04			-0.01	0.04			0.07		-0.02	-0.03		0.10	0.25	0.10	0.02		0.02	0.02	
External advocates and NGOs promoting maternal and reproductive health	C20					0.02		-0.02	0.06	0.06	-0.06	-0.09	0.04		0.13	0.04	-0.02			0.02	0.02

Legend: Each cell in the table corresponds to one relationship in the map. The relationships go from the category in the row to the category in the column. Bold numbers were the ten strongest levels of influence on the map for positive and negative relationships.

Appendices of Chapter 6 (manuscript 4)

Appendix M4 - 1. Evaluation of the implementation of the intervention and baseline characteristics

Community	Evaluation of the intervention					Proportion of households with the characteristic according to the baseline survey								
	As treated	Per Protocol status	Traditional Midwife	Intercultural Broker	Apprentice	Spanish speakers	Domestic violence	Women decide	Skilled attend.	Home deliveries	Intention of future hospital deliveries	Health facility in the community	Tap water	Remote
Cluster#1														
7101	A	Int.	1	Fair	Good	Low	High	High	High	Low	High	Yes	High	No
7102	C	No Int.	visiting TM	Bad*	Bad	High	Low	High	High	Low	High	Yes	High	No
7103	C	No Int.	visiting TM	Bad*	Bad	High	Low	Low	High	Low	High	Yes	High	No
7104	C	No Int.	1 ^a	Bad*	Good	Low	High	Low	Low	Low	High	Yes	High	No
7105	C	No Int.	Same 7104	Bad*	Good	Low	Low	Low	Low	Low	High	Yes	High	No
7106	B	No Int.	1	Good	Bad	High	High	High	Low	Low	High	Yes	High	No
7107	B	No Int.	Same 7106	Good	Bad	Low	Low	Low	Low	Low	High	Yes	High	No
7108	C	No Int.	visiting TM	No	No	High	Low	High	High	Low	High	Yes	High	Yes
7109	B	No Int.	1	Bad	Good	Low	High	Low	Low	High	Low	Yes	High	No
7110	B	No Int.	1	Bad	Good	Low	High	High	Low	High	Low	No	High	No
7111	C	No Int.	1	Bad*	Good	Low	Low	NA	High	Low	High	No	High	No
7112	B	No Int.	Same 7101	Fair	Fair	Low	Low	NA	High	High	Low	No	High	No
7113	C	No Int.	1 ^a	Bad*	Good	High	Low	Low	High	Low	High	Yes	High	No
7114	A	Int.	1	Good	Bad	Low	Low	High	Low	High	High	No	Low	Yes
7115	A	Int.	1	Good	Bad	Low	Low	Low	High	High	Low	No	High	Yes
7116	C	No Int.	visiting TM	No	No	Low	Low	Low	Low	High	Low	No	Low	Yes
7117	C	No Int.	1	Bad*	Good	Low	High	Low	Low	High	Low	Yes	High	Yes
7118	C	No Int.	1	Bad*	Good	Low	Low	High	High	Low	High	No	High	No

7119	C	No Int.	1	Bad*	Good	Low	High	High	High	High	Low	No	High	No
7120	C	No Int.	1	Bad*	No	Low	High	Low	High	Low	High	No	High	No
Cluster#2														
7601	A	No Int.	1	Fair	Good	Low	High	High	High	Low	High	Yes	High	No
7602	A	No Int.	1	Good	Good	Low	Low	High	Low	High	Low	Yes	High	No
7603	C	No Int.	1	Good	Good	Low	Low	Low	Low	Low	Low	Yes	Low	No
7604	A	Int.	visiting TM	Bad	No	High	High	High	High	Low	Low	Yes	Low	No
7605	A	Int.	1	Good	Good	High	Low	Low	Low	High	Low	Yes	High	No
7606	A	Int.	1+2	Good	Fair	Low	Low	High	High	High	Low	Yes	High	No
7607	A	Int.	1+4	Excellent	Fair	High	Low	High	High	High	High	Yes	High	No
7608	A	Int.	1	Good	Fair	High	Low	Low	High	High	Low	Yes	Low	No
7609	B	No Int.	1	Good	Fair	Low	Low	High	Low	High	Low	Yes	Low	No
7610	C	No Int.	1	Bad	Good	High	Low	Low	High	High	Low	Yes	Low	No
7611	A	Int.	visiting TM	No	No	Low	Low	High	Low	High	Low	Yes	High	Yes
7612	B	No Int.	1	Fair	Good	Low	Low	Low	Low	High	Low	No	Low	No
7613	A	Int.	1	Bad	Fair	Low	Low	Low	Low	High	High	No	Low	No
7614	C	No Int.	1 ^a	Good	Fair	High	Low	High	Low	Low	High	No	High	No
7615	B	No Int.	1	No	Fair	High	Low	Low	High	High	Low	No	High	No
7616	C	No Int.	1	Fair	Bad	Low	Low	Low	Low	High	Low	No	Low	Yes
7617	C	No Int.	visiting TM	No	No	High	High	High	High	Low	High	Yes	High	No
7618	C	No Int.	visiting TM	No	No	Low	Low	High	Low	Low	Low	Yes	Low	No
7619	B	No Int.	1 ^a	No	Good	High	Low	High	High	High	High	No	High	Yes
7620	A	Int.	1	Fair	Fair	Low	Low	Low	High	High	Low	No	Low	Yes

Appendix M4 - 2. Comparison of groups as treated using GLMMs

Table 1. OR and 95%CI for each comparison of groups as treated. We present in bold the measures showing significant differences.

	Four components	Three components	Less than three components	Control
Four components		Serious complications 0.66 0.13–3.37 Neonatal complication 1.49 0.31–7.06 Perinatal death 0.71 0.09–5.37	Serious complications 0.36 0.10–1.29 Neonatal complication 0.86 0.30–2.52 Perinatal death 1.22 0.27–5.56	Serious complications 0.35 0.14–0.92 Neonatal complication 0.61 0.25–1.71 Perinatal death 0.66 0.25– 1.77
			Serious complications 0.32 0.10–1.06 Neonatal complication 0.68 0.25–1.81 Perinatal death 0.85 0.21–3.43	
		Serious complications 0.42 0.12–1.46 Neonatal complication 0.99 0.35–2.81 Perinatal death 1.02 0.22–4.66		
		Serious complications 0.34 0.11–1.12 Neonatal complication 0.72 0.27–1.94 Perinatal death 0.83 0.21–3.38		
Three components			Serious complications 0.54 0.15–1.96 Neonatal complication 0.60 0.14–2.20 Perinatal death 1.83 0.33–9.90	Serious complications 0.47 0.14–1 .57 Neonatal complication 0.43 0.11–1.70 Perinatal death 1.05 0.21–5.09

Less than three components	Serious complications 0.43 0.16–1.16 Neonatal complication 0.75 0.29–1.95 Perinatal death 1.49 0.37–6.06		Serious complications 0.87 0.45 – 1.68 Neonatal complication 0.72 0.32–1.64 Perinatal death 0.58 0.16–2.06
Control	Serious complications 0.38 0.1 –0.91 Neonatal complication 0.54 0.23–1.29 Perinatal death 0.86 0.27–2.78		
Less than three components and Control	Serious complications 0.39 0.16–0.93 Neonatal complication 0.59 0.26– 1.36 Perinatal death 0.99 0.33–2.98		