Knowledge, Attitudes and Practices of Community Health Workers Regarding Noncommunicable Diseases in the Eastern Region of São Paulo, Brazil

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Abstract

Background

To tackle the growing burden of noncommunicable diseases (NCDs) around the world and in Brazil, the potential of community health workers (CHWs) has been recognized and put forward as a solution. In Brazil, CHWs are fully integrated in the national healthcare system and work in interdisciplinary primary health care teams. Training is an important enabler to CHWs' effectiveness in improving health outcomes. Appropriate type and amount of training depend on CHWs' pre-existing knowledge and skills, which can be measured through Knowledge, Attitudes and Practices (KAP) surveys. More research is needed regarding CHWs' training and KAP, especially in relation to NCDs.

Objective

This study aims to determine the Knowledge, Attitudes and Practices of CHWs in the eastern region of São Paulo, Brazil regarding NCDs and their risk factors, as a preliminary step to inform future training program optimization for CHWs.

Methods

This study stemmed out of a partnership between McGill University Department of Family Medicine and the *Atenção Primária à Saúde Santa Marcelina*, which provides care across five subprefectures in the eastern region of São Paulo, Brazil. A cross-sectional survey study was conducted using an online self-administered KAP questionnaire, containing 37 questions on sociodemographic characteristics and various NCD topics, developed based on previously validated instruments. The survey was made accessible to all CHWs working full-time in family health teams between January 28 and February 22, 2019. Descriptive analysis was performed for sociodemographic characteristics and KAP questions, and knowledge scores were calculated from the sum of correct knowledge answers.

Results

Out of 1,260 invited CHWs, 1,071 completed the questionnaire (85% response rate). The majority of respondents were women (96%), had completed secondary school (67%) and had less than five

years of work experience (61%). They mostly received teaching from nurses, but the teaching frequency varied across the five subprefectures. The mean overall knowledge score was 62%. The highest score was obtained for questions in the cardiovascular disease category (80.2%), and the lowest scores for questions in the chronic obstructive pulmonary disease (28%) and cervical cancer (32.9%) categories. The majority of CHWs agreed that NCDs are common amongst Brazilians and considered diabetes as the most important NCD in their communities. At the practice level, 71.7% of CHWs reported always discussing cervical cancer screening with community members and 87.1% felt either confident or very confident about their counselling on this topic. The topic they discussed the least and were the least confident about was colon cancer screening.

Conclusion

Several knowledge and practice gaps have been identified, in addition to self-reported training frequency disparities across the five subprefectures included in this study. Qualitative studies, in addition to further research exploring factors being associated with CHWs' knowledge, are needed to better understand the current results and CHWs' perspectives on their training experience. Such studies would be helpful in finding solutions to optimize CHWs' training and clinical activities in order to ultimately improve their effectiveness in tackling the NCD epidemic.

Résumé

Contexte

Pour faire face au fardeau grandissant des maladies non transmissibles (MNT) dans le monde et au Brésil, le potentiel des agents de santé communautaires (ASC) a été reconnu et présenté comme une solution. Au Brésil, les ASC sont intégrés au système de santé national et travaillent au sein d'équipes interdisciplinaires de soins de santé primaires. La formation est un catalyseur important pour l'efficacité des ASC dans l'amélioration de l'état de santé des populations. Le type et la quantité de formation appropriés dépendent des connaissances et des compétences préexistantes des ASC, qui peuvent être mesurées à l'aide d'enquêtes sur les Connaissances, les Attitudes et les Pratiques (CAP). Des études supplémentaires concernant la formation et les CAP des ASC sont nécessaires, en particulier en ce qui concerne les MNT.

Objectif

Cette étude vise à déterminer les Connaissances, Attitudes et Pratiques des ASC de la région Est de São Paulo au Brésil en lien avec les MNT et leurs facteurs de risque, et représente une étape préliminaire pour informer l'optimisation des futurs programmes de formation des ASC.

Méthodologie

Cette étude découle d'un partenariat entre le département de médecine familiale de l'Université McGill et l'*Atenção Primária à Saúde Santa Marcelina*, qui fournit des soins dans cinq sous-préfectures dans la région Est de São Paulo, au Brésil. Une enquête transversale a été réalisée à l'aide d'un questionnaire CAP électronique auto-administré, contenant 37 questions sur les caractéristiques sociodémographiques et divers thèmes liés aux MNT, élaboré à partir d'instruments préalablement validés. L'enquête a été rendue accessible à tous les ASC travaillant à temps plein dans des équipes de santé familiale entre le 28 janvier et le 22 février 2019. Une analyse descriptive a été réalisée pour les caractéristiques sociodémographiques et les questions CAP, et les scores de connaissances ont été calculés à partir de la somme des réponses correctes.

Résultats

Sur les 1260 ASC invités, 1071 ont rempli le questionnaire (taux de réponse de 85%). Les répondants étaient principalement des femmes (96%), avaient terminé leurs études secondaires (67%) et avaient moins de cinq ans d'expérience de travail (61%). Les ASC ont indiqué recevoir leur formation surtout de la part d'infirmières, mais la fréquence des formations variait d'une sous-préfecture à l'autre. Le score moyen global des connaissances était de 62%, avec le score le plus élevé obtenu pour les questions sur les maladies cardiovasculaires (80,2%) et les scores les plus faibles pour les questions sur la maladie pulmonaire obstructive chronique (28%) et le cancer du col utérin (32,9%). La majorité des ASC ont convenu que les MNT sont courantes chez les brésiliens et que le diabète est la MNT la plus importante dans leurs communautés. Au niveau des pratiques, 71,7% des ASC ont indiqué qu'ils discutaient toujours du dépistage du cancer du col utérin avec les membres de la communauté et 87,1% se sentaient confiants ou très confiants quant à leurs conseils sur ce sujet. Le sujet dont ils discutaient le moins et dont ils étaient le moins confiants était celui du dépistage du cancer du côlon.

Conclusion

Plusieurs lacunes dans les connaissances et les pratiques ont été identifiées, en plus des disparités de fréquence de formation entre les cinq sous-préfectures inclues dans cette étude. D'autres études doivent être menées afin d'explorer davantage les facteurs associés aux connaissances des ASC. Des études qualitatives sont également nécessaires afin de mieux comprendre les résultats actuels et le point de vue des ASC sur leur expérience de formation. De telles études permettraient par ailleurs d'élaborer des solutions pour optimiser la formation et les activités cliniques des ASC afin d'ultimement améliorer leur efficacité dans la lutte contre l'épidémie des MNT.

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List of Acronyms

AIDS	Acquired Immunodeficiency Syndrome
APS	*Atenção Primária à Saúde Santa Marcelina* or Santa Marcelina Primary Health Care Network
BHU	Basic Health Unit or *Unidade Básica de Saúde*
BMI	Body Mass Index
BP	Blood Pressure
CAAE	*Certificado de Apresentação para Apreciação Ética* or Certificate of Presentation for Ethical Appreciation
CHWs	Community Health Workers
COPD	Chronic Obstructive Pulmonary Disease
CRC	Colorectal Cancer
CSV	Comma-Separated Values
CVDs	Cardiovascular Diseases
DALYs	Disability-Adjusted Life Years
ESF	*Estratégia Saúde da Família* or Family Health Strategy
FHTs	Family Health Teams
HIV	Human Immunodeficiency Virus
IKTR	Integrated Knowledge Translation Research
iKUs	Integrated Knowledge Users
INCA	*Instituto Nacional de Câncer* or Brazilian National Cancer Institute
IQR	Interquartile Range
KAP	Knowledge, Attitudes and Practices
LMICs	Low- and Middle-Income Countries
NASF	*Núcleo de Apoio à Saúde da Família* or Family Health Support Units
NCDs	Noncommunicable Diseases
PHC	Primary Health Care
SUS	*Sistema Único de Saúde* or Unified Health System
WHO	World Health Organization

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Preface

This master's thesis is presented in the traditional format (i.e. not by manuscript). It is an original work by Catherine Ji (CJ). No part of this thesis has been published yet.

The research project, on which this thesis is based, received research ethics approval from the McGill Faculty of Medicine Institutional Review Board on May 24, 2018 (Study Number A05-B26-18A); from the Hospital of Santa Marcelina Ethics Committee on December 10, 2018 (CAAE 03653918.9.0000.0066); and from the São Paulo Municipal Secretary of Health Ethics Committee on December 13, 2018 (CAAE 03653918.9.3002.0086).

Chapter 1: Introduction

1.1. General purpose

Given the increasing burden of noncommunicable diseases (NCDs) around the world and the recognition of the potential role of community health workers in mitigating this burden, the general purpose of this thesis is to better understand the knowledge, attitudes and practices of community health workers regarding NCDs in the eastern region of São Paulo, Brazil. This can subsequently lead to optimization of their training curriculum and enhancement of their effectiveness in improving NCD-related health outcomes in their communities.

1.2. Outline of thesis

This thesis contains five chapters. This first chapter serves to introduce the general purpose of the project and the background information around noncommunicable diseases and the primary health care system in Brazil. Chapter 2 presents a review of the literature on community health workers, in general and more specifically in Brazil, on their effectiveness and their training in relation to NCDs. The chapter concludes with the research question underlying the scientific investigations and findings presented in this thesis. Chapter 3 presents a detailed description of the methodology, the development of the survey instrument, the data collection process and data analysis. Chapter 4 presents the study results. In Chapter 5, these results are then discussed and compared to other studies identified in the literature. Chapter 5 also acknowledges the limitations of the study and imparts the main conclusions and future directions.

The thesis includes four annexes. Annex 1 is the English version of the Knowledge, Attitudes and Practice survey instrument that was used to collect data. Annex 2 is the English version of the consent form that participants had to agree to before accessing the questionnaire. Annex 3 contains the R code used for data cleaning done prior to the statistical analysis. Annex 4 presents the detailed frequency distribution of answer options to each question of the survey instrument. Finally, all references of all chapters are included in the Reference section at the end of this thesis.

1.3. Noncommunicable diseases

1.3.1. Global burden of disease

Noncommunicable diseases are non-infectious and not transmissible directly from one person to another, and are defined by the World Health Organization (WHO) as diseases that "tend to be of long duration, generally slow progression and are the results of a combination of genetic, physiological, environmental and behavioural factors" (1). NCDs are also known as chronic diseases and include four main groups: cardiovascular diseases (such as myocardial infarction and stroke), cancer, chronic respiratory diseases (such as chronic obstructive pulmonary disease and asthma) and diabetes (1). These diseases share four known modifiable behavioral risk factors (tobacco use, physical inactivity, unhealthy diet and harmful use of alcohol), which can lead to four types of metabolic changes (hypertension, overweight/obesity, hyperglycemia and hyperlipidemia) that increase the overall risk of developing NCDs (1). These four main groups of diseases are the major causes of adult mortality and morbidity worldwide (1), but there are many other types of conditions that are often included under the umbrella term of NCDs, such as mental health and substance use disorders, violence and injuries, and chronic neurologic and musculoskeletal disorders (2).

NCDs are estimated to be the primary cause of death for 41 million people every year, which is equivalent to 71% of all deaths globally, with cardiovascular diseases (CVDs) alone causing 18 million deaths annually (1). Fifteen million of the global NCD deaths occur prematurely between the ages of 30 and 69 and disproportionately affect people in low- and middle-income countries (LMICs) (1). The proportion of disability-adjusted life years (DALYs) attributable to NCDs worldwide increased from 43% in 1990 to 54% in 2010; whereas DALYs due to communicable, maternal, neonatal and nutritional disorders decreased from 47% to 35% in the same period of time (2). The high mortality and morbidity from NCDs have an important economic impact due to lost productivity and direct medical costs of treatment. The World Economic Forum reported that the four main NCDs and mental health conditions will give rise to a cumulative output loss of US$ 47 trillion over the period 2011-2030, with more than US$ 21 trillion borne by LMICs (3). The global burden of NCDs, which is only projected to rise due to the growth, ageing, urbanization and globalization of the world population, has been reaffirmed as a priority by the

United Nations and WHO with the inclusion of a target to reduce premature deaths from NCDs by one-third by 2030 in the Sustainable Development Agenda (1, 3).

1.3.2. Burden of disease in Brazil

Brazil is the largest country of South America, and the fifth largest and fifth most populous in the world with a total population of 210 million people (4). It shares the global growing public health challenge of NCDs: from 1990 to 2015, proportional annual mortality caused by NCDs increased from 59.6% of deaths to 75.8%, with CVDs as the leading cause, followed by cancers (5-7). During the same period of time, mortality due to communicable, maternal, neonatal and nutritional disorders decreased from 25.6% to 12.4%, reflecting the epidemiological and demographic transitions that this upper middle-income country has been undergoing (6). These transitions can be explained by Brazil's rapid economic growth over the last decades and by the creation of a public national Unified Health System in 1990, which improved access to health care and public health interventions, such as immunizations and prenatal care (5).

Although the expansion of the universal public healthcare system, focused on prevention and primary care, and the implementation of stricter anti-tobacco policies both have been recognized for having reduced the age-standardised mortality for cardiovascular diseases and chronic respiratory diseases in the last three decades (6, 8), the improved socio-economic conditions of the Brazilian population also led to urbanization and globalization-induced lifestyle changes, such as unhealthy diets and physical inactivity. These changes are leading to an obesity epidemic and a rapid rise of hypertension and diabetes, which all contribute to CVDs (8, 9). In 2016, 23% of the Brazilian adult population had raised blood pressure, 47% were physically inactive, more than 50% were overweight and 22% were obese (6, 7). Moreover, the prevalence of obesity has increased by 60% in young adults aged 25-34 since 2006 (5). This burden of disease is also significantly influenced by social inequalities, in a country where 22% of the population live below the poverty line (4), with non-white, poorer and less educated people being more at risk and suffering from more severe functional limitations resulting from NCDs (5, 9-11). There is therefore an urgent need for effective and scalable strategies to limit incidence and prevalence of NCDs and improve chronic disease care in Brazil and globally.

1.4. Strategies to tackle noncommunicable diseases

"'Best Buys' and Other Recommended Interventions for the Prevention and Control of Noncommunicable Diseases" (12) were put forward by the WHO in 2013 as part of its Global Action Plan for the Prevention and Control of NCDs 2013-2020 (13) and updated in 2017. Brazil also developed its own "Strategic Action Plan to Tackle Noncommunicable Diseases in Brazil 2011-2022" (14). The interventions recommended in the two documents rely on political will, intersectoral collaboration and a strong primary health care (PHC) system.

PHC is generally the main access point to the healthcare system and therefore represents the best platform for screening, diagnosis, and the management and coordination of care (15). To tackle the NCD epidemic, primary care needs to be redesigned and strengthened, especially in LMICs, to combine four essential elements: i) integration of services through the use of multidisciplinary teams, where different health professionals provide care jointly, ensuring continuity and ease of access to preventive and curative care for patients; ii) health workforce innovations, such as task-shifting, for effective service delivery to palliate to general shortages of physicians; iii) a focus on patients and communities, where barriers to access to care for the most vulnerable populations can be mitigated by universal health coverage and training of community health workers for outreach services; and iv) adoption of new technologies for communication, such as mobile applications and health-related text messaging (15). Over the last 30 years, Brazil has been implementing what has become the largest public primary health care system in the world and features the four essential elements (16). With its multidisciplinary team-based and community-centred model, it has been recognized, among other positive effects, for enhancing access to and utilization of health services, especially for the poorest (17).

1.5. Primary health care in Brazil

In 1988, Brazil adopted a new constitution that recognized health as a citizen's right and duty of the state, which led to the creation of the *Sistema Único de Saúde* (SUS) or Unified Health System in 1990 (18). The SUS is responsible for providing comprehensive, universal preventive and curative care to all Brazilians through decentralized public and private health care institutions and for ensuring continuity of care at the community and hospital levels (18,

19). Health services and most common medications are accessible and free at the point of service for all citizens (19). One of the most important components of the SUS is the *Estratégia de Saúde da Família* (ESF) or Family Health Strategy, which was put in place in 1994 and reorganized primary care to focus on families and communities and to integrate medical care with health promotion (18, 20). This was done through the national deployment of interdisciplinary family health teams (FHTs) composed of one physician, one nurse, one nurse assistant and four to six community health workers (CHWs) (19). Up to seven FHTs are grouped together in physical clinics called *Unidade Básica de Saúde* or Basic Health Units (BHUs), usually located in the center of the communities they serve. The surrounding geographical area is divided between the FHTs so that each is responsible for up to 1,000 households with no overlap or gap between catchment areas. FHTs offer longitudinal, proactive and comprehensive care to all residents through monthly home visits done by the CHWs, linkage to social programs and public health campaigns, and coordination of care received elsewhere (19). In addition to the core family health teams, groups of allied health professionals (dentists, psychologists, physiotherapists, etc.) named *Núcleo de Apoio à Saúde da Família* (NASF) or Family Health Support Units, were created in 2008 to extend the scope of PHC services and are based in BHUs to facilitate integrated care for patients (19-21). The composition of the NASF depends on the health needs of the served territory, and the technical and educational support needs of the FHTs (21).

The expansion of the Family Health Strategy has been remarkable: it grew from 2,000 teams including 60,000 CHWs covering 4% of the Brazilian population in 1998 to 39,000 teams with more than 265,000 CHWs providing services to 62% of the population in 2014, with a focus on poorer-than-average municipalities and regions first (19). The SUS and ESF have been credited for increased access to care, better reporting of vital statistics, large reductions in under-five and neonatal mortality due to diarrheal disease and lower respiratory tract infections, universal coverage of vaccination and prenatal care, and reductions in avoidable hospitalization admissions and rates of complications from some chronic conditions (16-19, 22). This has also resulted in greater user satisfaction when compared to traditional models of primary health centers (19), which are often composed of internal medicine doctors, gynecologists and

pediatricians who do not offer integrated and comprehensive care and outreach services, and see patients on a walk-in basis (20).

Despite notable advances in Brazil's PHC, many financial and organizational challenges continue to hinder the development of the full potential of the SUS and ESF. Although annual governmental health expenditures should be increased to maintain the progress that has been made in the last decades and continue to improve health and social conditions, austerity measures have been voted in Brazil at the end of 2016 to restrict funds allocated to the health and education sectors for the next 20 years (5). There are also large variations in the capacity and quality of the family health teams, since the management of the ESF falls under the municipalities' responsibilities (19): availability of basic equipment, different types of health professionals, and institutional support for the teams vary from one municipality to another. Finally, a recent diplomatic conflict between Cuba and the new Brazilian president prompted Cuba to pull out in November 2018 its 8,300 doctors who were sent to work in poor and underserved regions of Brazil as part of the *Mais Medicos* (More Doctors) program (23). This program was introduced in 2013 to palliate to the physicians' shortage generated by the rapid expansion of the ESF, especially in remote regions of the Amazon (19, 23). By the end of December 2018, there were still a third of the positions left vacant by the Cuban doctors that remained unfilled, disrupting accessibility to medical services for thousands of people around Brazil (24).

In many other international settings where there are shortages of physicians and nurses, a solution put forward is task shifting, which is a process that "makes use of already available human resource by delegating tasks requiring high skills to health workers with lower qualification" (25, 26). One of the strengths of the Brazilian Family Health Strategy is the extensive and effective use of community health workers, who have been considered as instrumental in achieving some of the positive health outcomes mentioned earlier (19, 20). It is worth further exploring the potential role of CHWs in improving service delivery and in strengthening the primary health care system's capacity in tackling the NCD epidemic. The next chapter will review the literature on CHWs and what is known about their roles, effectiveness and training in relation to NCD prevention and management, around the world and in Brazil specifically, and will present the research question of this thesis.

Chapter 2: Literature Review

2.1. Community health workers

2.1.1. Who are they and what do they do?

Community health workers are defined by the International Labour Organization as health workers who "provide health education and referrals for a wide range of services, and provide support and assistance to communities, families and individuals with preventive health measures and gaining access to appropriate curative health and social services. They create a bridge between providers of health, social and community services and communities that may have difficulty in accessing these services" (27, 28).

In the 1970s, many large-scale national CHW programs were developed in low- and middle-income countries, especially following the Declaration of Alma-Ata on Primary Health Care in 1978 (29). The Declaration was a major public health milestone as it called for the achievement of Health for All by the year 2000 through primary health care and recognized the importance of health workers, including community health workers, in attaining this goal (30). However, many of these large-scale programs fell apart because of serious challenges such as inadequate training and supervision, insufficient remuneration or incentives for CHWs, lack of logistical support for supplies and medicines, poor integration with the health system and lack of acceptance by other health care providers (30). Political and financial support thus moved towards vertical health programs and secondary and tertiary levels of healthcare.

In the early 2000s, the World Health Organization promoted task-shifting as a solution to shortages of physicians and nurses (26), which prompted a renewed interest in involving CHWs to meet population health needs. In the last two decades, there has been a rapid growth of community-based interventions led by CHWs resulting in compelling evidence that they can be effective in helping health systems improve health outcomes (30).

CHWs perform a wide range of functions across low-, middle- and high-income countries, which can be clustered into six general categories: i) Diagnostic delivery, care and treatment provision, and other clinical services; ii) Assistance with appropriate utilization of health services and referral making; iii) Provision of health education and behavior change motivation to community members; iv) Data collection; v) Improvement of relationships between health services and communities; and vi) Provision of psychosocial support (31). CHWs generally are members of the communities where they work, are selected by and answerable to the communities, are supported by the health system but not necessarily a part of its organization, have shorter training than professional workers (usually less than two years), and can be paid or volunteers (31, 32).

There are now more than five million CHWs around the world, with very variable selection, training, supervision, incentives and career advancement opportunities (30). Some examples of successful large-scale CHW programs come from Brazil, as introduced in the previous chapter; Ethiopia, with its Health Extension Program that has trained more than 42,000 government-salaried health extension workers through a 12-month training program (30% theoretical courses and 70% practical training) since 2003 and has contributed to making progress towards achieving health Millennium Development Goals (33); and Pakistan, which has deployed 110,000 lady health workers, who undergo a 15-month training (integrated and task-based), to bridge urban and rural health disparities and strengthen the PHC system, empowering rural women along the way since 1994 (34). In-depth case studies of the CHW programs from these three countries, and from Bangladesh, Haiti, Mozambique, Thailand and Uganda, were reported in the "Global Experience of Community Health Workers for Delivery of Health Related Millennium Development Goals: A Systematic Review, Country Case Studies, and Recommendations for Integration into National Health Systems" published by the WHO in 2010 (4). The programs were evaluated on twelve key aspects, encompassing recruitment, CHW role, initial and ongoing training, equipment and supplies, supervision, performance evaluation, incentives, community involvement, referral system, professional advancement, and information system (4). Out of the eight countries, Brazil received the highest aggregated score for its CHW program functionality, summarized as a program with a "intermediate duration training, with mostly promotional and preventive tasks, and very restricted and basic curative tasks for CHWs, with a strong supportive supervision, and within a relatively strong health system, such as the Family Health Program" (4).

2.1.2. Community health workers in Brazil

The first CHWs in Brazil worked in isolated rural areas as early as the 1940s and served as extension workers for small hospitals and health centers to establish a link with the community, provide health education and primary care, and make referrals (35). The success of these CHWs in achieving high coverage for preventive care, immunization and prenatal care (35) influenced the subsequent Health Agents Initiative in the state of Ceará in the 1980s, which employed 6,000 villagers to extend health services under close supervision of nurses and again act as mediators between the community and health services (36, 37). This initiative was adopted by the Brazilian Ministry of Health and became the "Community Health Workers Program" in 1991 (36).

With the launch of the Family Health Strategy in 1994, CHWs became fully integrated into the national healthcare system and have become the cornerstone of the Brazilian primary health care system (38). Brazilian CHWs are selected by local health committees. They need to be major and residents of where they work for at least two years, and have completed a minimum of eight years of schooling (36). The Ministry of Health proposes the general CHW training curriculum outline; the Ministry of Education approves it; and then each municipality adapts it to its own epidemiological, social and economic context (4). CHWs usually undergo a training of eight weeks of formal didactic training given by nurses on how to conduct home visits and family census, on the cultural background and socioeconomic conditions of communities, on communication techniques, and on specific health care topics regarding the priority group of women and children (4). This is usually followed by four weeks of supervised fieldwork, and by periodic continuous education sessions thereafter where local concerns are addressed and standardized training is provided if new practices are implemented (4, 38). As Brazilian CHWs are mostly expected to adequately identify families and individuals at risk and refer them to other health professionals, their training is focused on promotion and prevention and very little on curative topics.

They work as members of family health teams, alongside of nurses, physicians and other allied health professionals. They are supervised by nurses mainly, who have protected time for supervision (38). CHWs earn a minimum monthly salary of 1,250 Brazilian reais (around 320 USD) for 40 hours of work per week (39). This salary floor established by a national law in 2014 has provided them financial security and incentives as the national minimum wage was around

725 Brazilian reais/month in 2014 and has progressively increased to an all-time high of 998 Brazilian reais/month in January 2019 (40). CHWs have also been legally recognized as health care professionals affiliated with the Unified Health System in 2002 (41), but they do not have structured opportunities for career advancement (38).

CHWs are responsible for approximately 150-200 households that they visit monthly, irrespective of need or demand, to update health records, provide health prevention counseling, arrange follow-up appointments at the clinic if needed, detect high-risk situations like violence and neglect, verify medication compliance, and look for specific symptoms and risk factors like smoking (18, 19). The routine tasks of CHWs vary in nature and frequency depending on their location (37). In addition to their technical and clinical tasks, CHWs consider their sociocultural broker role as primordial as they help persuade community members to seek medical care and help increase health professionals' awareness of the social conditions affecting their patients' health (42). The effectiveness of CHWs in contributing to health outcomes improvement in Brazil and around the world is discussed next.

2.1.3. Effectiveness of community health workers

Historically, CHWs have been mainly involved in maternal and child health, and infectious diseases interventions in low- and middle-income countries (19, 37, 43). Evidence has shown that CHWs can contribute to the reduction of childhood malnutrition and under-five mortality by educating mothers, to the diagnosis and treatment of illnesses such as pneumonia, diarrhea and malaria, to a better access to family-planning services and to the reduction of maternal mortality, and to the control of human immunodeficiency virus (HIV), malaria, and tuberculosis infections through education on prevention, case detection and treatment adherence (30, 31).

With the demographic and epidemiological transitions and the rise of noncommunicable diseases in LMICs, more CHW-led interventions have been implemented to prevent and manage NCDs in developing countries. Although the evidence is considered of low quality, CHWs have the potential of helping to increase tobacco cessation, and decrease systolic blood pressure and blood sugar levels (44). Their interventions for diabetes type 2 prevention and management, such as referral of high-risk individuals to physicians, patient education, social support through home

visits and motivational interviewing-based counseling, can also result in increased knowledge of symptoms, adoption of treatment-seeking and prevention measures, medication adherence, in improved blood sugar, lipid levels and body mass index, and in greater patient satisfaction with quality of care received (45, 46). There is still an overall lack of robust evidence for positive impact of CHW-led interventions for NCDs in LMICs (31), and very few studies included in reviews on this topic come from Brazil, despite this country's extensive national structured CHW program.

In a 2011 review on effectiveness of CHWs in Brazil, the major and most consistent improvements were found in some maternal and child health outcomes, such as frequency of child weighing, prevalence of breastfeeding, and delayed introduction of bottle-feeding (41). Chronic disease-related outcomes, such as adherence to cervical cancer screening, hospitalization due to cardiovascular conditions and detection of high blood pressure also generally improved, but all studies included in this review had very low to moderate levels of evidence (41). Out of the 23 studies included, only six looked at NCD outcomes. With the major role CHWs play in Brazil's primary health care system, more rigorous studies are needed to evaluate the impact of their actions across a broad range of health care interventions, especially related to NCD management, as these now represent the principal burden on the Brazilian healthcare system (6, 18).

Most of the evidence related to the effectiveness of CHWs in managing NCDs come from high-income countries and mostly from the United States, where "community health worker" has been recognized as an occupation in 2010 (30). Similarly to Brazil, CHWs in the United States provide health education (individual and group sessions), counseling to address barriers in adopting target behaviors and to reinforce health benefits of behavior change, case management, social services (e.g. referral of patients without health insurance coverage to low-cost or no-cost screening) and help with navigating the healthcare system (e.g. making appointments and accompanying patients to appointments) (47-49). Many studies of CHW interventions in the United States have shown positive effects on chronic disease risk factors, such as improvement in blood pressure, lipid profile, weight and blood glucose, and on rates of screening for breast, cervical and colorectal cancers, especially among low-income populations and ethnic minorities living in urban settings (30, 47-49). In addition to encouraging behavior changes in patients, CHWs can also increase patients' knowledge and positively influence their beliefs regarding certain health

topics after giving them education sessions, so the accuracy of information given by CHWs is important (49).

Overall, CHWs can contribute to improving health outcomes, particularly for underserved populations, but most of these conclusions are based on low levels of evidence, and results are often context-dependent and difficult to extrapolate to a larger scale (31). The WHO therefore published in 2018 evidence-based guidelines to inform policymakers in the optimization of national CHW programs in terms of their education, deployment and management (27). These guidelines are based on one overview of reviews (122 eligible articles), 15 systematic reviews on different policy questions (137 primary studies), and a survey of stakeholders' views on the acceptability and feasibility of the interventions (27). The overview of reviews confirm that CHWs are effective in improving health outcomes, but they "can only meet their potential in performing these roles and improving health outcomes when supported by a range of health system enablers, such as training and support", which are discussed next (31).

2.1.4. Enablers of and barriers to community health workers' effectiveness

As the interest in CHWs and the evidence of their effectiveness have increased, many studies have looked at the enablers and barriers to CHWs' work. Although there is little empirical evidence on which element of the work environment is the most important or how much influence one element has, some key features are recognized as being essential for successful CHW interventions (50).

CHWs' productivity in providing health services to community members relies on their capacity (knowledge, skills, and attitudes), motivation, and organizational support (resources, physical and social environment, working conditions, etc.) (50). Within the work environment, four important elements that affect productivity are: workload (number of tasks, organization of tasks, catchment area), supportive supervision (regular, reliable, good quality), supplies and equipment, and respect (50). The respect and acceptance of the CHWs from the community increase if CHWs are well integrated in the health system, if their work and referrals are respected by other health workers, and if they are competent. Lack of resources such as medicines, equipment

and transport means can disrupt CHWs' productivity but can also cause loss of respect from the community (50).

Intervention design factors that positively influence job satisfaction, motivation, self-confidence and performance of CHWs include frequent supportive supervision and continuous training, adequate logistical support and supplies, remuneration, community embeddedness and integration into health systems, clear roles and strong collaboration and communication with other health professionals (4, 31, 51, 52).

A Brazilian qualitative study asked CHWs in Salvador, Bahia in 2007 and in São Paulo in 2015 what were the challenges they faced in performing their tasks (42). Interestingly, the answers given by the two groups were very similar, despite the time and geographical differences. Key obstacles mentioned were "failure to be fully integrated into the primary care team, inability to follow-up on identified health needs due to limited resources, as well as community members' lack of understanding of their work and undervaluing of preventative medicine" (42). To enhance their effective, these CHWs suggested increased training and even professionalization of their role through a certification program, better incorporation of CHWs into clinic flow and decision making by improving communication between CHWs and clinic staff, and community education about the role of CHWs and importance of preventative health (42).

Training and continuous education are recognized as important enablers to CHWs' work, but more research is needed to determine the influence of different training formats, duration and content, as these characteristics are often poorly reported in studies, and how best to develop and implement these training programs (51).

2.1.5. Training of community health workers

Training of CHWs varies extensively around the world, from a few hours to a few years (4), and even from one city to another within Brazil (37). The heterogeneity in training processes and the underreporting of training format and content characteristics are often noted in systematic reviews looking at the effectiveness of CHWs, which conclude that detailed descriptions of

training and standardized reporting are needed to understand which components make the CHW interventions effective to then be able to optimize these components (45, 47, 48).

The most popular training methods are didactics and interactive sessions covering health information as well as communication skills, occasionally followed by competency evaluation done using role-playing scenarios or written assessments, and by refresher sessions (47, 48). Written assessments often take the form of pre- and post-test questionnaires that test for objective knowledge, perceived knowledge, perceived skills and perceived confidence, using multiple choice questions and Likert scales (53, 54). Training usually increases CHWs' knowledge, confidence and skills, which can in turn improve their motivation, satisfaction, performance and trust relationship with community members (31, 53, 54). Some aspects of training that CHWs themselves have identified as more satisfactory are qualified trainers who are familiar with their work environment, integration of practice sessions, adaptation of training material to the local context and seeking for CHWs' input when developing training material (51).

The WHO guidelines on optimization of CHW national programs recommend that: "the proper amount and type of training required by CHWs must be understood in relation to the health system context, the CHWs' pre-existing capacities, and the roles that CHWs are expected to play" (27, 31). The curriculum for preservice training should include technical competency, communication and counseling skills, and respect of confidentiality (31).

In addition to preservice training, continuing or refresher training is also important to maintain CHWs' acquired skills and knowledge (4, 32). A systematic scoping review published in 2017 looked at ongoing training of CHWs in LMICs, defined as "in-service or "refresher" training received after a period of initial training, or as supportive supervision (55). Out of the 35 original studies, the majority focused on the provision of ongoing training for maternal and child health or infectious diseases, none focused on NCDs, and only one was done in Brazil.

Although Brazil has a national training curriculum approved by the Ministries of Education and of Health (38), there are still many training delivery gaps and variability reported on the field, especially related to NCDs and their risk factors (37, 53, 54, 56). More attention is

thus needed towards optimizing preservice and ongoing training to improve knowledge and more importantly competencies of CHWs in the prevention and management of NCDs to tackle these health issues at a community level in Brazil.

2.2. Research question

Community health workers occupy an important role in the Brazilian primary health care system and have a large potential in contributing to the prevention and management of noncommunicable diseases as they are the first point of contact with healthcare services for community members and ensure strong continuity of care with monthly home visits. Through their outreach, education, counseling, support and navigation activities, they build individual and community capacity by increasing community members' health literacy and self-management behaviours (4). It is thus important that CHWs' receive adequate training to enhance their knowledge, skills and overall effectiveness in NCD prevention and management to answer population health needs. Adequately adapted training depends on CHWs' baseline capacities, which are commonly established using Knowledge, Attitudes and Practices (KAP) survey. The WHO describes KAP surveys as "a representative study of a specific population to collect information on what is known, believed and done in relation to a particular topic […]. KAP surveys can identify knowledge gaps, cultural beliefs, or behavioral patterns that may facilitate understanding and action […] KAP surveys may be used to identify needs, problems and barriers in program delivery, as well as solutions for improving quality and accessibility of services" (57, 58).

The research question that this study therefore aims to answer is: "What are the current knowledge, attitudes and practices of community health workers in the eastern region of São Paulo, Brazil, regarding noncommunicable diseases and their risk factors?" This will help to establish their current capacities, and to identify knowledge and practice gaps as a critical preliminary step to inform future training program optimization for CHWs (27).

Chapter 3: Methodology

3.1. Study setting and partnership

This research project stemmed out of a partnership between McGill University Department of Family Medicine and the *Atenção Primária à Saúde Santa Marcelina* (APS) or Santa Marcelina Primary Health Care Network in São Paulo, Brazil. The APS manages over 220 family health teams divided in approximately 50 Basic Health Units that cover a population of 1.8 million across five marginalized urban subprefectures in the outer limits of the eastern health administrative region of the city of São Paulo (59, 60). The five subprefectures are: Cidade Tiradentes, Guaianases, Itaim Paulista, Itaquera and São Miguel Paulista, where population vary from 212,000 to 524,000 (61). The APS employs more than 1,200 community health workers, 240 nurses, 260 doctors and hundreds of other allied health professionals in its community clinics that are part of the Family Health Strategy (60). CHWs working for the APS receive their pre-service training by the municipality; and the ongoing training is overseen by the APS and given by the nurses and other healthcare professionals in the BHUs.

3.1.1. Integrated knowledge translation research approach

One of the objectives of the partnership established between the two institutions was to share McGill's Department of Family Medicine's primary health care research expertise to strengthen the research capacity of the APS. A process inspired by the integrated knowledge translation research (IKTR) approach was followed for this project. IKTR "involves engaging and integrating those who will need to act on the findings, the knowledge users, into the research (knowledge creation) process [and] requires researchers and knowledge users to develop partnerships and engage in a collaborative process with the overarching goal being the coproduction of knowledge, its exchange and application", and is based on the principles of participatory research (62). This approach also ensures that the research project is culturally and logistically appropriate for the local medico-sociocultural context.

For this project, the relevant integrated knowledge users (iKUs) involved all worked in the APS network: the medical director, several medical managers, researchers, family physicians, one

nurse and a few medical students. Due to feasibility issues, ethics approval requirements and time constraints related to the master's program, it was decided not to involve patients as iKUs. The research group, composed of both researchers from McGill University and iKUs from São Paulo, jointly decided on the research question, methodology, tool development, data collection, result interpretation, and finally on how to disseminate results to move research findings into practice (62).

The partnership was built gradually starting in January 2018, when in-person meetings were held in Montreal with the APS medical director to discuss APS research needs and priorities. Through these meetings, the research question stated in the previous chapter was developed, and preliminary study methodologies were suggested. A draft of the research protocol was sent electronically to a small group of knowledge users; and its relevance, feasibility and acceptability were discussed via video conference in May 2018. The full protocol, including methods and data collection tools, was then thoroughly discussed and refined during a research trip in July 2018 where the McGill research team, including CJ and her thesis supervisors, travelled to São Paulo to meet the whole group of iKUs. The trip was essential to build trust, mutual respect and get the full buy-in of all partners; it was also an opportunity to clarify roles and responsibilities of both researchers and iKUs regarding the project (62). From then on, the group of knowledge users took on more responsibilities, such as application for the different ethics approval steps in Brazil, recruitment of participants, data collection and results interpretation. They will also play an essential role in the results dissemination process that will follow the end of this study.

To palliate to the geographical barriers, monthly video conference meetings were organized as of September 2018 at a date and time convened with the iKUs. Meeting minutes were sent to the whole group so everyone was kept up-to-date (62). As for the language and cultural barriers, it was less an issue as many members were both fluent in English and Portuguese and could help translate during meetings; important documents and emails were translated in both languages.

The partnership between the McGill University Department of Family Medicine and the *Atenção Primária à Saúde Santa Marcelina* was created with a long-term multidimensional vision,

including faculty and research capacity development and mutual learning. By applying the best iKTR practices to this research project, a strong, successful and sustainable research partnership was developed, allowing for meaningful participation from each member and for the elaboration of multiple other research projects.

3.2. Study design

To answer the project's research question: "What are the current knowledge, attitudes and practices of community health workers in the eastern region of São Paulo, Brazil, regarding noncommunicable diseases and their risk factors?", a cross-sectional survey study design was used and it followed a Knowledge, Attitudes and Practices survey model (57, 58). KAP surveys are well established in the literature to study infectious diseases (57, 63), but have been little used to explore KAP of the general population and of health workers around the topic of noncommunicable diseases (64). One study in Eastern Uganda focused on KAP related to NCDs among village health team members (65) and developed a KAP questionnaire based on a validated instrument previously used in Mongolia targeting community members (64) and on the 2014 Uganda STEPS survey (the WHO STEPwise approach to noncommunicable diseases risk factor surveillance instrument) (66, 67).

Similarly, previously validated questionnaires, and guidelines from the WHO and the Brazilian government were used to develop a preliminary survey instrument for this research project containing questions on the following thematic categories related to the four main NCDs (CVDs, diabetes, chronic respiratory diseases and cancer):

- socio-demographic characteristics;
- caseload and training (37);
- knowledge related to general NCD statements (64, 65), risk factors (56, 64, 68-70), cardiovascular diseases (64, 65), diabetes (64, 65, 71), chronic obstructive pulmonary disease (COPD) (72), and cervical cancer (64, 73);
- NCD-related attitudes (64, 65); and
- NCD-related practices (64, 65, 68).

The questionnaire was drafted in English and translated into Portuguese. General design, questions content and format were improved after discussions with a Canadian questionnaire expert and with members of the Brazilian research group who were familiar with the reality of the target population. The modified English version was translated into Portuguese again and then back translated into English by native speakers to ensure no loss of meaning during translation (74). Discrepancies were discussed with a few integrated knowledge users to determine the most appropriate Portuguese wording. The new English and Portuguese versions of the questionnaire were then inputted into the LimeSurvey online survey tool (75), available through the McGill University server. The online questionnaires followed best evidence-based practices recommended by Dillman et al. in terms of question organization, design and visual layout consistency, in an attempt to limit measurement errors and other types of bias that are commonly found in questionnaires (76).

Before launching the survey and starting data collection, the Portuguese version of the online consent form and questionnaire were pre-tested with ten community health workers from the target population in Brazil, who were randomly selected and represented the five subprefectures covered by the APS. The questionnaire was pre-tested individually with each CHW for timing, clarity of questions and instructions, and ease of navigation, using a retrospective interviewing technique (76). The small sample of CHWs was asked to complete the questionnaire just as they might if they were doing it alone, but they were being observed by CJ and one or two other Brazilian research partners. If a question was unclear to the CHWs and prevented them to move forward in the survey, they could ask for explanations. CJ observed the answering process, noting if mistakes were made, if questions took longer to read and complete, and if technical difficulties occurred. At the end of the questionnaire, CHWs were asked some probing questions about certain words and how they experienced specific aspects of the questionnaire.

The questionnaire was further improved by modifying or removing problematic questions and wording based on the feedback received and observations noted during the pre-testing. A pilot testing phase was not done as this was a self-administered online survey that did not require training of surveyors and extensive logistical planning (58). The final survey instrument had 37

questions: nine sociodemographic questions, 22 knowledge questions, four attitude questions and two practice questions (see Annex 1 for the English version of the survey).

To access the questions, participants first had to read a consent form and agree to participate. The consent form stated the objectives of the project, the estimated required duration of 20 minutes, that participants would not obtain any direct benefit/compensation, that the survey was not an evaluation/exam, that their participation was voluntary and would not affect their employment status in any way, and finally that answers remained completely anonymous (see Annex 2 for the English version of the consent form). The consent form also included three questions concerning work location solely for administrative purposes to help send reminders to clinics with lower response rates. For participants who agreed to participate, the geographical location information was included in the data analysis.

3.3. Participants

The inclusion criteria for study participants were: 1) working full-time as a community health worker; and 2) working in a family health team setting with nurses and physicians. As per the *Atenção Primária à Saúde Santa Marcelina*, there were around 1,260 CHWs working in their network in 47 different Basic Health Units and fitting our inclusion criteria (60). As the APS organizational structure allowed the possibility of reaching all 1,260 CHWs from the target population through the managers of the BHUs (see below), it was decided to use a census approach and not select only a sample of CHWs to survey.

3.4. Data collection

After discussions with our Brazilian research partners, it was decided that it was best for CHWs to fill the online questionnaire at work during regular working hours. The access link to the finalized Portuguese survey instrument was therefore sent out by the APS central management team to the managers of each of the 47 Basic Health Units. The managers, who had been informed of the project beforehand, were asked to facilitate participation by opening the survey link on computers at the clinic and by giving CHWs protected time to fill the questionnaire.

The survey link was active from January 28 to February 22, 2019. From January 28 to February 5, CJ visited 13 BHUs, where she presented the project more in detail to the managers and CHWs. Managers were notified in advance that CJ would be coming for a half-day on a specific date, so they ensured that all CHWs were back from their home visits and present in the BHU for that specific period of time. CJ was always accompanied by one or two local medical students to help with translation if needed. During the few hours CJ and the medical students were at the BHUs, they facilitated the questionnaire completion by opening the survey link on as many available computers as possible and ensuring a constant roll of CHWs who completed the online survey individually. They offered technical assistance if needed but declined to answer any content-related questions. All answers were automatically recorded in LimeSurvey upon submission of the questionnaire. A paper copy of the consent form was given to every single CHW who accessed the survey, whether they accepted to participate or not. After February 5, BHUs were no longer visited by the research team, but emails were sent on a regular basis to remind managers to continue facilitation of survey completion by the CHWs working in their clinics until the survey closed on February 22.

3.5. Data analysis

After the data collection period ended, answers from all completed questionnaires were downloaded from LimeSurvey in a comma-separated values (CSV) file format and were securely stored on a single local computer that was password encrypted and only used by CJ. The answers were processed and analyzed using the software R (version 3.5.2) (77) and RStudio (version 1.1.463) (78).

Data was analyzed primarily using descriptive statistics for sociodemographic characteristics, and for knowledge, attitudes and practices questions. For categorical data, frequency distributions of answer options were determined (absolute number and relative frequency reported as percentages). For numerical data, means and measures of dispersion (range and standard deviation) were calculated. Median and interquartile range (IQR) is also reported for the age variable. As the collected data did not represent a sample but a target population census, descriptive statistics such as means and proportions correspond to the respective population

quantities of interest so that no confidence intervals (or other inferential statistics) were computed. All analyses were conducted for the total population and stratified by the five different subprefectures to enable descriptive comparison of the respective subpopulations of CHWs.

For knowledge questions, answers were recoded into binary variables, where right answers were coded as "1", and wrong answers and "I don't know" as "0". When recoding questions with possibly multiple correct answers (Q11, Q15, Q24, Q25, Q27, Q28 – see Annex 1), the question response was coded as "1" only when all selected options were right; if there was one wrong selection, the whole question was coded as "0". The frequency distribution of correct answers was determined for all knowledge questions and reported as proportion of individuals who correctly answered the respective question. The binary answers were also summed up by knowledge categories and as an overall total and converted into a percentage score (further referred to as "knowledge score") by dividing the obtained sum by the maximum possible sum and multiplying this ratio by 100. Each question and each knowledge category were considered as having an equal weight in the category and total knowledge score calculations. Q12, Q19 and Q21 contained four, four, and six sub-questions respectively that were considered as independent individual questions during data analysis. On the other hand, the question "How much do you know about the following conditions?" (Q17) was not included in the score calculations as it was not an objective knowledge question. Therefore, the total maximum possible score for the 22 knowledge questions was 32 (100%).

3.6. Ethics approval

The study protocol, data collection tool, and consent form were reviewed and approved by the McGill Faculty of Medicine Institutional Review Board on May 24, 2018 (Study Number A05-B26-18A). Approval was obtained from the Hospital of Santa Marcelina Ethics Committee on December 10, 2018 (CAAE 03653918.9.0000.0066); and finally, from the São Paulo Municipal Secretary of Health Ethics Committee on December 13, 2018 (CAAE 03653918.9.3002.0086).

Chapter 4: Results

At the time of the study, 1,260 eligible CHWs were working within the *Atenção Primária à Saúde Santa Marcelina* network and were given access to the online survey. Between January 28 and February 22, 2019, 1,126 community health workers accessed the questionnaire and answered the consent form, out of which 1,071 agreed to participate and completed the whole survey. This is equivalent to a final response rate of 85% (1,071/1,260). The response rate varied across the five subprefectures: 87% in Cidade Tiradentes, 80% in Guaianases, 90% in Itaim Paulista, 84% in Itaquera and 81% in São Miguel Paulista. Results presented in this section are based on the responses provided by the 1,071 participants who completed the questionnaire.

As all questions had to be addressed to successfully complete the online survey, no missing data occurred within the set of 1,071 received questionnaires. However, some data cleaning was required for the questions "How many families do you follow?" (Q2), "How many people do you follow?" (Q3), and "How many home visits do you do?" (Q4), where unrealistically large numbers, presumably due to typing errors, were removed following pre-specified rules. For example, where the answer to Q2 was > 1,000 and the last three digits corresponded to the answer given to Q3 (e.g. "210850" and "850" respectively), the last three digits in the answer to Q2 were removed. A similar rule between answers for Q3 and Q4 was applied. As for Q4, answers above 25 were removed. In total, 16, 19 and 15 values were modified for Q2, Q3 and Q4 respectively in the data cleaning process (see Annex 3 for all data cleaning rules and associated coding for RStudio).

4.1. Socio-demographic characteristics

The characteristics of study participants are summarized in Table 1. The participants' age ranged from 19 to 67 years with a mean of 37.8 years (median 37 years). The majority of CHWs were female (96%) and two-thirds had completed secondary school.

Approximately 61% had worked as a CHW for less than five years, including 31% who had worked less than 12 months and 5% who had worked between 13 and 24 months. They followed on average 198 families and 611 people and did around 13 house visits per day. Group characteristics were very similar with respect to age and sex across the five subprefectures. One notable difference is the higher number of participants who had less than six months of experience in the Itaquera region (36%), compared to around 10% in the other regions. Similarly, the average number of families and people followed, and number of house visits done per day were lower in the Itaquera region compared to the other regions.

Table 1. Characteristics of community health workers who completed the survey (all participants and by subprefecture)

Variables	**All Participants (N = 1,071)**	**Subprefectures**				
		Cidade Tiradentes (N = 148)	**Guaianases (N = 160)**	**Itaim Paulista (N = 315)**	**Itaquera (N = 240)**	**São Miguel Paulista (N = 208)**
Age (years)						
Mean ± SD (Min-Max)	37.8 ± 9.3 (19-67)	36.2 ± 8.7 (19-60)	37.6 ± 9.2 (19-67)	37.8 ± 9.1 (19-65)	37.6 ± 9.5 (20-63)	39.6 ± 9.8 (19-66)
Median (IQR)	37 (31-44)	36 (31-41)	37 (30-43)	37 (31-44)	36 (31-43)	38 (33-46)
	N (%)					
Sex						
Female	1,026 (96)	146 (99)	153 (96)	301 (96)	232 (97)	194 (93)
Male	44 (4)	2 (1)	7 (4)	14 (4)	8 (3)	13 (6)
Prefer not to answer	1 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (0)
Highest level of education						
Primary school completed	38 (4)	9 (6)	12 (8)	7 (2)	4 (2)	6 (3)
Secondary school incomplete	30 (3)	4 (3)	4 (2)	7 (2)	6 (2)	9 (4)
Secondary school completed	717 (67)	86 (58)	96 (60)	231 (73)	166 (69)	138 (66)

Undergraduate studies incomplete	194 (18)	35 (24)	33 (21)	43 (14)	47 (20)	36 (17)
Undergraduate studies completed	87 (8)	13 (9)	14 (9)	26 (8)	15 (6)	19 (9)
Graduate studies	5 (0)	1 (1)	1 (1)	1 (0)	2 (1)	0 (0)
Level of experience						
Less than 6 months	177 (17)	14 (9)	18 (11)	31 (10)	86 (36)	28 (13)
6 - 12 months	150 (14)	14 (9)	11 (7)	48 (15)	43 (18)	34 (16)
13 - 24 months	50 (5)	12 (8)	8 (5)	13 (4)	5 (2)	12 (6)
2 - 5 years	265 (25)	53 (36)	53 (33)	90 (29)	34 (14)	35 (17)
6 - 10 years	294 (27)	32 (22)	56 (35)	87 (28)	49 (20)	70 (34)
11 - 15 years	88 (8)	19 (13)	13 (8)	28 (9)	10 (4)	18 (9)
More than 15 years	47 (4)	4 (3)	1 (1)	18 (6)	13 (5)	11 (5)
	Mean ± SD (Min-Max)					
Number of families followed	198 ± 36 (1-318)	204 ± 20 (150-285)	203 ± 20 (117-265)	208 ± 22 (100-280)	172 ± 57 (1-318)	204 ± 23 (113-265)
Number of people followed	611 ± 210 (5-1,920)	677 ± 220 (196-1,920)	626 ± 178 (100-1,250)	649 ± 189 (15-1,500)	515 ± 256 (5-1,500)	604 ± 149 (180-998)
Number of house visits per day	13 ± 2 (3-25)	14 ± 2 (9-20)	13 ± 2 (8-25)	13 ± 2 (8-20)	12 ± 3 (3-20)	13 ± 2 (8-20)

When asked about formal teaching frequency for continuing education (Table 2), most CHWs reported receiving teaching "At least once every 2 months" (20%) or even more frequently on a monthly basis (37%) or weekly basis (12%). When stratified by subprefectures, Itaquera and Cidade Tiradentes' participants reported the most frequent monthly and weekly teaching sessions combined (67% and 62% respectively). Participants from Itaim Paulista reported a different teaching frequency distribution compared to other subprefectures, with only 3% having weekly sessions, 28% monthly sessions and 19% who answered receiving formal teaching "At least once a year". This last option was selected by less than 10% of respondents in other groups. The majority of CHWs answered that

teaching is mainly provided by nurses (76%). Interestingly, 16% of participants chose "Other" as main source of teaching, including 6% who specified receiving most teaching from the NASF teams (groups of allied health professionals), which is more than from physicians (3%). The overall distribution of answers for the main source of teaching is similar among the different subprefectures.

Table 2. Frequency distribution of answers obtained to questions on teaching (all participants and by subprefecture)

	All Participants (N = 1,071)	Subprefectures				
		Cidade Tiradentes (N = 148)	Guaianases (N = 160)	Itaim Paulista (N = 315)	Itaquera (N = 240)	São Miguel Paulista (N = 208)
How often do you receive formal teaching from other health professionals? N (%)						
At least once a week	128 (12)	15 (10)	12 (8)	9 (3)	50 (21)	42 (20)
At least once a month	401 (37)	77 (52)	62 (39)	88 (28)	110 (46)	64 (31)
At least once every 2 months	210 (20)	32 (22)	38 (24)	61 (19)	36 (15)	43 (21)
At least once every 6 months	184 (17)	20 (14)	34 (21)	73 (23)	27 (11)	30 (14)
At least once a year	97 (9)	1 (1)	11 (7)	59 (19)	7 (3)	19 (9)
Other	51 (5)	3 (2)	3 (2)	25 (8)	10 (4)	10 (5)
- Once every 4 months	6 (1)	0 (0)	0 (0)	4 (1)	0 (0)	2 (1)
From which group of health professionals do you receive most formal teaching? N (%)						
Physicians	34 (3)	6 (4)	10 (6)	6 (2)	7 (3)	5 (2)
Nurses	817 (76)	109 (74)	116 (72)	236 (75)	200 (83)	156 (75)
Medical residents/students	10 (1)	7 (5)	1 (1)	1 (0)	1 (0)	0 (0)
Other community health workers	34 (3)	4 (3)	7 (4)	10 (3)	6 (2)	7 (3)
Other	176 (16)	22 (15)	26 (16)	62 (20)	26 (11)	40 (19)
- NASF	66 (6)	6 (4)	7 (4)	25 (8)	15 (6)	13 (6)
- Not specified	79 (7)	9 (6)	19 (12)	28 (9)	5 (2)	18 (9)

4.2. Knowledge regarding noncommunicable diseases

The proportion of participants who answered correctly to each knowledge question varied substantially across the six knowledge categories: 1) General, 2) Risk factors, 3) Cardiovascular diseases, 4) Diabetes, 5) Chronic obstructive pulmonary disease, and 6) Cervical cancer (Figure 1). The details for each knowledge category are described below; and Annex 4 contains the frequency distribution of responses for each question.

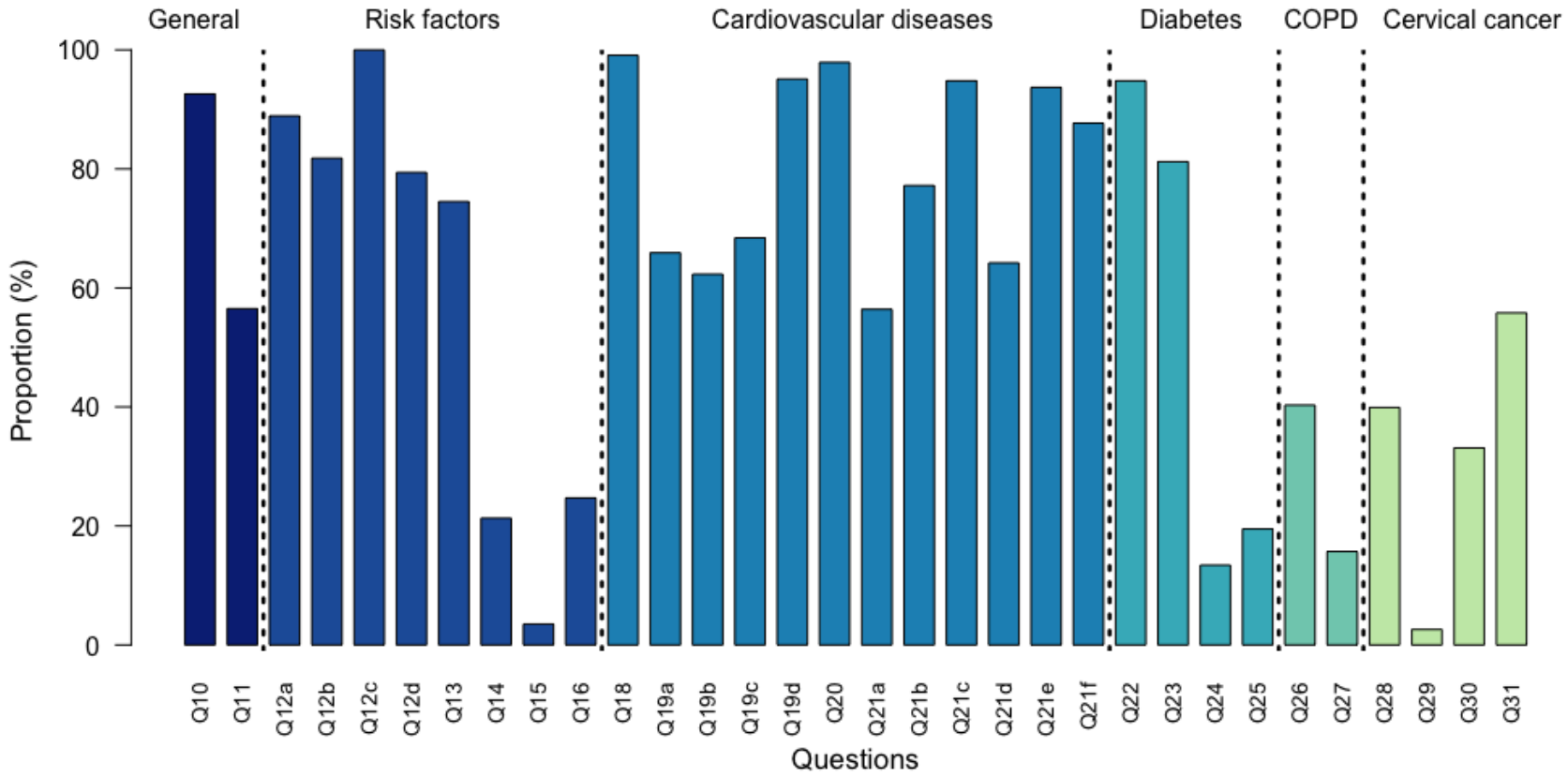
General knowledge

The majority of CHWs (92.6%) knew that a noncommunicable disease is one that cannot be spread between people (Q10). When asked to identify which options are considered as NCDs between diabetes, tuberculosis, asthma, stroke and acquired immunodeficiency syndrome (AIDS) (Q11), 94.5% of CHWs selected diabetes and 80.7% asthma, but only 64.7% selected stroke. Overall, only 56.5% correctly identified all diabetes, asthma and stroke as NCDs and excluded both tuberculosis and AIDS.

Risk factors

The first question in this section included four sub-questions regarding the harms of smoking (Q12a-d), which were very well answered – at least 80% of CHWs answered all of them correctly. Although 74.5% of CHWs knew that the largest amount of salt in the daily diet of Brazilian people comes from the salt in factory-made foods (Q13), only 3.5% correctly identified the recommendations from the "10 Steps to Healthy Diets" promoted as part of the Brazilian Ministry of Health 2014 Dietary Guidelines (Q15) (70). Approximately a fifth of CHWs knew that a body mass index (BMI) of 27 is considered as being overweight (Q14). Although not accurate, most of the remaining CHWs selected the BMI options of 30 and 33 (48%), which are considered as obesity and thus unhealthy, and only 10% selected options 20 and 23, which are considered in the healthy range of BMI. Finally, about 25% of CHWs correctly answered that adults require at least 150 minutes of moderate-intensity physical activity per week to achieve health benefits (Q16) (69).

Figure 1. Proportion of participants who answered correctly to knowledge questions



Notes: Q10 A NCD is one that cannot be spread between people; **Q11** NCDs include the following; **Q12a** Active smoking affects a person's health; **Q12b** Smoking around others does not harm their health; **Q12c** Smoking affects the lungs; **Q12d** Smoking affects the heart; **Q13** Which of the following sources contributes the largest amount of salt to the daily diet of Brazilian people?; **Q14** Which body mass index is considered as being overweight?; **Q15** Which of the following recommendations are part of the 10 Steps to Healthy Diets?; **Q16** How much total time of moderate-intensity physical activity per week is needed to achieve health benefits for adults?; **Q18** How does eating salty food affect the blood pressure?; **Q19** Does high blood pressure affect the **a)** brain; **b)** kidneys; **c)** stomach; **d)** heart; **Q20** People with high blood pressure are more likely to have a stroke; **Q21** Do the following factors increase the risk of CVDs? **a)** Insomnia; **b)** Running; **c)** Stress; **d)** Older age; **e)** High body mass index; **f)** Vegetarian diet; **Q22** Diabetes is when there is a lot of sugar in the blood; **Q23** Diabetes type 2 can be prevented; **Q24** What are signs and symptoms of diabetes type 2?; **Q25** Which of the following is not a complication of diabetes?; **Q26** What is the main cause of COPD?; **Q27** What are signs and symptoms of chronic obstructive pulmonary disease?; **Q28** Which medical condition is screened for with the Pap test?; **Q29** When should asymptomatic average-risk women begin having Pap tests?; **Q30** For a woman who has had two normal annual Pap tests, how often should she continue having the test?; **Q31** Can cervical cancer be prevented by vaccine?

Cardiovascular diseases

The knowledge was very good for questions on high blood pressure (BP): almost all CHWs knew that salty food raises the blood pressure (99.1%, Q18), that people with high BP are more likely to have a stroke (97.9%, Q20), and that high BP affects the heart (95.1%, Q19d). However, only 65.9% recognized that high BP can also affect the brain and 62.3% the kidneys (Q19a-b). When asked about risk factors for cardiovascular diseases: 56.4% correctly identified insomnia (Q21a), 94.8% stress (Q21c), 64.2% older age (Q21d), and 93.7% high BMI (Q21e).

Diabetes

Two questions about recognizing that diabetes happens when there is a lot of sugar in the blood (Q22) and that diabetes type 2 can be prevented (Q23) were well answered by 94.8% and 81.2% of participants respectively. However, only 13.4% could correctly identify signs and symptoms of diabetes type 2 (Q24). When asked "Which of the following **is not** a complication of diabetes?" (Q25), 58.2% selected the right answer "Loss of memory", but more participants selected "Damage to the heart" (63%), which is a complication of diabetes and therefore a wrong answer in this case. CHWs seemed familiar with the fact that loss of vision, loss of sensation to the feet and poor healing of wounds are complications of diabetes as less than 5% selected these answers to this question, but they were less familiar with erectile dysfunction and kidney damage as 26.5% and 17.8% respectively thought these were not complications of diabetes.

Chronic obstructive pulmonary disease

Although 100% of CHWs recognized that smoking affects the lungs in the risk factor section (Q12c), only 40.3% correctly identified smoking as the main cause of COPD (Q26). The majority of CHWs (91%) knew that COPD manifested as shortness of breath, but only 54.2% and 26.7% respectively knew that cough and sputum production are also important symptoms of COPD (Q27). Overall, only 15.7% correctly identified all signs and symptoms of COPD.

Cervical cancer

The four questions in this section were poorly answered in general. While 97.4% of CHWs correctly selected cervical cancer as the medical condition screened for with Pap tests (Q28), 49.4% also thought Pap tests screen for sexually transmitted infections, 30.3% for ovarian cancer and 18.8% for syphilis. Around 40% of CHWs ended correctly answering this question by only selecting cervical cancer. CHWs were also asked: "When should asymptomatic average-risk women begin having Pap tests?" (Q29): only 2.6% answered "At 25 years old" versus 92.5% who answered "After the first sexual relationship". To the following question: "For a woman who has had two normal annual Pap tests, how often should she continue having the test?" (Q30), only 33.1% of CHWs correctly answered "Every 2-3 years" and 63.3% wrongly answered "Every year", as per the Brazilian Cervical Cancer Screening Guidelines (79). Finally, 55.8% of CHWs knew that cervical cancer can be prevented by vaccine (Q31).

Scores on knowledge questions

To calculate the overall knowledge scores, the number of right answers were summed up and converted into percentages. The average total score aggregating responses to all knowledge questions was 62.0%, with the highest score obtained for the questions in the cardiovascular disease category (80.2%) and the lowest scores for questions in the COPD (28.0 %) and cervical cancer (32.9%) categories (Table 3). CHWs from the Cidade Tiradentes subprefecture had the highest total score (63.4%) and the highest score in all categories except for diabetes and COPD. CHWs from the São Miguel Paulista subprefecture had the lowest total score (61.1%) and the lowest score in the general knowledge and CVD categories, but they also had the highest score for diabetes questions. CHWs from the Itaquera subprefecture obtained the lowest score in the risk factor and diabetes categories but had the highest score in the COPD category. The lowest COPD score was obtained by both the Cidade Tiradentes and Itaim Paulista subprefectures. Guaianases had the lowest knowledge score for the cervical cancer category. The variability of total scores across the subprefectures indicated low heterogeneity with a range of only 2.3% (63.4% - 61.1%), but a larger variation in ranges was observed across the different category scores: 7.2% for general knowledge, 2.9% for risk factors, 2.7% for CVDs, 1.6% for diabetes, 4.2% for COPD, and 8.7% for cervical cancer.

Table 3. Average total and by category scores obtained on knowledge questions (all participants and by subprefecture) (%)

	All Participants (N = 1,071)	Subprefectures				
		Cidade Tiradentes (N = 148)	Guaianases (N = 160)	Itaim Paulista (N = 315)	Itaquera (N = 240)	São Miguel Paulista (N = 208)
Total Score						
Mean (Min-Max)	62.0 (12.5-87.5)	63.4 (34.4-87.5)	61.3 (25-84.4)	62.2 (12.5-81.3)	61.9 (28.1-81.3)	61.1 (37.5-84.4)
General knowledge						
Mean (Min-Max)	74.6 (0-100)	79.1 (0-100)	72.8 (0-100)	75.1 (0-100)	74.6 (0-100)	71.9 (0-100)
Risk Factors						
Mean (Min-Max)	59.3 (12.5-100)	61.2 (25-100)	59.2 (12.5-87.5)	59.5 (25-100)	58.3 (12.5-87.5)	58.6 (25-100)
Cardiovascular Diseases						
Mean (Min-Max)	80.2 (0-100)	81.0 (33.3-100)	80.4 (25-100)	80.7 (0-100)	80.8 (16.7-100)	78.3 (41.7-100)
Diabetes						
Mean (Min-Max)	52.2 (0-100)	52.0 (0-100)	52.7 (0-100)	52.2 (0-100)	51.4 (0-100)	53.0 (0-100)
Chronic Obstructive Pulmonary Disease						
Mean (Min-Max)	28.0 (0-100)	27.0 (0-100)	27.2 (0-100)	27.0 (0-100)	31.2 (0-100)	27.2 (0-100)
Cervical Cancer						
Mean (Min-Max)	32.9 (0-100)	36.8 (0-75)	28.1 (0-75)	33.4 (0-100)	31.9 (0-75)	34.0 (0-100)

One question asked: “How much do you know about the following conditions?” (Q17). Only 49.1% of CHWs reported having a good knowledge (“I know a lot” and “I know some”) on COPD, while that number for high blood pressure increased to 91.9% (Figure 2). Most of them (89.7%) also perceived their knowledge on diabetes as good, but less thought the same about stroke (65%) and myocardial infarction (65.5%). The subjective answers to this question were not included in the knowledge score calculations.

4.3. Attitudes regarding noncommunicable diseases

When asked about general attitudes regarding the importance of noncommunicable diseases in Brazil, 81.5% of the CHWs agreed or strongly agreed that NCDs are common amongst Brazilians (Table 4). The majority (89.1%) disagreed or strongly disagreed with the statement that cardiovascular diseases are becoming less common in Brazil, and almost all (94%) agreed or strongly agreed that diabetes is becoming more common in Brazil in general.

Figure 2. Answer distribution to the question "How much do you know about the following conditions?" (all participants)

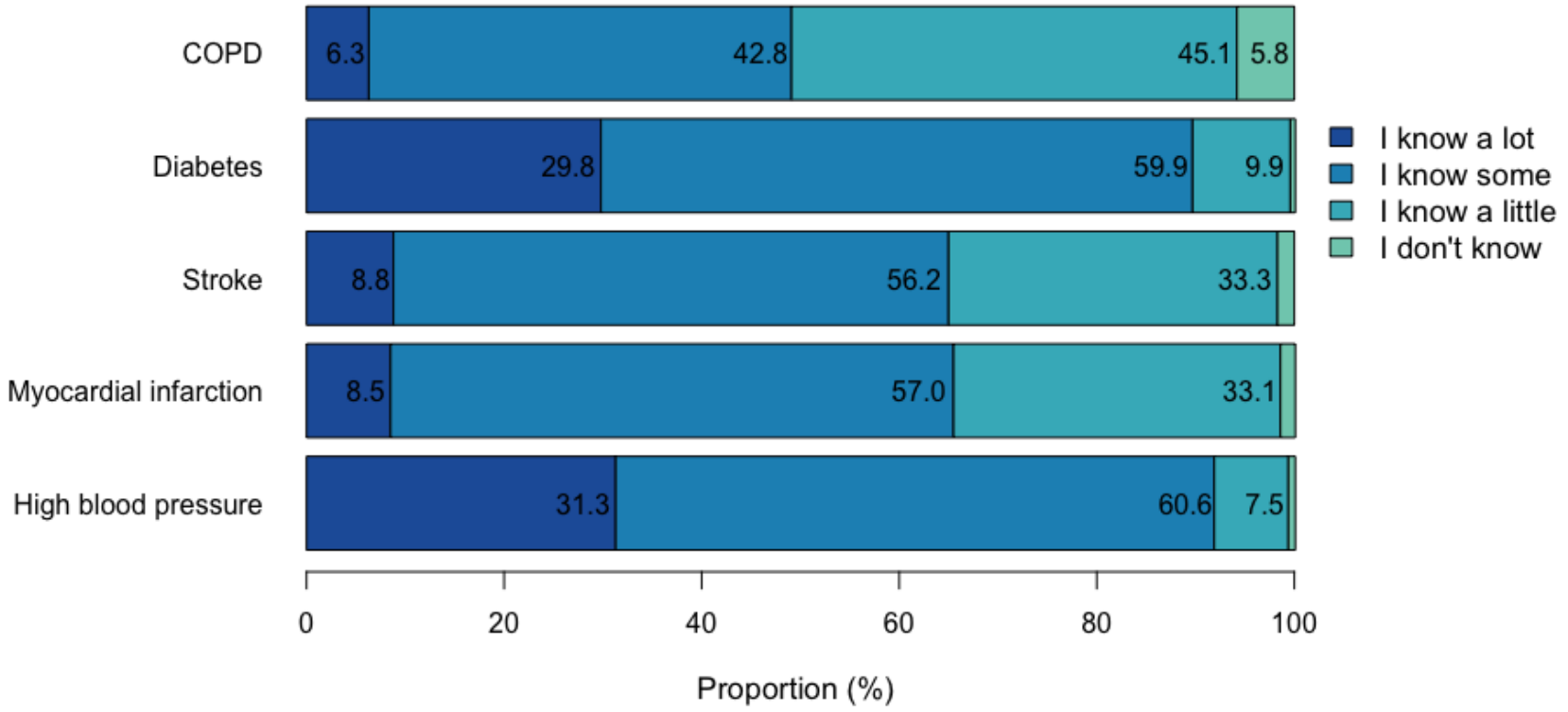


Table 4. Frequency distribution of answers to general attitude statements regarding noncommunicable diseases N (%)

N = 1071	Strongly agree	Agree	Disagree	Strongly disagree
I feel that noncommunicable diseases are common amongst Brazilians.	126 (11.8)	747 (69.7)	153 (14.3)	45 (4.2)
I feel that cardiovascular diseases are becoming **less** common in Brazil in general.	11 (1)	106 (9.9)	710 (66.3)	244 (22.8)
I feel that diabetes is becoming **more** common in Brazil in general.	203 (19)	803 (75)	50 (4.7)	15 (1.4)

Diabetes was also ranked as the most important health problem in their community by 47.9% of CHWs, followed by CVDs (20.4%), cancer (19.9%) and COPD (11.9%). The distribution of importance of these health problems was very similar among the five subprefectures (Figure 3).

4.4. Practices regarding noncommunicable diseases

In the last section of the questionnaire, CHWs answered two questions regarding the frequency at which they discuss different health topics with community members and their confidence in how accurately they can counsel community members on these health topics (Figures 4 and 5). The topics they discussed the most frequently were cervical cancer and breast cancer screening: more than 90% said they always or often discussed these issues with community members. They were also the most confident in the counselling they give regarding these two topics. The topic in which they were the least confident was colon cancer screening: 46.4% reported being moderately confident or less, compared to less than 33% saying the same for other topics. They also discussed this topic the least frequently, with 23% reporting rarely or never discussing it with community members. The distribution of answers for both questions followed a similar pattern, where the topics the most frequently discussed were also the topics which CHWs felt the most confident about. As such, after cervical and breast cancer screening, the topics they discussed most and were the most confident about were healthy nutrition and physical activity, followed by weight control, harms of smoking and harms of alcohol, and finally colon cancer screening.

Figure 3. Answer distribution to the question "According to your experience, which health problem is the most important in your community?" (all participants and by subprefecture)

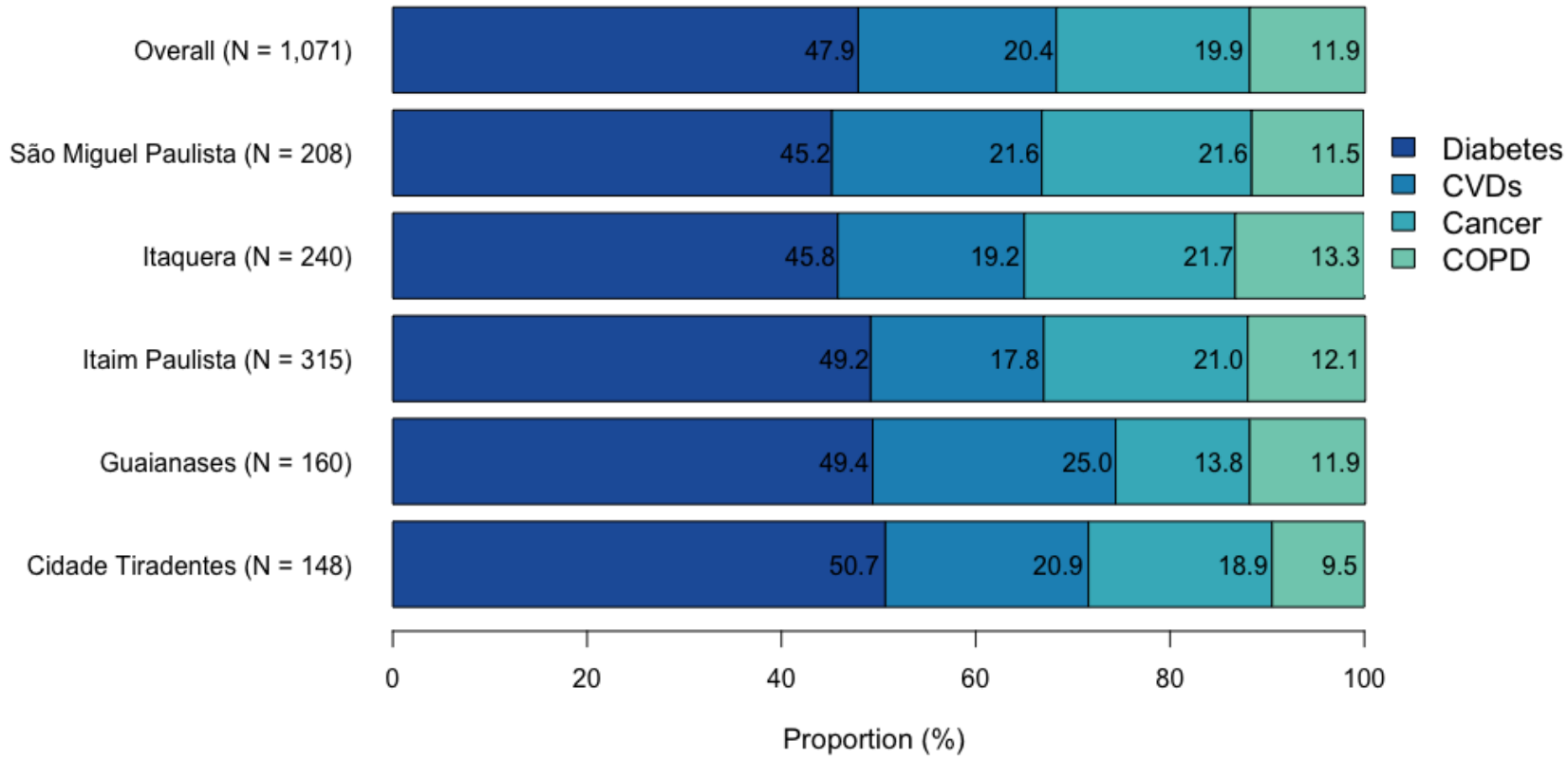


Figure 4. Answer distribution to the question "How frequently do you discuss the following topics with community members?" (all participants)

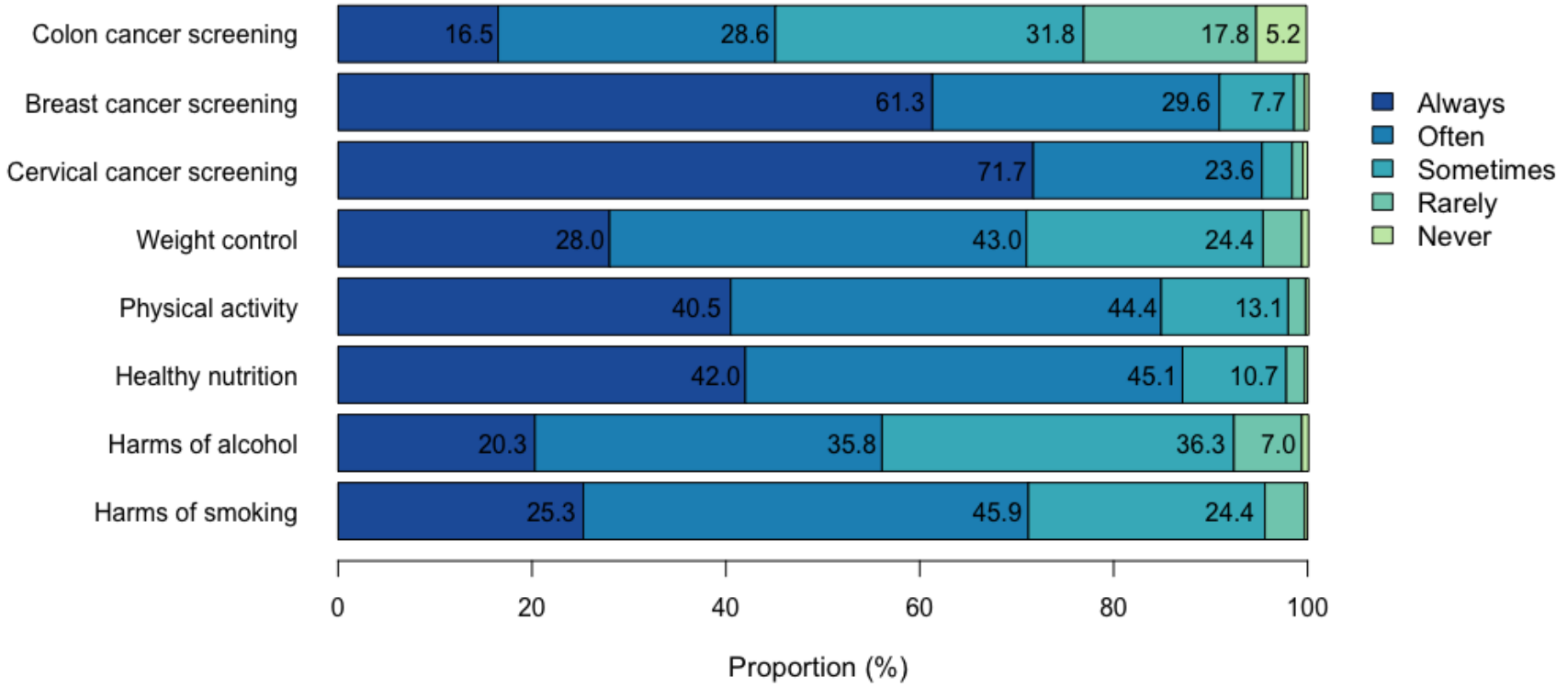
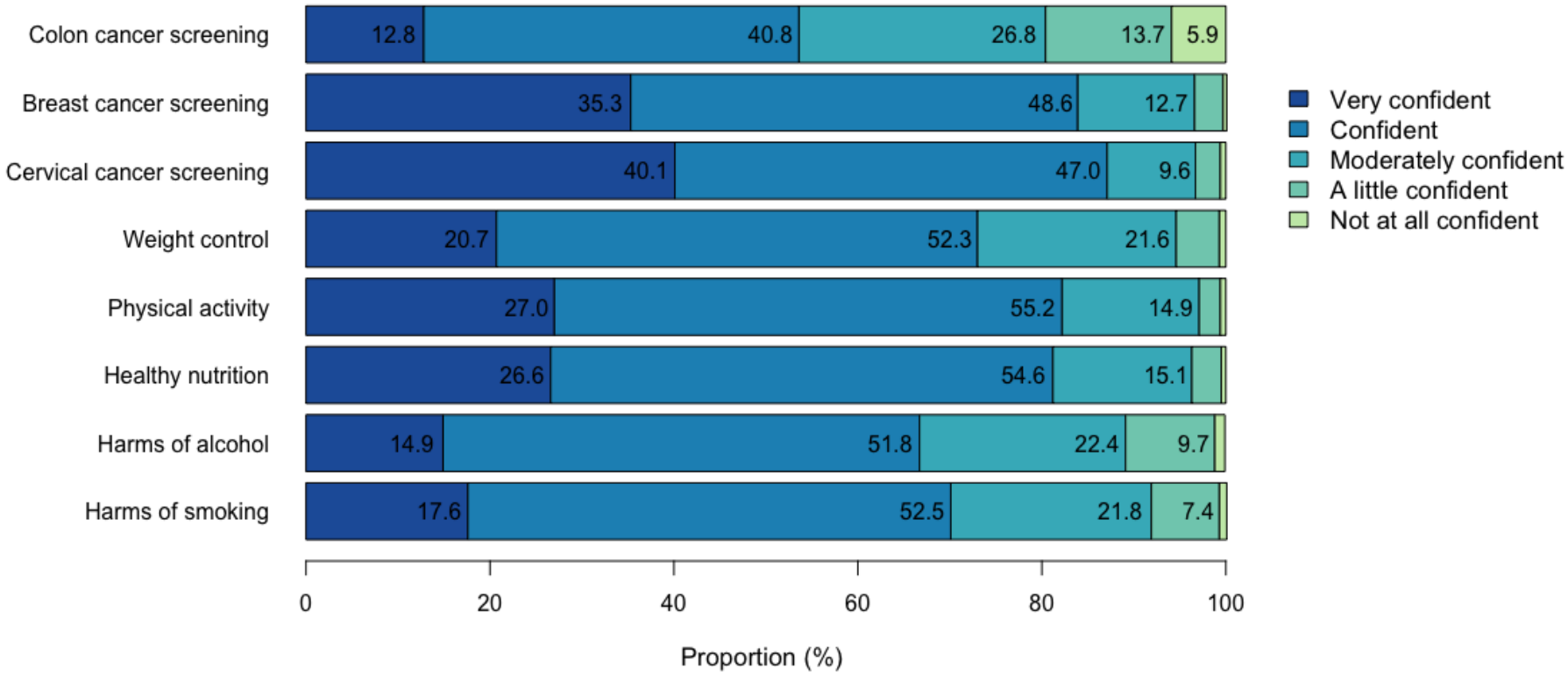


Figure 5. Answer distribution to the question "How confident are you that you can accurately counsel community members about the following topics?" (all participants)



Chapter 5: Discussion

The results of this study show that CHWs working for the APS Santa Marcelina in the eastern region of São Paulo, Brazil are aware that NCDs are important health problems in their country, and the problems they consider the most important in their communities are diabetes and cardiovascular diseases. They have good knowledge regarding CVDs; but knowledge and practice gaps regarding other NCDs and their associated risk factors, as well as teaching frequency variability across the five subprefectures, have been identified.

5.1. Socio-demographic characteristics and training

The socio-demographic characteristics of the CHWs who participated in this study are similar to the general Brazilian CHW population (4), with the majority of respondents being women, having completed high school, and following around 150-200 families.

Regarding continuing education, 76% of CHWs answered that they received most formal teaching from nurses, which is consistent with the Brazilian CHW model where nurses are their main supervisors and are also responsible for their initial and ongoing training (4). Although they are supposed to receive ongoing education during local monthly and quarterly meetings (4), participants reported a wide range of training frequency, with some notable differences between subprefectures. The ongoing education meetings can be oriented towards local concerns of the CHWs or of the health teams or can be more standardized training whenever new practices and protocols are instituted (4). As such, CHWs' interpretation of "formal teaching" might have been different and caused a large variation. The wording of the answer options of the question "How often do you receive formal teaching from other health professionals?" might also have caused confusion, as 1% of CHWs chose the option "Other" and specified "Once every 4 months", which could have been included in the answer option "At least once every 6 months".

While there are no clear guidelines on the optimal training frequency for CHWs, there is value in providing regular and frequent refresher training to update CHWs on new skills, reinforce

initial training and ensure that skills learnt are put in practice (55). The content of pre-service and ongoing training received by the participants was not assessed in this study, but another study on the work of CHWs in four Brazilian cities found great disparities in the specific training received on common health topics in between cities and within each city also (37); and other studies on training and KAP of Brazilian CHWs regarding breast and cervical cancers reported that some participants had never received specific training on these topics before (53, 54). It will therefore be important to clarify the real frequency of ongoing training the CHWs of this study receive and the content of these training sessions, in order to standardize training frequency for all CHWs working in the APS Santa Marcelina network.

5.2. Knowledge, attitudes and practices regarding noncommunicable diseases

This study focused on the four main types of NCDs as per the WHO (cardiovascular diseases, diabetes, cancer and COPD) and their main risk factors, which are categorized as modifiable behavioral risk factors (tobacco use, physical inactivity, unhealthy diet and the harmful use of alcohol) and metabolic risk factors (raised blood pressure, overweight/obesity, hyperglycemia and hyperlipidemia) (1). These diseases and risk factors are the leading causes of mortality and morbidity in Brazil (5). To be able to effectively prevent and manage NCDs in their daily work, CHWs and other primary healthcare professionals need to be knowledgeable and skilled about these health issues. Although participating CHWs were aware that NCDs are important and rising health problems among Brazilians, the results show that their knowledge scores were overall low, with an average score of 62.0% for all questions. The highest score was obtained in the cardiovascular disease category (80.2%), followed by general knowledge (74.6%), risk factors (59.3%), diabetes (52.2%), cervical cancer (32.9%) and the lowest score in the COPD category (28.0%), so these gaps will need to be addressed.

5.2.1. Knowledge about established guidelines and recommendations

Public health guidelines on healthy lifestyles and recommendations on screening for cancers and other NCDs have been developed in Brazil and all around the world for effective prevention and early detection. Since targeting risk factors are an effective way to prevent NCDs,

it is important for CHWs to be aware of the official recommendations to decrease risk factors and adopt healthy lifestyles. For example, only 25% of CHWs knew that guidelines recommend at least 150 minutes of moderate-intensity physical activity per week for adults to achieve health benefits. A low knowledge level was also found in a KAP phone survey on physical activity conducted in 2011 with physicians, nurses and CHWs sampled throughout Brazil: only 7.9% of physicians, 9.1% of nurses and 3.6% of CHWs knew that 150 minutes was the correct answer, and 97% of CHWs recognized that they needed more information on physical activity guidelines (56). This serves as a reminder that CHWs receive their training from nurses and physicians and looking into knowledge of nurses and physicians and the quality of the training they give to CHWs is crucial. Without proper knowledge of current recommendations and guidelines, CHWs and other professionals run into the potential issue of counselling inappropriately their patients and can be less effective in their capacity to prevent NCDs (56).

Similarly, in a study looking at cervical cancer-related KAP of health professionals working in primary health care units in Brazil, 93% of nurses and physicians reported screening women annually and 75% reported beginning to screen women younger than 25 years old (73), which are practices that do not respect the Brazilian Cervical Cancer Screening Guidelines. The guidelines recommend that Pap tests should be offered to sexually active women between the ages of 25 and 64, and that "the recommended routine for screening in Brazil is repeated Pap smears every three years after two consecutive normal exams performed at a one-year interval" (79). In this current survey, CHWs were asked "When should asymptomatic average-risk women begin having Pap tests?": only 2.6% answered "At 25 years old" versus 92.5% who answered "After the first sexual relationship". The question "For a woman who has had two normal annual Pap tests, how often should she continue having the test?" was also asked, to which 33.1% correctly answered "Every 2-3 years" and 63.3% answered "Every year". Again, if there is a knowledge and practice gap among nurses and physicians, it is likely that this would be transmitted to CHWs who learn directly from these health professionals.

Brazil has a national public cervical cancer screening program using Pap tests as the main primary screening strategy. Data from the Brazilian Ministry of Health from 2012-2013 confirms that around 50% of Pap tests in Brazil were conducted on an annual basis, and only

10% were conducted in a three-year interval (80). The estimated cervical cancer screening coverage rate over a three-year period is under 70% (80), and it is known that coverage is generally lower for women with higher social vulnerability and living in poorer regions (81), such as in the eastern region of São Paulo. It is important to respect guidelines to ensure effective use of medical resources and equitable access to screening for all women, especially the most vulnerable ones.

Colon or colorectal cancer (CRC), on the other hand, does not have a national public screening program in Brazil yet, despite being the third and second most frequent cancer in men and women respectively and having increasing mortality trends since 1996 (82, 83). In 2002, the Brazilian National Cancer Institute (INCA) recommended an annual fecal occult blood test for asymptomatic people aged 50 years or older as the initial CRC screening test, but the Ministry of Health has not put forward a national program to implement this recommendation yet (84). The previously mentioned 2011 Brazilian national phone survey regarding physical activity also explored Basic Health Units' capacity to offer CRC screening by interviewing BHU managers, physicians and nurses regarding CRC screening, but excluded CHWs from this portion as CRC screening was considered out of their portfolio. There was an overall poor intake of the INCA recommendations at the unit level and also at the individual physicians' practice level, with only 30% of physicians offering the screening (84). This general context could therefore explain why only 12.8% of CHWs in our study felt very confident about their counselling on colon cancer screening and 23% said they never or rarely discussed this topic with community members. With CHWs' important role in the Brazilian PHC system, future studies involving CHWs in outreach activities to promote CRC screening are warranted, as CHWs have been successfully trained and engaged in other settings to increase community members' awareness about colon cancer and uptake of screening (48, 49, 85).

5.2.2. Self-perceived knowledge and confidence in relation to measured knowledge scores

The results of this study identified consistency between self-perceived knowledge, self-confidence and objectively measured knowledge, but also several gaps to further explore.

In the knowledge section of the survey, one question assessed CHWs' self-perceived knowledge by asking them "How much do you know about the following conditions?", which were COPD, diabetes, stroke, myocardial infarction and high blood pressure. For these conditions, their self-perceived knowledge was generally consistent with the measured knowledge scores. Only 49.1% of CHWs stated that they know a lot or know some about COPD and they indeed obtained the lowest score in the COPD category. On the other hand, 91.9% of CHWs stated they know a lot or know some about high blood pressure, which was the main health condition tested in the cardiovascular disease category, in which CHWs obtained the highest overall score. Myocardial infarctions and strokes generally are acute consequences and presentations of cardiovascular diseases and are managed at the emergency department. They are out of CHWs' scope of practice, so it is coherent that only 65% of CHWs stated they know a lot or know some about these two problems, and that approximately the same proportion correctly identified stroke as an NCD. What is important is that CHWs are aware of the risk factors for these problems: reassuringly, almost all CHWs knew that people with high blood pressure are more likely to have a stroke (97.9%) and that high BP affects the heart (95.1%). Interestingly, a similar pattern was found in a study exploring NCD-related KAP of CHWs working in Eastern Uganda: 85.3% of their participants said they were familiar or knew a little about high blood pressure, 66.2% said the same about heart diseases and 60.3% about stroke (65). This study however did not calculate knowledge scores or compare self-perceived knowledge with objective knowledge assessment. Finally, in our study, 89.7% of CHWs said they know a lot or know some about diabetes, and 47.9% said it was the most important health problem in their community, but the overall knowledge score for this topic was only 52.2%. This gap will need to be further addressed to ensure that CHWs are properly prepared to prevent diabetes and support community members with diabetes, especially as Brazil has the fourth highest prevalence of type 2 diabetes in the world (46).

In the practice section of the questionnaire, CHWs were asked how frequently they discussed different health topics with community members and how confident they were that they could accurately counsel community members about the specified health topics. The distribution of answers for both questions followed a similar pattern, which can be interpreted as CHWs seem to discuss more frequently the topics in which they are more confident, or as CHWs seem to have

a higher confidence in the topics they discuss the most frequently. As such, after cervical and breast cancer screening, the topics they discuss most frequently and are the most confident about are healthy nutrition and physical activity, followed by weight control, harms of smoking and harms of alcohol, and colon cancer screening last. A similar pattern was found in a study that surveyed a national sample of Brazilian CHWs and other health professionals in 2011 about their perceived level of training when speaking to patients about nutrition, physical activity, weight control, and breast and cervical cancer screening: 57.6% and 50.6% of CHWs felt very prepared for cervical and breast cancer respectively, but this proportion decreased to 46.3% for weight control, 40.3% for physical activity and 32.1% for nutrition (68). In terms of frequency of activity, the study looking at the work of CHWs in four Brazilian cities found that the most frequently performed health promotion and prevention actions were related to prevention of cervical cancer and healthy diet information, similarly to our findings (37). It is clear that cervical cancer screening promotion is part of Brazilian CHWs' daily tasks and that CHWs feel confident about this topic. However, their overall poor knowledge score in this category (32.9%) in our study reflects an important knowledge gap concerning the national screening guidelines and best practices and will need to be further explored to determine the impact on screening rates for women living in the eastern region of São Paulo.

5.3. Strengths and limitations

This study has some limitations related to its design and survey instrument development. To the best of our knowledge, no other similar instrument existed already in the literature, so the questionnaire was built from multiple questionnaires that contained relevant questions to the topic but that had been validated in other settings. While the development of this survey received close input from our research partners and other experts, respected the proper translation and backtranslation processes, and was pretested with a small sample of CHWs, it would have benefitted from a pilot-testing phase to fully validate this new questionnaire in the intended setting (86). Nonetheless, this instrument is still valuable as it aimed to obtain an overview of CHWs' KAP on the main NCDs and their risk factors and not focus on one single disease. This is more representative of CHWs' integrated role in primary health care teams and of the wide-ranging knowledge they need in order to perform their daily tasks of visiting and appropriately counselling

community members (87), especially as NCDs share common features and often present as comorbidities. In return, the survey could not assess in depth each disease to limit the length of the survey and avoid overburdening the participants.

Exploring the knowledge related to some of the major causes of burden of disease, such as lung, breast and colorectal cancers (5), was limited by the lack of previously validated questionnaires explicitly assessing CHWs' knowledge on these topics in the literature. The focus was therefore put on cervical cancer, for which a previous KAP questionnaire was found (73), and which has clear screening guidelines and is the third most common cancer in women in Brazil (80).

Other limitations relative to the interpretation of the results come from the cross-sectional survey design and the purely descriptive nature of the data analysis. Apart from establishing the current knowledge, attitudes and practices of the participants using descriptive statistics, no inferential analyses that aimed at identifying associations between variables and/or questionnaire domains were conducted. Data was collected at one single point in time, so no temporal associations or trends can be concluded. There is a risk of selection bias as participation to this study was voluntary; however, response rate was high (85%), so the risk that the results would drastically change if the 15% of CHWs who refused to participate or did not access the survey had participated, is small. As data was collected from self-reported answers, there is also a small risk for social desirability bias and recall bias, especially for the Practice section questions. Generalizability to other CHWs working in the municipality of São Paulo may be possible as all CHWs receive their initial training from the municipality, but it is ultimately still limited as all participants from this study work for and receive adapted ongoing training from the APS Santa Marcelina in the specific setting of the eastern region of São Paulo.

Major strengths of this study were the establishment of a sustainable partnership between two primary health care institutions and the close involvement of our Brazilian research partners at all steps of this study. Their input contributed to the possibility of using a census-based approach and the obtention of an overall high response rate, which increases the representativity and relevance of the results. However, due to administrative barriers, it was

difficult to involve CHWs as integrated knowledge users, which is a limitation as they were the main concerned participants and their input would have been relevant to shape the study instrument and methodology.

5.4. Conclusions and Future Directions

With the growing burden of noncommunicable diseases in Brazil and all around the world, there is an urgent need to mobilize community health workers for NCD prevention and control. While CHWs have been effective in improving maternal and child health and infectious diseases outcomes in the last decades, their tasks need to adapt to the changing health needs of the population. In addition to health promotion and prevention, they have the potential to participate in NCD detection and management, provided that they are adequately trained and supported by the rest of the system (88). Appropriate training depends on CHWs' pre-existing capacities and knowledge, the community's health priorities and the tasks to be performed (27).

In order to optimize training of CHWs working for the APS Santa Marcelina, this study's purpose was to first establish their current knowledge, attitudes and practices regarding NCDs and their risk factors. Many knowledge and practice gaps have been identified in this study, especially around cervical cancer and colon cancer screening, COPD, and behavioral factors such as physical activity and weight control. There are limitations to this study and to this type of assessment of the effectiveness of training programs as the results do not necessarily reflect the abilities of CHWs to perform their tasks, the satisfaction of community members regarding their work, nor their own experiences of training (55). It is important to "assess the effectiveness of training programs, both from the perspective of the individual CHW and the health system in which they operate", to ensure meaningful improvement of the quality of care (55). Very few studies pertaining to CHWs' training however involve CHWs in the design and delivery of training programs or ask for their feedback (55). When it is done, CHWs can significantly influence the duration, content and format of the training and improve their post-training assessment scores and knowledge retention (89).

Future studies therefore need to prioritize participatory input from CHWs to better understand their perceptions on their training needs, on the community health needs, on the challenges they face in their work environment and what they need to perform better (50, 90). This can be done with more qualitative and mixed methods research to compare experiences of CHWs receiving specific and broad competency-based training and the effectiveness of different training modalities (91). Qualitative studies help provide context and further explain findings generated by quantitative studies only, and thus increase validity of the conclusions drawn from the research (92, 93). In addition to measuring the impact on knowledge acquirement, it will be important to assess the impact of different training characteristics on CHWs' performance, and ultimately on population- and patient-level health outcomes (91). Input from nurses, physicians and clinic managers is also relevant to seek out as they are closely involved in the CHW training process and can identify administrative barriers unbeknown to CHWs (55).

Future directions following this study are to conduct further analysis on the data to explore potential associations between knowledge scores, answers to attitude and practice questions and other variables, such as level of education, level of experience, teaching frequency, number of people followed, etc. The current results and results from further analysis will be disseminated back to our participants and other knowledge users, such as the managers, nurses and physicians working in the APS Santa Marcelina network. This will be the opportunity to conduct a qualitative study to explore CHWs' and other stakeholders' interpretation of the results and perspectives on the identified knowledge and practice gaps. Their experiences with the current teaching content, format and frequency; ideas to improve training and performance assessment; ideas to develop practice-based knowledge tools to better support CHWs (e.g. clinical reference guides, mobile applications, etc.); and suggestions on how CHWs could contribute more to NCD prevention and control within family health teams and within the eastern region of São Paulo context will also be reviewed and explored. The results dissemination and the qualitative research steps are crucial as they will deepen the understanding of the results of this current study.

This will eventually lead to the development and implementation of a community-based participatory study aiming to evaluate CHW-informed training processes for impact on their

knowledge and performance, and most importantly on population health outcomes. Having more community-based studies exploring effectiveness of CHW training and interventions will reduce the knowledge gap around optimal CHW training and support CHWs' appropriate involvement in NCD prevention, detection and treatment, and ultimately help mitigate the burden of noncommunicable diseases.

Annex 1: Knowledge, Attitudes and Practices Survey

Thank you very much for agreeing to participate in this survey! The survey starts with the following questions to help us better understand your background and your work. Please answer all the questions to the best of your ability.

A) DEMOGRAPHIC INFORMATION

1. How long have you been working as a community health worker?
    a. Less than 6 months
    b. 6 – 12 months
    c. 13 - 24 months
    d. 2 - 5 years
    e. 6 -10 years
    f. 11 -15 years
    g. More than 15 years

2. How many families do you follow (approximately)?

3. How many people do you follow (approximately)?

4. How many home visits do you do per day on average?

5. How often do you receive teaching from other health professionals?
    a. At least once a week
    b. At least once a month
    c. At least once every 2 months
    d. At least once every 6 months
    e. Other: _____

6. From which group of health professionals do you receive most formal teaching? (Choose only one answer)
    a. Physicians
    b. Nurses
    c. Medical residents/students
    d. Other community health workers
    e. Other: _____

7. How old are you?

8. Sex
    a. Female
    b. Male
    c. Other
    d. Prefer not to answer

9. What is your highest level of education?
    a. Primary school completed
    b. Secondary school incomplete
    c. Secondary school completed
    d. Undergraduate studies incomplete
    e. Undergraduate studies completed
    f. Graduate studies

B) KNOWLEDGE, ATTITUDES AND PRACTICES RELATED TO NONCOMMUNICABLE DISEASES

The questions in the following sections will now focus on the topic of noncommunicable diseases. Please answer all the questions to the best of your ability. Please do not look up answers, and do not discuss your answers with other community health workers before, during or after you have

filled the survey. This will help us collect the most accurate information on your current knowledge, attitudes and practices regarding noncommunicable diseases to inform our research.

Section 1

10. **A noncommunicable disease is one that cannot be spread between people.**
    a. True
    b. False
    c. I don't know

11. **Noncommunicable diseases include the following.**
    You can choose more than one answer if applicable.
    a. Diabetes
    b. Tuberculosis
    c. Asthma
    d. Stroke
    e. AIDS

Section 2

The next questions are about lifestyle habits that are related to noncommunicable diseases.

12. **Select an answer for each of the following statements about smoking.**

	True	False	I don't know
Active smoking affects a person's health			
Smoking around others does not harm their health			
Smoking affects the lungs			
Smoking affects the heart			

13. **Which of the following sources contributes the largest amount of salt to the daily diet of Brazilian people?**
    a. The table salt they add to their food

b. The salt in foods such as milk, meat and vegetables
c. The salt in factory-made foods such as bread, sausages and canned foods
d. I don't know

14. Being overweight is considered a risk factor for many diseases. Which body mass index is considered as being overweight?

a. 20
b. 23
c. 27
d. 30
e. 33
f. I don't know

15. **The Ministry of Health of Brazil promotes 10 Steps to Healthy Diets. Which of the following recommendations <u>are part of</u> the 10 Steps?**

You can choose more than one answer if applicable.

a. Make natural or minimally processed foods the basis of your diet
b. Avoid all oils, fats, salt and sugar for seasoning and cooking foods
c. Avoid consumption of ultra-processed foods
d. Eat regularly and alone to avoid distractions
e. Be wary of food advertising and marketing

16. **How much total time of moderate-intensity physical activity per week is needed to achieve health benefits for adults?**

a. Less than 30 minutes per week
b. 30-60 minutes per week
c. 60-120 minutes per week
d. 120-150 minutes per week
e. At least 150 minutes per week
f. I don't know

Section 3

The next questions are about cardiovascular diseases, diabetes and chronic obstructive pulmonary disease (COPD).

17. **How much do you know about the following conditions?**

Choose an answer for each row.

	I don't know	I know a little	I know some	I know a lot
High blood pressure				
Myocardial infarction				
Stroke				
Diabetes				
Chronic obstructive pulmonary disease (COPD)				

18. **How does eating salty food affect the blood pressure?**

a. It lowers the blood pressure
b. It doesn't affect the blood pressure
c. It raises the blood pressure
d. I don't know

19. **Does high blood pressure affect the following body parts?**

Choose an answer for each row.

	Yes	No	I don't know
The brain			
The kidneys			
The stomach			
The heart			

20. **People with high blood pressure are more likely to have a stroke.**

a. True
b. False

c. I don't know

21. Do the following factors <u>increase</u> the risk of cardiovascular diseases?

Choose an answer for each row.

	Yes	No	I don't know
Insomnia			
Running			
Stress			
Older age			
High body mass index			
Vegetarian diet			

22. **Diabetes is when there is a lot of sugar in the blood.**

a. True
b. False
c. I don't know

23. **Diabetes type 2 can be prevented.**

a. True
b. False
c. I don't know

24. **What are signs and symptoms of diabetes type 2?**

You can choose more than one answer if applicable.

a. Frequent urination
b. Increased thirst
c. Loss of appetite
d. Weight loss
e. Fatigue

25. **Which of the following <u>IS NOT</u> a complication of diabetes?**

You can choose more than one answer if applicable.

a. Damage to the heart
b. Loss of vision
c. Loss of memory
d. Loss of sensation to the feet
e. Damage to the kidneys
f. Erectile dysfunction
g. Poor healing of wounds

26. **What is the main cause of chronic obstructive pulmonary disease (COPD)?**

a. Air pollution
b. Chronic asthma
c. Genetics
d. Smoking
e. Recurrent lung infections
f. I don't know

27. **What are signs and symptoms of chronic obstructive pulmonary disease (COPD)?**

You can choose more than one answer if applicable.

a. Cough
b. Leg swelling
c. Shortness of breath
d. Fatigue
e. Sputum production

Section 4

The next questions are related to women's health.

28. **Which medical condition is screened for with the Pap test?**

You can choose more than one answer if applicable.

a. Sexually transmitted infections

b. Cervical cancer
c. Ovarian cancer
d. Pregnancy
e. Syphilis
f. I don't know

29. **When should asymptomatic average-risk women begin having Pap tests?**
a. After the first sexual relationship
b. At 21 years old
c. At 25 years old
d. At 28 years old
e. I don't know

30. **For a woman who has had two normal annual Pap tests, how often should she continue having the test?**
a. Every 6 months
b. Every year
c. Every 2-3 years
d. Every 4-5 years
e. I don't know

31. **Can cervical cancer be prevented by vaccine?**
a. Yes
b. No
c. I don't know

Section 5

Now, read the following statements and select the answer that best matches your opinion.

32. **I feel that noncommunicable diseases <u>are common</u> amongst Brazilians.**
a. Strongly disagree

b. Disagree
c. Agree
d. Strongly agree

33. **I feel that cardiovascular diseases are becoming <u>less common</u> in Brazil in general.**
    a. Strongly disagree
    b. Disagree
    c. Agree
    d. Strongly agree

34. **I feel that diabetes is becoming <u>more common</u> in Brazil in general.**
    a. Strongly disagree
    b. Disagree
    c. Agree
    d. Strongly agree

35. **According to your experience, which health problem is the most important in <u>your community</u>?**
    Please rank each of the following conditions in order of importance. Double-click or drag-and-drop <u>all items</u> in the left list to move them to the right - your highest-ranking item should be on the top right, moving through to your lowest ranking item.
    a. Diabetes
    b. Cardiovascular diseases (heart attacks, stroke)
    c. Cancer
    d. Chronic respiratory diseases (COPD, asthma)

Section 6

The following questions will help us understand your current activities as a community health worker.

36. **How frequently do you discuss the following topics with community members?**

Choose an answer for each row.

	Never	Rarely	Sometimes	Often	Always
Harms of smoking					
Harms of alcohol					
Healthy nutrition					
Physical activity					
Weight control					
Cervical cancer screening					
Breast cancer screening					
Colon cancer screening					

37. **Finally, how confident are you that you can accurately counsel community members about the following topics?**

Choose an answer for each row.

	Not at all confident	A little confident	Moderately confident	Confident	Very confident
Harms of smoking					
Harms of alcohol					
Healthy nutrition					
Physical activity					
Weight control					
Cervical cancer screening					
Breast cancer screening					
Colon cancer screening					

Thank you very much for taking the time to fill this survey!

Annex 2: Consent Form

Study Title: Exploring Knowledge, Attitudes and Practices Regarding Noncommunicable Diseases Among Community Health Workers in São Paulo, Brazil: A Mixed-Methods Study

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The purposes of this study are to determine the current knowledge, attitudes and practices of community health workers relating to the topic of noncommunicable diseases, and to explore the training and roles of community health workers in the prevention, diagnosis and management of noncommunicable diseases.

You have been invited to participate in the first phase of this study because you are a community health worker working within the Atenção Primária à Saúde Santa Marcelina. The first phase of this study is an online survey that will take approximately 20 minutes to complete.

This study is not funded by private industry. There are no direct immediate benefits to your participation to this survey, but you will contribute to a better understanding of how to potentially adapt training given to community health workers on chronic diseases. You might benefit from this training in the future. There are no cost, no compensation and no foreseeable risks associated to your participation to this study. The research team has no conflict of interest to declare.

Study participation is voluntary. Refusal to participate will involve no penalty or loss of benefits to which you are otherwise entitled. You have the right to ask questions at any time and the right to discontinue participation at any time without penalty or loss of benefits to which you are otherwise entitled. All your answers will be kept confidential and anonymous, so they cannot be linked back to you. Only the Principal Investigator and Co-Investigators will have access to the individual anonymous answers.

Participation in this study will have NO impact on your work and relations with other health professionals in the Atenção Primária à Saúde Santa Marcelina. The survey's purpose is NOT to

evaluate your knowledge/performance as employees of the Network; results will not and cannot be used for or against work retention/ promotion purposes.

If you have any questions regarding this document, you may contact the Research Ethics Committee of Santa Marcelina Hospital, located at Rua Santa Marcelina, 177, telephone (11) 2070-6433 and e-mail (comissoes@santamarcelina.org), or the Research Ethics Committee of the Municipal Health Department of São Paulo. Rua General Jardim, 36 - 8º andar Vila Buarque, CEP: 01223-010. E-mail: smscep@gmail.com, telephone (11) 3397-24-64 or 3397-24-65. If you would like more information about this research study, contact Dr. Julie Silvia Martins, by phone (11) 2344-4600 R:1138 and/or e-mail (julie@aps.santamarcelina.org).

I have read the clarifications presented above and understood the purpose of the study "Exploring knowledge, attitudes and practices regarding noncommunicable diseases among community health workers in São Paulo, Brazil: A Mixed-Methods Study", and to which procedure I will be subjected to. The explanation I received clarifies the risks and benefits of the study. I understand that I am free to interrupt my participation at any time without justifying my decision. I know that my name will not be disclosed, that I will not have expenses and will not receive money for participating in the study. I further affirm that I have received a way for a copy of this Consent Form to remain in my possession.

- Select the subprefecture in which you currently work.
    - ☐ Cidade Tiradentes; Guaianases; Itaim Paulista; Itaquera; São Miguel Paulista
- Select your Basic Health Unit (BHU) from the following list of BHU located in [*Subprefecture selected above*].
- Select your CNES team number from the following list for [*Subprefecture selected above*].

- Select one of the following options.
    - ☐ I agree with the above and agree to participated in the survey.
    - ☐ I do not agree with the above and do not agree to participate in the survey.

Annex 3: Data Cleaning Coding

Importing the data

```
# Read in the data
Fulldata<-read.csv("/Users/catherineji/Dropbox/CSP + MSc/Thesis/Trip Jan 22-Feb 5/Survey results/Analysis/SurveyDataCleaned.csv", header=T)

#make variable names available
attach(Fulldata)
```

Cleaning of Q2: "How many families do you follow?"

1. When Q2 value > 1,000 and last 3 digits match first 3 digits of Q3, remove the last 3 digits of Q2.
2. For the remaining Q2 > 1,000, keep only the first 3 digits so that all values ~ 200 families.
3. For the remaining Q2 = 0 and > 500, replace them by NA.
4. For the remaining Q2 = 1 and for which Q3 >10, replace by NA

```
# 1) When Q2 value > 1000 and last 3 digits match first 3 digits of Q3, remove the last 3 digits of Q2.
Q2[which(Q2>1000)]
##  [1] 211820  21533 213688 200804   2002 210850   2046 219694   1796 180430
length(Q2[which(Q2>1000)])
## [1] 10
repl<-which(Q2[which(Q2>1000)]%%1000==as.numeric(substring(as.character(Q3[which(Q2>1000)]),1,3)))
Q2[which(Q2>1000)][repl]<-as.numeric(substring(as.character(Q2[which(Q2>1000)][repl]),1,3))

# 2) For the remaining Q2 > 1000, keep only the first 3 digits so that all values ~ 200 families.
Q2[which(Q2>1000)]
## [1] 211820  21533 200804   2002   2046   1796
Q2[which(Q2>1000)]<-as.numeric(substring(as.character(Q2[which(Q2>1000)]),1,3))

# 3) For the remaining Q2 = 0 or > 500, replace them by NA.
Q2[which(Q2>500)]
## [1] 660 583 680 725
Q2[which(Q2>500)]<-NA

Q2[which(Q2==0)]
```

```
## [1] 0
Q2[which(Q2==0)] <-NA

# 4) For the remaining Q2 = 1 and for which Q3 >10, replace by NA
Q2[which(Q2==1 & Q3>10)]
## [1] 1
Q2[which(Q2==1 & Q3>10)] <- NA
```

Cleaning of Q3: "How many people do you follow?"

1. When Q3 value > 2,000 and last 2 digits match 2 digits of Q4, remove the last 2 digits of Q3.
2. For the remaining Q3 < 5 and > 2,500, replace them by NA.

```
# 1) When Q3 value > 2000 and last 2 digits match 2 digits of Q4, remove the last 2 digits of Q3.
Q3[which(Q3>2000)]
##  [1] 100014   5821  12200   6501   3000   6881  65715  66812  20012 125012
## [11]  75012  69420   7800  65012  58010
length(Q3[which(Q3>2000)])
## [1] 15
repl2<-which(Q3[which(Q3>100000)]%%100==as.numeric(substring(as.character(Q4[which(Q3>100000)]),1,2)))
Q3[which(Q3>100000)][repl2]<-as.numeric(substring(as.character(Q3[which(Q3>100000)][repl2]),1,4))
repl3<-which(Q3[which(Q3>2000)]%%100==as.numeric(substring(as.character(Q4[which(Q3>2000)]),1,2)))
Q3[which(Q3>2000)][repl3]<-as.numeric(substring(as.character(Q3[which(Q3>2000)][repl3]),1,3))

# 2) For the remaining Q3 < 5 and > 2500, replace them by NA.
Q3[which(Q3>2500)]
## [1] 100014   5821  12200   6501   3000   6881   7800  65012
length(Q3[which(Q3>2500)])
## [1] 8
Q3[which(Q3<5)]
## [1]    2    3 -800    0
length(Q3[which(Q3<5)])
## [1] 4
Q3[which(Q3>2500)]<- NA
Q3[which(Q3<5)] <- NA
```

Cleaning of Q4: "How many home visits do you do per day?"

1. For Q4 = 0 or = 13.16 or > 25, replace them by NA.

```
# 1) For Q4 = 0 or = 13.16 or > 25, replace them by NA.
Q4[which(Q4>25)]
##  [1] 200 210 200 187 197 230 180 215 140  97  98 230 255
length(Q4[which(Q4>25)])
## [1] 13
Q4[which(Q4>25)]<-NA

length(Q4[which(Q4==0)])
## [1] 1
Q4[which(Q4==0)] <-NA

length(Q4[which(Q4==13.16)])
## [1] 1
Q4[which(Q4==13.16)]<-NA
```

Annex 4: Detailed Answers on Knowledge Questions

Table 5. Frequency distribution of responses obtained to knowledge questions included in knowledge score calculations

***Bold = correct answers**

Questions	Responses N (%)		
General knowledge			
Q10. A noncommunicable disease is one that cannot be spread between people.			
True	**992 (92.6)**		
False	70 (6.5)		
I don't know	9 (0.8)		
Q11. Noncommunicable diseases include the following: *(Multiple selection)*	Selected	Not selected	
Diabetes	**1,012 (94.5)**	59 (5.5)	
Tuberculosis	24 (2.2)	1,047 (97.8)	
Asthma	**864 (80.7)**	207 (19.3)	
Stroke	**693 (64.7)**	378 (35.3)	
AIDS	20 (1.9)	1,051 (98.1)	
N (%) of participants who correctly answered this question	**605 (56.5)**		
Risk factors/Lifestyle habits			
Q12. Select an answer for each of the following statements about smoking.	True	False	I don't know
Active smoking affects a person's health	**952 (88.9)**	119 (11.1)	0 (0)
Smoking around others does not harm their health	194 (18.1)	**876 (81.8)**	1 (0.1)
Smoking affects the lungs	**1071 (100.0)**	0 (0)	0 (0)
Smoking affects the heart	**850 (79.4)**	119 (11.1)	102 (9.5)
Q13. Which of the following sources contributes the largest amount of salt to the daily diet of Brazilian people?			
The table salt they add to their food	261 (24.4)		
The salt in foods such as milk, meat and vegetables	4 (0.4)		

The salt in factory-made foods such as bread, sausages and canned foods	**798 (74.5)**	
I don't know	8 (0.7)	
Q14. Which body mass index is considered as being overweight?		
20	50 (4.7)	
23	60 (5.6)	
27	**228 (21.3)**	
30	278 (26.0)	
33	237 (22.1)	
Q15. The Ministry of Health of Brazil promotes 10 Steps to Healthy Diets. Which of the following recommendations are part of the 10 Steps? *(Multiple selection)*	Selected	Not selected
Make natural or minimally processed foods the basis of your diet	**359 (33.5)**	712 (66.5)
Avoid all oils, fats, salt and sugar for seasoning and cooking foods	715 (66.8)	356 (33.2)
Avoid consumption of ultra-processed foods	**693 (64.7)**	378 (35.3)
Eat regularly and alone to avoid distractions	82 (7.7)	989 (92.3)
Be wary of food advertising and marketing	**335 (31.3)**	736 (68.7)
N (%) of participants who correctly answered this question	**38 (3.5)**	
Q16. How much total time of moderate-intensity physical activity per week is needed to achieve health benefits for adults?		
Less than 30 minutes per week	64 (6.0)	
30-60 minutes per week	370 (34.5)	
60-120 minutes per week	169 (15.8)	
120-150 minutes per week	171 (16.0)	
At least 150 minutes per week	**265 (24.7)**	
I don’t know	32 (3.0)	
Cardiovascular diseases/Hypertension		
Q18. How does eating salty food affect the blood pressure?		
It lowers the blood pressure	4 (0.4)	
It doesn’t affect the blood pressure	1 (0.1)	
It raises the blood pressure	**1061 (99.1)**	
I don’t know	5 (0.5)	

Q19. Does high blood pressure affect the following body parts?	Yes	No	I don't know
Brain	**706 (65.9)**	267 (24.9)	98 (9.2)
Kidneys	**667 (62.3)**	280 (26.1)	124 (11.6)
Stomach	133 (12.4)	**733 (68.4)**	205 (19.1)
Heart	**1019 (95.1)**	32 (3.0)	20 (1.9)
Q20. People with high blood pressure are more likely to have a stroke.			
True	**1049 (97.9)**		
False	13 (1.2)		
I don't know	9 (0.8)		
Q21. Do the following factors increase the risk of cardiovascular diseases?	Yes	No	I don't know
Insomnia	**604 (56.4)**	306 (28.6)	161 (15.0)
Running	154 (14.4)	**827 (77.2)**	90 (8.4)
Stress	**1015 (94.8)**	31 (2.9)	25 (2.3)
Older age	**688 (64.2)**	302 (28.2)	81 (7.6)
High BMI	**1004 (93.7)**	40 (3.7)	27 (2.5)
Vegetarian diet	26 (2.4)	**939 (87.7)**	106 (9.9)
Diabetes mellitus			
Q22. Diabetes is when there is a lot of sugar in the blood.			
True	**1015 (94.8)**		
False	53 (4.9)		
I don't know	3 (0.3)		
Q23. Diabetes type 2 can be prevented.			
True	**870 (81.2)**		
False	91 (8.5)		
I don't know	110 (10.3)		
Q24. What are signs and symptoms of diabetes type 2? *(Multiple selection)*	Selected	Not selected	
Frequent urination	**769 (71.8)**	302 (28.2)	
Increased thirst	**913 (85.2)**	158 (14.8)	
Loss of appetite	178 (16.6)	893 (83.4)	

Weight loss	**643 (60.0)**	428 (40.0)
Fatigue	**487 (45.5)**	584 (54.5)
N (%) of participants who correctly answered this question	**143 (13.4)**	
Q25. Which of the following IS NOT a complication of diabetes? *(Multiple selection)*	Selected	Not selected
Damage to the heart	675 (63.0)	396 (37.0)
Loss of vision	39 (3.6)	1032 (96.4)
Loss of memory	**623 (58.2)**	448 (41.8)
Loss of sensation to the feet	49 (4.6)	1022 (95.4)
Damage to the kidneys	191 (17.8)	880 (82.2)
Erectile dysfunction	284 (26.5)	787 (73.5)
Poor healing of wounds	46 (4.3)	1025 (95.7)
N (%) of participants who correctly answered this question	**209 (19.5)**	
Chronic obstructive pulmonary disease (COPD)		
Q26. What is the main cause of COPD?		
Air pollution	34 (3.2)	
Chronic asthma	182 (17.0)	
Genetics	14 (1.3)	
Smoking	**432 (40.3)**	
Recurrent lung infections	323 (30.2)	
I don't know	86 (8.0)	
Q27. What are signs and symptoms of COPD? *(Multiple selection)*	Selected	Not selected
Cough	**581 (54.2)**	490 (45.8)
Leg swelling	67 (6.3)	1004 (93.7)
Shortness of breath	**975 (91.0)**	96 (9.0)
Fatigue	**747 (69.7)**	324 (30.3)
Sputum production	**286 (26.7)**	785 (73.3)
N (%) of participants who correctly answered this question	**168 (15.7)**	
Cervical cancer		
Q28. Which medical condition is screened for with the Pap test? *(Multiple selection)*	Selected	Not selected

Sexually transmitted infections	529 (49.4)	542 (50.6)
Cervical cancer	**1043 (97.4)**	28 (2.6)
Ovarian cancer	325 (30.3)	746 (69.7)
Pregnancy	31 (2.9)	1040 (97.1)
Syphilis	201 (18.8)	870 (81.2)
N (%) of participants who correctly answered this question	**427 (39.9)**	
Q29. When should asymptomatic average-risk women begin having Pap tests?		
After the first sexual relationship	991 (92.5)	
At 21 years old	51 (4.8)	
At 25 years old	**28 (2.6)**	
At 28 years old	0 (0.0)	
I don't know	1 (0.1)	
Q30. For a woman who has had two normal annual Pap tests, how often should she continue having the test?		
Every 6 months	38 (3.5)	
Every year	678 (63.3)	
Every 2-3 years	**355 (33.1)**	
Every 4-5 years	0 (0.0)	
I don't know	0 (0.0)	
Q31. Can cervical cancer be prevented by vaccine?		
Yes	**598 (55.8)**	
No	426 (39.8)	
I don't know	47 (4.4)	

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