Gender Inequality and Food Security:
A Global Comparative Analysis

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ABSTRACT

After years of decreases in global hunger, recent estimates from the Food and Agriculture Organisation showed that the number of undernourished people increased to 815 million in 2016 from 777 million in 2015. This reversal in trends suggests that new approaches are needed to tackle global food insecurity. Studies have shown that one potential approach is to reduce gender inequality; however, there are no studies looking at the global level and across regions, with internationally validated food security tools. This study fills this research gap by exploring the association between gender inequality and food security at the global level and across regions. This quantitative, cross-sectional study used 2015 data from three sources: Gallup World Poll, United Nations Development Programme, and the World Bank. The sample included 119 countries and 116,077 respondents. Food security was assessed using the Food Insecurity Experience Scale, and gender inequality was assessed using the Gender Inequality Index. Two thresholds were developed to assess food insecurity: the prevalence of moderate or severe food insecurity, and the prevalence of severe food insecurity only. In order to ensure international comparability, a common global reference was used to calibrate individual responses, and generate comparable estimates of food insecurity at the global level. Countries were classified into seven regions based on the World Bank regional classification: East Asia and the Pacific (EAP), Europe and Central Asia (ECA), Latin America and the Caribbean (LAC), Middle East and North Africa (MENA), North America (NAM), South Asia (SA), and sub-Saharan Africa (SSA). Spearman's rank correlation and generalized linear models were used to assess the association between gender inequality and prevalence of food insecurity. Models were adjusted for health (assessed using the personal health index). Only significant factors ($p < 0.05$) were retained in the multivariate models. Statistical analyses were conducted using R and SAS with statistical significance set at $p < 0.05$. Findings from the Spearman's rank correlation showed that gender inequality was significantly associated with moderate or severe food insecurity ($r_s = 0.88$, $p < 0.001$) and severe food insecurity ($r_s = 0.79$, $p < 0.001$). Results from the generalized linear models showed that gender inequality was significantly associated with both thresholds of food insecurity at the global level ($p < 0.0001$). However, great heterogeneity was observed across regions. While gender inequality was a significant predictor of the prevalence of moderate or severe food insecurity in EAP, ECA, LAC, and MENA, it was not significantly associated in SA and SSA. When analyses were conducted only for severe food insecurity, the effect of gender inequality was significant in EAP, LAC, and SA, but not in ECA, MENA, and SSA. Multivariate findings showed that when controlling for health, there was a significant positive association between gender inequality and the prevalence of food insecurity globally. At the regional level, there was also variability in the degree of significance in the relationship. Gender inequality was a significant predictor of moderate or severe food insecurity in three regions (EAP, ECA, and LAC). For severe food insecurity, gender inequality had a significant effect in EAP, SA, and SSA. Results from this study suggest that health was the main predictor of food insecurity in region where the effect of gender inequality on food insecurity was not significant, which was the region with greater levels of gender inequality (i.e., SSA). This means that there are other mitigating factors, such as climate change, which could explain the lack of significance in some regions. To our knowledge, this is the first study examining the association between gender inequality and food security at the global and regional levels.

RÉSUMÉ

Bien que la faim ait connu une réduction pendant plusieurs années, des estimations récentes de l'Organisation des Nations Unies pour l'alimentation et l'agriculture ont indiqué que le nombre de personnes sous-alimentées est passé de 777 millions en 2015 à 815 millions en 2016. Cette inversion des tendances suggère que de nouvelles approches seraient nécessaires pour lutter contre l'insécurité alimentaire mondiale. De nombreuses études ont suggéré qu'une des approches possibles consisterait à réduire l'inégalité entre les sexes. Cependant, aucune étude n'utilise des outils de sécurité alimentaire validés au niveau international pour étudier des situations aux niveaux global et régional. Cette étude comble ce manque de recherche en explorant l'association entre l'inégalité entre les sexes et la sécurité alimentaire aux niveaux mondial et régional. Cette étude quantitative et transversale a analysé les données du *Gallup World Poll* tirées du Programme des Nations Unies pour le développement, ainsi que celles de la Banque mondiale pour 2015. L'échantillon comprenait 119 pays et 116 077 répondants. La sécurité alimentaire a été mesurée à l'aide de l'échelle de mesure de l'insécurité alimentaire vécue « *Food Insecurity Experience Scal*e », et l'inégalité entre les sexes a été évaluée à l'aide de l'indice d'inégalité de genre « *Gender Inequality Index* ». Deux seuils ont été définis pour évaluer l'insécurité alimentaire: la prévalence de l'insécurité alimentaire modérée ou sévère, et la prévalence uniquement de l'insécurité alimentaire sévère. Afin de garantir la comparabilité internationale, une référence mondiale commune a été utilisée pour calibrer les réponses individuelles et générer des estimations comparables de l'insécurité alimentaire au niveau mondial. Les pays ont été classés en sept régions selon la classification régionale de la Banque mondiale: Asie orientale et Pacifique (EAP), Europe et Asie centrale (ECA), Amérique latine et Caraïbes (LAC), Moyen-Orient et Afrique du Nord (MENA), Amérique du Nord (NAM), Asie du Sud (SA) et Afrique subsaharienne (SSA). Les corrélations de Spearman et les modèles linéaires généralisés ont été utilisés pour évaluer l'association entre l'inégalité entre les sexes et la prévalence de l'insécurité alimentaire. Les modèles ont été ajustés pour la santé (évaluée en utilisant l'indice de santé personnel). Seuls les facteurs significatifs ($p < 0,05$) ont été retenus dans les modèles multivariés. Les analyses statistiques ont été menées en utilisant R et SAS avec une signification statistique fixée à $p < 0,05$. Les résultats des corrélations de Spearman ont montré que l'inégalité entre les sexes était associée significativement à une insécurité alimentaire modérée ou sévère ($r_s = 0,88$, $p < 0,001$) et une insécurité alimentaire sévère ($r_s = 0,79$, $p < 0,001$). Les résultats des modèles linéaires généralisés ont montré que l'inégalité entre les sexes était associée significativement aux deux seuils d'insécurité alimentaire au niveau mondial ($p < 0,0001$). Cependant, une grande hétérogénéité a été observée entre les régions. L'inégalité entre les sexes était un prédicteur significatif de la prévalence de l'insécurité alimentaire modérée ou sévère en EAP, ECA, LAC et MENA, mais cela n'a pas été observé en SA et SSA. En ce qui concerne l'insécurité alimentaire sévère, l'effet de l'inégalité entre les sexes était significatif en EAP, LAC et SA. Aucun effet significatif n'a été observé en ECA, MENA et SSA. Les résultats multivariés ont montré que lorsque l'insécurité alimentaire était contrôlée par la santé, il y avait une association positive significative entre l'inégalité entre les sexes et l'insécurité alimentaire à l'échelle mondiale. Au niveau régional, il y avait une variabilité dans le degré d'importance de la relation. Alors que l'inégalité entre les sexes était un prédicteur significatif de l'insécurité alimentaire modérée ou sévère en EAP, ECA et LAC, elle n'en était pas un dans la région MENA, SA et SSA. En cas d'insécurité alimentaire grave, l'inégalité entre les sexes a eu un effet significatif en EAP, SA et SSA. Les résultats de cette étude suggèrent que la santé était le

principal prédicteur de l'insécurité alimentaire dans la région où l'inégalité entre les sexes n'était pas significative, à savoir la région les plus touchées par l'inégalité entre les sexes (SSA). Ceci signifie qu'il existe d'autres facteurs atténuants, tel que le changement climatique, qui pourraient expliquer le manque d'importance de l'association dans certaines régions. À notre connaissance, il s'agit de la première étude sur l'association entre l'inégalité entre les sexes et la sécurité alimentaire aux niveaux mondial et régional.

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CONTRIBUTION OF AUTHORS

The authors listed in the manuscript of this thesis all made important contributions to this research project. As the first author of the manuscript, I developed the research question, reviewed existing literature, analyzed and interpreted the data, and wrote the manuscript. Hugo Melgar-Quiñonez and Theresa Thompson-Colón provided feedback and support through all stages of the research. Timothy Schwinghamer helped with the analysis and interpretation of the results. Arlette Saint Ville contributed her knowledge on food security for the literature review and interpretation of the findings, and provided overall support and guidance throughout this project.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ACRONYMS & ABBREVIATIONS

CAADP – Comprehensive Africa Agriculture Development Programme
CEDAW – Convention on the Elimination of All Forms of Discrimination against Women
CILSS – Permanent Interstate Committee for Drought Control in the Sahel
EAP – East Asia and the Pacific
EBFSS – Experienced Based Food Security Scale
ECA – Europe and Central Asia
EC-JRC – European Commission's Joint Research Centre
ECOWAS – Economic Community of West African States
ELCSA – Escala Latinoamericana y Caribeña de Seguridad Alimentaria
FAO – Food and Agriculture Organisation
FEWS-NET – Famine Early Warning Systems Network
FIES – Food Insecurity Experience Scale
GDI – Gender-related Development Index
GDP – Gross Domestic Product
GDP PC PPP – Gross Domestic Product Per Capita Obtained by Purchasing Power Parity
GEM – Gender Empowerment Measure
GII – Gender Inequality Index
GWP – Gallup World Poll
IFAD – International Fund for Agricultural Development
ILO – International Labour Organisation
IMF – International Monetary Fund
IRT – Item Response Theory
LAC – Latin America and the Caribbean
MENA – Middle East and North Africa
MDG – Millennium Development Goals
NAM – North America
NEPAD – New Partnership for Africa's Development
OECD – Organisation for Economic Co-operation and Development
PHI – Personal Health Index
SA – South Asia
SDG – Sustainable Development Goals
SIGI – Social Institutions and Gender Index
SSA – Sub-Saharan Africa
US HFSSM United States Household Food Security Survey Module
UN – United Nations
UNDP – United Nations Development Programme
UN ECOSOC – United Nations Economic and Social Council
UNICEF – United Nations Children's Fund
VoH – Voices of the Hungry Project
WAEMU – West African Economic and Monetary Union
WFP – World Food Programme
WHO – World Health Organisation

CHAPTER 1: GENERAL OVERVIEW

1.1 INTRODUCTION

In 2015, the United Nations (UN) introduced 17 SDGs in the "2030 Agenda for Sustainable Development" as part of a global call to action to eliminate poverty, promote peace and prosperity, and improve sustainability (United Nations General Assembly, 2015a). Two of the 17 SDGs inform this research: SDG 2: Zero Hunger aims to "end hunger, achieve food security and improved nutrition, and promote sustainable agriculture;" and SDG 5: Gender Equality intends to "achieve gender equality and empower all women and girls." The links between these two goals can be seen in the traditional roles and responsibilities of women related to food, specifically in food production and preparation. Globally, women represent 43% of the agricultural labour force (FAO, 2011). In low- and middle-income countries, women are more likely to be given responsibility of household chores as well as activities involving the production, preparation, and purchase of food (Quisumbing, Brown, Feldstein, Haddad, & Peña, 1995; Bhandari, 2017). Therefore, it is argued through the literature that an increase in women's status could improve the nutritional status of women and their family members (Bhandari, 2017).

Food was first recognized as a basic human right in the International Declaration of Human Rights (UNGA, 1948). The right to food was then incorporated within the International Covenant on Economic, Social, and Cultural Rights, and adopted by 160 countries in 1966 (UNGA, 1966). Under the right to food, States are legally obligated to respect, protect, and fulfill the right to food, and ensure that all individuals have access to adequate food that meets their dietary requirements. Despite global efforts to eliminate hunger, recent estimates from the Food and Agriculture Organisation (FAO) show that the current state of global food insecurity is worsening (FAO, IFAD, UNICEF, WFP, & WHO, 2017). It was estimated that the number of chronically undernourished individuals increased to 815 million in 2016 from 777 million in 2015. Some regions, in particular, had very high levels of chronic undernourishment, specifically sub-Saharan Africa, Western Asia, and South-Eastern Asia.

To monitor and evaluate the targets of the SDGs, measurement tools are required. For SDG 2.1.2, a new tool called the Food Insecurity Experience Scale (FIES) was used as an indicator to

assess the prevalence of food insecurity (United Nations General Assembly, 2015b). Over the years, many tools were developed in order to better understand the complexity and the multidimensionality of the phenomenon of food security; however, there is no gold standard available to measure and assess the food security status (Cafiero, Melgar-Quiñonez, Ballard, & Kepple, 2014; Pérez-Escamilla & Segall-Correa, 2008). One of the most recent tools is the FIES, which is a validated measurement tool used to assess the food security status of individuals by specifically using the access dimension of food security (FAO, 2016). Previous ethnographic research was used to form the basis of the FIES, and showed that people reported a wide range of food security experiences, which range from anxiety about lack of money to purchase food to going without food for an entire day (Radimer, Olsen, Greene, Campbell, & Habicht, 1992; Ballard, Kepple, & Cafiero, 2013). The purpose of the FIES is to grasp the various experiences of food insecure individuals, and to determine the level of severity based on their experiences (Ballard et al., 2013). One of the major advantages associated with the FIES is the potential for conducting cross-national and regional comparisons of food security trends to monitor progress in reaching zero hunger (Ballard et al., 2013).

Gender is considered to be one of the main determinants of food security (Bhandari, 2017; Belachew et al., 2011). Gender refers to the social norms and roles associated with men and women (Quisumbing, 1996). The relationship between gender and food security has been widely examined in the literature, with a focus on women (Bhandari, 2017; Njuki, Parkins, & Kaler, 2016). Women and girls are more vulnerable to food security, partly due to discriminatory gender norms and social and cultural practices (Baig-Ansari, Rahbar, Bhutta, & Badruddin, 2006; Sida, 2015), and limited access to resources (Quisumbing et al., 1995; Selim, 2014; Ivers & Cullen, 2011; Kassie, Stage, Teklewold, & Erenstein, 2015). Within the field of gender and food security, there is an interest in exploring the relationship between gender equality and food security (Bhandari, 2017). It has been previously shown that gender equality is associated with food security and nutrition (Smith, Ramakrishnan, Ndiaye, Haddad, & Martorell, 2003; von Grebmer et al., 2009); however, most studies focus on the individual and household levels (Belachew et al., 2011; Kassie, Ndiritu, & Stage, 2014; Tibesigwa & Visser, 2016; Kassie et al., 2015). To our knowledge, no study has examined the association between gender inequality and food security at the global and regional levels (Ridgeway, 2011; Bhandari, 2017).

1.2 STUDY RATIONALE

As demonstrated by the recent increase in the number of undernourished people, this reversal in trends suggests that new approaches are needed to tackle global food insecurity. Studies have shown that one potential approach is to reduce gender inequality, but there are no studies examining the association between gender inequality and food security at the global level and across regions, with internationally validated food security tools. With the projected increase in undernourishment, a deeper understanding of the determinants and causes of food insecurity is needed in order to achieve our goal of zero hunger.

1.3 OVERALL STUDY AIM

The purpose of this study is to explore the relationship between gender inequality and food security.

1.4 RESEARCH OBJECTIVES

The objectives of this study are twofold: 1) to examine the association between gender inequality and food security at the global level; and 2) to assess how gender inequality is associated with food security on a region-by-region basis.

CHAPTER 2: LITERATURE REVIEW

2.1 FOOD SECURITY

2.1.1 DEFINING FOOD SECURITY

Food security was defined, at the 1996 World Food Summit, as existing "when all people, at all times, have physical and economic access to sufficient, safe, and nutritious food that meets their dietary needs and food preferences for an active and healthy life" (FAO, 1996). Therefore, food security can be perceived to include four dimensions, namely, (1) access, (2) availability, (3) utilization, and (4) stability (FAO, 2006).

Availability refers to the physical availability of sufficient amounts of food (FAO, 2008; WFP, 2009). This dimension includes food that is produced, imported, stored, traded, or provided by government or aid organisations (WFP, 2009).

Access refers to physical and economic access to resources needed to procure food (FAO, 2008; WFP, 2009). Physical access is influenced by factors, including lack of railways and limited road infrastructures, whereas economic access is determined by factors, such as income and food prices (FAO, 2008). It was previously argued that the main cause of food insecurity was the lack of food production and availability; however, this perspective neglects the unequal distribution of resources and tools, and the presence of poverty and socioeconomic inequalities as stated by Amartya Sen who argues that "Starvation is the characteristic of some people not having enough food to eat. It is not the characteristic of there being not enough food to eat." (Sen, 1982). The level of access is determined by how food is acquired by an individual or household, whether it is produced, purchased, bartered, hunted, or given as a gift (WFP, 2009).

Utilization refers to the way in which food is processed as well as the nutritional quality and safety of food (FAO, 2008; WFP, 2009). This component involves factors, such as quality of diet, preparation, storage, and processing of food, individual health status, intra-household distribution of food, and access to clean water and sanitation facilities (WFP, 2009).

Stability refers to the economic, social, and political context in terms of the access to food (FAO, 2008). This dimension addresses factors associated with variations in the level of food security over time, and is influenced by severe climatic events, high food prices, and political instability, for example (FAO, 2008).

Food insecurity can be classified as transitory or chronic, depending on the duration (FAO, 2008). While transitory food insecurity is short-term, and exists when there is a temporary inability to achieve their energy requirements due to changes in the availability and access to food, chronic food insecurity is long-term, and exists when there is an inability to achieve the required energy levels for a period of six months or more due to limited access to resources and assets (FAO, 2008).

Frequently, food insecurity is described as synonymous to hunger; however, these two terms have different meanings (Maletta, 2014). Hunger has been defined as a subjective feeling in which a person feels the desire to eat, which can also occur when there is insufficient amount of food to achieve the required energy needs, meaning that there is a lack of nutrients to support adequate growth and promote overall health (Maletta, 2014). This state is described as malnutrition, which refers to undernutrition and overnutrition (WFP, 2016). According to Radimer, Olsen, & Campbell (1990), hunger also encompasses individual behaviours and experiences reflective of the severity of food insecurity. Based on their observations, a new conceptual definition of hunger was developed, focusing on the quality of food, quality of diet, psychological factors, and social determinants. Their research also showed that hunger was a "managed process," and that the use of coping mechanisms was applied to delay or avoid experiences associated with severe outcomes.

Based on the ethnographic research conducted by Radimer et al. (1990) and Radimer et al. (1992), food insecurity was characterized as a sequence of experiences related to hunger along a continuous scale. These experiences range from anxiety over the ability to purchase food, compromising on the quality of food, decreasing the quality of food consumed, and going without eating for a whole day (Ballard et al., 2013). These domains are organized along a continuum of severity, and the severity of food insecurity increases as an individual progressively goes from one stage to another. Four categories of food security were developed

using this construct, which are 1) food secure, 2) mildly food insecure, 3) moderately food insecure, and 4) severely food insecure (Ballard et al., 2013). Further research was conducted to demonstrate how the experiences of food insecurity included in this construct were common in different cultures and contexts (Coates et al., 2006).

2.1.2 CAUSES AND CONSEQUENCES OF FOOD INSECURITY

Food insecurity is influenced by social, political, economic, and environmental factors, which are related to all four dimensions: availability, access, utilization, and stability (Pérez-Escamilla & Segall-Correa, 2008). In addition, food insecurity can occur due to the presence of factors at four different levels: individual, household, national, and global (Smith, El Obeid, & Jensen, 2000). According to a conceptual framework developed by Smith et al. (2000), determinants of food insecurity vary depending on the country and context. Food security depends on the level of global and national food supply available to support the dietary needs of the population (Smith et al., 2000). For the past decades, per capita food availability has increased (FAO, IFAD, & WFP, 2015). In addition, current global food production levels are increasing faster than the level of global population growth, meaning that there is enough food to feed everyone in the world (FAO et al., 2015). Climate change can negatively affect the level of food production at the global level due to the increase in severe weather events, such as hurricanes and droughts, which can damage food crops and limit food availability (Wossen & Berger, 2015). Several factors can influence the availability of food at the national level, including transportation, infrastructure, and level of food production in the country (Smith et al., 2000). The causes of food insecurity also comprise of short-term shocks (associated with acute food crises) and long-term forces (associated with chronic food shortages) (Smith et al., 2000).

At the household level, food security is closely associated with the dimensions of availability and access of food, specifically the level of household food production, and physical and economic access (Melgar-Quiñonez & Hackett, 2008). One of the main determinants of household food security is the intra-household distribution of food (Smith et al., 2000; Warr, 2014). Gender plays an important role in understanding the dynamics of food allocation at the household level because in some regions, such as South Asia, women and girls are often more likely to receive less food than boys and men, resulting in increased vulnerability to food insecurity (Harris-Fry et

al., 2018). Socio-economic status, household size, ethnicity, age, and maternal education are additional factors affecting household food security (Melgar-Quiñonez & Hackett, 2008). There are also various determinants that influence the status of food security at the individual level, including gender, income, low level of education, rurality, and limited social resources (Olsen, 1999). Food insecurity is known to have negative implications on the physical and mental health, and social wellbeing of individuals (Smith et al., 2000). The consequences of food insecurity can be seen beyond the individual level, and can negatively affect human development (Conceicão, Fuentes-Nieva, Horn-Phathanothai, & Ngororano, 2011).

2.1.3 MEASURING FOOD INSECURITY

A proper measurement tool is required to measure the impact of interventions designed to reduce food insecurity (FAO, 2016). Various measurement tools were developed and proposed as ways to assess food security on an individual, household, and country level (Pérez-Escamilla & Segall-Correa, 2008). Although there are many available measurement tools, no gold standard exists due to the complex nature of the concept of food security (Cafiero et al., 2014; Pérez-Escamilla & Segall-Correa, 2008). Food security is a multidimensional phenomenon; therefore, it is difficult to assess it using a single measure (Cafiero et al., 2014). Food security is considered to be a latent trait, meaning that it cannot be observed (Ballard et al., 2013). In national surveys, there are five main methods to measure food insecurity, namely, (1) FAO estimates of the prevalence of undernourishment, (2) household income and expenditures, (3) individual's dietary intake, (4) anthropometry, and (5) experienced-based food security scales (Ballard et al., 2013). Experience-based food security scales are especially useful because they are reliable, valid, affordable to use, and can be applied in a relatively short amount of time (Cafiero et al., 2014). In contrast to other indicators, experience-based food security scales are also able to consider the psychosocial and emotional aspects of food insecurity.

Results from ethnographic research conducted by Radimer and colleagues were used for the development of food security survey measurement tools, one of which was the United States Household Food Security Survey Module (US HFSSM) (Radimer et al., 1992). Since 1995, the US HFSSM was administered to assess food security in the United States (Hamilton et al., 1997). Various scales were developed soon after, such as the Latin American and Caribbean Food

Security Scale (ELCSA), which was applied in different countries in Latin America, the Caribbean, and other regions for more than ten years, and its wide use demonstrates its ability to effectively assess food security of people from different cultures and backgrounds (Ballard et al., 2013). The success in the implementation of ELCSA resulted in the development of the Food Insecurity Experience Scale (FIES) by FAO through the Voices of the Hungry project (Ballard et al., 2013). In 2014, FIES was used as a global indicator for the measurement and monitoring of food security in over 150 countries, and the scale has been shown to be a reliable and valid measure of food insecurity (FAO, 2016). In order to examine and address the causes and consequences of food insecurity, reliable and valid tools are needed (Cafiero et al., 2014; Pérez-Escamilla & Segall-Correa, 2008).

2.2 GENDER

2.2.1 DEFINING GENDER

Historically, gender and sex were used interchangeably; however, these two terms are distinct constructs (Krieger, 2003). The term "gender" was introduced in the 1970s as a means to distinguish the role of biology and cultural norms on observed differences in social roles, health status, and performance between men and women (Krieger, 2003). Gender refers to the social norms and roles associated with men and women (Quisumbing, 1996). Specifically, these responsibilities and roles of men and women are dependent on place and life stage, and evolve over time (Phillips, 2005). In addition, gender roles are influenced by various factors, including religion, ideology, economics, culture, and ethnicity (Moser, 1989). Sex, on the other hand, refers to the biological differences between men and women (Quisumbing, 1996), and involves biological characteristics, such as genes and hormone profile (Phillips, 2005).

It is important to distinguish between sex and gender differences. Examples of sex differences include disparities in health outcomes between men and women. Health research has shown that women have a longer life expectancy than men; however, there are greater morbidity rates among women (Rieker & Bird, 2005). While women are more likely to develop nonfatal acute and chronic diseases, and disability, men are more likely to develop fatal chronic conditions. Moreover, there are also sex-based differences in the nutritional needs of men and women (Ivers

& Cullen, 2011; Fikree & Pasha, 2004). For example, women have higher nutritional needs, especially those who are pregnant and breastfeeding (Ivers & Cullen, 2011). When the nutritional needs of women are not met, pregnant women are more likely to have low-birth weight babies (Ivers & Cullen, 2011). Consequently, low-birth weight children are more vulnerable to mortality, wasting, and stunting (Branca, Piwoz, Schultink, & Sullivan, 2015). In contrast, examples of gender differences involve the distribution of responsibilities, which are influenced by social and cultural norms. Traditionally, women hold primary responsibility for taking care of children and the elderly (Inglehart & Norris, 2003). Women were also expected to perform household chores, such as cooking and cleaning, and other forms of unpaid work, which were not fully appreciated (Sayer, 2005). As we can see, gender differences can have implications for the division of roles and responsibilities between men and women.

Gender operates at three different levels, according to Wharton (2005). Firstly, individuals are considered to be gendered beings as gender is manifested at the individual level. Secondly, relationships and interactions between men and women can create gender inequalities. Thirdly, gender is manifested at the institutional level, and is influenced by the way in which organisations are arranged. While gender is produced at three levels, the area of the role of institutions at the country and regional levels is under researched (Branisa, Klasen, & Ziegler, 2013).

2.3 GENDER INEQUALITY

2.3.1 DEFINING GENDER INEQUALITY

Gender influences many parts of everyday life (Lorber, 1994), and is a major contributor to inequality between individuals in a society (Ridgeway, 2011). There are various definitions for gender inequality. This research uses the following definition by Ridgeway (2011), which conceptualizes gender inequality as an "ordinal hierarchy between men and women in material resources, power, and status." This definition was used because it includes other forms of inequality besides unequal distribution of resources, specifically power and status. All three components are also represented at the micro and macro levels.

Gender equality exists when women, men, girls, and boys share the same rights and responsibilities, and have access to equal opportunities (OSAGI, 2001). Three components form the basis of gender equality between men and women, namely, (1) access to resources and opportunities (equal access to productive resources and assets, and political decision-making); (2) human endowments (capabilities necessary for well-being, including health, education, and nutrition); and (3) security (ability to be safe and free from violence) (UN Millennium Project, 2005). Based on this definition of gender equality, women and men are not exactly the same; it advocates that men and women should be able to make decisions that are not determined by gender roles, stereotypes, and prejudices, and that an individual's gender should not be used to assign opportunities and responsibilities (OSAGI, 2001).

Individuals are exposed to gender roles, norms, and stereotypes at a very young age in a process recognized as the gender socialization of girls and boys, which refers to "the process through which individuals learn the gender norms of their society" (Ryle, 2012). Gender identities are then formed following the socialization of gender norms and stereotypes, which are labelled as either masculine or feminine (Ridgeway, 2011). This form of socialization takes place over the course of the life cycle (Ryle, 2012). The state plays a major role in facilitating the gender socialization process of children through the education system (Stromquist, 2007). Children are socialized during their interaction with the curriculum, for example (Kangethe, Lyria, & Nyamanga, 2014). Girls are directed to subjects, including home-science and nursing, because these subjects can help lead girls to professions based on caregiving (Chege & Sifuna, 2006). In contrast, boys are encouraged to study subjects, such as sciences and mathematics, because these subjects are associated with physical and mental toughness, which are certain characteristics of masculinity (Chege & Sifuna, 2006). It is important to note that since gender is a learned social construct, gender norms and practices can also be unlearned (Lorber, 1994).

Gender inequalities are long-term, institutionalized inequalities, and are recognized as deeply rooted and embedded in a society (Tilly, 1998). However, these inequalities are not static as they are continuously evolving over time (Lorber, 1994). Compared to other forms of inequality, gender inequality is considered to be the most common (Kabeer, 2015). It exists in all communities and societies, but varies by type and degree of severity (Akter et al., 2017; Kabeer, 2015). For example, countries with high levels of gender inequality are those where women's

participation and movements outside of the household are limited due to discriminatory norms, and where women have restricted control over income and resources within the household (Kabeer, 2003). There can still be gender discrimination in countries where women are able to gain paid work, particularly in terms of labour market outcomes (Kleven & Landais, 2017). Therefore, it is important to examine the determinants and consequences of gender inequality since it affects all countries, both developed and developing (Kabeer, 2015).

Gender inequalities are also reflective of a society's norms and traditions, and differ from country-to-country (Lorber, 1994). Most communities and societies are defined by a degree of gender inequality, which, in many cases, tends to favour men over women (Wharton, 2005). This social system is defined as patriarchy, which refers to the "process, structure, and ideology of women's subordination." (Lorber, 1994). In this system, men tend to hold dominant positions in all institutions of society (Paxton & Hugues, 2015). This systematic influence over women by men can limit how women access economic resources and opportunities (Borrell et al., 2013; Walby, 1989), resulting in less social, economic, and political power (Paxton & Hugues, 2015). Because of the heterogeneity of gender issues, national policies need to reflect the context in which they will be applied (Htun & Weldon, 2010).

2.3.2 GLOBAL AGENDA FOR GENDER EQUALITY

International agreements are often used to promote gender equality and women's empowerment at the global and national levels (Esquivel & Sweetman, 2016). Discrimination based on gender is a recognized form of discrimination in several laws and legislations, including the Convention on the Elimination of All Forms of Discrimination against Women (CEDAW) (1979), the Beijing Declaration and Platform for Action (1995), the Millennium Development Goals (MDGs) (2000), and the Sustainable Development Goals (SDGs) (2015) (Dhar, 2018). International agreements are key to promoting women's empowerment for several reasons, according to Esquivel and Sweetman (2016). Firstly, international agreements can help influence policies at the national and regional levels. Secondly, they can be used to support the rights of marginalized individuals. Thirdly, they can change social and cultural practices in a community. Most importantly, international agreements can hold governments accountable, and sets out guidelines to help countries achieve their targets.

2.3.3 GLOBAL TRENDS IN GENDER INEQUALITIES

In the past few decades, there were significant improvements in the status of women in the world; however, more work needs to be done in order to achieve parity (Waylen, 2013). Women and girls have been historically more disadvantaged by gender inequalities than boys and men (World Bank, 2015). The following sub-sections summarize findings from a recent report by the International Monetary Fund (Stotsky, Shibuya, Kolovich, & Kebhaj, 2016) that examined global and regional trends in gender inequality using indicators in education, health, employment, and political representation.

***Education*:** Historically, the rate of enrollment in primary and secondary school was higher for boys than girls, particularly in developing countries (World Bank, 2011). However, the gap in net enrollment rates between boys and girls is decreasing globally (World Bank, 2011). Data show that the female-to-male ratio of gross secondary enrollment increased in Africa, Europe, the Americas and the Caribbean, Asia and Pacific, and Middle East and Central Asia between 1980 and 2014, which demonstrates that there is a decrease in the gender gap in education (Stotsky et al., 2016). Nevertheless, in some regions, including the Middle East and Central Asia, and sub-Saharan Africa, there are still persistent gender gaps in education as the rates of secondary school enrollment are lower among girls than boys.

***Health*:** The female-to-male ratio of life expectancy at birth was higher than one in all of the regions between 1980 and 2014, indicating that females are more likely to live longer than males (Stotsky et al., 2016). Data showed that the female-to-male ratio of child mortality was also greater than one in all of the regions between 1990 and 2014. Furthermore, the maternal mortality ratio decreased in all regions between 1980 and 2014. Sub-Saharan Africa was the region with the highest maternal mortality ratio. Nonetheless, it saw a decrease in maternal mortality of nearly 50% during this period. There was also significant progress in reducing maternal mortality in the Middle East and Central Asia, and Asia and the Pacific.

***Employment*:** Overall, the gender gap in labour force participation of individuals between the ages of 15 and 64 decreased between 1980 and 2014 (Stotsky et al., 2016). There is a wide gap in the female-to-male ratio of labour force participation between the Middle East and Central Asia

and other regions. The female-to-male ratio of labour force participation decreased in Asia and the Pacific, which was influenced by a decrease in the labour force participation among females in India, resulting from a lack of job opportunities in female-dominated fields, increase in the number of women enrolled in secondary and tertiary education, and barriers at work affecting women. In addition, between 1980 and 2014, there was a slow decrease in the wage gap between women and men.

***Political representation*:** In every region, there were significant improvements in the proportion of seats held by women in national parliaments (Stotsky et al., 2016). Despite the increase in the number of female parliamentarians, the proportion of seats held by women in national parliaments is still lower than 50% in all of the regions. In 2015, only two countries, Rwanda and Bolivia, reported that more than half of their parliamentarians were women. Interestingly, there was substantial progress made in the Middle East and Central Asia (where women have limited economic empowerment), and sub-Saharan Africa.

These findings show that women have seen improvements in terms of health, education, employment, and political representations, but that there are still significant barriers for women, which could be addressed by policies and programs.

2.3.4 BENEFITS OF GENDER EQUALITY

Gender equality and women's empowerment are associated with various outcomes related to education, health, and empowerment at the household, community, and national levels (York & Bell, 2014). At the household level, it has been suggested that women's empowerment is associated with improved health and nutritional status (Van den Bold, Quisumbing, & Gillespie, 2013). For example, there is a relationship between women's empowerment and improved health status and survival rates among infants and children (Caldwell & Caldwell, 1993; Kishor, 2000). One of the hypotheses is that women tend to consider family planning when they are more autonomous, which is supported by findings from a meta-analysis conducted by Taukobong et al. (2016). In this study, the authors argued that with more autonomy, women have greater control over reproductive decisions, and can choose the number of children and timing and spacing of pregnancies, which can lead to decreased morbidity and mortality of infants, children, and

mothers. Evidence has also demonstrated that there is an association between women's status and child nutritional status. For example, a study conducted in India found that child stunting was associated with low levels of autonomy among women (Shroff, Griffiths, Adair, Suchindran, & Bentley, 2009). Improving access to education has also been shown to lead to positive health outcomes. A study by Lee (2000) concluded that men and women lived longer in developing countries where the gap in education between men and women was small. It was also found that improving levels of female educational attainment was strongly associated with a decrease in mortality rates in developing countries.

Women's empowerment can improve the well-being at the community level (York & Bell, 2004). For example, women's participation in the public sphere and civic life can promote significant social changes through community-led action and causes, such as health care, welfare, and employment rights (York & Bell, 2004). Greater gender equality in the political field has been associated with decreases in human rights abuses by the government (Melander, 2005), increases in women's reporting of crimes (Iyer, Mani, Mishra, & Topalova, 2012), and decreases in corruption (Swamy, Knack, Lee, & Afzar, 2001). At the national level, countries with high levels of gender equality at the political level were more likely to have greater life satisfaction (York & Bell, 2014). It has been suggested that gender equality could have a positive impact on economic development (Kabeer & Natali, 2013; Klasen & Lamanna, 2009; World Bank, 2006). While gender equality lead to positive individual, household, community, and national outcomes, there is little information on the impact of gender policies on outcomes at different levels.

2.3.5 ROLE OF MEN AND BOYS IN ACHIEVING GENDER EQUALITY

It is important to consider that men and boys play a central role in achieving gender equality (Connell, 2005). In certain contexts, men and boys can experience relative disadvantage and can also be affected by certain forms of gender disparities (Seguino, 2016). In some countries, for example, the level of educational attainment in boys is lower than the level of educational attainment in girls, according to recent trends (Seguino, 2016). In addition, male disadvantage can differ from female disadvantage (Kabeer, 2003). For example, when there is an economic recession, men might lose their job and income as well as their role as the main provider for the

household while women might have to increase the number of hours spent at work in order to meet the financial needs of the household and to make up for the loss of income (Kabeer, 2003). Programs and policies designed to eliminate gender disparities require the support and involvement of men and boys in order to prevent resistance and ensure effectiveness, which means that decreases in the absolute well-being of men should be viewed as a negative outcome and should be addressed for the benefit of the population (Seguino, 2016). This point is reflected in the following statement made during the consultation on the Post-2015 Development Agenda that "gender equality is not about transferring opportunities from men to women, but about realizing the rights of everyone, and creating conditions where both all have the right and ability to realise their full human potential" (UNICEF and UN Women, 2013:35). While previous policies focused on women, there is a new understanding that men need to participate and engage in the process of promoting gender equality and women's empowerment in order for policies to be effective (Connell, 2005).

2.3.6 MEASURING GENDER INEQUALITY

Since the 1990s, several organisations, particularly the World Bank, International Labour Organisation (ILO), Organisation for Economic Co-operation and Development, and World Economic Forum, have worked to increase the availability of data on gender, which has led to improvements in the quality of gender-disaggregated data in the domains of health, education, and employment at the global and national levels (Gaye, Klugman, Kovacevic, Twigg, & Zambrano, 2010). There are seven available gender inequality measurement tools with varying purposes and strengths and limitations, namely, (1) the Gender Empowerment Measure, (2) Gender-related Development Index, (3) Gender Equity Index, (4) Gender Gap Index, (5) Social Institutions and Gender Index, (6) Women's Economic Opportunity Index, and (7) Gender Inequality Index. Measuring gender inequalities is important for many reasons. Firstly, women and girls have been historically more disadvantaged by these inequalities than boys and men, which is a pattern found in many countries, both industrialized and developing (Inglehart & Norris, 2003; Permanyer, 2013b). As a result, men and boys tend to have better access to resources and opportunities, which can increase their well-being as well as their social, economic, and political power in their societies. (UN Millennium Project, 2005). Secondly, there is a need for gender-disaggregated data to identify the main forms of gender inequalities and

learn how to address these inequalities (Hawken & Munck, 2012). Finally, these measurement tools can also be used to monitor targets and determine the impact of national-level policies on addressing gender inequalities (Gaye et al., 2010; Hawken & Munck, 2012).

2.4 GENDER INEQUALITY AND FOOD SECURITY

Gender is important to food security and nutrition for many reasons. Because of gender disparities, women and girls are considered to be more vulnerable to food insecurity than men (Dallmann, Melgar Quiñonez, & Ballard, 2015; Selim, 2014; FAO, 2009). To illustrate, 60% of individuals experiencing chronic hunger are women and girls globally (UN ECOSOC, 2007). This vulnerability to hunger and poverty is partly due to discriminatory gender norms, social structures, and cultural practices in their communities (Hadley, Lindstron, Tessema, & Belachew, 2008; Baig-Ansari et al., 2006). For example, girls face discrimination in relation to feeding practices where there is a preference for boys, which results in poorer health and nutritional status of girls (Nube & Van Den Boom, 2003; Hadley et al., 2008). Differences in the quality and quantity of food consumed by men, women, boys, and girls is especially common in communities where boys are more valued than girls, and as a result, boys are more likely to receive more high-quality foods than girls (World Bank, 2006; Dey & Chaudhuri, 2008). In a study conducted in Pakistan, it was found that the rate of stunting among boys was almost three times lower than that of girls (Baig-Ansari et al., 2006). In another study, researchers in Bangladesh found that females were particularly vulnerable to severe malnutrition, compared to males (Choudhury, Hanifi, Rasheed, & Bhuiya, 2000). Furthermore, a study examining the gender inequalities in the nutritional status of boys and girls under the age of five in Kenya found that girls had lower energy consumption levels than boys (Ndiku, Jaceldo-Siegl, Singh, & Sabate, 2011). The findings of this study also demonstrated that the rates of underweight, stunting, and wasting were higher for girls than boys in all of the age groups. This adds to the evidence that there are gender inequalities related to intra-household distribution of food as well as son bias, in certain contexts.

Gender is recognized as a cross-cutting issue in food security (O'Brien et al., 2016). The importance of gender is highlighted in the Rome Declaration on World Food Security and the World Food Summit Plan of Action of 1996, which states that governments should work to

"ensure an enabling political, social, and economic environment designed to create the best conditions for the eradication of poverty and for durable peace, based on full and equal participation of women *and* men, which is most conducive to achieving sustainable food security for all" (emphasis added) (FAO, 1996). A large body of literature demonstrates that gender inequality is associated with food insecurity (Belachew et al., 2011; Haidar & Kogi-Makau, 2009; Choudhury et al., 2000; Ndiku et al., 2011; Hadley et al., 2008). Gender equality was recognized as "the single most important determinant of food security." (ADB, 2013). There are various factors influencing the linkages between gender inequality and food insecurity, making it a complex relationship to examine (Njuki et al., 2016). Evidence from two cross-national studies shows that there is a relationship between decrease in gender inequality and reduction in hunger. For example, in developing countries, it is estimated that 55% of the decrease in hunger between 1970 and 1995 was attributed to improvements in women's status (Smith & Haddad, 2000). In addition, an analysis of the findings from the 2009 Global Hunger Index and the World Economic Forum's 2008 Global Gender Gap Index highlighted that countries with higher levels of gender inequalities were associated with higher levels of hunger (von Grebmer et al., 2009). Many studies have examined the relationship between women's status and food security and nutrition, particularly children's nutrition. For example, a study examined the association between women's status (defined as women's power relative to men's power) and children's nutrition in 39 countries, and observed that women's status had a significant effect on children's nutrition (Smith et al., 2003).

Much of the research on gender inequality and food security focuses on the individual and household levels. A study in Ethiopia examined the health status of adolescents between the ages of thirteen and seventeen and found that the rate of food insecurity was higher for girls (25.5%) than boys (15.8%) (Belachew et al., 2011). It also observed that food insecure girls and girls who were living in food-insecure households were three times as likely to indicate that they have an illness than boys. In Pakistan, researchers conducted a study analyzing relationship between the food security status in children and the women's status within the household, and concluded that the proportion of the household's budget used to buy items, such as clothing and shoes for adults, and tobacco decreased as women's status increased, suggesting that a larger share of the budget was used to buy food and meet the needs of the children (Guha-Khasnobis & Hazarika, 2006).

Decision-making power within the household and control over income are also key determinants of food security (Quisumbing & Maluccio, 2003; Hoddinott & Haddad, 1995; O'Brien et al., 2016). Research has shown that men and women spend the household income in different ways, and that increased women's access to income and decision-making power was positively associated with improved children's health because women were more likely to spend a larger proportion of the household income to meet the health, nutrition, and education needs of the children, compared to men (Quisumbing et al., 1995; Quisumbing & Maluccio, 2003; Smith et al., 2003). In addition, the impact of increasing access to credit on improving child nutritional status was greater for women, compared to men (Pitt, Khandker, Chowdhury, & Millimet, 1998; Hazarika & Guha-Khasnobis, 2008).

A major trend in gender inequality and food security research in developing countries has been focused on agriculture and farm households (O'Brien et al., 2016). This focus is because as Adeyemi (2010) put it, "gender-based inequalities all along the food production chain 'from farm to plate' impede the attainment of food and nutritional security." The large number of women in the agriculture sector is another reason. In low- and middle-income countries, women represent 43% of the agricultural labour force (FAO, 2011). Efforts to improve resource allocation are needed because women and girls are more vulnerable to food insecurity, partly due to limited access to resources (Quisumbing et al., 1995; Selim, 2014; Ivers & Cullen, 2011; Kassie et al., 2015). FAO estimates that the level of agricultural output would increase by 2.5 to 4% if women were given the same access to resources and tools as men (FAO, 2011). As a result, the number of hungry people would decrease by 12 to 17% (FAO, 2011). The traditional role of women as caregivers in the household is also an important area. Although women are traditionally responsible many tasks associated with household food consumption, including growing, processing, purchase, and preparation of food, they often lack the essential information on nutrition and health as well as resources necessary to increase their food security status, such as land, income, tools, access to financial services, and training (Ivers & Cullen, 2011). Gender inequalities limit women farmers' access to physical and financial resources, such as inputs and agricultural extensions, which can lead to outcomes, including lower level of productivity and higher post-harvest loss (Agarwal, 2015). Findings from a literature review conducted by Peterman and colleagues (2014) found that in 79% of reviewed studies, men were more likely to

have greater access to various agriculture inputs, such as fertilizers, pesticides, and seed varieties, compared to women. Gender gaps in agricultural productivity is particularly an issue in developing countries, as demonstrated by the results from an analysis by O'Sullivan, Rao, Banerjee, Gulati, & Vinez (2014) examining the state of agriculture in Africa found that the level of productivity of female farmers was lower than that of male farmers. Specifically, the analysis demonstrated that female farmers produce 13 to 25% less on the same size plot, compared to men. Various studies have shown that different factors are associated with food security for female farmers and female-headed households. A study in Western Kenya found that women farmers face various barriers, such as limited access to extension services, land, income, and credit, and lack of education (Mikalitsa, 2010). In another study, it was showed that female-headed households were more vulnerable to food insecurity than male-headed households (Kassie et al., 2014). It also found that an increase in land quality, social capital and network, and farm size led to improved food security in female-headed households. Clearly, while this focus on agriculture helps identify important factors for gender inequality and food security, it does not demonstrate the impact of macro-level policies on gender inequality.

2.5 CONCLUSIONS FROM THE LITERATURE

There are a number of conclusions drawn from the review of the literature to inform and guide this research. Firstly, cross-national studies on this topic tend to use indirect measures of food insecurity (e.g., nutritional outcomes). Secondly, the majority of studies on gender inequality and food security use individual- and household-level measurements. In addition, the measurements used to assess gender inequality and food security tend to vary depending on the study, and are not consistent across the literature. Thirdly, studies examining the relationship between gender inequality and food security in low- and middle-income countries tend to focus on differences in intra-household distribution of food, and unequal access to resources among female farmers and female-headed households. A growing number of interventions and programs are considering the implications of gender on food security. However, there are no studies examining the relationship between gender inequality and food security at the global and regional levels using internationally validated measurement tools. It is important to assess how these two phenomena interact with each other in order to enhance our understanding of the topic and develop effective

interventions. Overall, the aim of this study is to explore the association between gender inequality and food security.

CHAPTER 3: METHODS

3.1 RESEARCH DESIGN

This study is quantitative, and uses a cross-sectional survey design. Data were collected at one point in time.

3.2 RESEARCH CONTEXT

This research is conducted within the context of a collaborative project between the McGill Institute for Global Food Security and the Food and Agricultural Organisation (FAO) called the Voices of the Hungry (VoH). VoH was created by FAO in 2013, and its main objective was to develop a global standard as a measure to assess direct experiences of food insecurity on a global scale (Ballard et al., 2013). In 2014, the Food Insecurity Experience Scale (FIES) was included as part of the Gallup World Poll (GWP) questions, and used to collect nationally representative data on food security.

3.3 MEASUREMENTS

3.3.1 GALLUP WORLD POLL

Every year, Gallup carries out surveys in over 150 countries globally, which is representative of approximately 99% of the global adult population (Gallup Incorporated, 2017). The survey data are collected from random, nationally representative samples from approximately 1000 respondents per country. The survey includes core questions, which are asked to respondents in all regions, and supplemental questions asked to respondents in specific regions. All of the questions are translated into the most commonly spoken languages in each country.

3.3.2 FOOD INSECURITY EXPERIENCE SCALE

In 2014, GWP included the FIES for the first time (Ballard et al., 2013). This experience-based food security scale is used to assess direct experiences of food insecurity at the individual level. It measures the access dimension that captures the range of experiences of food insecurity. Furthermore, the FIES incorporates a twelve-month reference period, and includes eight questions (see Appendix A), which are used to measure the severity of food insecurity (Ballard et al., 2013). This measurement tool uses a theoretical construct of food insecurity based on ethnographic research that showed the universality of food insecurity experiences, ranging from worrying about obtaining food (mildly food insecure) to skipping meals or going hungry for a whole day (severely food insecure) (Ballard et al., 2013; Radimer et al., 1992). Participants provide a yes/no answer to the questions, and the sum of the answers provide an indication of the level of severity (Ballard et al., 2013).

Two methods, namely Item-Response Theory and Rasch Modelling, were used to develop and validate FIES (Ballard et al., 2013; Cafiero et al., 2014). Food insecurity is recognized as a latent trait, which means that it cannot be observed (FAO, 2016). The Item Response Theory works with the assumption that in a series of questions, an unobservable construct can be measured with the use of yes/no answers (Ballard et al., 2013; FAO, 2016). According to this theory, if a question results in a high number of positive responses, then the question is correlated with a less severe state of food security. On the other hand, if a question results in a high number of negative responses, then the question is associated with a more severe state of food insecurity. Responses are measured as a raw score in order to assess how questions are associated with a certain level of severity. Rasch modelling is used to determine the probability that a question will generate a positive response (Ballard et al., 2013; FAO, 2016). These probabilities are used to determine the severity of food insecurity associated with each question. Importantly, the severity of each question is measured independently of the other questions (Ballard et al., 2013; Nord, 2014). Based on the theoretical construct, three categories of food insecurity were developed using the cumulative positive responses of questions: 1) mildly food insecurity (questions 1 through 3); 2) moderately food insecurity (questions 4 through 6); 3) severely food insecurity (questions 7 and 8) (Ballard et al., 2013).

3.3.3 GENDER INEQUALITY INDEX

The Gender Inequality Index (GII) is a composite measure developed by the United Nations Development Programme to measure gender inequality at the national level in 159 countries (UNDP, 2017a). GII has been applied every year since 2010 (Gaye et al., 2010), and uses data from various sources, such as UNICEF, UN Department of Economic and Social Affairs, ILO, International Parliamentary Union, among others (UNDP, 2017b). The index looks at gender inequality from three dimensions, namely health, empowerment, and labour market (Gaye et al., 2010; Permanyer, 2013a). In the health dimension, gender inequality is measured by the maternal mortality ratio (represented by the number of deaths per 100000 live births) and adolescent birth rates (represented by the births per 1000 women between the ages of 15 and 19). Two indicators for the empowerment dimension are representation at the parliamentary level (referring to the percentage of women and men occupying seats in parliament) and education attainment (referring to the percentage of women and men who completed secondary or higher education). The labour market dimension is measured by the proportion of men and women who are fifteen years old and above in the formal labour force. Using data collected from these dimensions, a country is assigned a score between 0 and 1 (Gaye et al., 2010; Permanyer, 2013a). A high score (closer to 1) means that there is a high level of gender inequality in a particular country. GII is calculated using the aggregation of achievements (see Gaye et al., 2010 for more information on the methods). It requires obtaining the overall mean of general means of various orders. First, a geometric mean is calculated for the three dimensions in order to get the first aggregation. Data are used to calculate means for women and men independently. The aggregation of the means is followed to create a harmonic mean for men and women. With this index, no country has been shown to have perfect equality (Gaye et al., 2010).

GII will be used to measure gender inequality in this study. There are two reasons for its use: 1) it was developed to address the limitations of previous indices; and 2) it includes new indicators that were not present in other indices (Permanyer, 2013a). The first set of composite measures of gender inequality included the Gender Empowerment Measure (GEM) and Gender-related Development Index (GDI) (Gaye et al., 2010; Permanyer, 2013a). These two measurement tools were widely used by academics and policymakers to examine disparities between men and women based on different dimensions of gender inequality (Gaye et al., 2010; Permanyer, 2013a). Although they were relevant, they had many limitations in their methodological

composition (Dijkstra, 2006; Hawken & Munck, 2009; Klasen, 2006; Schuler, 2006). For example, in order to deal with missing data, many imputations were required, particularly for the gender-disaggregated incomes in the GEM and GDI (Gaye et al., 2010). In addition, some of the indicators used in the previous indices were not pertinent to low- and middle-income countries. Furthermore, it was argued that the income component of the GDI was overweighted, which meant that the other components were perceived to be less important (Ferrant, 2010). For low-income countries, inequalities were underestimated by the GDI. Conversely, for high-income countries, inequalities were overestimated by the GDI. It has been demonstrated that low-income countries have lower scores than high-income countries, even though they have similar levels of gender inequalities (Dijkstra, 2002). In an effort to remedy these limitations, the GII was developed as an alternative measurement tool (Permanyer, 2013b).

Despite its strengths, there are some limitations associated with the GII. For the labour market dimension, it does not include data on job types and engagement in unpaid work, which is often performed by women (Gaye et al., 2010). Furthermore, other key factors important to women excluded from the index were child care support, asset ownership, decision-making in the community, and gender-based violence because there were not enough data available. Despite these limitations, there are many advantages associated with the Gender Inequality Index. One of the main features is its suitability to conduct international comparisons between countries and across different years (Gaye et al., 2010). All of the countries have the same dimensions and indicators, which makes it easy to compare scores across different countries and regions. In addition, data can be used by governments and international organisations to support the implementation of policies and programs aimed at eliminating gender inequality based on highlighted dimensions of concern (Gaye et al., 2010).

3.3.4 GROSS-DOMESTIC PRODUCT PER CAPITA

This study included the Gross-domestic Product per capita (Purchasing Power Parity) or GDP PC PPP (World Bank, 2018). Data on GDP PC PPP were provided by the World Bank. The GDP at purchaser's price is considered to be the value added to the economy of a country by the product taxes and producers. For this study, the GDP PC PPPs were adjusted to an international

dollar using price power parity rates by converting to the equivalent purchasing power of 1 US$ in the United States based on the 2011 International Comparison Program.

3.4 SAMPLING DESIGN

In each country, Gallup uses nationally representative data, which are directly collected from the respondents who are fifteen years old and older (Gallup Incorporated, 2017). Two methods of data collection are applied, specifically face-to-face and telephone interviews. In countries where face-to-face interviews were used, sampling is carried out in three steps. During the first stage, clusters of households are developed to act as sampling units. Using stratifications, around 100 to 135 ultimate clusters are chosen, which reflects the size of the population of a country. As a result, the sampling of the survey reflects the proportionality of the size of the population, if that information is available. In cases where there is a lack of information, simple random sampling methods are used to collect data. During the second stage, households are selected with the help of a random routes method. Each household is contacted three times, and a replacement household is selected using simple substitution methods when the previously chosen household could not be reached. During the third stage, participants are selected within the target household. Interviewers apply the Kish grid method to select from all of the eligible household members or use of their date of birth.

Participants are contacted for telephone interviews in countries where 80% of individuals can be contacted by telephone (Gallup Incorporated, 2017). In countries where telephone interviews were used, the Random-Digit Dial method is used to select respondents in these countries. A dual-sample frame is used in places where the use of cellular phones is high. For telephone interviews, the Kish grid method or the date of birth are used to select the respondents. Similar to the face-to-face interviews, target households are contacted three times by trying to reach them on different dates and times.

3.5 SAMPLE SIZE

In total, the sample used for this study included 116077 respondents from 119 countries. Selected sample sizes were nationally representative of the population aged 15 years and older for each

country. There were approximately 1000 respondents per country. In some countries, such as Russia and India, larger samples were collected in order to ensure proper representation.

3.5.1 SAMPLE INCLUSION

For this study, data from 2015 were used for the GWP, GII, and GDP PC PPP. Individuals aged 15 years and older were included, regardless of gender and area of residence.

3.5.2 SAMPLE EXCLUSION

Some countries were not included because of missing data for any of the following variables: FIES, GII, and GDP PC PPP. As a result, the following countries were not included in the statistical analyses: Syria, Venezuela, Brazil, Nigeria, Palestinian Territories, Madagascar, Taiwan, Guinea, Libya, Qatar, Somalia, Turkmenistan, Kosovo, Northern Cyprus, South Sudan, Spain, Thailand, Afghanistan, Sierra Leone, and Liberia. In addition, China, Bhutan, and Azerbaijan were removed because FIES was deemed to be an inappropriate measure of food insecurity in those countries.

3.6 STATISTICAL ANALYSIS

The statistical programs used for analysis were R (version 3.4.3) and SAS (SAS Institute Inc., Cary, NB). Data were weighted using sampling weights provided by Gallup. Statistical significance was set at $p < 0.05$.

3.6.1 KEY VARIABLES

For this study, food insecurity was considered to be the dependent variable, and it was characterized as a truncated continuous variable. Using the data collected in the FIES, comparable prevalence rates of food insecurity were calculated for each country using the *RM.weights* package in R. Data were collected in nationally representative surveys based on responses from adult respondents to determine the level of individual severity. Three steps were applied to generate the prevalence rates used in this study, as applied by FAO in the 2017 State of Food Security and Nutrition in the World report (see FAO (2016) for more information on the steps). The first step involved generating raw scores using responses from the FIES. The second

step required the use of Rasch modelling to assess the psychometric properties of the responses. In order to generate internationally comparable prevalence rates, a common global reference scale of severity was used to calibrate individual responses, and to calculate estimates of prevalence rates for food insecurity for each country (FAO, 2016; Cafiero, Viviani, & Nord, 2018). The third step involved developing two thresholds: the prevalence of moderate or severe food insecurity, and the prevalence of severe food insecurity only. When an individual is identified as moderately or severely food insecure, they tend to decrease the level of food intake and skip meals, and are more likely to report more severe experiences of food insecurity (Cafiero et al., 2018). When an individual is classified as severely food insecure, they are more likely to go without eating for an entire day (Cafiero et al., 2018). These two thresholds are used to monitor progress in achieving SDG 2.1 at the global level (FAO et al., 2017; Cafiero et al., 2018). Regional prevalence rates of food insecurity were calculated using the average of results across countries. Food insecurity was transformed using the logit scale for the bivariate analyses (generalized linear models), whereas it was transformed using the lognormal scale for the multivariate analyses.

Predictor variables measured on a national level were FIES, GII, and GDP PC PPP. Sociodemographic variables measured on an individual level were gender, age, level of education, marital status, employment status, area of residence, and household income per capita. Gender was categorized into two levels, namely, 1) female and 2) male. Employment status was characterized as a categorical variable with four levels, which were 1) employed full-time, 2) employed part-time, 3) out of workforce, and 4) unemployed. Age was categorized into 1) 15-17 years, 2) 18-64 years, and 3) 65 years. Marital status was a categorical variable with six levels, which were 1) divorced, 2) domestic partners, 3) married, 4) separated, 5) single/never been married, and 6) widowed. Area of residence was categorized into four levels, which were 1) a large city, 2) a rural area, 3) a small town or village, and 4) a suburb of a large city. Household income per capita in International Dollars (ID) was transformed into a categorical variable with five levels: 1) less 5000ID, 2) 5000-9999ID, 3) 10000-14999ID, 4) 15000-19999ID, and 5) 20000ID and more. Health was assessed using the personal health index (see Appendix B), measured on an individual level, and transformed to calculate scores for each country by using weighted average of the responses.

3.6.2 DATA ANALYSIS

Descriptive statistics were used to examine the distribution of responses, and to analyze the sociodemographic characteristics of the sample. Main characteristics described include gender, employment status, level of education, age, and household income per capita. Countries were classified into seven regions based on the World Bank regional classification: East Asia and the Pacific (EAP), Europe and Central Asia (ECA), Latin America and the Caribbean (LAC), Middle East and North Africa (MENA), North America (NAM), South Asia (SA), and sub-Saharan Africa (SSA).

Bivariate analyses were performed using chi-square tests for independence, Spearman's rank correlations, and generalized linear models. Chi-square tests for independence were used to assess the sociodemographic characteristics by gender. The sociodemographic characteristics used were categorical variables. The purpose of Spearman's rank correlations and generalized linear models were to examine associations between gender inequality and the prevalence of food insecurity at the global and regional levels. Gender inequality and the prevalence of food insecurity were characterized as truncated continuous variables. Spearman's rank correlation was selected because the assumption of normally distributed variables for Pearson's correlation was not met. Generalized linear models were used to model the relationship between gender inequality and the prevalence of food insecurity. For the bivariate analyses, the beta-binomial distribution was selected based on model fit statistics.

Multivariate analyses were performed using generalized linear models. These analyses were used to determine whether gender inequality could predict food insecurity at the global and regional levels. Gender inequality and prevalence of food insecurity were characterized as truncated continuous variables. Health was selected as a control for the models, and calculated for each country based on the weighted average of the individual responses from the personal health index. GII scores, prevalence of food insecurity (calculated by Rasch modeling), and health variables were rank-transformed separately for the global and regional data. Therefore, the rank-transformed variables in the regional scale models can be interpreted as the ranking of countries within the region. The initial models included linear, crossproduct, and quadratic effects of the variables of interest as independent or predictor variables. The lognormal distribution was

selected based on model fit statistics (Bayesian information criterion) for the multivariate analyses. The hypothetical but not statistically significant factors were removed iteratively based on the *p*-value, and only factors that contributed to a statistically significant degree ($p < 0.05$) were retained in the models.

3.7 ETHICAL CONSIDERATIONS

Data on food security and sociodemographic characteristics were provided by the Gallup World Poll. Gallup aims to accurately collect data from respondents around the world (Gallup Incorporated, 2017). One of the main objectives of the organisation is to provide reliable and impartial data. As a means to ensure the impartiality of the data, the organisation is not affiliated with political or advocacy groups. Data collected by Gallup can be used by individuals, governments as well as organisations. As part of their data management policies, Gallup has strict protocols to ensure that the identities of respondents are kept confidential.

The World Bank provided data on GDP PC PPP. In an effort to ensure the confidentiality of these data, the organisation has developed and implemented various protocols (World Bank, 2015). For example, there are guidelines related to the disclosure of information provided by governments and institutions. There are also policies regarding access to financial information.

Data on gender inequality were provided by UNDP. The organisation aims to be transparent, and to increase access to information (UNDP, n.d.). UNDP has developed policies to facilitate access to data. These policies emphasize the importance of carefully managing sensitive information in situations where there are challenges associated with the disclosure of information in a community.

CHAPTER 4: MANUSCRIPT

Gender Inequality and Food Security: A Global Comparative Analysis

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4.1 ABSTRACT

Studies have shown that high levels of gender inequality are associated with increased food insecurity; however, few studies have examined this association at the global and regional levels. This study aimed to explore the association between gender inequality and food security on a global scale, and to examine how gender inequality and food security are associated across regions. This quantitative, cross-sectional study used 2015 data from three sources: Gallup World Poll, United Nations Development Programme, and the World Bank. The sample included 119 countries and 116077 respondents. Food security was assessed using the Food Insecurity Experience Scale and gender inequality was assessed using the Gender Inequality Index. Two thresholds were developed to assess food insecurity: the prevalence of moderate or severe food insecurity, and the prevalence of severe food insecurity only. Spearman's rank correlation and generalized linear models were used to assess the association between gender inequality and prevalence of food insecurity. Models were adjusted for health (assessed using the personal health index). Statistical analyses were conducted using R and SAS with statistical significance set at $p < 0.05$. Globally, gender inequality was significantly associated with both thresholds of food insecurity. However, great heterogeneity was observed across regions. For example, gender inequality was a significant predictor in all regions for moderate or severe food insecurity, except in sub-Saharan Africa and South Asia. Multivariate analyses suggest that health was the main predictor of food insecurity in the region where the effect of gender inequality on food insecurity was not significant, which was the region with greater levels of gender inequality (i.e., sub-Saharan Africa). This study will help contribute knowledge on the impact of gender-related macro-level factors on food insecurity.

4.2 INTRODUCTION

After years of decreases in global hunger, recent estimates from the Food and Agriculture Organisation showed that the number of undernourished people increased to 815 million in 2016 from 777 million in 2015 (FAO et al., 2017). This reversal in trends suggests that new approaches are needed to tackle global food insecurity. Food security was defined, at the 1996 World Food Summit, as existing "when all people, at all times, have physical and economic access to sufficient, safe, and nutritious food that meets their dietary needs and food preferences for an active and healthy life" (FAO, 1996). Therefore, food security can be perceived to include four dimensions, namely, (1) access, (2) availability, (3) utilization, and (4) stability (FAO, 2006).

Gender is considered to be one of the main determinants of food security (Bhandari, 2017; Belachew et al., 2011). Gender refers to the social norms and roles associated with men and women (Quisumbing, 1996). It influences many parts of everyday life (Lorber, 1994), and is a major contributor to inequality between individuals in a society (Ridgeway, 2011). There are various definitions for gender inequality. This research uses the following definition by Ridgeway (2011), which conceptualizes gender inequality as an "ordinal hierarchy between men and women in material resources, power, and status." Gender inequalities are long-term, institutionalized inequalities, and are recognized as deeply rooted and embedded in a society (Tilly, 1998). However, these inequalities are not static as they are continuously evolving over time (Lorber, 1994). Compared to other forms of inequality, gender inequality is considered to be the most common (Kabeer, 2015). It exists in all communities and societies, but is highly dependent on the context (Akter et al., 2017; Kabeer, 2015).

Gender inequalities are also reflective of a society's norms and traditions, and differ from country-to-country (Lorber, 1994). Most communities and societies are defined by a degree of gender inequality, which, in many cases, tends to favour men over women (Wharton, 2005). This social system is defined as patriarchy, which refers to the "process, structure, and ideology of women's subordination." (Lorber, 1994). In this system, men tend to hold dominant positions in all institutions of society (Paxton & Hugues, 2015). This systematic influence over women by

men can limit how women access economic resources and opportunities (Borrell et al., 2013; Walby, 1989), resulting in less social, economic, and political power (Paxton & Hugues, 2015). Because of the heterogeneity of gender issues, national policies need to reflect the context in which they will be applied (Htun & Weldon, 2010).

The relationship between gender and food security has been widely examined in the literature, with a focus on women (Bhandari, 2017; Njuki et al., 2016). This is because gender is important to food security and nutrition for many reasons. Because of gender disparities, women and girls are considered to be more vulnerable to food insecurity than men (Dallmann et al., 2015; Selim, 2014; FAO, 2009). To illustrate, 60% of individuals experiencing chronic hunger are women and girls globally (UN ECOSOC, 2007). This vulnerability to hunger and poverty is partly due to discriminatory gender norms, social structures, and cultural practices in their communities (Hadley et al., 2008; Baig-Ansari et al., 2006). For example, girls face discrimination in relation to feeding practices where there is a preference for boys, which results in poorer health and nutritional status of girls (Nube & Van Den Boom, 2003; Hadley et al., 2008).

A large body of literature demonstrates that gender inequality is associated with food insecurity (Belachew et al., 2011; Haidar & Kogi-Makau, 2009; Choudhury et al., 2000; Ndiku et al., 2011; Hadley et al., 2008). Gender equality was recognized as "the single most important determinant of food security." (ADB, 2013). There are various factors influencing the linkages between gender inequality and food insecurity, making it a complex relationship to examine (Njuki et al., 2016). Evidence from two cross-national studies shows that there is a relationship between decrease in gender inequality and reduction in hunger. For example, in developing countries, it is estimated that 55% of the decrease in hunger between 1970 and 1995 was attributed to improvements in women's status (Smith & Haddad, 2000). In addition, an analysis of the findings from the 2009 Global Hunger Index and the World Economic Forum's 2008 Global Gender Gap Index highlighted that countries with higher levels of gender inequalities were associated with higher levels of hunger (von Grebmer et al., 2009). Many studies have examined the relationship between women's status and food security and nutrition, particularly children's nutrition. For example, a study examined the association between women's status (defined as women's power relative to men's power) and children's nutrition in 39 countries, and observed that women's status had a significant effect on children's nutrition (Smith et al., 2003).

Much of the research on gender inequality and food security focuses on the individual and household levels. In addition, cross-national studies on this topic tend to use indirect measures of food insecurity (e.g., nutritional outcomes). Furthermore, studies examining on the relationship between gender inequality and food security in low- and middle-income countries tend to focus on differences in intra-household distribution of food, and unequal access to resources among female farmers and female-headed households. A growing number of interventions and programs are considering the implications of gender on food security. However, there are no studies examining the relationship between gender inequality and food security at the global and regional levels using internationally validated measurement tools. Overall, the objectives of this study are twofold: 1) to examine the association between gender inequality and food security at the global level; and 2) to assess how gender inequality is associated with food security on a region-by-region basis.

4.3 METHODS

4.3.1 RESEARCH DESIGN AND CONTEXT

This study is quantitative, and uses a cross-sectional survey design. This research is conducted within the context of a collaborative project between the McGill Institute for Global Food Security and the Food and Agricultural Organisation (FAO) called the Voices of the Hungry (VoH).

4.3.2 MEASUREMENTS

For this study, data were obtained from three different sources. Data on food security and sociodemographic characteristics were provided by the 2015 Gallup World Poll. Data on gender inequality were obtained from the United Nations Development Programme. The World Bank provided data on Gross-domestic product per capita (Purchasing Power Parity) in current international $ (GDP PC PPP) for 2015.

In 2014, GWP included the FIES for the first time (Ballard et al., 2013). This experience-based food security scale is used to assess direct experiences of food insecurity at the individual level. It measures the access dimension that captures the range of experiences of food insecurity.

Furthermore, the FIES incorporates a twelve-month reference period, and includes eight questions (see Appendix A), which are used to measure the severity of food insecurity (Ballard et al., 2013). This measurement tool uses a theoretical construct of food insecurity based on ethnographic research that showed the universality of food insecurity experiences, ranging from worrying about obtaining food (mildly food insecure) to skipping meals or going hungry for a whole day (severely food insecure) (Ballard et al., 2013; Radimer et al., 1992). Participants provide a yes/no answer to the questions, and the sum of the answers provide an indication of the level of severity (Ballard et al., 2013). Two methods, namely Item-Response Theory and Rasch Modelling, were used to develop and validate FIES (Ballard et al., 2013; Cafiero et al., 2014). Based on the theoretical construct, three categories of food insecurity were developed using the cumulative positive responses of questions: 1) mildly food insecurity (questions 1 through 3); 2) moderately food insecurity (questions 4 through 6); 3) severely food insecurity (questions 7 and 8) (Ballard et al., 2013).

For this study, gender inequality was assessed using the Gender Inequality Index. The Gender Inequality Index (GII) is a composite measure developed by the United Nations Development Programme to measure gender inequality at the national level in 159 countries (UNDP, 2017a). GII has been applied every year since 2010 (Gaye et al., 2010). The index looks at gender inequality from three dimensions, namely health, empowerment, and labour market (Gaye et al., 2010; Permanyer, 2013a). In the health dimension, gender inequality is measured by the maternal mortality ratio (represented by the number of deaths per 100000 live births) and adolescent birth rates (represented by the births per 1000 women between the ages of 15 and 19). Two indicators for the empowerment dimension are representation at the parliamentary level (referring to the percentage of women and men occupying seats in parliament) and education attainment (referring to the percentage of women and men who completed secondary or higher education). The labour market dimension is measured by the proportion of men and women who are fifteen years old and above in the formal labour force. Using data collected from these dimensions, a country is assigned a score between 0 and 1 (Gaye et al., 2010; Permanyer, 2013a). A high score (closer to 1) means that there is a high level of gender inequality in a particular country. GII is calculated using the aggregation of achievements (see Gaye et al., 2010 for more information on the methodology). It requires obtaining the overall mean of general means of various orders.

First, a geometric mean is calculated for the three dimensions in order to get the first aggregation. Data are used to calculate means for women and men independently. The aggregation of the means is followed to create a harmonic mean for men and women. One of the main features is its suitability to conduct international comparisons between countries and across different years (Gaye et al., 2010).

This study included the Gross-domestic Product per capita (Purchasing Power Parity) or GDP PC PPP (World Bank, 2018). Data on GDP PC PPP were provided by the World Bank. The GDP at purchaser's price is considered to be the value added to the economy of a country by the product taxes and producers. For this study, the GDP PC PPPs were adjusted to an international dollar using price power parity rates by converting to the equivalent purchasing power of 1 US$ in the United States based on the 2011 International Comparison Program.

4.3.3 SAMPLING AND RECRUITMENT

In each country, Gallup uses nationally representative data, which are directly collected from the respondents who are fifteen years old and older (Gallup Incorporated, 2017). Two methods of data collection are applied, specifically face-to-face and telephone interviews. In countries where face-to-face interviews were used, sampling is carried out in three steps. During the first stage, clusters of households are developed to act as sampling units. Using stratifications, around 100 to 135 ultimate clusters are chosen, which reflects the size of the population of a country. As a result, the sampling of the survey reflects the proportionality of the size of the population, if that information is available. In cases where there is a lack of information, simple random sampling methods are used to collect data. During the second stage, households are selected with the help of a random routes method. Each household is contacted three times, and a replacement household is selected using simple substitution methods when the previously chosen household could not be reached. During the third stage, participants are selected within the target household. Interviewers apply the Kish grid method to select from all of the eligible household members or use of their date of birth.

Participants are contacted for telephone interviews in countries where 80% of individuals can be contacted by telephone (Gallup Incorporated, 2017). In countries where telephone interviews

were used, the Random-Digit Dial method is used to select respondents. A dual-sample frame is used in places where the use of cellular phones is high. For telephone interviews, the Kish grid method or the date of birth are used to select the respondents. Similar to the face-to-face interviews, target households are contacted three times by trying to reach them on different dates and times.

4.3.4 SAMPLE SIZE

In total, the sample used for this study included 116077 respondents from 119 countries, which were selected based on the inclusion and exclusion criteria. Selected sample sizes were nationally representative of the population aged 15 years and older for each country.

4.3.4.1 SAMPLE INCLUSION

For this study, data from 2015 were used for the GWP, GII, and GDP PC PPP. Individuals aged 15 years and older were included, regardless of gender and area of residence.

4.3.4.2 SAMPLE EXCLUSION

Some countries were not included because of missing data for any of the following variables: FIES, GII, and GDP PC PPP. As a result, the following countries were not included in the statistical analyses: Syria, Venezuela, Brazil, Nigeria, Palestinian Territories, Madagascar, Taiwan, Guinea, Libya, Qatar, Somalia, Turkmenistan, Kosovo, Northern Cyprus, South Sudan, Spain, Thailand, Afghanistan, Sierra Leone, and Liberia. In addition, China, Bhutan, and Azerbaijan were removed because FIES was deemed to be an inappropriate measure of food insecurity in those countries.

4.3.5 STATISTICAL ANALYSIS

The statistical programs used for analysis were R (version 3.4.3) and SAS (SAS Institute Inc., Cary, NB). Data were weighted using sampling weights provided by Gallup. Statistical significance was set at $p < 0.05$.

4.3.5.1 KEY VARIABLES

For this study, food insecurity was considered to be the dependent variable, and it was characterized as a truncated continuous variable. Using the data collected in the FIES, comparable prevalence rates of food insecurity were calculated for each country using the *RM.weights* package in R. Data were collected in nationally representative surveys based on responses from adult respondents to determine the level of individual severity. Three steps were applied to generate the prevalence rates used in this study, as applied by FAO in the 2017 State of Food Security and Nutrition in the World report (see FAO (2016) for more information on the steps). The first step involved generating raw scores using responses from the FIES. The second step required the use of Rasch modelling to assess the psychometric properties of the responses. In order to generate internationally comparable prevalence rates, a common global reference scale of severity was used to calibrate individual responses, and to calculate estimates of prevalence rates for food insecurity for each country (FAO, 2016; Cafiero, Viviani, & Nord, 2018). The third step involved developing two thresholds: the prevalence of moderate or severe food insecurity, and the prevalence of severe food insecurity only. Regional prevalence rates of food insecurity were calculated using the average of results across countries. Food insecurity was transformed using the logit scale for the bivariate analyses (generalized linear models), whereas it was transformed using the lognormal scale for the multivariate analyses.

Predictor variables measured on a national level were FIES, GII, and GDP PC PPP. Sociodemographic variables measured on an individual level were gender, age, level of education, marital status, employment status, area of residence, and household income per capita. Health was assessed using the personal health index (see Appendix B), measured on an individual level, and transformed to calculate scores for each country by using the weighted average of responses.

4.3.6 DATA ANALYSIS

Descriptive statistics were used to examine the distribution of responses, and to analyze the sociodemographic characteristics of the sample. Main characteristics described include gender, age, level of education, marital status, employment status, area of residence, and household income per capita. Countries were classified into seven regions based on the World Bank regional classification: East Asia and the Pacific (EAP), Europe and Central Asia (ECA), Latin

America and the Caribbean (LAC), Middle East and North Africa (MENA), North America (NAM), South Asia (SA), and sub-Saharan Africa (SSA).

Bivariate analyses were performed using chi-square tests for independence, Spearman's rank correlations, and generalized linear models. Chi-square tests for independence were used to assess the sociodemographic characteristics by gender. The sociodemographic characteristics used were categorical variables. The purpose of Spearman's rank correlations and generalized linear models were to examine associations between gender inequality and the prevalence of food insecurity at the global and regional levels. Gender inequality and the prevalence of food insecurity were characterized as truncated continuous variables. Spearman's rank correlation was selected because the assumption of normally distributed variables for Pearson's correlation was not met. Generalized linear models were used to model the relationship between gender inequality and the prevalence of food insecurity. For the bivariate analyses, the beta-binomial distribution was selected based on model fit statistics.

Multivariate analyses were performed using generalized linear models. These analyses were used to determine whether gender inequality could predict food insecurity at the global and regional levels. Gender inequality and prevalence of food insecurity were characterized as truncated continuous variables. Health was selected as a control for the models, and calculated for each country based on the weighted average of the individual responses from the personal health index. GII scores, prevalence of food insecurity (calculated by Rasch modeling), and health variables were rank-transformed separately for the global and regional data. Therefore, the rank-transformed variables in the regional scale models can be interpreted as the ranking of countries within the region. The initial models included linear, crossproduct, and quadratic effects of the variables of interest as independent or predictor variables. The lognormal distribution was selected based on model fit statistics (Bayesian information criterion) for the multivariate analyses. The hypothetical but not statistically significant factors were removed iteratively based on the *p*-value, and only factors that contributed to a statistically significant degree ($p < 0.05$) were retained in the models.

4.4 ETHICAL CONSIDERATIONS

Data on food security and sociodemographic characteristics were provided by the Gallup World Poll. Gallup aims to accurately collect data from respondents around the world (Gallup Incorporated, 2017). One of the main objectives of the organisation is to provide reliable and impartial data. As a means to ensure the impartiality of the data, the organisation is not affiliated with political or advocacy groups. Data collected by Gallup can be used by individuals, governments as well as organisations. As part of their data management policies, Gallup has strict protocols to ensure that the identities of respondents are kept confidential.

The World Bank provided data on GDP PC PPP. In an effort to ensure the confidentiality of these data, the organisation has developed and implemented various protocols (World Bank, 2015). For example, there are guidelines related to the disclosure of information provided by governments and institutions. There are also policies regarding access to financial information.

Data on gender inequality were provided by UNDP. The organisation aims to be transparent, and to increase access to information (UNDP, n.d.). UNDP has developed policies to facilitate access to data. These policies emphasize the importance of carefully managing sensitive information in situations where there are challenges associated with the disclosure of information in a community.

4.5 RESULTS

4.5.1 DESCRIPTIVE ANALYSES

In this study, 116077 respondents were included for statistical analyses (see Table 1 for the number of individuals per country). These respondents were sampled from 119 countries, which were classified into seven regions based on the World Bank regional classification, namely (1) East Asia and the Pacific (EAP), (2) Europe and Central Asia (ECA), (3) Latin America and the Caribbean (LAC), (4) Middle East and North Africa (MENA), (5) North America (NAM), (6) South Asia (SA), and (7) sub-Saharan Africa (SSA) (see Table 2 for the regional classification of countries included in this study).

Table 1. Number of respondents per country

Country	n	Country	n	Country	n	Country	n
Albania	983	Egypt	999	Lebanon	983	Russia	1855
Argentina	827	El Salvador	793	Lithuania	924	Rwanda	992
Armenia	950	Estonia	972	Luxembourg	984	Saudi Arabia	999
Australia	959	Ethiopia	992	Macedonia	972	Senegal	966
Austria	982	Finland	982	Malawi	973	Serbia	937
Bahrain	985	France	982	Malaysia	945	Singapore	947
Bangladesh	943	Gabon	941	Mali	960	Slovakia	952
Belarus	932	Georgia	947	Malta	953	Slovenia	967
Belgium	980	Germany	981	Mauritania	933	South Africa	974
Benin	979	Ghana	959	Mexico	933	South Korea	965
Bolivia	983	Greece	996	Moldova	886	Sri Lanka	1011
Bosnia Herzegovina	953	Guatemala	801	Mongolia	963	Sweden	977
Botswana	964	Haiti	470	Montenegro	963	Switzerland	468
Bulgaria	931	Honduras	828	Morocco	1037	Tajikistan	844
Burkina Faso	975	Hungary	951	Mozambique	946	Tanzania	959
Cambodia	991	India	2709	Myanmar	1017	Togo	933
Cameroon	950	Indonesia	982	Nepal	984	Tunisia	960
Canada	957	Iran	981	Netherlands	962	Turkey	962
Chad	986	Iraq	979	New Zealand	950	Uganda	934
Chile	1008	Ireland	984	Nicaragua	774	Ukraine	895
Colombia	968	Israel	946	Niger	936	United Arab Emirates	1771
Congo Brazzaville	967	Italy	992	Norway	959	United Kingdom	986
Congo Kinshasa	933	Ivory Coast	951	Pakistan	986	United States	916
Costa Rica	847	Japan	986	Panama	950	Uruguay	852
Croatia	971	Jordan	970	Paraguay	943	Uzbekistan	988
Cyprus	990	Kazakhstan	903	Peru	979	Vietnam	968
Czech Republic	945	Kenya	982	Philippines	997	Yemen	986
Denmark	981	Kuwait	932	Poland	913	Zambia	961
Dominican Republic	911	Kyrgyzstan	956	Portugal	1001	Zimbabwe	983
Ecuador	981	Latvia	944	Romania	960		

Note: n represents the number of respondents in each country
Source: Gallup survey (2015 data)

Table 2. List of countries per region

Region	List of Countries
East Asia and the Pacific	Indonesia, Singapore, Japan, Australia, Philippines, Vietnam, Cambodia, Myanmar, New Zealand, South Korea, Malaysia
Europe and Central Asia	Turkey, United Kingdom, France, Germany, Netherlands, Belgium, Italy, Poland, Hungary, Czech Republic, Romania, Sweden, Greece, Denmark, Belarus, Georgia, Kazakhstan, Kyrgyzstan, Moldova, Russia, Ukraine, Albania, Armenia, Austria, Bosnia and Herzegovina, Bulgaria, Croatia, Cyprus, Estonia, Finland, Ireland, Latvia, Lithuania, Luxembourg, Macedonia, Malta, Mongolia, Montenegro, Norway, Portugal, Serbia, Slovakia, Slovenia, Switzerland, Tajikistan, Uzbekistan
Latin America and the Caribbean	Mexico, Costa Rica, Argentina, Bolivia, Chile, Colombia, Dominican Republic, Ecuador, El Salvador, Guatemala, Haiti, Honduras, Nicaragua, Panama, Paraguay, Peru, Uruguay
Middle East and North Africa	Egypt, Morocco, Lebanon, Saudi Arabia, Jordan, Iran, Israel, Bahrain, Iraq, Kuwait, Tunisia, United Arab Emirates, Yemen
North America	United States, Canada
South Asia	Pakistan, Bangladesh, India, Sri Lanka, Nepal
Sub-Saharan Africa	Kenya, Tanzania, Ghana, Uganda, Benin, Malawi, South Africa, Botswana, Ethiopia, Mali, Mauritania, Mozambique, Niger, Rwanda, Senegal, Zambia, Burkina Faso, Cameroon, Zimbabwe, Chad, Congo (Kinshasa), Congo Brazzaville, Gabon, Ivory Coast, Togo

Source: World Bank

Table 3 contains a summary of findings of key descriptive statistics of the sample. Findings highlighted that there were more female respondents (50.9%) than male respondents (49.1%) in the sample. Results showed that 36.6% of the respondents reported completing elementary education or less. Most of the respondents (over 80%) were between the ages of 18 and 64. In terms of employment status, 37.7% of the sample indicated that they were out of the workforce. In addition, 34.4% of the respondents were classified as living in a small town or village. Furthermore, 61.9% of the sample reported having a household income per capita of less than 5000 ID. Table 4 shows the means and standard errors of selected indicators for each region. When data were analyzed across regions, findings showed that there was a wide variability in food insecurity. Food insecurity prevalences ranged from 11.4% in ECA to 56.6% in SSA for

moderate or severe food insecurity, and 2.0% in ECA to 25.6% in SSA for severe food insecurity.

Table 3. Sociodemographic characteristics of the sample (weighted)

Characteristics	**%**
Gender	
Male	49.1
Female	50.9
Age	
15-17	7.2
18-64	81.1
>65	11.6
Marital status	
Divorced	2.9
Domestic partners	5.7
Married	51.8
Separated	2.1
Single/never been married	31.5
Widowed	5.8
Level of education	
Elementary education or less	36.6
Secondary education and beyond	63.4
Employment status	
Employed full-time	41.3
Employed part-time	14.2
Out of workforce	37.7
Unemployed	6.8
Area of residence	
A large city	29.9
A rural area or on a farm	26.7
A small town or village	34.4
A suburb of a large city	9.0
Household income per capita	
<5000	61.9
5000-9999	15.7
10000-14999	8.2
15000-19999	4.5
>20000	9.6

Note: Weighted data analysis of individuals' responses
Source: Gallup survey (2015 data)

Table 4. Means and standard errors of Gender Inequality Index, moderate or severe food insecurity, severe food insecurity, and GDP per capita by region

Region	Gender Inequality Index	Moderate or severe food insecurity	Severe food insecurity	GDP per capita
EAP	0.265±0.049	0.15±0.0421	0.0399±0.0134	26155±7133.1
ECA	0.169±0.0144	0.114±0.0115	0.0203±0.00235	28007.67±2703.57
LAC	0.413±0.0190	0.325±0.0433	0.124±0.0339	11990.29±1520.92
MENA	0.398±0.0497	0.241±0.0438	0.0757±0.0162	26552.54±6418.82
NAM	0.151±0.0525	0.123±0.0380	0.0339±0.0104	48015.5±5013.5
SA	0.496±0.0286	0.265±0.0383	0.103±0.0197	5418.6±1563.26
SSA	0.568±0.0170	0.566±0.0244	0.259±0.0220	3799.92±871.80

Note: Abbreviated terms include East Asia and the Pacific (EAP); Europe and Central Asia (ECA); Latin America and the Caribbean (LAC); Middle East and North Africa (MENA); North America (NAM); South Asia (SA); Sub-Saharan Africa (SSA); Gross domestic product per capita (GDP per capita).
Source: Gallup survey (2015 data), United Nations Development Programme (2015 data), and World Bank (2015 data)

4.5.2 BIVARIATE ANALYSES

Results from bivariate analyses conducted with chi-square test for independence explored the possible relationships between sociodemographic characteristics and gender. Table 5 shows bivariate analyses of sociodemographic characteristics by gender. Findings showed that more men reported completing secondary education and higher than women (66.6% and 60.3%, respectively). In addition, more women were significantly found to be out of the workforce than men (46.9% and 28.1%, respectively). A greater number of women reported having a household income per capita of less than 5000 ID than men (63.3% and 60.4%, respectively). When Spearman's rank correlation was used to describe the association between gender inequality and food insecurity at the global and regional levels. Table 6 shows Spearman's rank-based correlations of the Gender Inequality Index with the prevalence of food insecurity. The results showed that gender inequality was positively and statistically significantly associated with moderate or severe food insecurity ($r_s = 0.88$, $p < 0.001$) and severe food insecurity ($r_s = 0.79$, $p < 0.001$). However, there was great heterogeneity across regions. Gender inequality was statistically significantly ($p < 0.05$) associated with moderate or severe food insecurity in EAP, ECA, LAC, and MENA. For severe food insecurity, gender inequality was statistically significantly ($p < 0.05$) associated in EAP and LAC.

Table 5. Bivariate analysis of sociodemographic characteristics by gender

Characteristics	Male	Female	*p*
Age			
15-17	7.7	6.8	$1.33x10^{-5}$
18-64	81.0	81.3	
>65	11.3	11.8	
Marital status			
Divorced	2.1	3.8	$<2.2x10^{-16}$
Domestic partners	5.5	5.9	
Married	51.9	51.8	
Separated	1.6	2.6	
Single/never been married	36.3	26.9	
Widowed	2.5	9.0	
Level of education			
Elementary education or less	33.4	39.7	$<2.2x10^{-16}$
Secondary education and beyond	66.6	60.3	
Employment status			
Employed full-time	51.2	31.8	$<2.2x10^{-16}$
Employed part-time	13.7	14.6	
Out of workforce	28.1	46.9	
Unemployed	7.0	6.7	
Area of residence			
A large city	30.3	29.5	0.057
A large area or on a farm	26.7	26.6	
A small town or village	33.9	34.8	
A suburb of a large city	9.1	9.0	
Household income per capita			
<5000	60.4	63.3	$<2.2x10^{-16}$
5000-9999	15.4	15.9	
10000-14999	8.3	8.1	
15000-19999	4.8	4.3	
>20000	11.0	8.3	

Note: Chi-square test for independence; categorical variables expressed in weighted %; significance level set at $p < 0.05$; p values correspond to differences between gender
Source: Gallup survey (2015 data)

Table 6. Spearman's rank-based correlation of the Gender Inequality Index with the prevalence of food insecurity, coefficients by region

Region	**Food Insecurity (*FI*)**	r_s	p
EAP	Moderate or severe	0.95	<0.001
EAP	Severe	0.80	0.005
ECA	Moderate or severe	0.63	<0.001
ECA	Severe	0.053	0.73
LAC	Moderate or severe	0.70	0.0023
LAC	Severe	0.63	0.008
MENA	Moderate or severe	0.71	0.008
MENA	Severe	0.50	0.08
SA	Moderate or severe	0.70	0.23
SA	Severe	0.90	0.08
SSA	Moderate or severe	0.029	0.89
SSA	Severe	0.021	0.92

Note: Abbreviated terms include East Asia and the Pacific (EAP); Europe and Central Asia (ECA); Latin America and the Caribbean (LAC); Middle East and North Africa (MENA); South Asia (SA); Sub-Saharan Africa (SSA); Food Insecurity (FI). No results for NAM due to insufficient sample size.
Source: Gallup survey (2015 data) and United Nations Development Programme (2015 data)

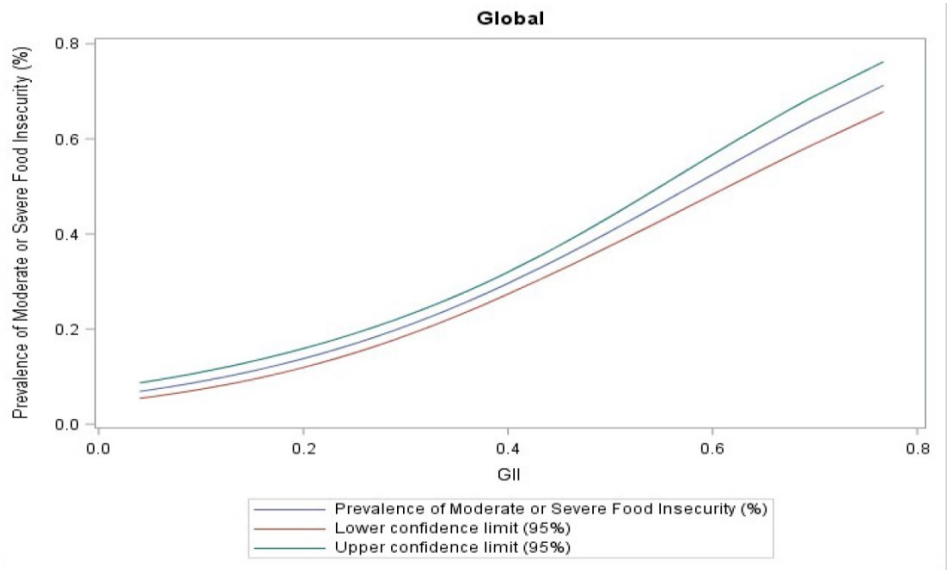
Generalized linear models were used to determine the sign and size of the effect of gender inequality on food insecurity at the global and regional levels. The response variable (food insecurity) was modeled using the Beta-binomial distribution in a generalized linear model. The results indicated that the effect of GII on moderate or severe food insecurity and severe food insecurity was statistically significant at the global level ($p < 0.0001$) (see Figures 1 and 2 for the generalized linear models at the global level). Referring to the parameter estimates, one unit increase in GII was found to increase the probability of moderate or severe food insecurity and severe food security by 4.8332 units and 4.2070 units on the logit scale, respectively. However, findings from the regional level analysis again showed variation depending on the region. Table 7 shows the estimates and standard errors for the generalized linear models on the logit scale for each region (see Figures 3 to 14 for the generalized linear models for each region). While the effect of gender inequality on the prevalence of moderate or severe food insecurity of countries was statistically significant in the EAP, ECA, LAC, and MENA, gender inequality did not affect (to a statistically significant degree) the prevalence of moderate or severe food insecurity in the SA and SSA. For severe food insecurity, the effect of gender inequality was not statistically significant in ECA, MENA, and SSA; however, gender inequality was a statistically significant predictor of severe food insecurity in EAP, LAC, and SA.

Table 7. Generalized linear models of the logit of the prevalence of moderate or severe food insecurity and severe food insecurity (*FI*): $\text{Ln}(FI) = b_0 + (b_1 \times GII)$

Region	**Food Insecurity (*FI*)**	b_0	b_1
Global	Moderate or severe	-2.7991±0.1387	4.8332±0.3183
Global	Severe	-3.8528±0.1827	4.2070±0.3799
EAP	Moderate or severe	-3.7294±0.4036	6.3481±1.0523
EAP	Severe	-5.0182±0.6228	5.6736±1.5729
ECA	Moderate or severe	-2.9100±0.1594	4.6741±0.7009
ECA	Severe	-4.0461±0.2194	0.9699±1.0644
LAC	Moderate or severe	-4.1239±0.7239	8.1056±1.6680
LAC	Severe	-5.9828±1.1642	9.3824±2.5114
MENA	Moderate or severe	-2.6152±0.4691	3.4552±0.9849
MENA	Severe	-3.3522±0.4769	2.0103±0.9747
SA	Moderate or severe	-3.2735±1.2882	4.5137±2.5470
SA	Severe	-6.5734±1.0165	8.7225±1.9716
SSA	Moderate or severe	0.2708±0.6699	-0.01520±1.1680
SSA	Severe	-1.0013±0.7354	-0.09468±1.2801

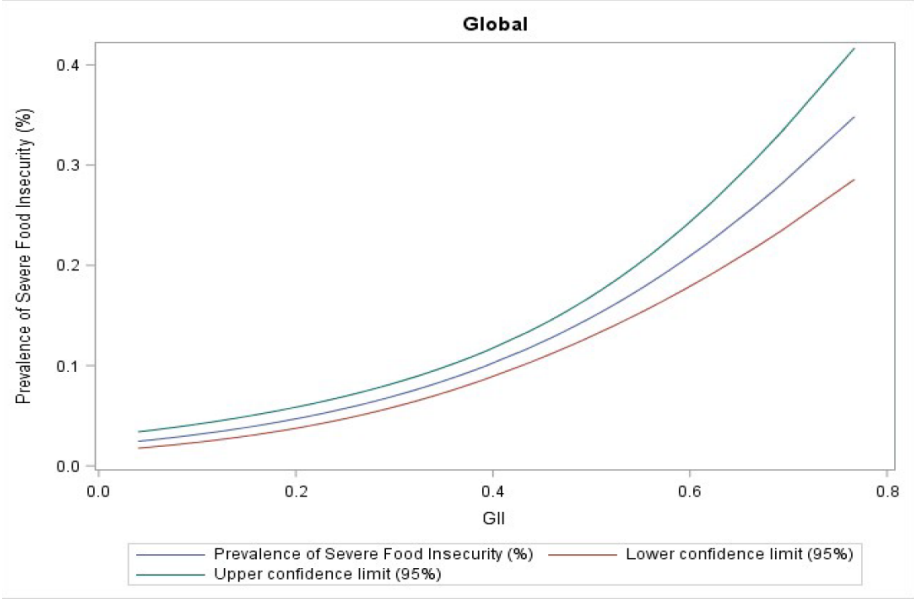
Note: Estimates and standard errors are on the logit scale. Abbreviated terms include East Asia and the Pacific (EAP); Europe and Central Asia (ECA); Latin America and the Caribbean (LAC); Middle East and North Africa (MENA); South Asia (SA); Sub-Saharan Africa (SSA); Food Insecurity (FI); Gender Inequality Index (GII). No results for NAM due to insufficient sample size.
Source: Gallup survey (2015 data) and United Nations Development Programme (2015 data)

Figure 1. Generalized linear model showing the effect of gender inequality on moderate or severe food insecurity at the global level



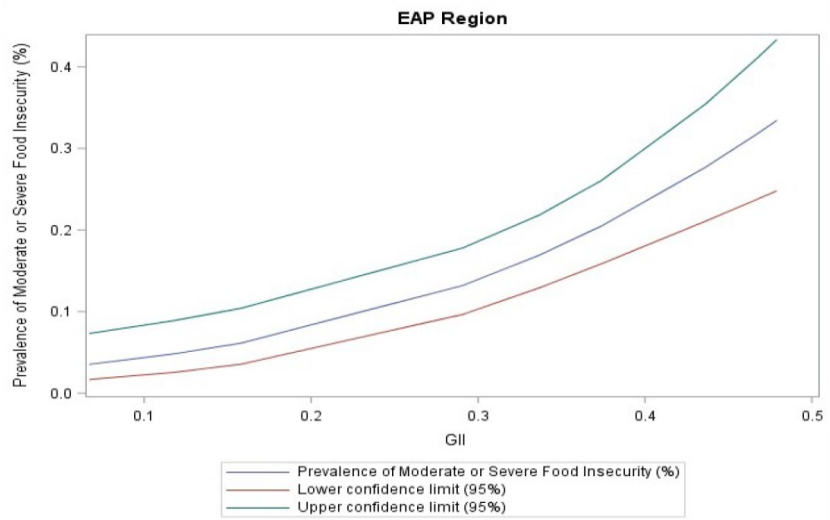
Note: Gender Inequality Index (GII); Moderate or severe food insecurity on the vertical axis, and GII on the horizontal axis. The solid blue line is a series plot of the predictive values based on the global model. The green and red lines are the upper and lower 95% confidence limits, respectively.
Source: Gallup survey (2015 data) and United Nations Development Program (2015 data)

Figure 2. Generalized linear model showing the effect of gender inequality on severe food insecurity at the global level



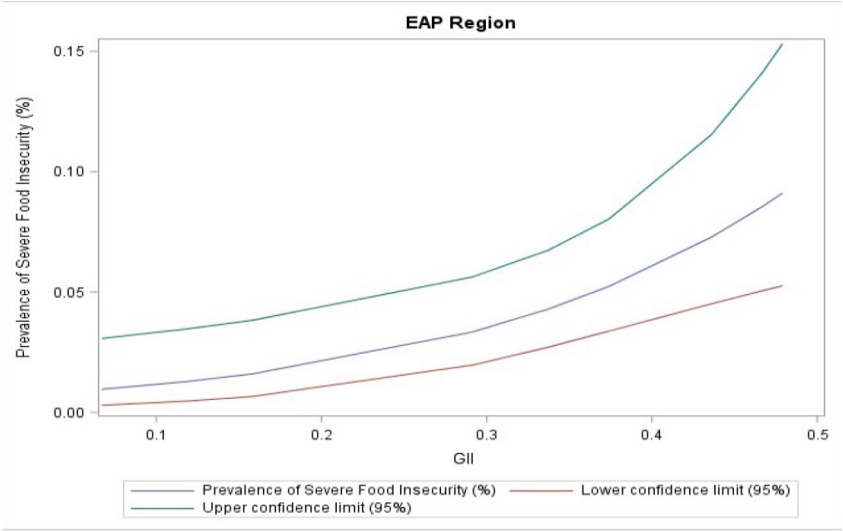
Note: Gender Inequality Index (GII); Severe food insecurity on the vertical axis, and GII on the horizontal axis. The solid blue line is a series plot of the predicted values based on the global model. The green and red lines are the upper and lower 95% confidence limits, respectively.
Source: Gallup survey (2015 data) and United Nations Development Programme (2015 data)

Figure 3. Generalized linear model showing the effect of gender inequality on moderate or severe food insecurity in East Asia and the Pacific



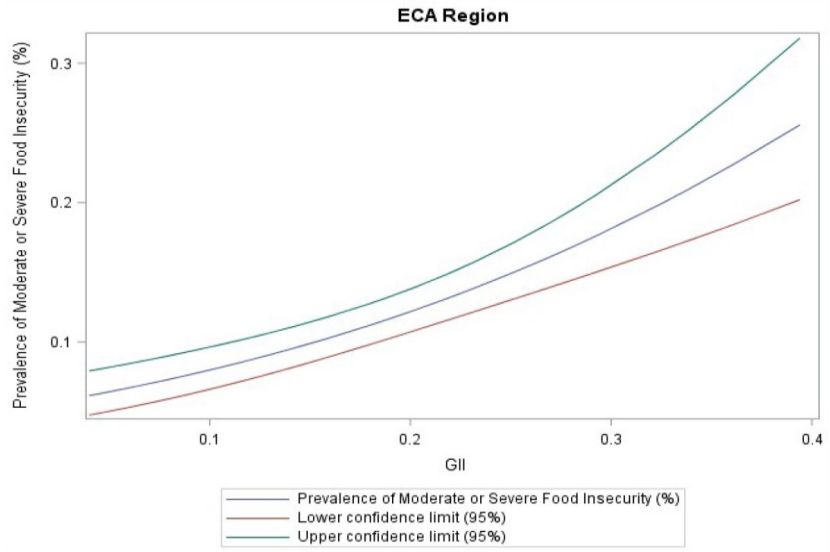
Note: Abbreviated terms include Gender Inequality Index (GII) and East Asia and the Pacific (EAP); Moderate or severe food insecurity on the vertical axis, and GII on the horizontal axis. The solid blue line is a series plot of the predicted values based on the EAP model. The green and red lines are the upper and lower 95% confidence limits, respectively.
Source: Gallup survey (2015 data) and United Nations Development Programme (2015)

Figure 4. Generalized linear model showing the effect of gender inequality on severe food insecurity in East Asia and the Pacific



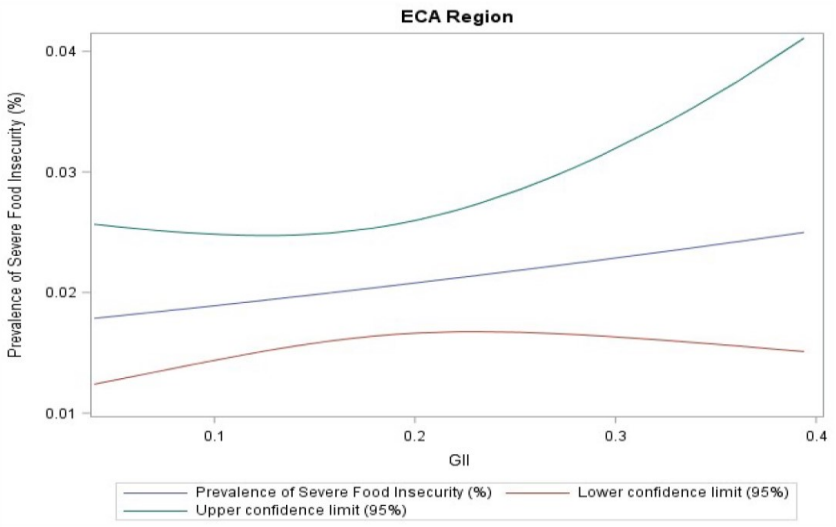
Note: Abbreviated terms include Gender Inequality Index (GII) and East Asia and the Pacific (EAP); Severe food insecurity on the vertical axis, and GII on the horizontal axis. The solid blue line is a series plot of the predicted values based on the EAP model. The green and red lines are the upper and lower 95% confidence limits, respectively.
Source: Gallup survey (2015 data) and United Nations Development Programme (2015 data)

Figure 5. Generalized linear model showing the effect of gender inequality on moderate or severe food insecurity in Europe and Central Asia



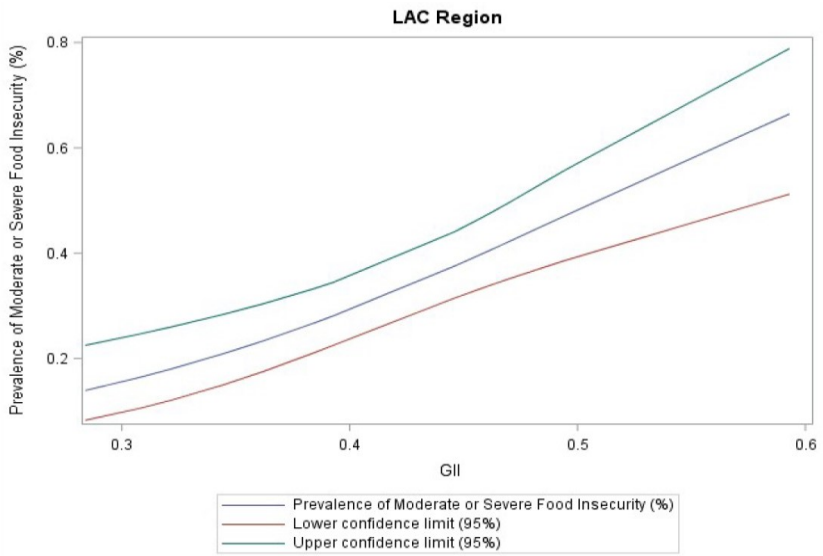
Note: Abbreviated terms include Gender Inequality Index (GII) and Europe and Central Asia (ECA); Moderate or severe food insecurity on the vertical axis, and GII on the horizontal axis. The solid blue line is a series plot of the predicted values based on the ECA model. The green and red lines are the upper and lower 95% confidence limits, respectively.
Source: Gallup survey (2015 data) and United Nations Development Programme (2015 data)

Figure 6. Generalized linear model showing the effect of gender inequality on severe food insecurity in Europe and Central Asia



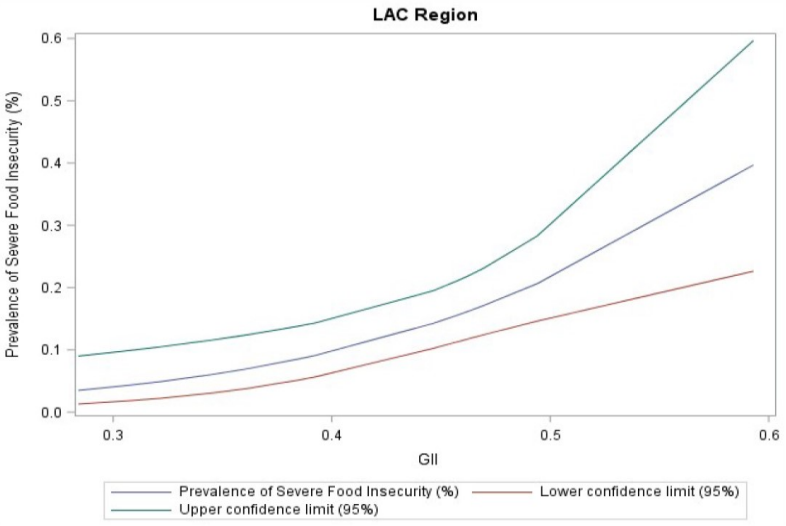
Note: Abbreviated terms include Gender Inequality Index (GII) and Europe and Central Asia (ECA); Severe food insecurity on the vertical axis, and GII on the horizontal axis. The solid blue line is a series plot of the predicted values based on the ECA model. The green and red lines are the upper and lower 95% confidence limits, respectively.
Source: Gallup survey (2015 data) and United Nations Development Programme (2015 data)

Figure 7. Generalized linear model showing the effect of gender inequality on moderate or severe food insecurity in Latin America and the Caribbean



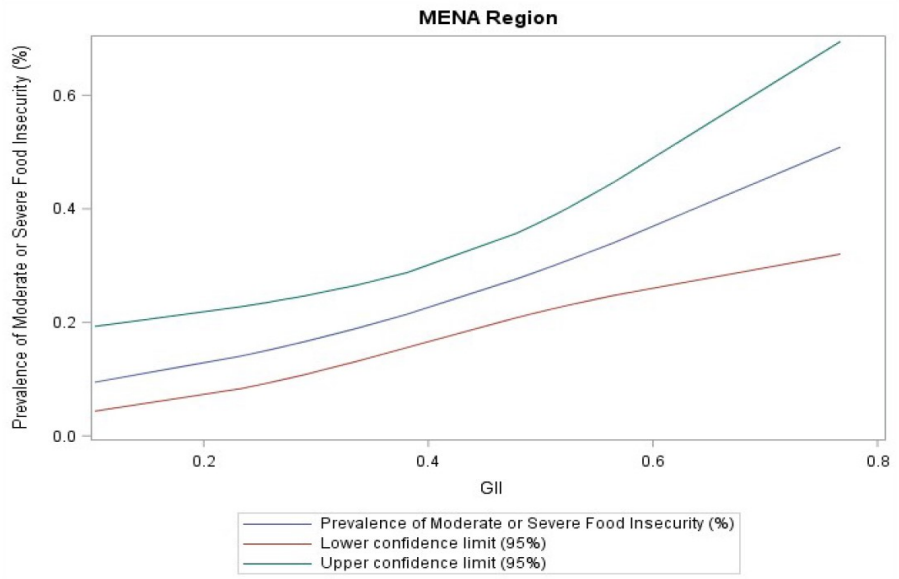
Note: Abbreviated terms include Gender Inequality Index (GII) and Latin America and the Caribbean (LAC); Moderate or severe food insecurity on the vertical axis, and GII on the horizontal axis. The solid blue line is a series plot of the predicted values based on the LAC model. The green and red lines are the upper and lower 95% confidence limits, respectively.
Source: Gallup survey (2015 data) and United Nations Development Programme (2015 data)

Figure 8. Generalized linear model showing the effect of gender inequality on severe food insecurity in Latin America and the Caribbean



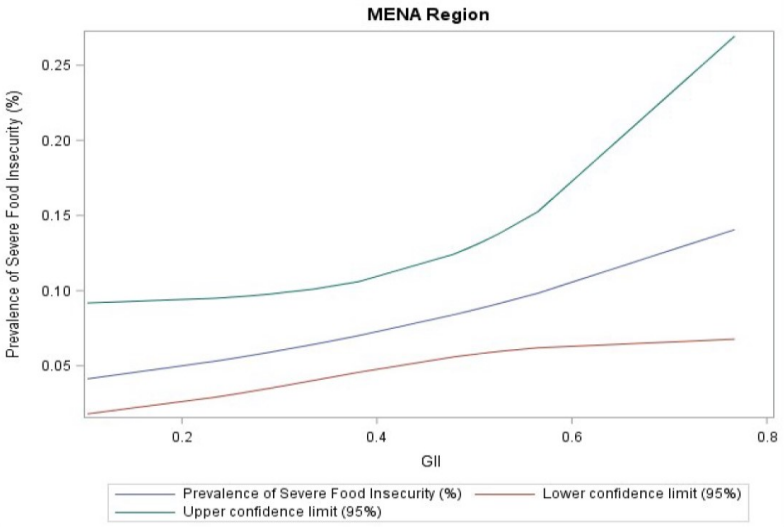
Note: Abbreviated terms include Gender Inequality Index (GII) and Latin America and the Caribbean (LAC); Severe food insecurity on the vertical axis, and GII on the horizontal axis. The solid blue line is a series plot of the predicted values based on the LAC model. The green and red lines are the upper and lower 95% confidence limits, respectively.
Source: Gallup survey (2015 data) and United Nations Development Programme (2015 data)

Figure 9. Generalized linear model showing the effect of gender inequality on moderate or severe food insecurity in Middle East and North Africa



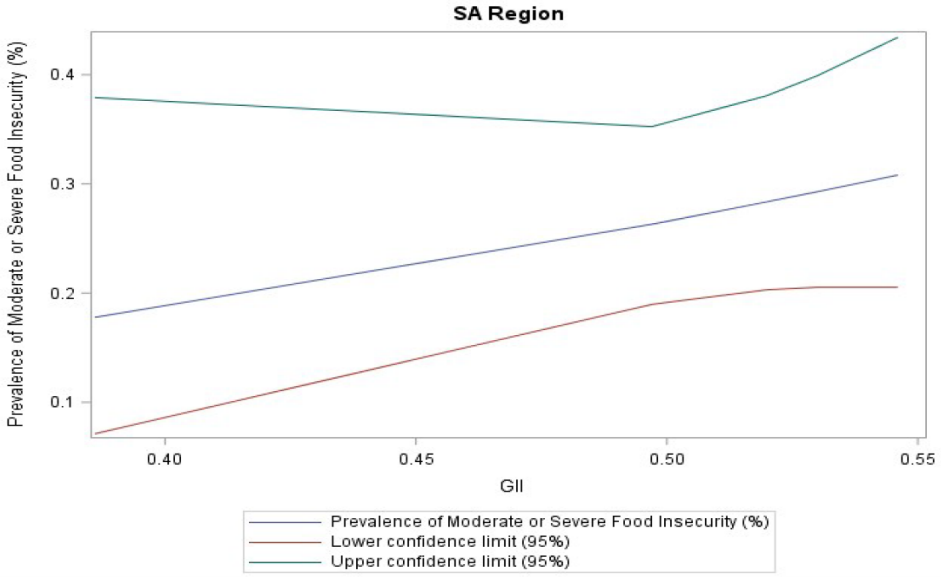
Note: Abbreviated terms include Gender Inequality Index (GII) and Middle East and North Africa (MENA); Moderate or severe food insecurity on the vertical axis, and GII on the horizontal axis. The solid blue line is a series plot of the predicted values based on the MENA model. The green and red lines are the upper and lower 95% confidence limits, respectively.
Source: Gallup survey (2015 data) and United Nations Development Programme (2015 data)

Figure 10. Generalized linear model showing the effect of gender inequality on severe food insecurity in Middle East and North Africa



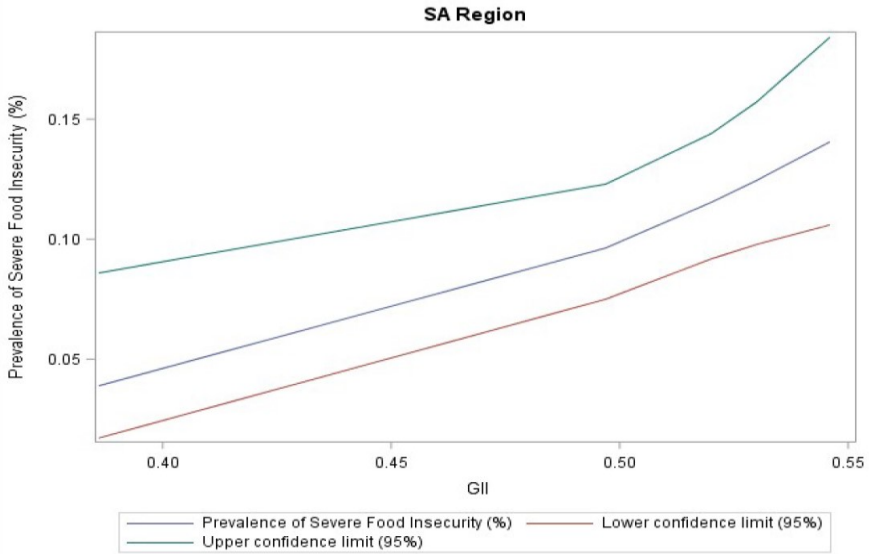
Note: Abbreviated terms include Gender Inequality Index (GII) and Middle East and North Africa (MENA); Severe food insecurity on the vertical axis, and GII on the horizontal axis. The solid blue line is a series plot of the predicted values based on the MENA model. The green and red lines are the upper and lower 95% confidence limits, respectively.
Source: Gallup survey (2015 data) and United Nations Development Programme (2015 data)

Figure 11. Generalized linear model showing the effect of gender inequality on moderate or severe food insecurity in South Asia



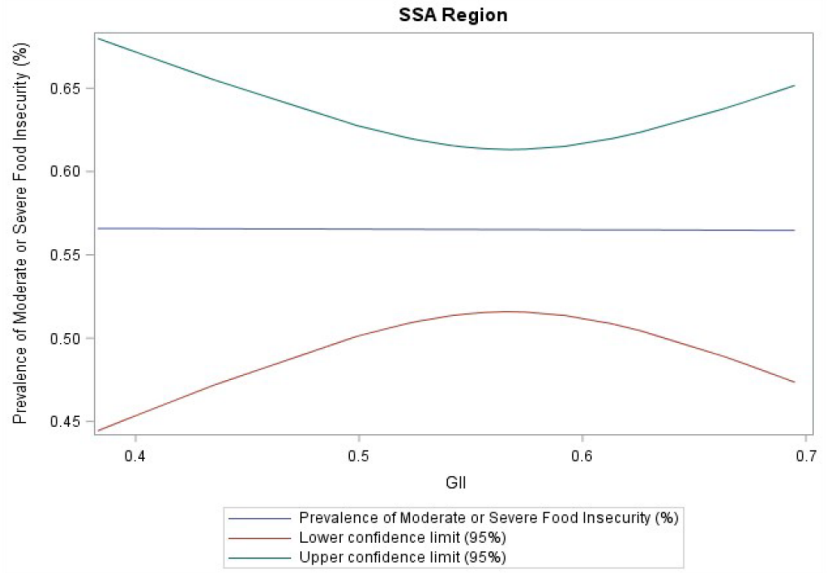
Note: Abbreviated terms include Gender Inequality Index (GII) and South Asia (SA); Moderate or severe food insecurity on the vertical axis, and GII on the horizontal axis. The solid blue line is a series plot of the predicted values based on the SA model. The green and red lines are the upper and lower 95% confidence limits, respectively.
Source: Gallup survey (2015 data) and United Nations Development Programme (2015 data)

Figure 12. Generalized linear model showing the effect of gender inequality on severe food insecurity in South Asia



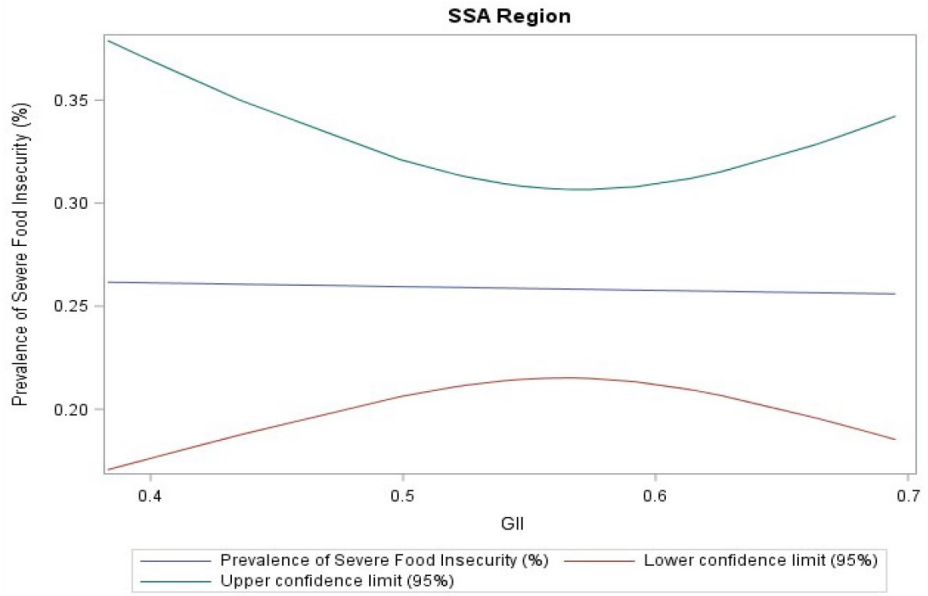
Note: Abbreviated terms include Gender Inequality Index (GII) and South Asia (SA); Severe food insecurity on the vertical axis, and GII on the horizontal axis. The solid blue line is a series plot of the predicted values based on the SA model. The green and red lines are the upper and lower 95% confidence limits, respectively.
Source: Gallup survey (2015 data) and United Nations Development Programme (2015 data)

Figure 13. Generalized linear model showing the effect of gender inequality on moderate or severe food insecurity in sub-Saharan Africa



Note: Abbreviated terms include Gender Inequality Index (GII) and sub-Saharan Africa (SSA); Moderate or severe food insecurity on the vertical axis, and GII on the horizontal axis. The solid blue line is a series plot of the predicted values based on the SSA model. The green and red lines are the upper and lower 95% confidence limits
Source: Gallup survey (2015 data) and United Nations Development Programme (2015 data)

Figure 14. Generalized linear model showing the effect of gender inequality on severe food insecurity in sub-Saharan Africa



Note: Abbreviated terms include Gender Inequality Index (GII) and sub-Saharan Africa (SSA); Severe food insecurity on the vertical axis, and GII on the horizontal axis. The solid blue line is a series plot of the predicted values based on the SSA model. The green and red lines are the upper and lower 95% confidence limits, respectively.
Source: Gallup survey (2015 data) and United Nations Development Programme (2015 data)

4.5.3 MULTIVARIATE ANALYSES

In order to further examine these relationships, multivariate analyses were conducted using generalized linear models to predict the effect of gender inequality on food insecurity, when controlling for personal health index. Data on gender inequality and food insecurity were assessed at the country level. Food insecurity was the predicted outcome variable while gender inequality and personal health index were the predictors. All three variables were rank-transformed, and data fit on the natural log scale. Based on the models, variables were selected based on the significance level of the F-test. Findings from the generalized linear models showed that the global model for moderate or severe food insecurity included linear and cross-product effects. Specifically, it was found that gender inequality, health, and the interaction between gender inequality and health were significant predictors of food insecurity. For severe food insecurity, the global model only contained linear effects of gender inequality and health, besides the intercept.

Based on the regional generalized linear models, significant predictors included were found to differ depending on the region. Table 8 shows the estimates and standard errors for the generalized linear models on the natural log scale for each region. For moderate or severe food insecurity, the models for EAP, ECA, and LAC included linear effects of gender inequality as a significant predictor. The model for ECA also showed that there were linear effects of health and cross-product effects of gender inequality and health. According to the models for MENA and SSA, the main predictor of moderate or severe food insecurity was health. Furthermore, the model for SA only included the intercept.

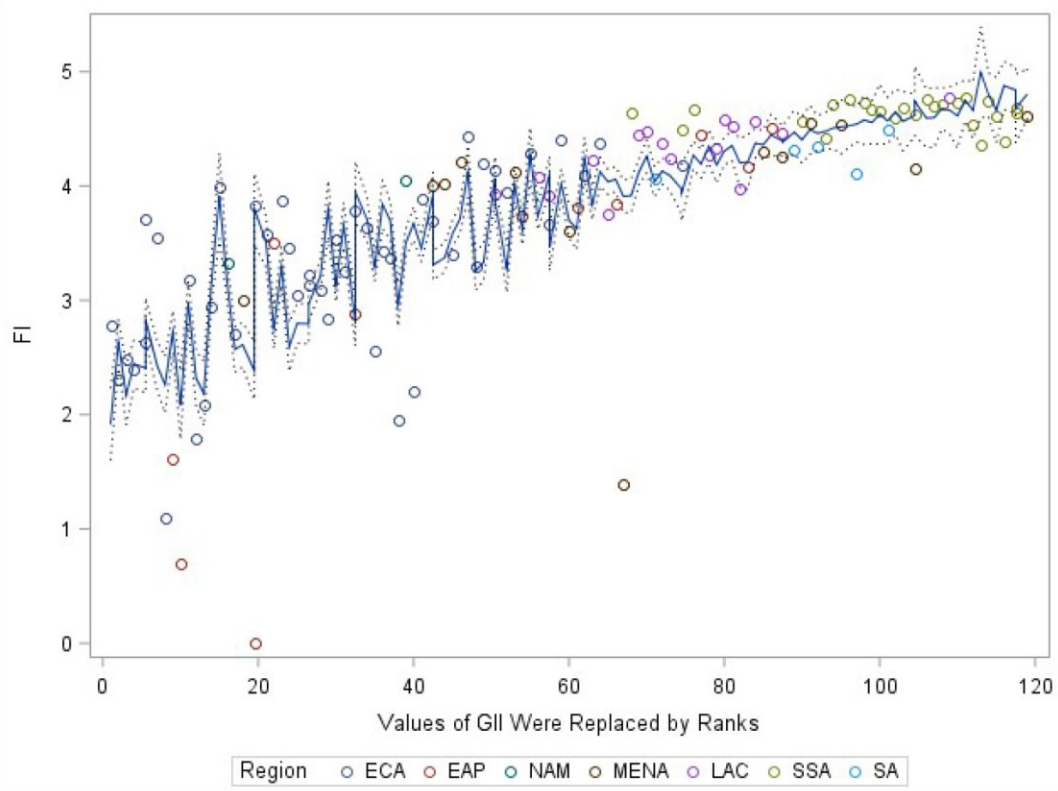
Table 8. Generalized linear models of the natural logarithm of the rank-transformed prevalence of moderate or severe food insecurity and severe food insecurity (*FI*): $\text{Ln}(FI) = b_0 + (b_1 \times GII) + (b_2 \times PHI) + (b_3 \times GII \times PHI) + (b_4 \times GII \times GII)$

Region	***FI***	b_0	b_1	b_2	b_3	b_4
Global	MSFI	3.9860±0.2550	0.005599±0.003126	-0.01856±0.003151	0.000195±0.000044	.
Global	SFI	3.1550±0.2285	0.01522±0.002143	-0.00436±0.002143	.	.
EAP	MSFI	0.4500±0.2704	0.1902±0.03986	.	.	.
EAP	SFI	0.6172±0.3511	0.1623±0.05177	.	.	.
ECA	MSFI	3.6744±0.5472	-0.00244±0.01747	-0.05659±0.01810	0.001176±0.000598	.
ECA	SFI	2.8903±0.1303	.	.	.	.
LAC	MSFI	1.0711±0.3223	0.09997±0.03145	.	.	.
LAC	SFI	1.9709±0.1930	.	.	.	.
MENA	MSFI	2.7078±0.3325	.	-0.1390±0.04190	.	.
MENA	SFI	2.7691±0.3102	.	-0.1478±0.03908	.	.
SA	MSFI	0.9575±0.2842	.	.	.	.
SA	SFI	-0.1298±0.3327	0.3624±0.1003	.	.	.
SSA	MSFI	3.1003±0.2981	.	-0.06001±0.02005	.	.
SSA	SFI	1.3129±0.5001	0.2201±0.08876	.	.	-0.00839±0.00316

Note: Estimates and standard errors are on the natural logarithm. Abbreviated terms include East Asia and the Pacific (EAP); Europe and Central Asia (ECA); Latin America and the Caribbean (LAC); Middle East and North Africa (MENA); South Asia (SA); Sub-Saharan Africa (SSA); Food Insecurity (FI); moderate or severe food insecurity (MSFI); severe food insecurity (SFI); Gender Inequality Index (GII); personal health index (PHI). Estimates that were not statistically significant are denoted with a "." No results for NAM due to insufficient sample size.
Source: Gallup survey (2015 data) and United Nations Development Programme (2015 data)

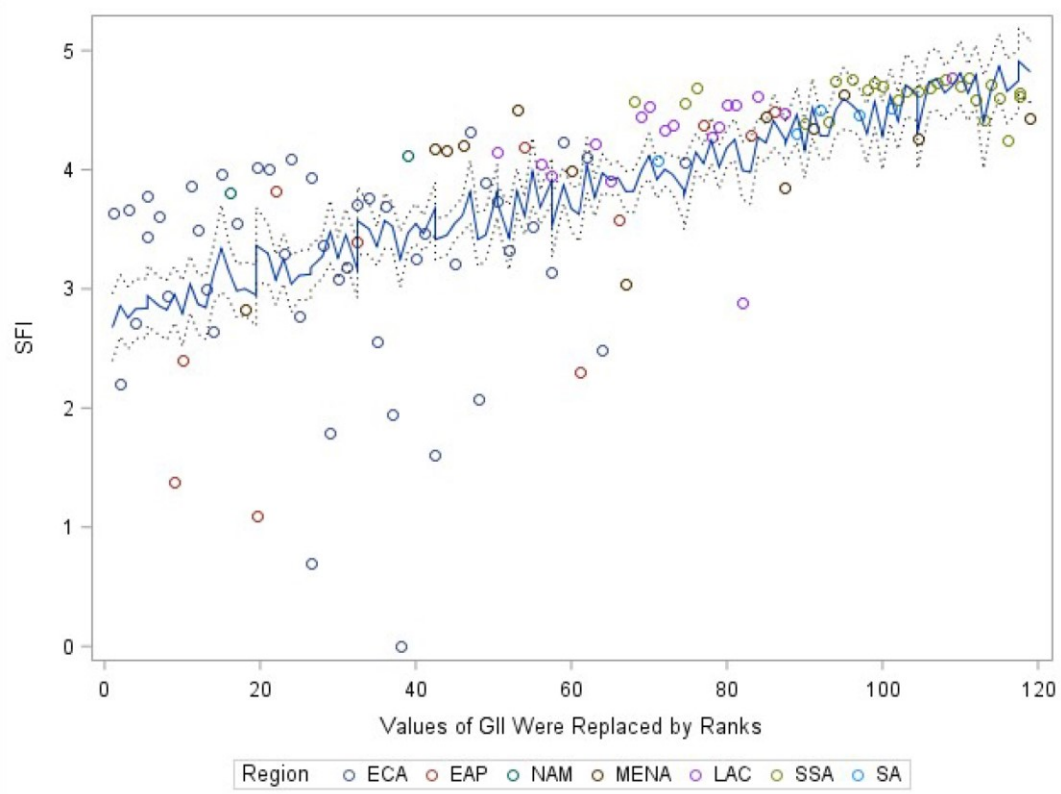
For severe food insecurity, the models for EAP, SA, and SSA contained gender inequality as a significant predictor. The model for SSA also demonstrated that there was a quadratic effect due to gender inequality on severe food insecurity. Based on the model for MENA, health was the main predictor of severe food insecurity. In addition, the models for ECA and LAC only included the intercept. Figures 15 and 16 show that the region with the highest levels of gender inequality did not have gender inequality as a significant predictor of food insecurity (i.e., SSA).

Figure 15. Generalized linear model showing the effect of gender inequality on moderate or severe food insecurity at the global level, when controlling for health



Note: Abbreviated terms include Food Insecurity (FI) and Gender Inequality Index (GII); The natural logarithm of the rank of the prevalence of moderate or severe food insecurity on the vertical axis, and the rank of GII on the horizontal axis. The solid blue line is a series plot of the predicted values of based on the global model. The dotted black lines are the upper and lower 95% confidence limits
Source: Gallup survey (2015 data) and United Nations Development Programme (2015 data)

Figure 16. Generalized linear model showing the effect of gender inequality on severe food insecurity at the global level, when controlling for health



Note: Abbreviated terms include severe food insecurity (SFI) and Gender Inequality Index (GII); The natural logarithm of the rank of the prevalence of severe food insecurity on the vertical axis, and the rank of GII on the horizontal axis. The solid blue line is a series plot of the predicted values based on the global model. The dotted black lines are the upper and lower 95% confidence limits
Source: Gallup survey (2015 data) and United Nations Development Programme (2015 data)

4.6 DISCUSSION

The overall objective of this study was to explore the association between gender inequality and food security. To do so, I examined the association between gender inequality and food security at the global level, and assessed how gender inequality was associated with food security on a region-by-region basis.

4.6.1 GENDER INEQUALITY AND FOOD SECURITY AT THE GLOBAL LEVEL

Statistical analyses were conducted to assess whether gender inequality and food security were associated at the global level. Findings showed that there was a significant positive relationship between gender inequality and the prevalence of moderate or severe food insecurity, and severe food insecurity, after controlling for health. In other words, an increase in gender inequality was significantly associated with an increase in the prevalence of food insecurity at the global level. These findings are consistent with the literature showing that gender inequality is a contributor of food insecurity. There are few cross-national studies on gender inequality in the field of nutrition, and most of the research use outcome variables other than food insecurity (e.g., hunger and nutritional status). In a study by von Grebmer et al. (2009), researchers examined the relationship between gender inequality (assessed using the Gender Gap Index) and hunger (assessed using the Global Hunger Index). The study found that countries with higher levels of gender inequality had greater levels of hunger. In another study, Smith and colleagues (2003) conducted a cross-national analysis, examining the association between hunger and women's status. Results from this study showed that 55% of the improvements in hunger in developing countries was attributed to improvements in women's status between 1970 and 1995. To our knowledge, this is the first cross-national study to assess the association between gender inequality and food insecurity. Given the lack of global and regional studies, these results provide strong scientific evidence on this topic, which can improve our understanding of a field that has not been fully examined.

4.6.2 GENDER INEQUALITY AND FOOD SECURITY ACROSS REGIONS

Statistical analyses were performed to examine the association between gender inequality and food security at the regional level. While there was a strong relationship between gender inequality and food insecurity at the global level, findings suggested that there was great heterogeneity across regions. Results from the bivariate analyses showed that gender inequality was a significant predictor of the prevalence of moderate or severe food insecurity in all regions, except in SA and SSA. On the other hand, for the prevalence of severe food insecurity, gender inequality was not a significant determinant in ECA, MENA, and SSA. The effects of gender inequality on food insecurity were not detectable in SA and SSA, likely due to the small sample size (n = 5) in SA (the relatively few countries in the region), and the high variability in the level

of food insecurity in SSA (from 30.4% to 77.3% for moderate or severe food insecurity, and from 6.4% to 50.5% for severe food insecurity). Interestingly, SSA was the only region where gender inequality was not significantly associated with the prevalence of both moderate or severe food insecurity, and severe food insecurity.

When controlling for health, gender inequality did not significantly predict the prevalence of moderate or severe food insecurity in MENA, SA, and SSA. These three regions share some common characteristics. MENA, SA, and SSA have relatively high levels of gender inequality. In the case of SA and SSA, these two regions have high levels of food insecurity. For the prevalence of severe food insecurity, gender inequality was not found to be a significant predictor in ECA, LAC, and MENA; however, the effect of gender inequality on the prevalence of severe food insecurity was significant in EAP, SA, and SSA. Two of the three regions (SA and SSA) have high levels of gender inequality and food insecurity.

There are several possible explanations for these findings. First, these findings suggest that there are large regional differences in the effect of gender inequality on the prevalence of food insecurity, and that the social, economic, political, and environmental contexts could explain these differences at the regional level. This is supported by the literature, showing that the determinants of food insecurity can differ depending on the country and region. In high-income countries, for example, the determinants of food insecurity include inequalities related to income, gender, ethnicity/race, and education, whereas in low-income countries, low agricultural productivity and limited access to technology are the main causes of food insecurity (De Souza De Oliveira et al., 2010). Although gender inequality is present in all societies, it is highly dependent on the context (Akter et al., 2017; Kabeer, 2015). The level and forms of gender inequality can vary by country and region due to the inherent diversity and complexity of gender systems. This means that efforts required to promote women's empowerment will be different depending on each community, country, and region. For example, in North America and Europe, one of the main priorities is to eliminate the gender pay gap while addressing inequalities in education, health, and decision-making is the main focus in low- and middle-income countries (Jayachandran, 2015).

4.6.3 SUB-SAHARAN AFRICA: FURTHER EXAMINED

The unexpected results for SSA make this region particularly interesting to study. As seen in Figures 15 & 16, findings from these two series plots illustrate that as gender inequality increases, the effect of gender inequality on food insecurity decreases, when controlling for health. In other words, gender inequality is not a significant predictor of food insecurity in regions with high levels of gender inequality, such as SSA. While it was expected (von Grebmer et al., 2009) that as gender inequality increased, food insecurity increased, this relationship was not clearly seen in SSA. This suggest that there could be other mitigating factors, which could be better predictors of food insecurity in SSA. According to the generalized linear models for SSA, one such factor is health. This was because health was the only significant predictor of moderate or severe food insecurity.

To better understand these unexpected results, I applied a heuristic tool to look at trends across the countries. First, I ranked SSA countries based on their level of gender inequality and the prevalence of moderate or severe food insecurity. I divided the 25 SSA countries into two groups. I did this in order to identify those that followed the expected trend (either high gender inequality/high food insecurity or low gender inequality/low food insecurity), and those that did not. Only a small number of countries were found to follow the expected trend, which included Ethiopia, South Africa, Senegal, and Tanzania. These four countries, in particular, had low gender inequality and low food insecurity. The majority of SSA countries included in this study did not follow the expected trend.

In order to further examine the group of countries that did not follow the expected trend, I further sub-divided them into two smaller groups. I did this to further unpack the differences within this group. The first sub-group is comprised of countries with low gender inequality and higher-than-expected food insecurity, including Botswana, Uganda, Zambia, and Zimbabwe. The second sub-group is comprised of countries with high gender inequality and lower-than-expected food insecurity, including Burkina Faso, Mauritania, Côte d'Ivoire, Mali, Niger, and Chad. An interesting finding was there seemed to be a geographical component to the distribution of countries. The first sub-group (low gender inequality and high food insecurity) is mostly

comprised of countries from Southern Africa, whereas the second sub-group (high gender inequality and low food insecurity) is mainly made up of countries from West Africa. The grouping of countries suggests that there could be different regional or geographical factors influencing the effect of gender inequality on food insecurity in SSA. Due to the cross-sectional nature of this study, causation cannot be established. Nevertheless, I explored some of the potential mechanisms and pathways behind these unexpected results. In particular, I follow, based on the literature, with a discussion on factors, such as access (or lack of) to basic infrastructure and level of development as potential predictors to understanding the relationship between gender inequality and food insecurity within the SSA context. I also take a closer examination as to why we find countries with high gender inequality/low food insecurity and low gender inequality/high food insecurity in SSA.

4.6.3.1 ACCESS TO BASIC INFRASTRUCTURE

The basic goods approach argues that access to basic goods and services is key to promoting human development and well-being (Reinart, 2011). Such basic goods are necessary for people to have positive health and education outcomes, and to actively engage in decision-making in their communities, and are necessary requirements for an individual to live an active and health life (Reinart, 2015). Since ensuring access to basic goods and services is also a matter of supporting basic human rights, food security status can be seen to be strongly influenced by the physical and social environment. In SSA, access to basic services is low, mainly due to the lack of investments in the basic infrastructure, which requires large amounts of public funding from the government to build and maintain (Prüss-Ustün et al., 2014). In such settings where basic services are not available, non-food inputs, including education, access to healthcare, and access to clean water and sanitation are determinants of good nutritional status. For example, in 2015, 28% of people had access to basic drinking water sources, 28% of people had access to basic sanitation facilities, 23% of people practiced open defecation, and 63% of people did not have access to handwashing facilities (WHO & UNICEF, 2017).

Access to clean water and sanitation is one of the main components of the utilization dimension of food security (FAO, 2008). Here, utilization refers to how the nutrients are absorbed and

utilized by the body. Consumption of unsafe drinking water can lead to incidences of diarrhoeal diseases (Oloruntoba, Folarin, & Ayede, 2014). The region has one of the lowest of access to sanitation facilities, handwashing stations, and clean water in the world, with only 68% of the population having access to improved sources of drinking water in 2015 (WHO & UNICEF, 2017). In a study, it was observed that poor handling of water was significantly associated with diarrhea in children under the age of five in Nigeria (Oloruntoba et al., 2014). Research has shown that inconsistent access to infrastructure in urban areas is associated with increased household food insecurity vulnerability. A study conducted by Frayne & McCordic (2015) examined urban households in Southern Africa, and found that household access to infrastructure was a significant predictor of food security status. Specifically, findings showed that urban households were 11 times more likely to be categorized as food insecurity when they had either inadequate or no access to basic infrastructure, including electricity and water. This demonstrates the importance of ensuring access to adequate non-food inputs. The lack of access to infrastructure and high prevalence of food insecurity might explain the lack of statistical significance in SSA.

4.6.3.2 STAGE OF DEVELOPMENT

The early stages of SSA countries in their development is another possible reason for the unexpected results. It has been noted that countries differ based on their stage of development, which can be assessed using income, level of human development, and composition of total output (Arora, 2009). Inglehart and Norris (2003) propose that the stage of development can influence the priorities identified by people living in those countries. The authors explain that in developing countries, for example, the main priorities for the poor are ensuring that their basic needs, such as access to food and clean water, are met in order for them to live a healthy life, whereas in most developed countries, governments have programs in place to provide these basic services, such as adequate housing and food banks. As a result, in low-income countries, people are more vulnerable to shocks, such as poor health, loss of employment and income, loss of crops, and disasters. Development and economic growth cannot be used to fully explain the differences in gender inequality among the countries (Inglehart & Norris, 2003). To explain this point, Inglehart and Norris (2003) discuss the case of Sweden (country with low levels of gender

inequality) and the Middle East (region with high levels of gender inequality). Sweden, has a similar GDP per capita to countries, such as Kuwait, Qatar, and Saudi Arabia, yet those countries have high levels of gender inequality and limited rights for women. Two important questions to ask are what would happen if people in those countries had better gender equality, and would that have an effect on the GDP per capita?

4.6.3.3 COUNTRIES WITH LOW GENDER INEQUALITY AND HIGH FOOD INSECURITY

Southern Africa is characterized as having the lowest levels of gender discrimination out of the sub-regions, according to the Social Institutions and Gender Index, which assesses how discriminatory social institutions impact empowerment of women and girls (OECD, 2016). The region has high levels of literacy among young females (UNICEF, 2014). For example, the literacy rate among females between the ages of 15 and 24 was 98% in Botswana and 92% in Zimbabwe (UNICEF, 2014). Despite progress made in reducing gender inequality, there are still persistent gender norms and barriers affecting women and girls (OECD, 2016). For example, women in the region are disproportionately affected by the HIV/AIDS epidemic (Chersich & Rees, 2008).

In this study, countries in Southern Africa had higher-than-expected food insecurity. One of the potential reasons is the vulnerability of the region to climate change. Climate change, agriculture, and food security are inextricably linked (FAO, 2008). Over the past decades, the frequency and intensity of extreme weather events, such as droughts and floods, has dramatically increased, and these phenomena are negatively affecting global food production and food access (FAO, 2008). In 2015, it was announced that Southern Africa was experiencing one of the most powerful El Niño events in the last 50 years, causing an extreme drought in the region (FAO, EC-JRC, FEWS-NET, & WFP, 2016). As a result of the climatic variability in Southern Africa, climate change is now recognized as the largest threat to public health (Bickton, 2016). Southern Africa as semi-arid region is known for significant changes in seasonal rainfall patterns, and there have been reportedly a greater frequency of severe droughts and intense floods. With these observed changes, food insecurity is increasingly becoming an issue in Southern Africa (Rurinda et al.,

2015). Agriculture is considered to be the foundation of Southern African countries, and plays an important role in protecting livelihoods and ensuring food security (Bickton, 2016).

Findings from this study showed that the number of food insecurity people was relatively high in this region (Bickton, 2016). In 2015/16, Southern Africa recorded the driest agricultural season in the last 35 years (FAO, 2017). Countries, such as Botswana, Namibia, and Zimbabwe, have been greatly affected by droughts (FAO, 2017). The devastating impact of climate change could explain the rise in the prevalence of food insecurity and the unexpected relationship with gender inequality. This is because climate change can have an impact on food systems through different pathways, such as changes in the level of crop production, volatility in food prices, shifts in access to markets, and changes in the supply chain (Gregory, 2015). Climate change could explain the higher-than-expected levels of food insecurity in Southern Africa, a region with low levels of gender inequality.

4.6.3.4 COUNTRIES WITH HIGH GENDER INEQUALITY AND LOW FOOD INSECURITY

West Africa is characterized as having the highest levels of gender discrimination out of the sub-regions, according to the Social Institutions and Gender Index (Bouchama, Ferrant, Fuiret, Meneses, & Thim, 2018). In particular, four of the six countries included in this group (Chad, Mali, Niger, and Mauritania) exhibited very high levels of gender discrimination. Some of the common characteristics included presence of discriminatory social norms and practices, weak implementation and enforcement of laws, and poor comprehensive legal protection. There have been some improvements in the level of gender inequality over the years; however, there are still significant barriers for women and girls, particularly in social institutions (Bouchama et al., 2018). For example, West Africa has some of the lowest literacy rates among girls in the continent (UNICEF, 2014). The literacy rate for girls between 2009-2013 was 15% in Niger and 44% in Chad, which were both significantly less than the continent average of 69% (UNICEF, 2014). Child marriage is also a common practice in West Africa (Koski, Clark, & Nandi, 2017). Some countries, such as Mauritania, have implemented laws that set the legal age of marriage to

18; however, despite these laws, girls under the age of 18 are still able to marry under customary laws (UNICEF, 2015).

In this study, countries in West Africa were characterized by having lower levels of food insecurity than expected for their level of gender inequality. As a region, West Africa reached the MDG 1c. target of halving the proportion of people suffering from hunger, outperforming other SSA sub-regions: Eastern Africa, Southern Africa, and Central Africa (FAO, 2015). The proportion of people suffering from hunger decreased by 60%, from 24.2% in 1990-92 to 9.6% in 2014-16 (FAO, 2015). There are various reasons given for this success. One of the suggested reasons has been the development and implementation of the Comprehensive Africa Agriculture Development Programme (CAADP) (FAO, 2015). CAADP was a policy framework designed to promote reforms in the agriculture sector, improve food security and nutrition, promote wealth creation, and stimulate economic growth and prosperity (NEPAD, 2013). Furthermore, other spinoff investments promoting the development of human capital and institutions at the regional level to increase agriculture development include initiatives by the Economic Community of West African States (ECOWAS), the West African Economic and Monetary Union (WAEMU), and the Permanent Interstate Committee for Drought Control in the Sahel (CILSS), with a focus on risk mitigation and monitoring of food security in the region (FAO, 2015).

4.6.4 POLICY IMPLICATIONS

This study highlighted the importance of global and regional-level analyses on the impact of gender inequality on food insecurity. It is clear that gender inequality does negatively affect the prevalence of food insecurity at the global level. Results from regional analyses demonstrate the need for further research on the key determinants affecting the relationship between gender inequality and food insecurity in 7 regions: EAP, ECA, LAC, MENA, NAM, SA, and SSA. As previously mentioned, both food security and gender inequality are context-specific; therefore, more research is needed examining the specific contributions of these two phenomena at the country and regional levels to better understand differences observed in this study. Research is also needed to determine the impact of gender inequality dimensions (education, health, and employment) towards achieving food insecurity.

By conducting more country- and region-specific studies, more targeted recommendations can be made to governments and organisations working on developing policies and programs to address gender inequality. Such context-specific studies will ensure that policies are effective and tailored to the particular context. Overall findings from this study suggest that increasing investments in gender equality could lead to decreases in food insecurity around the world. As a result of these findings, from a policy perspective, this suggests that gender equality should be integrated into national food security strategies, and be included as a key component in policy and program design. In addition, these findings also highlight the need for national governments to recognize gender equality as part of their national agenda to reduce food insecurity. Steps should be taken to include women in discussions on food security. By working on addressing gender issues, we will be closer to achieving the global goal of zero hunger by 2030. One way that governments can act is by including questions on gender equality into national food security questionnaires. Such data can provide information on how gender inequality directly impacts food security. Food security is a complex and multidimensional phenomenon, and should be approached from multiple sides. Clearly, the perspective of women should become more integrated into food security policies. In order to fully maximize the impact of food security interventions, gender equality should be included, along with other strategies.

4.7 LIMITATIONS

There are some limitations of this study. Due to the cross-sectional nature of this study, causal relationships cannot be established. As a result, the direction of the relationship between gender inequality and food insecurity cannot be determined. For example, it could be the case that one may be food insecure, resulting in experiencing the effects of gender inequalities due to their inability and lack of tools to confront the systematically discriminatory structures and institutions. Another limitation of this study is that the measurement tools used to assess gender inequality and food insecurity did not come from the same source. Nevertheless, both tools were internationally validated. Furthermore, other mitigating factors were not explored. Although this study was not able to provide exhaustive answers, it brought forward potential explanations for some of the outcomes observed. Finally, given the nature of the study, context-specific analyses

were not conducted. Nonetheless, global analyses strengthen the argument highlighting the relationship between gender inequality and food insecurity.

4.8 CONCLUSION

This study aimed to explore the relationship between gender inequality and food insecurity. Overall, analyses showed that gender inequality was significantly associated with the prevalence of food insecurity at the global level. A major contribution of this study is that it highlights the importance of understanding the effect of gender inequality as a significant predictor of food insecurity. This empirically-based research also provides strong scientific evidence, which can be used to enhance our understanding of the topic and the implications of addressing gender inequality to reduce food insecurity. Food security is a complex and multidimensional phenomenon. In order to address food insecurity, it is important to incorporate different approaches. This study suggests that one of those approaches should include gender equality. By considering gender equality, food security policies and programs will be more inclusive and able to meet the needs of men, women, boys, and girls. Future research should further investigate the determinants influencing the relationship between gender inequality and food insecurity at a country-level. In addition, it is recommended that research should be conducted to examine the effect of the sub-components of gender inequality on food insecurity to better understand how they contribute differently to food insecurity at the country and regional levels.

CHAPTER 5: FINAL CONCLUSIONS

This study aimed to explore the relationship between gender inequality and food insecurity. Overall, analyses showed that gender inequality was significantly associated with the prevalence of food insecurity at the global level. In other words, an increase in gender inequality was a significant predictor of an increase in food insecurity. Given the lack of global and regional studies, this study aimed to fill a research gap. These analyses provide strong scientific evidence that enhances our understanding of the relationship between gender inequality and food insecurity. These findings highlight the need to incorporate gender equality in policies. Food security is a complex and multidimensional phenomenon, and as such there is no silver bullet to address it. Therefore, multiple approaches are required when designing interventions. This study suggests that one of those approaches is gender equality. As a result, these findings may help influence future policies by emphasizing the need for gender-sensitive food security programs at the national, regional, and global levels. It is important to examine how gender inequality interacts with food insecurity in different countries and regions in order to develop context-specific policies and programs. For future research, it is recommended that research be conducted on the determinants influencing the relationship between gender inequality and food insecurity at a country level. In addition, research is recommended to examine the effect of the sub-components of gender inequality on food security to better understand the contributors and improve gender equality policy targeting. In summary, this study highlights the requirement of addressing gender inequality as a strategy to reduce food insecurity. By promoting gender equality, gendered barriers associated with access to food will be removed, which will contribute to reducing hunger. Currently, ensuring food security is a strategic global priority, as seen by its inclusion in the SDGs. In order to eliminate global hunger, it is important to examine the main determinants of food insecurity and their impact in different contexts, and how these issues intersect. Future research could build on these findings by examining the impact of gender inequality on food insecurity at the country level. These efforts may help reduce the level of food insecurity in the world.

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APPENDICES

APPENDIX A – FOOD INSECURITY EXPERIENCE SCALE

Question	
Now I would like to ask you some questions about your food consumption in the last 12 months. During the last 12 MONTHS, was there a time when:	
1	You were worried you would run out of food because of a lack of money or other resources?
2	You were unable to eat healthy and nutritious food because of a lack of money or other resources?
3	You ate only a few kinds of foods because of a lack of money or other resources?
4	You had to skip a meal because of a lack of money or other resources?
5	You ate less than you thought you should because of a lack of money or other resources?
6	Your household ran out of food because of a lack of money or other resources?
7	You were hungry but did not eat because of a lack of money or other resources?
8	You went without eating for an entire day because of a lack of money or other resources?

APPENDIX B – PERSONAL HEALTH INDEX

The Personal Health Index is a measure used by Gallup to perceptions of health by individuals. Scores are obtained by calculating the mean of the valid responses, which is then multiplied by 100. Country-level scores are generated by calculating the mean of all individual scores for each country. Gallup uses the following questions included in the survey to create the index and to calculate score for each respondent:

- *Do you have any health problems that prevent you from doing any of the things people your age normally can do?*
- *Now, please think about yesterday, from the morning until the end of the day. Think about where you were, what you were doing, who you were with, and how you felt. Did you feel well-rested yesterday?*
- *Did you experience the following feelings during a lot of the day yesterday? How about physical pain?*
- *Did you experience the following feelings during a lot of the day yesterday? How about worry?*
- *Did you experience the following feelings during a lot of the day yesterday? How about sadness?*