# ABSTRACT


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| Title of Dissertation: | DETERMINANTS OF FOOD INSECURITY IN THE LEAGUE OF ARAB STATES |
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**Background** Food insecurity (FI) is widespread in the League of Arab States (LAS) due to factors including gender inequality, conflict, and political turmoil. However, limited data are available on its prevalence and determinants in that region. This dissertation aims to 1) validate the Food Insecurity Experience Scale (FIES), developed by the UN Food and Agriculture Organization, and assess the prevalence of FI in that region; 2) examine the association between FI, physical health, and mental well-being by sex and whether social support modifies this association in women; 3) examine the relationship between Palestinian live-in grandparents (GP) and the health and well-being of their grandchildren.

**Methods** Rasch modeling was applied to the Gallup World Poll data to validate FIES in 19 countries of the region. Descriptive and logistic regression analyses were applied to data from 62,261 respondents aged 19 and over to examine determinants of FI. Logistic regression was also used to analyze the data of 2707 households and 8,034 children ages 0-17 from two surveys of Palestinian refugees.

**Results** FIES met the Rasch assumptions indicating good internal validity. The prevalence of severe FI was 15.7% and women were at highest risk compared to men (17.6% vs. 14.1%, respectively, $p<0.0001$). Older age, living in rural areas, and high dependency ratio were associated with severe FI in women. High negative experience and low income were associated with severe FI, but good physical health and high positive experience with lower prevalence of severe FI. Having a live-in GP in the household was associated with grandchildren's lower odds of experiencing an acute disease and higher odds of attending school.

**Conclusion** FIES is a valid tool; however, cognitive testing of some items and omission of correlated ones may improve the scale. FI is highly prevalent and should be monitored to develop multi-sectoral intervention strategies. Mixed method studies are needed to better understand the relationship between grandparents and their grandchildren.

**Keywords:** The Food Insecurity Experience Scale; Gallup World Poll; League of Arab States; Human development index, physical health; mental well-being; positive experience, negative experience, gender inequality index, social support, and women.

# DETERMINANTS OF FOOD INSECURITY IN THE LEAGUE OF ARAB STATES

By

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# Dedication

This Dissertation is dedicated to my Mom, my kids Mohammed and Omar, my sister Effat, my Brothers, Adnan, Ibraheem, Ehab, and Ahmed, and to my best friend Tala. Your love and support pulled me through some very trying periods.

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# 1. Chapter 1: Introduction

The world population is projected to increase from 7.3 billion in 2015 to 8.5 billion in 2030 and will further increase in the following years [1, 2]. Within the League of Arab States (LAS), total population has tripled since 1980, from ~165 million to ~392 million in 2015, and is projected to reach approximately 598 million inhabitants by 2050 [3].

The Arab population growth has led to high urbanization, unemployment, and gender inequality in education and employment [4, 5]. Also, the LAS region has limited water and arable land and mostly depends on imported food, making the population highly affected by food price volatility and inflation. All of these factors together may not only increase the risk of poverty but also increase the risk of food insecurity (FI) [5-10]. Moreover, recent turmoil and war in some LAS countries forced people to flee as refugees or asylum seekers to neighboring countries. Such displacement also increases the risk of poverty and FI among the refugees themselves and also impacts the population of the host countries due to limited resources across the LAS region [11, 12].

The 1996 World Food Summit defined food security (FS) as "when all people at all times have sustainable physical and economic access to sufficient, safe, and nutritious food, to meet their dietary needs and food preferences, for a healthy and productive life" [13]. This definition highlights the four key dimensions of FI: food availability, accessibility, utilization, and stability [14]. A deficit in one or more of these dimensions can lead to FI at different severity levels. Access can be inadequate in terms of quality, quantity, safety, and/or cultural acceptability, leading to food intake below calorie needs and/or below nutritional recommendations [15]. In turn, FI may cause malnutrition, impairs physical health, and compromises mental development and well-being.

Previous studies indicate that FS is affected by global, regional, household, and individual factors. Global level factors include climate change and natural disasters; regional-level factors include civil conflicts, urbanization, and social and political norms; household-level factors include household size, area of residence, and environmental conditions; and individual-evel factors include demographic, socioeconomic, health status, and social support. However, these factors may contribute to several nutritional and non-nutritional adverse effects that relate to diverse physical and mental health and well-being, which may act differently based on the severity level of FI and the demographic groups such as women, children, or older adults.

Women in the LAS region may be at higher risk of FI than men due to inequality in education and employment opportunities. To our knowledge, there is only one study of women aged 18-70 years in northern Jordan, that assessed the prevalence of FI and socioeconomic determinants [16]. Elsewhere, there are few studies also focused on women in other countries, such as women in Iran [17], Nepal [18], Tanzania [19], and the USA [20]. Although older women may be more vulnerable, they have a powerful influence on their families, especially on the lives of their grandchildren [7, 21]. This is because grandparents, especially grandmothers, may provide help with supervision and childcare as well as other emotional, social, and economic resources, all of which can be beneficial for grandchildren's health and well-being. Examining the FS status and the association between living with a grandparent (GP) and grandchildren's health and well-being has never been explored in any LAS countries.

To our knowledge, there is a lack of information and limited studies addressing the prevalence of FI and its determinants in the LAS countries. The prevalence of FI was

reported at the regional level using different geographical classifications, such as Near East and North Africa (NENA) region in the Food and Agriculture Organization (FAO)'s reports [22, 23]. However, such reports have not addressed the determinants of FI in that region. A few studies have assessed the prevalence of FI, which were conducted in Yemen [24], and in Lebanon among rural Bedouins [25], Iraqi refugees [26], Palestinian refugees [26, 27], and in the south of Lebanon [28].

Having large nationally representative population data, such as Gallup World Pull (GWP), provides an opportunity to explore the demographic and socioeconomic factors associated with FI in all region countries using the same tool. This will help in guiding policy decisions and tailoring food aid programs. The purpose of the current study is to estimate the overall prevalence of FI in the LAS region and to examine whether its determinants differ by sex using 2014, 2015, and 2016 Gallup World Poll data. Also, to examine whether social support has a modification effect on these determinants. This study also focuses on Palestinian refugees as a case study and examines the association between the presence of GP in the household and the health and well-being of grandchildren using data collected in refugee camps in Lebanon in 2010 and 2015 surveys.

# 2. Chapter 2: Literature Review

## 2.1.League of Arab States

The LAS is a regional, social, cultural, and economic organization consisting of 22 Arabic-speaking countries in the Middle East and Africa, as shown in **Figure 2.1**. It includes Algeria, Bahrain, Comoros, Djibouti, Egypt, Iraq, Jordan, Kuwait, Lebanon, Libya, Mauritania, Morocco, Oman, Palestine territories, Qatar, Saudi Arabia, Somalia, South Sudan and Sudan, Syria, Tunisia, United Arab of Emirates (UAE), and Yemen [29, 30]. These countries share common environmental challenges such as limited agricultural resources, growing water scarcity, and climate change but vary by levels of economic development [6]. In addition, many of these countries face rapid population growth, urbanization, high unemployment rates, food price volatility, violent conflict, and political turmoil, all of which exacerbate the risk of FI [6], hence the need to monitor it in this region.

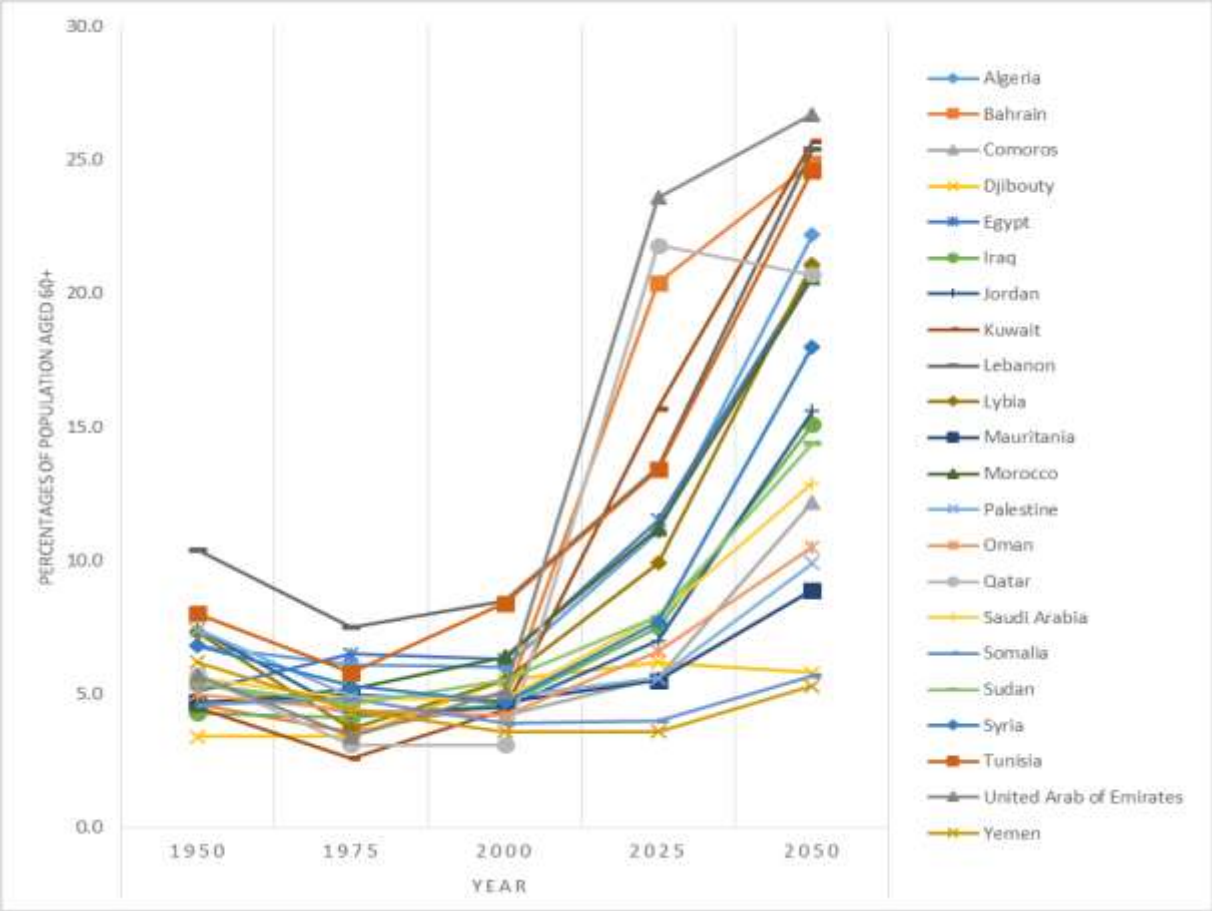
**Figure 2.1: Map showing the League of Arab States members [29].**

## 2.2.Population size and growth of the Arab population

Most recent data from World Bank showed that the combined LAS population has almost tripled since 1980 from about 165 million to 392 million in 2015 [3], and is projected to reach 598 million by 2050 [31]. This population growth could be due to many factors: 1) the high population growth rate in the LAS region, which is faster than in most other global regions. Based on 2015 data from the World Bank, overall population growth in North Africa, the Arabian Peninsula, and the Middle East (22 countries) is almost 2% per year [3]. This growth rate is substantially higher than that of other developing countries and the world growth rate, which is 1.18% per year [3]. 2) Lower mortality, and 3) longer life expectancy, which has increased from 69 years in 2004 to 71 in 2015 [3], and is expected to reach 79 years by 2050 [31].

As a result of the high fertility rates between the 1980s and 2010, populations in the LAS are considered relatively young. One-third of the LAS population is under 15 years, and one-fifth are aged 15-24 years [32]. Despite an observed "Youth Bulge," the aging population is predicted to grow rapidly during the coming decades (**Figure 2.2**). In 2015, older adults aged 65 and over comprised 4.3% of the total population [3, 33]. By 2050, the proportion of older persons (60 years or more) is predicted to increase to 19 % [31].

**Figure 2.2: Population aged 60+ in Arab countries in 1950 - 2050 [34].**




## 2.3. Food security in the League of Arab States

### 2.3.1. Measurement of food insecurity levels

The severity of FI can be measured at household and/or individual levels using a series of questions addressing the accessibility of food. These questions are designed to identify whether household members experienced a reduction in the quantity or the quality of food over a specific period due to the lack of access to food or resources to obtain food. Although several different tools have been used to assess the severity of FI, each tool must use questions that focus on a household's or person's behavior and their

experiences in obtaining and eating food. Such tools may vary from simple indicators that can be quickly and easily collected to comprehensive measures that require more details and sophisticated analytics [35]. Nord et al. noted that "FS questionnaires do not need to be identical in order for the results to be comparable." Instead, the items must have an equivalent meaning across countries or populations and similar key questions in common across surveys [24].

Several tools have been developed to assess FI at the household or the individual level. One of the first FS scales for use at the household level is the U.S. Household Food Security Survey Module (HFSSM). It consists of an 18-question survey module, (ten of the questions are specific to the experience of adults, while eight are specific to the experience of children under 18 years old) that asks household members to recall their subjective experiences of FI dimensions over 12 months, including concern about household food supplies, adequacy of the quality or quantity of food consumed, and reduction in food intake [35]. In turn, households are classified as either food secure, having low FS, or very low FS. The HFSSM was first administered in 1995 to monitor unemployment and poverty in the United States. Approximately 45,000 households respond to the HFSSM annually, and it has been incorporated into many surveys such as the Census yearly Current Population Survey and the National Health and Nutrition Examination Health Survey [35]. Another tool is the Household Food Insecurity Access Scale (HFIAS), derived from the HFSSM and consisting of nine questions. It was developed as a simpler and faster tool to assess the prevalence of household FI of the population and monitor the changes in FI over time [36]. The respondent is first asked to recall experiences of FI over the previous four weeks (yes or no). If the respondent

answers “yes,” a frequency of occurrence question is asked to determine whether the condition rarely happened (once or twice), sometimes (three to ten times), or often (more than ten times) in the past four weeks. The frequency response questions are incorporated into the calculation of the scale score. It generates a score from 0 to 27; the higher the score, the more FI the household is experiencing. The HFIAS indicator categorizes households into four levels of household FI: food secure, or mild, moderately, or severely FI [35, 36].

Another tool is the Latin American and Caribbean Household Food Security Scale (ELCSA – Escala Latinoamericanay Del Caribe de Seguridad Alimentaria). ELCSA is a comprehensive region-specific, experience-based FS measure that has been internally and externally validated across countries in Latin America [35]. ELCSA consists of a 15-item scale with a three-month recall period, seven of which are for households with children. Total raw scores for households without children range from 0 to 8 and from 0 to 15 for households with children. Households can be classified as food secure, mildly, moderately, or severely FI [37].

Studies on FS were conducted in some countries of the LAS using two tools adapted from the U.S. HFSSM. The first one is the Yemeni National Food Insecurity Survey (YNFIS), developed in 1996 when the World food summit (WFS) requested the development of a national Food Insecurity and Vulnerability Information and Mapping Systems (FIVIMS) in Yemen. The purpose of this survey was to help national agencies and international organizations to identify groups of people and geographical locations with a high prevalence of FI for possible interventions. The YNFIS module consists of 16 questions, six of which are related to household size and coping strategies, and the other

ten are used to assess household FI and hunger. The questions are only administered to those who affirmatively respond that they could not afford to eat what they usually ate in the previous 12 months. Responses to the questions are then used to classify households into six categories: subjectively food insecure, vulnerable to FI, food insecure with moderate hunger, food insecure with severe hunger, food insecure with moderate hunger among children, and food insecure with severe hunger among children [24, 38].

Another household FS tool is the Arab Family Food Security Scale (AFFSS). In 2010, researchers from the American University of Beirut and the University of Maryland, College Park, collaborated to develop and validate a tool based on the U.S. HFSSM and the YNFIS. This scale consists of 7-items to assess household FS over the previous six or 12 months. The total raw score is used to classify households as food secure, moderately food insecure, and severely food insecure. The tool was validated among Lebanese and refugee populations in Lebanon [28].

More recently, the Food and Agriculture Organization-Voices of the Hungry project (FAO-VoH) developed an experiential measure of FI, the Food Insecurity Experience Scale (FIES). FIES consists of eight questions with a 12 month recall period. The purpose of developing the tool was to directly measure the severity of FI at the individual level across different geographic areas and cultures, and provide comparable estimates between countries or between populations on a global scale [39, 40]. The FIES was pilot-tested and linguistically adapted in Angola, Ethiopia, Malawi, and Niger during the GWP 2013 survey to ensure that the questions are understood similarly across countries. A pilot study was not conducted in any Arabic-speaking country, as it is logistically impossible to conduct pilot-test studies in every country and language. Then,

using the GWP global data collected in 2014, the FIES was internally validated for each country using Rasch modeling and calibrated to the global reference to use it as a FI measurement tool for global monitoring. The psychometric properties and the quality of the FIES data collected were assessed by testing their consistency with the assumptions of the Rasch model, as explained in the methods chapter. Fulfilling these assumptions means that the tool is validated to be used globally [41]. However, the similarity of psychometric properties across LAS countries that would allow aggregation of data for the LAS region and compare results for subpopulation by age group and gender have not been tested. Thus, it is essential to validate the FIES in the LAS region because people's experiences of FI in those countries may vary from other world regions due to language, cultural, and socioeconomic differences. Therefore, using the Rasch model as described below, we will validate the tool for its use in LAS and identify appropriate thresholds to categorize individuals as food secure versus food insecure.

### 2.3.2. Prevalence of Food insecurity in the LAS

Globally, the prevalence of FI is increasing according to the 2021 global report that measures the prevalence of FI using the Integrated Food Security Phase Classification (IPC). IPC is a five-phase scale that describes the severity of food emergencies [42] . In 2021, 142 million people reported a FI crisis level, representing a 32% increase compared to 108 million people in 2017 [42, 43]. This trend is consistent with the results of the 2021 FAO report, which indicated that moderate or severe FI has been on the rise since 2014, however, the increment in 2021 was the highest and equal to increment in the previous five years combined due to the COVID-19 pandemic [44].

According to the FAO 2015 and 2017 report, the NENA region has not achieved the WFS goal nor the Millennium Development Goal (MDG) of halving both the absolute number and the proportion of undernourished people by 2015 [22, 23]. However, fifteen out of nineteen countries have halved only the proportion of undernourished people but not the absolute number. This includes Algeria, Bahrain, Egypt, Iran, Jordan, Kuwait, Lebanon, Libya, Mauritania, Morocco, Oman, Qatar, Saudi Arabia, Tunisia, and the United Arab Emirates, while Kuwait and Oman have halved the number of undernourished people. Algeria and Tunisia were very close to meeting this target [22]. Djibouti and Sudan made plodding progress toward decreasing the number of undernourished people, and Yemen and Iraq showed an increase in the number of undernourished people [45]. The MDG expired in 2015 and shifted to the more targeted and comprehensive Sustainable Development Goals (SDGs), which are set to be achieved by 2030. In the 2021 report, it was declared that based on the recent trends in hunger and FI, it will be difficult for the region to achieve the goal of zero hunger by 2030. This is true as the region has been exposed to multiple stresses such as poverty, inequality, conflict, and recently the COVID pandemic [46].

Since 2012, deterioration of the FS in Iraq, Libya, Sudan, Syria, and Yemen, as well as in the West Bank and the Gaza Strip as a result of ongoing conflicts [23, 47]. Political instability and turmoil affect the country itself and the neighboring countries, such as Lebanon and Jordan, as they have had to absorb refugees or asylum seekers [22, 23, 48]. Disruptions in essential nutrition interventions and negative impacts on dietary patterns during the COVID-19 pandemic made achieving SDG 2 challenging [49].

**Table 2.1: Prevalence of food insecurity (FI) in the League of Arab States region (LAS) [46, 49].**

| LAS Countries | Prevalence of undernourishment (PoU)[1,2] | | Prevalence of severe FI[1, 3] | | Prevalence of moderate and severe FI[1, 3] | |
|---|---|---|---|---|---|---|
| | 2004-2006 | 2017-2019 | 2014-2016 | 2017-2019 | 2014-2016 | 2017-2019 |
| **Algeria** | 6.7 | 2.8 | 13.0 | 9.3 | 22.9 | 17.6 |
| **Bahrain** | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. |
| **Egypt** | 6.5 | 4.7 | 8.4[a] | 7.8 | 27.8[a] | 34.2 |
| **Iraq** | 23.9 | 23.7 | n.a. | n.a. | n.a. | n.a. |
| **Jordan** | 5.6 | 8.5 | n.a. | n.a. | n.a. | n.a. |
| **Kuwait** | <2.5 | <2.5 | 4.9 | 4.9 | 12.6 | 12.3 |
| **Lebanon** | 11.0 | 5.7 | n.a. | n.a. | n.a. | n.a. |
| **Libya** | n.a. | n.a. | 11.2 | 16.8 | 29.1 | 35.9 |
| **Mauritania** | 9.6 | 11.9 | 14.2 | 22.4 | 31.6 | 44.8 |
| **Morocco** | 5.5 | 4.3 | n.a. | n.a. | n.a. | 25.9[b] |
| **Palestine territories** | n.a. | n.a. | n.a. | 4.4[b] | n.a. | 26.3[b] |
| **Saudi Arabia** | 4.8 | 4.8 | n.a. | n.a. | n.a. | n.a. |
| **Somalia** | n.a. | n.a. | n.a. | 43.0 | n.a. | 79.1 |
| **South Sudan** | n.a. | n.a. | 65.4 | 63.7 | 85.1 | 84.9 |
| **Sudan** | 21.3 | 12.4 | 13.4 | 16.4 | 41.4 | 48.9 |
| **Syria** | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. |
| **Tunisia** | 4.3 | <2.5 | 9.1 | 9.1 | 18.2 | 20.0 |
| **UAE** | 8.9 | 3.1 | n.a. | n.a. | n.a. | n.a. |
| **Yemen** | 43.4 | 45.4 | n.a. | n.a. | n.a. | n.a. |

[1] National estimates were included when more than 50 percent of population was covered. To reduce the margin of error, estimates are presented as three-year averages.

[2] PoU: Measured as a percentage of a population with inadequate calorie intake; obtained through the food balance sheet for each country, and computed as a per capita dietary energy requirement [22]

[3] FAO estimates of the percentage of food insecure people in the total population. it is a country-level results are based on FAO data collected through the Gallup World Poll, presented only for countries whose national relevant authorities expressed no objection to their publication.

[a]The 2015 estimates was based on Household Income, Expenditure, and Consumption Survey (HIECS) data, using the WFP consolidated approach for reporting indicators of food security.

[b]Based on official national data.

Abbreviation: n.a.: not available, UAE: United Arab of Emirates.

### 2.3.3. Potential determinants of food insecurity in the LAS

FI is determined by several diverse, economic, environmental, social, and political factors. Specific causes may differ by location or population, including a country's economy and stability, health care access and medical services, household composition and size, rural vs. urban residence, employment, individual incomes, educational attainment, health status, and social support.

#### 2.3.3.1. Economic status

FS can be achieved if a country's economic growth is sustainable [50]. In the LAS region, a recent report showed that FI is more prevalent in poorer countries than countries of better economic standing [42]. In fact, poor economic countries mostly have food access problems due to poor gross domestic product and low income [50].

Economic status in the LAS varies widely according to the World Bank, which classifies countries based on the gross national income per capita or based on the Human Development Index (HDI). According to the United Nations Development Programme (UNDP) report, the HDI is a summary measure used to categorize all countries in the world based on average achievement in three key dimensions related to human development: 1) a long and healthy life, measured by life expectancy at birth, 2) Education, assessed by average years of schooling for adults aged 25 and over and expected years of schooling for children, and 3) having a decent standard of living, measured by gross national income per capita. The scores of the three dimensions of the HDI are then aggregated into a composite index. Then, the index is used to classify countries into one of the following four levels of HDI, namely: 1) Very High HDI, 2) High HDI, 3) Medium HDI, and 4) Low HDI [51]. According to the 2017 report of the

HDI, Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and UAE are classified as very high-HDI, Algeria, Jordan, Lebanon, Libya, and Tunisia as high-HDI countries, Egypt, Iraq, Morocco, and Palestine territories as Medium HDI countries, and low-HDI countries include Comoros, Djibouti, Mauritania, Somalia, Sudan, South Sudan, Syria and Yemen (**Table 2.2**).

**Table 2.2: Economic classification of League of Arab States using the 2017 Human Development Index (HDI).**

| HDI Level | List of Countries in each level |
|---|---|
| Very High HDI | Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and United Arab of Emirates. |
| High HDI | Algeria, Jordan, Lebanon, Libya, and Tunisia |
| Medium HDI | Egypt, Iraq, Morocco, and Palestinian |
| Low HDI | Comoros, Djibouti, Mauritania, Somalia, Sudan, South Sudan, Syria and Yemen. |

Several studies have shown that poverty is an underlying cause of FI [26, 27, 38, 52, 53]. Further, poor households are twice as likely to be severely FI [27]. Before the COVID-19 pandemic, the number of people living in poverty declined from 10.1% in 2015 to 9.3% in 2017 worldwide [54]. Some of the LAS countries had made progress in combating poverty, and despite this progress, the LAS region continues to lag in its efforts to reduce poverty.

In Syria, Iraq, Libya, and Yemen, the conflict remains one of the main drivers of poverty. In Syria, according to the World Food Programme (WFP) it is estimated that 90% of the population lives in poverty, which is approximately 12.4 million people [55]. The Syrian crisis has left nearly 60% of Syria's population as food insecure [55]. In Iraq, after almost two decades since its invasion in 2003, poverty rates are on the rise according to the World Bank showing that 24.8% of Iraqi families lived below the

poverty line in the first half of 2020 [56]. Libyans are still under the aftershocks of the conflict in 2011. Hundreds of thousands of people across the country are living in unsafe conditions with little access to healthcare, food, safe drinking water, shelter, and education. About 53% of the population could not afford all their basic needs due to insufficient economic resources [57]. Yemen has the highest incidence of poverty, unemployment, and child malnutrition in the NENA region, where fighting has devastated its economy and destroyed critical infrastructure [46]. At the beginning of 2017, 14.1 million people required humanitarian assistance representing 51% of the population [22, 43]. Recently, the UN has estimated that 24.3 million people in 2021 were at risk of hunger and disease, roughly 14.4 million were in acute need of assistance [58].

#### 2.3.3.2. Urbanization and food price

Almost all developed countries have a high level of gross domestic product (GDP) per capita and a high level of urbanization [59]. Most of the countries in the LAS are experiencing significant population movements from rural to urban areas. Although urbanization promotes economic growth through the expansion of modern industries, it also suppresses agricultural practices to some extent.

In the LAS region, the urban population increased from 43 million in 1980 to 199 million in 2010 [31], and will more than triple by 2050 (646 million residents) [5]. This movement to urban areas may be partly an outcome of the challenges faced in agriculture, such as water scarcity, climate change, lack of arable land in the region, and poor agricultural technology. These factors lead to high migration of young people who leave traditional farming searching for more reliable and better-paid jobs available in

cities or urban areas [32]. LAS region is considered one of the biggest food importers in the world, which affects local food prices. Therefore, the lack of farmers, agricultural challenges decreases food production and increases dependence on imported food.

An increase in food prices affects household food accessibility and diversity. The food purchasing power in the LAS was affected by the global food crisis in 2007-2008, when environmental resources affected global food production, leading to an increase in food price volatility [60]. In addition to the food crisis, the economic recession in 2009-2010 has severely compromised FS in many countries. The FAO estimates that the number of food-insecure people globally has increased to more than one billion after the crisis, adding 75 million more than the total number in 2008 relative to 2003-05 [43, 45, 61]. The countries most vulnerable to food price volatility are Yemen, Jordan, Djibouti, Lebanon, Iraq, and Tunisia, resulting in low grain reserve stocks and the inability to bear the costs of imports and their subsidization. The risk is lower in Egypt and Morocco, due to higher domestic production levels of crops and in oil-producing countries, such as Saudi Arabia and Kuwait, due to higher income which allows them to build high reserve stocks and offer subsidies [8]. Urbanization and increased reliance on food import affects food availability and FS [62].

In Yemen, rural-urban inequalities are very high, as Ecker et al. (2010) found that the number of food-insecure people living in rural areas is more than five times higher than in urban areas [63]. However, a study conducted by Ghattas and colleagues found that 55% of a Bedouin settled community who depended on purchasing food was food insecure compared to only 29% of those who have greater land access and depend on self-production of food [25]. Thus, the population living in rural areas with good

agricultural facilities such as accessible lands, irrigation water, and food self-production will decrease their risk of FI [64].

#### 2.3.3.3. Household size and its composition

Household size is defined as the number of persons living in the same household that share resources to cover living expenses [65]. Household size has been found to be positively associated with FI; the larger the family size, the higher the risk of being moderately or severely food insecure. A study conducted by Ghattas et al. (2015) showed that household size was positively associated with severe FI among Palestinian refugees [27]. Housing instability, defined as having difficulty paying rent, spending more than 50% of household income on housing, having frequent moves, or living in overcrowded conditions [66], was associated with FI. Bawadi et al. found that in Northern Jordan, FI was more prevalent among those with rented houses and in houses headed by women [16]. The relationship between the number of children under 15 years in a household and FI is inconsistent. The World Food Programme reported that in internally displaced Iraqi families, the presence of children was found to be significantly associated with FI [67]. However, the number of children was found to be insignificantly associated with FI among Palestinian refugees in Lebanon [27].

#### 2.3.3.4. Unemployment rate

The LAS region is characterized by large numbers of youth and adults of working age (15-64 years) [32]. This may imply a society with a lower total dependency rate and a higher proportion of the population working. However, there is an incompatibility between the large cohorts of young people entering the labor market and the number of existing jobs in the LAS region. This has led to the highest unemployment rates in the

world [32, 68]. According to the ILO estimate, in 2019, the total youth unemployment rate in the Arab world was 26.5%, almost twice the global average (15.3%) [69], but this percent declined in 2021 to be 22.9% [70]. Among young women, the unemployment rate (42.5%) is almost twice that of young men (19.6%), which may reflect social and cultural norms that restrict young women's access to employment due to gender inequality in the region [70].

Unemployment is highly associated with poverty, which impacts food expenditure and increases the risk of FI [71-73]. The high unemployment rate is associated with lower income affecting the availability and stability of food in the household [32]. Educational level and health status are considered the main factors associated with employment status and, consequently, poverty status.

#### 2.3.3.5. Educational attainment

The Middle East and North Africa Region have made great strides in education. It has quadrupled the average level of schooling since 1960 and halved illiteracy between 1980 and 2015 [32]. Studies have found that educational attainment is inversely associated with FI [27, 28, 74, 75]. Despite relatively high levels of educational attainment in the Arab region, unemployment remains an issue, even among educated persons. Some employers frequently cite the lack of employable skills among the region's youth as a barrier to employment [76].

#### 2.3.3.6. Health status

Health is a form of human capital. According to the Organization for Economic Co-operation and Development, human capital is defined as "the knowledge, skills, competencies and other attributes embodied in individuals or groups of individuals

acquired during their life and used to produce goods, services or ideas in market circumstances" [77]. Better health implies higher productivity, leading to a higher probability of being employed and increased income, hence food security. Previous literature has shown a positive effect of health on employment [78, 79]. In a 2010 study, the impact of health on employment status among the working-age population found that health limitations increase the probability of unemployment by 58% for men and 39% for women.

Moreover, the study showed that impaired mental health increases the risk of unemployment [78]. The U.S. Panel Study of Income Dynamics also showed that good health positively affects the probability of being employed (healthy people have 285% more chances of having a job than unhealthy people) [71]. Mental illness and physical disability, in particular, were associated with unemployment. An analysis of data collected by Mental Health Economics European Network in 32 countries showed that compared to the general European population, persons with mental disorders experience on average 15–30% lower employment rates [80, 81]. Additionally, employed people tend to report better health status than those who are unemployed or have unstable jobs [72, 82]. There is a higher risk of developing mental health issues, cardiovascular disease, and all-cause mortality among unemployed individuals [80].

The relationship between FI and health outcomes is bi-directional, as identified by several studies [53, 83-89]. By definition, food insecure households have fluctuations in food availability, constrained dietary options, and compensatory eating behaviors, which lead to accumulation of visceral fat, weight gain, and, in turn, increased disease onset and progression [90, 91]. It is well known that obesity plays a direct role in developing

chronic conditions [92, 93]. For example, there is a consistent association between household FI and diabetes prevalence and poor diabetes control and management [94, 95]. Other chronic conditions associated with FI include cardiovascular risk factors [53], dyslipidemia [96], hypertension [53, 97], and chronic kidney disease [98].

Based on several previous studies conducted in various settings, the negative effect of FI on health and well-being through its effect on nutritional status [83, 87, 88] is well documented. Such studies are limited in the LAS population. Studies conducted among Palestinian and Iraqi refugees in Lebanon indicated that FI is more prevalent in households with at least one member suffering from chronic or acute diseases [26, 27]. And in the same population, Salti and Ghattas noted a significant association between FI and disease-related disability [99].

Another factor prevalent among FI individuals is stress as one of the mental health indicators. Stress plays a significant role in slowing the metabolism, influences visceral fat accumulation, and can contribute to metabolic syndrome and the development of chronic conditions s [100, 101]. FI was found to be associated with mental health problems, including depression, anxiety, and stress in different settings [102-105].

#### 2.3.3.7. Healthcare access

Considering the association between FI and disease, FI is associated with health care expenditure. Food insecure persons who are already in poor health may require higher treatment costs than food-secure individuals [106], leading to poor management of diet-related chronic conditions [107] due to financial constraints and poor access to health care [66]. Kushel et al. in 2006 found that postponement of medical care was more prevalent among food insecure individuals [66]. However, postponement or

unavailability of health care services may lead to deterioration of health status and could exacerbate the severity of FI.

In particular, older adults need to have easier access to medical and health care facilities since they are at higher risk of developing chronic conditions. Most developing countries lag behind in providing social security, pensions, and health care systems to support older adults. As a result, the provision of health care for older adults tends to be seen as a family rather than a societal responsibility and is typically assumed by the women in the family. In the LAS, older adults often share households with their offspring, and the health care support may be from 1) informal care providers, such as unpaid family members, mostly women, and/or 2) formal care providers, such as nursing aides, home care assistance, or other paid care workers [108]. However, the availability and willingness of family members to provide care for older adults are negatively affected by women's participation in the labor force, change in the family structure, and youth migration, all of which may hinder their ability to provide such care [109] Also, resources, insurance coverage, and benefits provided to older persons vary across the Arab countries. In oil-rich countries, such as the Gulf Cooperation Council (GCC), free health care services are provided, but out-of-pocket health expenditures also represent the highest contribution to financing health care [110]. People tend to use private health care more often because of the lengthy waits for appointments in the public sector and greater reputation and experience of physicians in the private sector [110].

#### 2.3.3.8. Gender inequality

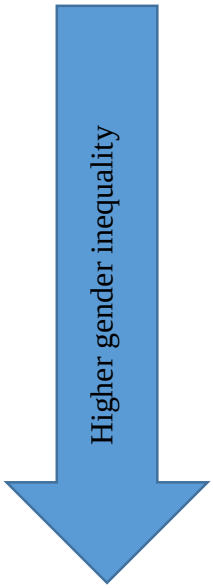
Gender inequality is particularly related to inequality in education, occupational opportunities, and income. The United Nations Development Programme developed the

gender inequality index (GII) to score each country based on three women-related dimensions; 1) reproductive health measured by maternal mortality rate and adolescent fertility rate, 2) empowerment measured by the percentage of men and women aged 25 years and older with at least some secondary education, and proportion of parliamentary seats occupied by women, and 3) labor market participation measured by the percentage of men and women aged 15 years and older in the labor force [111]; the higher the score, the higher the gender inequality.

Gender inequality leads to food and nutrition insecurity, especially among women. In the LAS region, women face discrimination in education and employment opportunity, which are both considered protection against FI [112]. Moreover, food discrimination, which means that women and girls eat the food remaining after the men and boys have eaten, is prevalent in some LAS countries, especially in rural areas [112]. These constraints create obstacles towards women's economic sufficiency and weaken their position within the family. Regarding differential feeding and caregiving practices favoring boys and men, weak positioning leads to food and nutrition insecurity and poorer health status for women and girls. Since there are varying degrees of gender inequality across the LAS countries, as shown in **Table 2.3**, differences in determinants of FI by gender may also exist. To our knowledge, several studies found a high prevalence of FI among women [16, 113-115]; however, there is limited data that looked at the difference between the determinants of FI by gender in the LAS region. One study among Northern Jordanian women found that several socioeconomic factors are linked to a higher risk of FI, including income below the poverty line, illiteracy, unemployment, rented housing, and women heading the household [16].

**Table 2.3: 2017 Gender inequality index (GII) for the League of Arab States (LAS) countries [111].**

| LAS Countries | 2017 GII |
|---|---|
| Libya | 0.170 |
| Qatar | 0.206 |
| Bahrain | 0.222 |
| UAE[1] | 0.232 |
| Saudi Arabia | 0.234 |
| Oman | 0.264 |
| Kuwait | 0.270 |
| Tunisia | 0.298 |
| Lebanon | 0.381 |
| Algeria | 0.442 |
| Egypt | 0.449 |
| Jordan | 0.460 |
| Morocco | 0.482 |
| Iraq | 0.506 |
| Syria | 0.547 |
| Sudan | 0.564 |
| Mauritania | 0.617 |
| Yemen | 0.835 |
| Comoros* | --- |
| Djibouti* | --- |
| Palestine territories* | --- |
| Somalia* | --- |
| South Sudan* | --- |




*Data not available.
[1]UAE: United Arab of Emirates.

### 2.3.3.9. Conflicts and political unrest

Conflict and political instability remain the primary drivers of severe FI and hunger in many countries. Conflicts lead to population displacement, both internal and external, disruptions in agriculture, food production and trade, loss or spoiling of crops, food stocks, and livestock, and eventually, increases in food prices [15, 36]. Conflicts also lead to fragile health care systems and curtailed access to services and basic amenities. At the individual level, conflicts may lead to loss of employment, income, and assets. These factors directly or indirectly impact the availability, accessibility, and utilization of food, leading to or worsening the FI status. In the long term, conflicts seriously hamper development efforts in several sectors, such as education, employment,

and economic growth. These conflicts also burden neighboring countries, which host the influx of displaced persons, asylum seekers, and refugees.

According to the World Bank, the country-level Political Stability and Absence of Violence and Terrorism (PSAVT) is a Worldwide Governance Indicator. It captures the likelihood that the government will be destabilized due to violence, including the frequency of politically-motivated violence and terrorism. The higher the PSAVT score, the stronger the governance performance [116]. The LAS countries were stratified into three categories based on tertiles of the 2017 PSAVT country's data: 1) high political stability countries (Morocco, Jordan, Mauritania, Kuwait, UAE), 2) medium political stability countries (Egypt, Saudi Arabia, Algeria, Bahrain, Tunisia), and 3) low political stability (Lebanon, Palestine territories, Iraq, Somalia, Sudan, Yemen, Syria, Libya, South Sudan) (**Table 2.4**).

The LAS region has been experiencing turmoil and conflict in some countries. One of the consequences of recent upheavals is the large flow of refugees to border countries. At the end of 2019, there were 79.5 million people who were forcibly displaced from their homes by war, conflict, or persecution worldwide [117]. Among those are the 5.6 million Palestinian refugees registered and under the protection of the United Nations Relief and Works Agency for Palestinian Refugees in the Near East (UNRWA) [118].

As mentioned above, one of the primary effects of conflict is internal and external displacement, which can impoverish people, affect the FI of those displaced, and put an enormous strain on the existing resources of the host countries. In the case of Syria, since the beginning of the conflict in 2011, around 6.8 million people have fled the country

seeking safety in neighboring countries as of mid 2021 [117]. According to the UNHCR, in mid 2021 , there were 2.2 million people in South Sudan, about 5 million people in Yemen, and more than 2.9 million in Somalia have been internally displaced due to conflicts [117]. Out of all the Arab countries, Lebanon hosts the largest number of refugees in proportion to its own population. As the mid of 2021, 1.5 million Syrian refugees were residing in Lebanon [119]. These families joined the Palestinian refugees in the 12 camps or in segregated gatherings outside the camps, who are already suffering from serious issues such as poverty, overcrowding, unemployment, poor housing conditions, and lack of infrastructure [120, 121].

Several studies have identified refugees as a vulnerable population. For instance, a study aimed at estimating the prevalence of FI among refugees living in the United States showed that FS increases with time spent in a new country, which might be due to increased employment and household income, increased language acquisition, and resettlement [122]. However, this is not the case for Palestinian refugees. Despite settling in Lebanon almost 70 years ago, they have still been considered a marginalized population in terms of social, political, and economic status, as well as in employment opportunities [123]. Due to their limited civil rights, these Palestinian refugees are at higher risk of meeting basic needs, such as access to health care, good education, and food.

Several studies show the high prevalence of FI among Palestinian and Iraqi refugees. In 2010 Ghattas et al. found that about 41% of households of Palestinian refugees living in Lebanon were moderately FI, and 20% were severely FI [27]. That survey was repeated in 2015, and the results were similar (38.2% moderately food

insecure, and 24% severely food insecure) [75]. FI prevalence among the newly arrived Palestinian refugees from Syria was higher at 94.2% (31% moderately FI and 63.2% severely FI) [75]. In 2010, Shannon conducted a study of Iraqi refugees in Syria (n= 1,200) and Jordan (n= 813) to provide information on FS status. In Syria, 60% of households reported a decline in food consumption compared to 46% in Jordan [12], while in Lebanon, 35.5% were moderately FI, and 44.4% were severely FI [26]. According to the 2017 Global Food Crises Report, in some of the Arab countries, the negative effects of conflict left significant numbers of food-insecure people in need of urgent assistance; for example, in Yemen, there were 17 million, Syria 7 million, in South Sudan 4.9 million; and in Somalia 2.9 million people who need urgent assistance [43, 124]. While the most recent 2021 reported a slight decline in the numbers of food insecure people in need of urgent assistance in Yemen 16.1 million and Somalia (2.7 million), but a dramatic increase in South Sudan (7.2 million), and Syria (12.4 million) [42].

**Table 2.4: Political stability and Absence of Violence and Terrorism (PSAVT) score of Arab countries included in the analysis.**

| PSAVT score | | | | | |
|---|---|---|---|---|---|
| Low | | Medium | | High | |
| Country | Score | Country | Score | Country | Score |
| Yemen | -2.961164 | Egypt | -1.415257 | Mauritania | -0.6191258 |
| Syria | -2.631369 | Tunisia | -1.052719 | Jordan | -0.5281549 |
| Iraq | -2.33111 | Algeria | -0.9602967 | Morocco | -0.409674 |
| Somalia | -2.326141 | Bahrain | -0.9481785 | Kuwait | -0.404395 |
| Libya | -2.325987 | Saudi Arabia | -0.6207026 | UAE | 0.6274605 |
| South Sudan | -2.007265 | | | | |
| Sudan | -2.007265 | | | | |
| Palestine territories | -1.643773 | | | | |
| Lebanon | -1.593746 | | | | |

Note: UAE: United Arab Emirates

## 2.4.Social support and food insecurity

Women in the LAS countries usually receive social support, especially financial support from their father, brother, or husband, which may promote FS among women. There is no consensus definition of social support, and the literature includes several interpretations of the term. There is also no standard method for measuring social support. It is multi-dimensional, just like food security, making it a challenge to assess it comprehensively. Social support can be provided in various ways; financial or instrumental support, emotional or informational support through friends, family, neighbors, coworkers, religious communities, or other social groups. Additionally, social support may be assessed by evaluating individuals' perception of the support available to them [125, 126].

Several studies showed that lack of social support might be associated with FI [125, 127, 128]. Being surrounded by positive relationships with family and friends was negatively associated with FI [125]. Among older adults, Sahyoun and Zhang (2005) found that frequency of social contacts was positively associated with better nutritional

status and higher quality of dietary intake [129]. In 2004, Martin et al. investigated the relationship between social support and household FS. Interviews were conducted in 330 households. The HFIAS was used as FI measure, while social capital was assessed using a 7-item questionnaire evaluating social networks and neighborhood trust and reciprocity. Results indicate that lack of social support was significantly associated with FI in this sample [128]. However, no such studies were conducted in the LAS region.

## 2.5.Grandparent effect on grandchildren's health and well-being

The population of older adults, in particular, is increasing worldwide. In 2015, there were 901 million (12% of the global population) people aged 60 and older, and this age group is projected to reach 1.4 billion by 2030 and continue to increase to 2.1 billion in 2050 [1, 2]. The current Arab population is considered relatively young due to high fertility rates, which was an average of six children per woman (40+ years old) in 1980 [32, 130]. Nearly 60% of the population is under 30, with a median age of 22 years compared to a global median of 28 years [68]. However, fertility rates have been declining, and so have the mortality rates [130, 131]. Life expectancy is increasing in the LAS. By 2050, the proportion of older persons (60 years or more) is predicted to reach 19 % (103 million) compared to only 7 % (22 million) in 2010 [31].

Traditional family structural norms and intergenerational support systems in the LAS dictate that older adults live with their offspring, especially older women. However, the role of women in the LAS region is changing; women are getting more educated and participating more frequently in the labor market [76]. Women are often nurturers; when they receive an income, they are more likely to take care and invest most of their income back into their families [132]. This may lead to lower FI and better health. Additionally, a

woman in LAS household tends to take care of chores and children [10]. This may be particularly true of the role of a grandparent in the households.

Parents and children benefit from living with grandparents, especially grandmothers [133]. Grandparents may receive social and financial support from the younger generation, while grandparents assist with the caretaking of younger children or take care of household chores. It is expected that, in general, grandparent involvement would positively influence children and intergenerational relationships and might play a role in improving a child's health and well-being. However, the results are inconsistent.

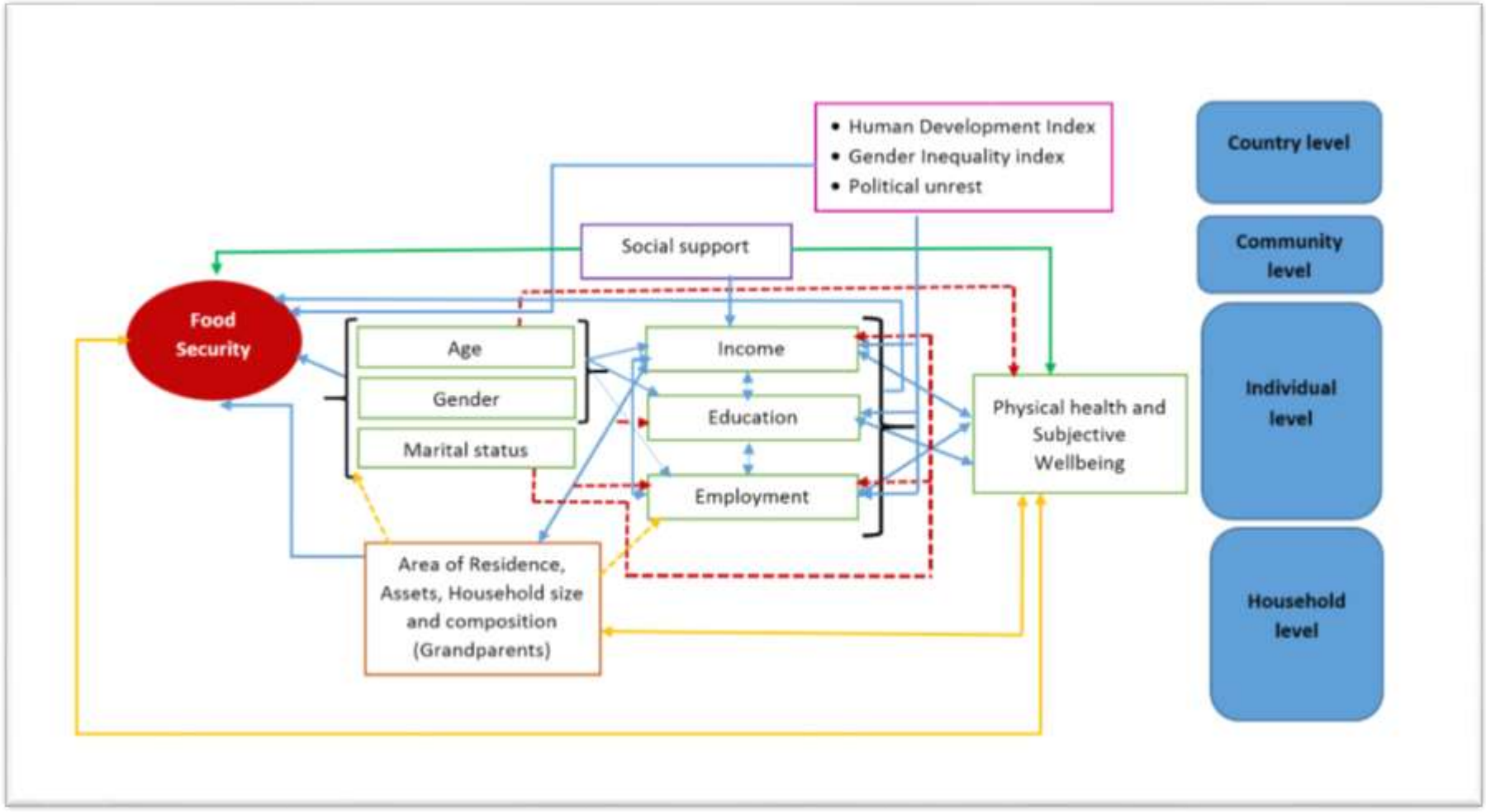
One cross-sectional study conducted in England showed that a high level of grandparental involvement increased the well-being of children 11- 16 years old, and decreased their emotional and behavioral problems [134], Similarly, in a German study of grandchildren 12-16 years old who received early care from grandparents, they tended to have closer relations with their grandparents in adulthood [21]. In contrast, a study conducted in the US showed that some school-age children developed higher behavioral problems and lower educational attainment [135]. Also, a study conducted by Dunifon in the US on the influence of the relationship between youth and grandparents using three important dimensions of well-being on youth: grades in school, risky behaviors in the last 30 days, and whether the child has had sex. The results showed no impact on youth's well-being [133]. The influence of grandparents on grandchildren's health and well-being in the LAS country is unknown. To our knowledge, this association has never been assessed in the Arab population.

## 2.6. Conceptual framework of the overall study

This study used the conceptual framework adapted from the WFP [136] and United Nations Children's Fund [137] (**Figure 2.3**). This framework highlights the relationship between food security, risk factors, and potential consequences. At the country level, HDI, GII, and political unrest, play different roles in FS status through their effects on individual-level factors (educational attainment, income, and employment), which are directly associated with FI. At the community level, social support is associated with food security, employment, income, physical health and mental well-being. Social support may modify the association between sociodemographic and economic characteristics and FI, and also affects physical health and mental well-being, hence FI, especially among women.

At the household level, area of residence, household size, and composition are associated with food security. The presence of a grandparent in the household may be associated with the health and well-being of grandchildren. However, the health of residing grandparents may determine their contributions to grandchildren. At the individual level, income, education, and employment impact FS directly through the possession of assets and livelihoods. Gender, age, and marital status are also directly related to FI, as well as income, education, employment, health status, and mental well-being.

**Figure 2.3: Conceptual frame work of the overall study**




The diagram illustrates the relationships between FI, its risk factors, and health related consequences at the country, community, household and individual level. Adapted from WFP and UNESCO conceptual frameworks [135, 136].

There is no universal definition for older age. Generally, older adults are defined according to several characteristics, including chronological age, change in social role, and functional abilities. In developed countries, the age of 60 or 65 is considered older age, which is related to retirement and receipt of a pension. In developing countries, older people may be defined as over 50 years [108]. The age of 50 years was accepted as the definition of older people for the purpose of the WHO Older Adult Health and Ageing in Africa project [108]. The population structure of the Arab region is still young, with nearly 60% of the population under 30 years old compared to only 29% in the developed countries [68]. Since the LAS region includes African and Arab populations whose life expectancy varies [108], we propose to use the chronological age of 50 years and over to define older adults in this dissertation.

## 2.7.Specific Aims

The population growth in the Arab region has been occurring in parallel with urbanization, high unemployment rates, education inequality, food price volatility, and turmoil in some of its countries. This tremendous increase in the population can be attributed to several demographic trends, including lower mortality rates, longer life expectancies, and higher fertility rates in 1980 [3]. Such factors increase the risk of poverty, FI, and also challenges governments, policymakers, and even the family structure to maintain the well-being of older adults via providing basic necessities. Older adults are more vulnerable to FI due to their higher risk of developing chronic conditions and/or functional impairments and a greater likelihood of lacking income and/or social support. According to the International Labour Organization, the Arab region still maintains a low gender equality rate, which includes lower educational and employment

opportunities for women than men. Such factors may increase the risk of FI among women; however, different types of social support may attenuate this risk. Despite the fact that older women are vulnerable, they may play an essential role in affecting the health and well-being of children living with them. Research examining FI and its determinants among older adults and gender in the Arab region remains sparse.

In this dissertation, we validated the FIES for its use in the LAS region and estimated the prevalence of FI and its demographic and socioeconomic determinants by HDI and sex. We also assessed the associations between FI, physical health, and mental well-being by sex. In addition, we examined whether emotional, instrumental and embedded support modified theses associations among sub-sample of women stratified by GII. In an additional analysis, we examined whether the presence of grandparents in the household is associated with better health and well-being of grandchildren. Through this dissertation, we identified the determinants of FI, especially among women, in the LAS region. The results may have policy implications for intervention programs that target vulnerable populations. The specific research components of this dissertation include:

1) Assess the validity of FIES for use in the LAS, determine the prevalence of FI by age group, sex, HDI, and PSAVT, and whether the characteristics of food insecure individuals are differ by HDI?
2) Are there differences in the demographic, socioeconomic, and health determinants of FI by sex, and is FI associated with physical health and mental well-being by sex? Also, stratifying the analysis by country's GII, we assessed whether the emotional, instrumental, and embedded social

support are associated with FI among women? And do they attenuate the relationship between FI and its determinants?

3) Is the presence of a grandparent in the household associated with better health and well-being of grandchildren?

# 3. Chapter 3: Research Design and Methods

For this dissertation, GWP data were used to answer the first two research questions, and the United Nations Relief and Works Agency for Palestinian Refugees in the Near East (UNRWA) data were used to answer the third question.

## 3.1. Gallup World Poll Study

The GWP is an annual survey that has been conducted in over 150 countries, areas, and territories since 2005. The purpose of the GWP survey is to collect data on people's opinions, experiences, and aspirations on various topics, including law and order, food and shelter, institutions and infrastructure, job climate, and financial, social, physical, and self-reported well-being [138]. The survey consists of both core questions and additional ones tailored to each region. The survey is translated into more than 140 languages and administered to nationally representative non-institutionalized men and women aged 15 and above living in both rural and urban areas to account for 95% of the adults in the world. Typically, a sample size of 1,000 is collected from each country [139].

## 3.2.GWP sampling method

Gallup uses two primary methodological designs in the LAS countries: 1) one-hour, face-to-face interviews, or 2) 30-minute telephone surveys. For face-to-face interviews, Gallup uses a multistage probability sampling approach. The first sampling stage is identifying of primary sampling units (PSU), which are clusters of households. Then these PSU are stratified by population size, geography, or both. Finally, individuals are selected in proportion to population size if population information is available; otherwise, simple random sampling is used. To increase the probability of completion,

interviewers make three attempts when a household member refuses to be interviewed or is unavailable [139]. For the 30-minute telephone survey, Gallup uses a Random-Digit-Dial method or nationally representative list of phone numbers in countries where ≥80% of the population has landline phones. A dual sampling frame is used in countries where cell phone penetration is high. Respondents were selected using either the latest birthday or Kish grid method. The type of interview for each country is presented in (**Table 3.1**).

**Table 3.1: Methodological design and language used in each of the League of Arab States (LAS) countries.**

| LAS countries | Interview mode | Interview language |
|---|---|---|
| Algeria | Face to face | Arabic |
| Bahrain | Landline and Cellular Telephone | Arabic, English |
| Egypt | Face to face | Arabic |
| Iraq | Landline and Cellular Telephone | Arabic, Kurdish |
| Jordan | Face to face | Arabic |
| Kuwait | Landline and Cellular Telephone | Arabic, English |
| Lebanon | Face to face | Arabic |
| Libya | Face to face | Arabic |
| Mauritania | Face to face | French, Hassanya, Poulaar, Wolof, Soninke |
| Morocco | Face-to-Face | Arabic, French, Moroccan |
| Palestine territories | Face to face | Arabic |
| Saudi Arabia | Landline and Cellular Telephone | Arabic, English |
| South Sudan | Face to face | Arabic, English, Bari, Dinka, Juba Arabic, Nuer, Zande |
| Sudan | Face to face | English, Sudanese Arabic |
| Somalia | Face to face | Somali |
| Syria | Face to face | Arabic |
| Tunisia | Face to face | Arabic |
| United Arab Emirates | Landline and Cellular Telephone | Arabic, English |
| Yemen | Face to face | Arabic |

## 3.3. Inclusion and exclusion criteria for this study

For our analysis, we appended data collected in 2014, 2015, 2016, and 2017 from 19 countries in the LAS region. A few countries did not have data collected in all four years, as shown in **Table 3.2**. Data were collected over the four years on 73,135

individuals aged 15 years and older. Excluding respondents aged less than 19 years (n= 5,852), those with missing age (n=24), and those with missing responses to any of the FIES questions (n=4,998). The final analytical sample for this study after exclusions is 62,261 individuals.

**Table 3.2: List of the LAS countries included in this analysis and sample size collected in each year.**

| League of Arab States | Sample size[1] | | | |
|---|---|---|---|---|
| | **2014** | **2015** | **2016** | **2017** |
| Algeria | 921 | n.a | 899 | 872 |
| Bahrain | 956 | 946 | 933 | 1023 |
| Egypt | 898 | 915 | 927 | 925 |
| Iraq | 934 | 947 | 954 | 931 |
| Jordan | 888 | 860 | 892 | 888 |
| Kuwait | 935 | 953 | 961 | 970 |
| Lebanon | 891 | 914 | 911 | 951 |
| Libya | n.a | 971 | 958 | 945 |
| Mauritania | 817 | 824 | 761 | 755 |
| Morocco | 903 | 965 | 915 | 898 |
| Palestine territories | 874 | 903 | 892 | 878 |
| Saudi Arabia | 941 | 930 | 893 | 961 |
| South Sudan | 789 | 830 | 801 | 815 |
| Sudan | 867 | n.a | n.a | n.a |
| Somalia | 748 | 835 | 972 | n.a |
| Syria | n.a | 241 | n.a | n.a |
| Tunisia | 934 | 886 | 903 | 908 |
| United Arab Emirates | 944 | 1815 | 1779 | 1740 |
| Yemen | 870 | 877 | 880 | 848 |
| **Total** | **17,085** | **17,979** | **16,887** | **15,308** |

[1]The number of sample size after excluding those who are less than 19 years old and those with missing information on ages.
Abbreviation: n.a= not available.

## 3.4.Variables used in this analysis

### 3.4.1. Food Insecurity Experience Scale (FIES)

The Food Insecurity Experience Scale (FIES) was used to assess the FS status. This tool includes 8-item with a 12-month reference period. The FIES was designed to collect data on individuals and to classify respondents according to their experiences of FI, asking if they had to compromise the quality and quantity of their food intake due to

limited resources, as shown in **Table 3.3**. The sum of the scores ranges from 0 to 8, the severity of FI increasing with the score [39].

**Table 3.3: Questions in the FIES Survey Module for Individuals as Fielded in the Gallop World Poll [GWP).**

| During the last 12 months, was there any time when … : | | | | |
|---|---|---|---|---|
| **Questions** | | **Label** | **Domains of FI construct** | **Assumed severity of FI** |
| Q1 | You were worried you would not have enough food to eat because of a lack of money or other resources? [a] | WORRIED | Uncertainty and worry about food | Mild |
| Q2 | You were unable to eat healthy and nutritious food because of a lack of money or other resources? | HEALTHY | Inadequate food quality | Mild |
| Q3 | You ate only a few kinds of foods because of a lack of money or other resources? | FEWFOOD | Inadequate food quality | Mild |
| Q4 | You had to skip a meal because there was not enough money or other resources to get food? | SKIPPED | Insufficient food quantity | Moderate |
| Q5 | You ate less than you thought you should because of a lack of money or other resources? | ATELESS | Insufficient food quantity | Moderate |
| Q6 | Your household ran out of food because of a lack of money or other resources? | RUNOUT | Insufficient food quantity | Moderate |
| Q7 | You were hungry but did not eat because there was not enough money or other resources for food? | HUNGRY | Insufficient food quantity | Severe |
| Q8 | You went without eating for a whole day because of a lack of money or other resources? | WHLDAY | Insufficient food quantity | Severe |

[a] "Other resources" is used in all the questions to make it suitable for respondents who usually acquire food in ways other than purchasing it with money. Interviewers are trained to emphasize the expression "because of a lack of money or other resources" to avoid receiving affirmative responses due to other reasons such as dieting or fasting [39].

### 3.4.2. Physical and mental health measurements

For this analysis, we have three exposure variables: 1) the Physical Health Index (PHI), which measures the respondent's perceptions of their health status. It is composed of five questions that inquire about whether the respondent has any health problem, feels well-rested, or experiences any physical pain, worry, or sadness.

Mental well-being was assessed using two five-item scales; 2) Positive Experience Index (PEI) and 3) Negative Experience Index (NEI). The PEI measures whether the respondent considers the day before the survey to be an overall positive

experience. The five components of this index are as follows: 1) feeling well-rested, 2) being treated with respect, 3) smiling or laughing, 4) learning or doing something interesting, and 5) experience of enjoyment (yes vs. no). The NEI scale examines whether the respondent perceives the day prior to the survey as an unpleasant experience or not. It is also based on five questions looking at the experience of 1) physical pain, 2) worry, 3) sadness, 4) stress, and 5) anger (yes vs. no) (**Table 3.4)**.

All three indices were scored by giving a 1 to yes responses and a zero to all other responses, including "don't know" and "refused." The mean scores of the five questions were calculated and multiplied by 100 [10]. The final scores ranged from 0 to 100, in increments of 20, with a higher score (60-100) indicating good physical health, higher positive experience, and higher negative experience, while a lower score (0-40) indicate poor physical health, lower positive experience, and lower negative experience. Negative experiences were inversely coded so that low positive experiences and high negative experiences are an indication of poor mental well-being. Items with a missing response were excluded from the calculation, and the index was calculated only if at least four out of five questions were answered.

**Table 3.4: Physical health index and mental well-being as exposure variables.**

| Label | Variables | Questions | Coding |
|---|---|---|---|
| **Physical Health Index** | INDEX_PH | ▪ (WP23) "*Do you have any health problems that prevent you from doing any of the things people your age normally can do?"*<br>▪ (WP60) *"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?"*<br>▪ (WP68) "*Did you experience the following feelings during a lot of the day yesterday? How about physical pain?"*<br>▪ (WP69) *"Did you experience the following feelings during a lot of the day yesterday? How about worry?"*<br>▪ (WP70) *"Did you experience the following feelings during a lot of the day yesterday? How about sadness?"* | Responses range from 0 to 100<br><br>Code for the index<br>0-40 = Poor<br>60-100 = Good<br>Missing = 0 |
| **Positive Experience Index** | INDEX_PX | ▪ (WP60) *"Did you feel well-rested yesterday?"*<br>▪ (WP61) *"Were you treated with respect all day yesterday?"*<br>▪ (WP63) *"Did you smile or laugh a lot yesterday?"*<br>▪ (WP65) "*Did you learn or do something interesting yesterday?"*<br>▪ *(WP67) "Did you experience the following feelings during a lot of the day yesterday? How about enjoyment?"* | Responses range from 0 to 100<br><br>Code for the index<br>0-40 = Low<br>60-100 = High<br>Missing = 0 |
| **Negative Experience Index** | INDEX_NX | ▪ (WP68) *"Did you experience the following feelings during a lot of the day yesterday? How about physical pain?"*<br>▪ (WP69) "*Did you experience the following feelings during a lot of the day yesterday? How about worry?"*<br>▪ *(WP70) "Did you experience the following feelings during a lot of the day yesterday? How about sadness?"*<br>▪ (WP71) "*Did you experience the following feelings during a lot of the day yesterday? How about stress?"*<br>▪ (WP74) *"Did you experience the following feelings during a lot of the day yesterday? How about anger? "* | Responses range from 0 to 100<br><br>Code for the index<br>0-40 = Low<br>60-100 = High<br><br>Missing = 0 |

### 3.4.3. Sociodemographic and economic variables

The sociodemographic and economic variables used for this analysis are summarized in **Table 3.5** and the coding scheme. These include age, sex, marital status, place of residence, and employment status, and these were examined as dichotomous

variables. After accounting for the diverse national education classifications across countries and making them comparable, educational attainment was categorized based on the number of years studied. Additionally, the other variables, household size, and composition, were treated as a continuous variable using the following questions: 1) "How many children under 15 years of age are now living in your household?" and "How many residents aged 15 and older are living in your household?" The number of individuals from the two questions was combined to provide the total household headcounts.

The household income quintile was included to measure the respondent's wealth relative to other respondents in the same country. GWP converted annual household income into international dollars by dividing the income in local currency by the World Bank's purchasing power parity (PPP) conversion factor [140]. The definition of PPP "is the number of units of a country's currency required to buy the same amount of goods and services in the domestic market as a U.S. dollar would buy in the United States" [13]. The income is then divided into quintiles and coded as 1 to 5.

**Table 3.5: Demographic and socioeconomic variables needed for aim one.**

| Label | Variables | Questions | Coding |
|---|---|---|---|
| **Demographic variables** | | | |
| Age | WP1220 | Please tell me your age. | Missing will be excluded |
| Age group | Age_group | The age variable is categorized into younger adults (19 - 49) and older adults (≥ 50). | younger adults= 1<br>older adults= 2 |
| Sex | WP1219 | The sex is … | men =1<br>women =2 |
| Marital status | WP1223/ Marital | What is your current marital status? | Single, separated, divorced and widowed ➔ Single = 1<br><br>Married and domestic partner ➔ Married = 2<br><br>Don't know and refused ➔ missing = 999 |
| Place of residence | WP14 | Do you live in …..?<br>living in a, vs. a | Responses include: rural area or on a farm, a small town or village ➔ Rural =1<br>large city, and a suburb of a large city ➔ Urban =2<br>Don't know and Refused ➔ missing = 999 |
| Number of children under 15 years | WP1230 | How many children under 15 years of age are now living in your household? | Count<br>missing = 999 |
| Number of residents 15 and over | WP12 | Total number residents 15 and over in household | Count<br>missing = 999 |
| Total Number Living in Household | WP1230 + WP12 | Total number living in the household will be calculated using the two previous variables. | Count<br>missing = 999 |
| **Socioeconomic variables** | | | |
| Educational level | WP9811 | What is your highest completed level of education? | Elementary education or less (≥ 8 yrs of basic education) = 1<br><br>Secondary education (9-12 yrs of education) = 2<br><br>1-4 years of education after high school = 3 |

| | | | |
|---|---|---|---|
| | | | Don't know and Refused ➔ missing = 999 |
| Employment Status | EMP_2010 | Gallup classifies respondents into one of six categories of employment based on a respondent's combination of answers to a series of questions about employment. | employed or self-employed Full time or Part time ➔ employed =1<br>Unemployed and Out of workforce ➔ unemployed =2<br>Missing = 999 |
| **Income variables** | | | |
| Income quintiles | INC_004 | Provide a measure of the respondents' wealth relatively to the other respondents in that country | lowest 20% = 1<br>second 20% = 2<br>middle 20% = 3<br>fourth 20% = 4<br>highest 20% = 5<br>Missing = 999 |

### 3.4.4. Social support variables

Six questions administered by the GWP were used to capture aspects of social support, as shown in **Table 3.6**. In addition, using age and the number of adults in the household, we created a living arrangement variable, which classified individuals as living alone versus living with another adult (embedded social support).

**Table 3.6: Variables used to calculate the social support index.**

| Label | Variables | Questions | Coding |
|---|---|---|---|
| **Emotional Social support** | | | |
| Opportunities to make friends | WP10248 | In the city or area where you live, are you satisfied or dissatisfied with the opportunities to meet people and make friends? | Yes =1<br>No =0<br>Don't know and Refused ➔ missing = 999 |
| Someone encourage your health | WP14444 | Thinking about your life in general, please rate your level of agreement with each of the following using a five-point scale, where 5 means you strongly agree and 1 means you strongly disagree. "Someone in your life always encourages you to be healthy," | Strongly agree and agree ➔ Yes =1<br>All other responses ➔ No =0 |
| Someone gives you positive energy | WP14445 | Thinking about your life in general, please rate your level of agreement with each of the following using a five-point scale, where 5 means you strongly agree and 1 means you strongly disagree. "Your friends and | Strongly agree and agree ➔ Yes =1<br>All other responses ➔ No =0 |

| | | | |
|---|---|---|---|
| | | family give you positive energy every day." | |
| Having someone to count on | WP27 | If you were in trouble, do you have relatives or friends you can count on to help you whenever you need them, or not?" | Yes =1<br>No =0<br>Don't know and Refused ➔ missing = 999 |
| **Instrumental Social support** | | | |
| People Outside Country to Rely On | WP3333 | Do you have relatives or friends who are living in another country whom you can rely on to help you when you need them, or not? | Yes =1<br>No =0<br>Don't know and Refused ➔ missing = 999 |
| Receiving money or goods | WP9086 | In the past 12 months, did this household receive help in the form of money or goods from another individual living inside this country, living in another country, both, or neither? | Living inside this country, living in another country, or Both ➔ Yes =1<br>Neither ➔ No =0<br>Don't know and Refused ➔ missing = 999 |
| **Embedded social support variables** | | | |
| Living arrangement | Living_arrangement | Were created using the number of adult in the household to classify the living arrangement of individuals | Living with adult = 1<br>Living alone =2<br>Missing = 999 |

### 3.4.5. Country-level variables

The Human Development Index (HDI)

This analysis was stratified by the HDI, which is a statistic composite of three dimensions related to human development: 1) a long and healthy life, measured by life expectancy at birth, 2) education, assessed by average years of schooling for adults aged 25 and over, and expected years of schooling for children, 3) having a decent standard of living, measured by gross national income per capita [51]. Based on the 2017 HDI, LAS countries were classified as very high HDI, high HDI, medium HDI, and low HDI [51, 141]. Data from very high and high HDI countries and those from low and very low were combined (**Table 2.2**).

Political Stability and the Absence of Violence and Terrorism (PSAVT)

Considering the political unrest in some countries of the LAS in this analysis, we included one of the World Bank's country-level indicators, the PSAVT [142]. LAS countries were stratified into three categories based on tertiles of the PSAVT 2017 score; high politically stable countries, medium politically stable countries, and low politically stable countries (**Table 2.4**) [116].

Gender inequality index (GII)

The 2017 GII score for each LAS country was used to develop a GII mean score for the LAS countries excluding those with missing values (Somalia, South Sudan, and Palestine territories). The countries were then classified as "low gender inequality countries" if the country's GII is below the region's mean score and "high gender inequality countries" if the country's GII is equal, or above the region's mean score. Countries with missing GII values were added to the high GII countries since some of the available indicators, such as maternal mortality, adolescent birth, the share of seats in parliament, and labor force participation, which were used in calculating the index, were relatively similar to the values of the countries classified as high GII countries (**Table 2.3**).

## 3.5.Research questions

I. **Aim one: to assess the validity of Food Insecurity Experience Scale (FIES) for use in the LAS region, determine the prevalence of FI, by age group, sex, and human development index (HDI), and to examine sociodemographic characteristics of severe FI individuals stratified by HDI.**

### I-a. Internal validation of FIES using Rasch modeling

For this analysis, we used the Rasch model, a single-parameter logistic measurement model based on Item Response Theories (IRT). The main purpose of Rasch modeling is to examine the psychometric properties of scales. The Rasch model allows for estimating the locations of both the items and the person's latent trait on the same scale [143]. In our case, the latent variable is the FI level measured by the FIES scale. Using Rasch modeling, we developed the LAS regional and country-specific FI thresholds to classify individuals according to their total raw score instead of using the global standard thresholds provided by VoH-FAO to account for language, culture, and socioeconomic differences. To develop a regional threshold, we performed Rasch modeling on the data of all LAS countries combined (19 countries out of 22 have FIES data). To quantify country-specific thresholds for moderate and severe FI, we first performed Rasch modeling separately for each country of the LAS. We then adjusted each country's parameters to the standard regional metric by equating their means and standard deviations. After obtaining the regional and the country-specific thresholds, we plotted the raw score parameter estimates of the regional standard metric against the ones for each country and determined the threshold levels for moderate and severe FI. Then, we used the developed country-specific thresholds to classify individuals as either food secure, moderately FI, or severely FI. For this analysis, an open-source statistical R software, (version 3.2.3, Foundation, Vienna, Austria) was used to perform the

psychometric analysis on the FIES using the Rasch model. Also, Excel 2010 was used to run the equating and plotting procedures.

**I-b. Determination of LAS food security thresholds and prevalence of FI**

To determine FI thresholds for LAS, the item severity parameter estimates needed to be comparable across targeted countries. If the severities of the two scales compared are similar, then the prevalence rates of the latent trait for those populations can also be meaningfully compared. We used the following procedure to equate the item severity parameter estimates of each country to the regional one:

1) Calculated a LAS standard metric based on item severity parameters of all LAS countries.
2) Adjusted each country's item severity parameters to that of the LAS regional standard metric, transforming them to that of the LAS standard metric. Then, each country's adjusted raw score parameter was also plotted against the regional one.
3) Specified thresholds for moderate and severe FI on the LAS scale.

To determine the FS status, the total raw scores were stratified into three categories: food secure, moderately FI, and severely FI. In most countries examined, the threshold for moderate FI was 4, but the threshold for severe FI was seven except for Sudan, Syria, and Yemen, where the severe FI threshold was 8. We classified individuals based on the total raw score to estimate the overall prevalence of FI, by age group (19-59 vs. 60+ years), sex, PSAVT, and the HDI.

**I-c. Examination of socio-economic and demographic characteristics of food insecure individuals**

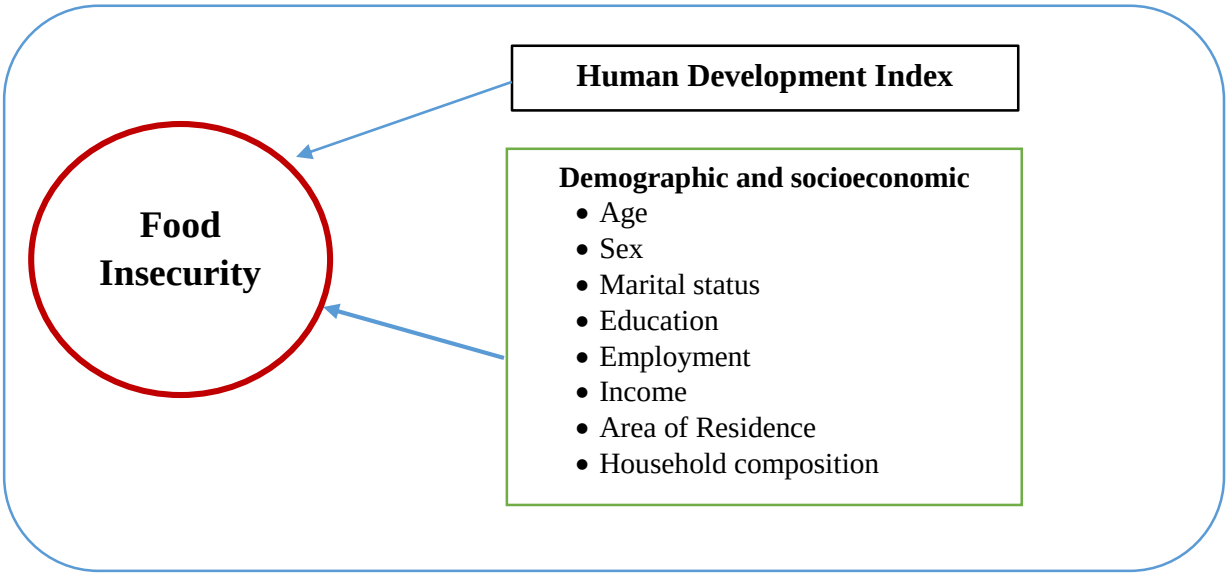
For this analysis, FS was reported at two levels (food secure and moderately FI versus severely FI). We assessed the prevalence of FS status for the entire sample, by age group, sex, PSAVT, and HDI. We presented the sociodemographic and economic variables shown in **Table 3.5** as frequencies and percentages or means and standard deviation. This includes age (19-49 versus 50+ years), sex, marital status, place of residence, employment status, educational attainment, household size, number of children under 15 years, number of adults, and household income quintile. Differences in proportions were examined using Chi-square analysis, and differences in means were examined using a T-test. All analysis were controlled for complex survey design, using the sample weights, cluster and strata to account for the unequal probabilities of selection, nonresponse, and non-coverage.

**I-d. To assess the determinants of FI stratified by HDI.**

Using logistic regression analysis, we examined the associations between the FI and sociodemographic variables summarized and defined in **Table 3.5.** We stratified all the models by HDI, controlling for complex survey design, and GWP survey year and country as fixed effects. The sociodemographic variables included in this analysis included age, number of children under 15, and number of adults as continuous variables and sex, marital status, place of residence, PSAVT, and educational attainment, or employment, or income quintile as categorical variables. We stratified all the models of our analysis by the 2017 HDI level of each country.

We used the stepwise forward method in the multivariate logistic regression models. The inclusion of variables was determined using the Wald Chi-Square p-values <0.05. We checked for multicollinearity between education, employment, and income and included them in separate models. We also assessed whether the models were a good fit for the data through Hosmer and Lemeshow goodness-of-fit tests. All data were analyzed using SAS statistical software (version 9.4; SAS Institute Inc., Cary, NC).

**Figure 3.1: Conceptual model of associations between FI and demographic and socioeconomic in LAS.**



## II. Aim two: To explore the associations between FI, physical health and mental well-being by sex, and whether these associations are modified by social support in women in the LAS region stratified by country's gender inequality index (GII).

### II-a. The prevalence of food insecurity and the characteristics of the study sample by sex.

Characteristics of the sample were reported by sex and included information on demographic and socioeconomic characteristics as explained previously under aim one and shown in **Table 3.5**. This included: age (19-59 versus 60+ years), marital status, area of residence, household size, number of children under 15 in the household, independence ratio, educational attainment, employment status, and income quintile. Differences in characteristics of men and women were tested using t-tests for continuous variables and chi-square tests for categorical variables.

### II-b. To assess the association between food security status physical health, and mental well-being by sex.

Multivariate logistic regression analysis, stratified by sex, was used to assess the associations of FI with physical health and mental well-being. These models were adjusted for sociodemographic variables such as age group (19-59 vs 60+), marital status, area of residence, independence ratio, and income quintile, controlled for complex survey design, GWP survey year, and the country as fixed effects. The strength of these associations was determined based on the estimated odds ratios (OR) with 95% Confidence Intervals (CIs). We also assessed whether the models are a good fit for the data through Hosmer and Lemeshow goodness-of-fit tests. All data were analyzed using SAS statistical software (version 9.4; SAS Institute Inc., Cary, NC).

**II-c. To assess whether the associations between food security status, physical health, and mental well-being were modified by social support variables among women in the LAS countries stratified by gender inequality index (GII).**

We examined the modifying effect of social support variables on the association between FI, physical health, and mental well-being. Due to missing values in three of the social support questions, this analysis was conducted in a sub-sample of women. These questions include whether the respondent has someone to encourage their health, give them positive energy, and rely on people out of the country. The data were missing in both high and low GII countries and phone and face-to-face interview modes. The final analytical sub-sample is 11,393 women. To rule out bias due to missing data, we examined differences in characteristics between those with and without missing social support data. The results showed no significant differences in age, area of residence, employment status, household size, number of children, number of adults, and independence ratio.

Logistic regression models were adjusted for social support variables and stratified by country's GII. Seven social support questions measuring several facets of social support, six of which were derived from GWP, and one was created and coded as shown in **Table 3.6,** were used in this study. To decrease the dimensions of the social support components, principal component analysis was used; we transform each categorical social support item into numerical score by running a qualitative principal component analysis on social support items using the SAS PRINQUAL procedure. We determined the associations of each social support items with hypothesized components of emotional, instrumental, and embeddedness support. We then ran factor analysis and used the Mineigen criteria (Eigenvalue scores > 1) to determine the number of social

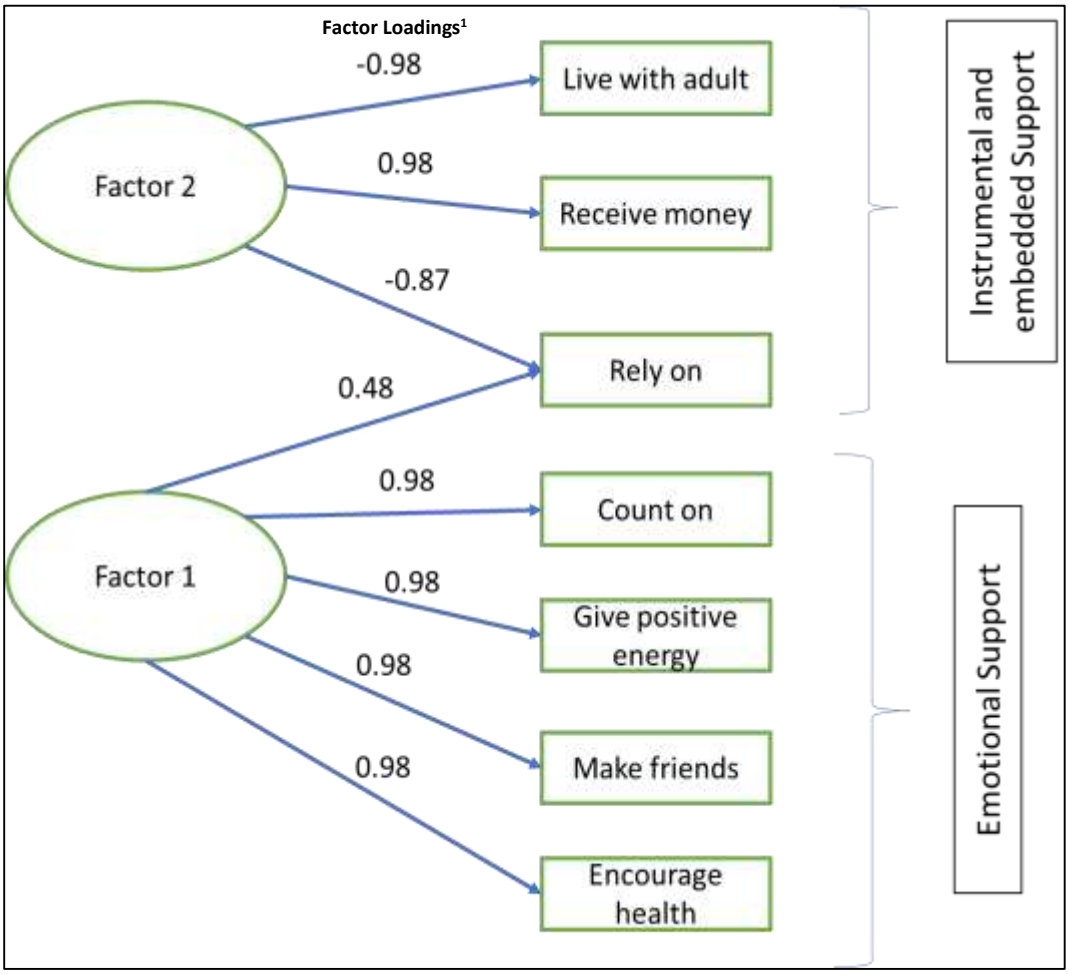
support components to retain. We assessed the eigenvectors of each item (how strongly the items are associated with the social support components), and weighted them by multiplying the transformed items by their corresponding factor loadings. We obtained the variances by multiplying the social support component scores with their corresponding eigenvalues. [144]. This exploratory analysis showed significant clustering factors and indicated that the seven items measured two dimensions of social support based on the factor loading pattern, as shown in **Figure 3.2**. Items included in both dimensions; "emotional support" and "instrumental and embedded support" are presented in **Table 3.7.**

Data were analyzed using SAS (version 9.4; SAS Institute Inc., Cary, NC). All the regression models were adjusted for age, marital status, area of residence, independence ratio, and income quintile as potential confounders. All analysis were controlled for the multistage probability sampling described above by, using the sample weights, cluster, and strata. Country and survey year were also included in the models as fixed effects. All the associations were considered statistically significant at $p<0.05$.

**Table 3.7: Classifications of social support questions based on principal component analysis, 2014-2017 Gallup World Poll survey.**

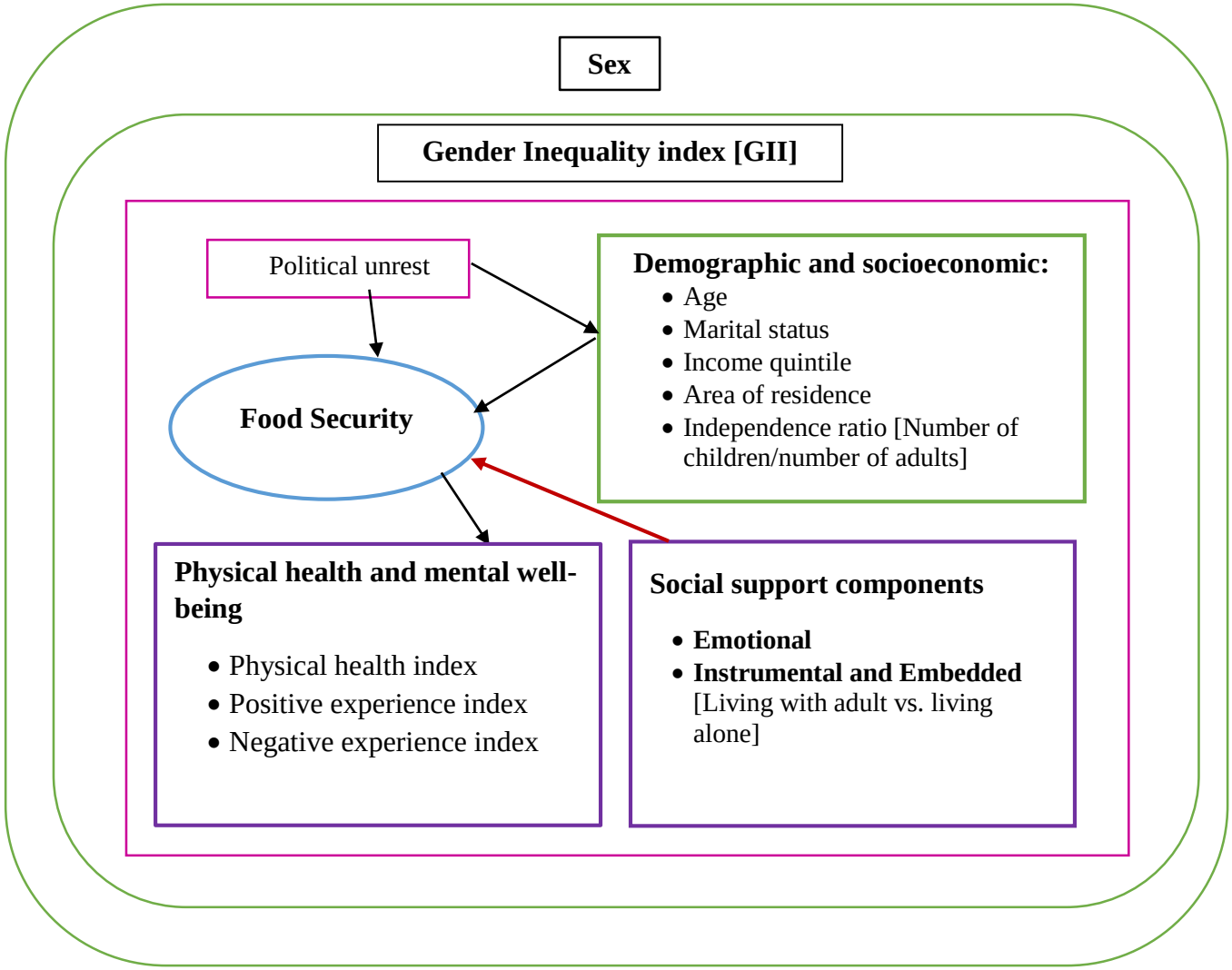
| Social support types | Questions from Gallop World Poll (GWP) |
|---|---|
| **Emotional** | *If you were in trouble, do you have relatives or friends you can count on to help you whenever you need them, or not?* |
| | *In the city or area where you live, are you satisfied or dissatisfied with the opportunities to meet people and make friends?* |
| | *Please rate your level of agreement to having someone in your life always encourages you to be healthy* |
| | *please rate your level of agreement about that your friends and family give you positive energy every day* |
| **Instrumental and Embedded** | *Do you have relatives or friends who are living in another country whom you can count on to help you when you need them, or not?* |
| | *In the past 12 months, did this household receive help in the form of money or goods from another individual?* |
| | *Living alone versus with adults* |

**Figure 3.2: Classification of social support items based on principal component analysis, (2014-2017 Gallup World Poll survey).**




[1]Factor loadings determine the factor that has the most influence on each item. Loadings close to -1 or 1 indicate that the factor strongly influences the item and those close to 0 indicate that the factor has a weak influence on the item [54].

**Figure 3.3: Conceptual model of associations between food security status and social support components among women in the LAS countries stratified by country-level gender inequality index.**



### III. Aim three: To assess the association between the presence of a grandparent in the household and children's health and well-being controlling for household food security.

To answer the third research questions, we used the 2010 and 2015 United Nations Relief and Works Agency (UNRWA) data.

## 3.6. UNRWA's Dataset

In 2010 and 2015, UNRWA funded the American University of Beirut to conduct surveys on the socioeconomic status of Palestinian refugees living in Lebanon. The purpose of these surveys was to collect information, at the household-level, on demographic and economic indicators of poverty, housing status, FS, and coping strategies of Palestinian refugees. Data were also collected on the household composition and the demographic, health status, educational attainment, and employment status of each member of the household.

### 3.6.1. Sampling and study population

The surveys were conducted in July-August 2010 and April 2015, targeting Palestinian refugees living in all 12 official Palestinian refugee camps and gatherings outside the camps. A gathering is where a minimum of 25 Palestinian households live close to each other in a geographically defined area [74].

The sampling frame for the 2010 survey was based on the Palestinian refugee's list from the UNRWA Refugee Registration and Information System, while the sampling frame for the 2015 survey used the list of Palestinian refugees in Lebanon compiled by the Palestinian Central Bureau of Statistics in 2010. In both surveys, a representative sample of households was obtained using a stratified multistage cluster sampling using a

simple random approach for the data collected from camps and a snowball sampling technique for the data collected from non-camp gatherings [74, 75].

### 3.6.2. Questionnaire development

Data were collected using a questionnaire developed by the research team and translated into Levantine Arabic dialect. Written or oral consent was obtained from individuals prior to participation in the survey. Information about the household and its members was collected through face-to-face interviews with a proxy adult responsible for food preparation, preferably a woman in the selected household. If a woman was not present, any adult family member was interviewed and served as a proxy.

The questionnaire was designed to collect information at household and individual levels. The first section inquired about household composition and socio-demographic information, types of health care services, and other household expenditures, including expenditures on health and food. Information was also collected on household dietary diversity, FS status and coping strategies, use of welfare programs, housing quality and crowding index, household assets such as transportation vehicles and home appliances. The second part of the questionnaire was designed to obtain data from the interviewee on each household member, including age, marital status, relationship to the head of household, school attendance and educational attainment, employment, and medical history. Information such as a mental health inventory and self-reported health status was obtained from the interviewee only.

All information collected was similar for both survey years; however, household FS information was collected using two slightly different questionnaires in each survey as described below.

### 3.6.3. Inclusion and exclusion criteria for aim 3

In our proposed project, we appended the data of 2010 and 2015 surveys and examined information of children aged 0 to 17, their parents, and grandparents (GP). We excluded households with incomplete information on household FS status and individuals with missing information on age. The 2010 survey includes 2,627 households of Palestinian refugees living in Lebanon (PRL) and 11,072 individuals, while the 2015 survey includes 3,300 PRL households and 13,417 individuals.

### 3.6.4. Variables used in this analysis

#### 3.6.4.1. Measuring food insecurity

In 2010 survey, household FI experience was assessed using a 6-item scale with a reference period of 6 months (**Table 3.8**). This scale was derived from the US Food Security Survey Module [145] and the Yemen National Food Security Survey [38]. Household FS status was classified based on the total score as food secure (0–1), moderately food insecure (2–4), and severely food insecure (5–6). The FS information collected in the 2010 survey was used to develop and validate the Arab Family Food Security Scale (AFFSS) used in the 2015 survey.

The AFFSS was used to assess the FS status in the 2015 survey (**Table 3.8**). This scale consists of 7-item that includes components similar to the 2010 questions in addition to a question “In the last 6 months, was there a time when you were concerned that you would run out of food for your household for the next month? Household FS status was classified based on the final score as food secure (0–2), moderately food insecure (3–5), and severely food insecure (6–7).

**Table 3.8: Measurement tools used to assess food security among Palestinian refugees in 2010 and 2015 surveys.**

| Item label | Palestinian Refugee Survey 2010 | Arab Family Food Security Scale (AFFSS) 2015 |
|---|---|---|
| 1. Inadequate quality food (food sufficiency question)[1] | Which of these sentences applies the most to the food eaten by your household during the past 6 months?<br>• We had enough to eat of the kinds of food we wanted<br>• We had enough to eat but not always the kinds of food we wanted<br>• Sometimes we did not have enough to eat<br>• Often we did not have enough to eat | Which of these sentences applies the most to the food eaten by your household during the past 6 months?<br>• We had enough to eat of the kinds of food we wanted<br>• We had enough to eat but not always the kinds of food we wanted<br>• Sometimes we did not have enough to eat<br>• Often we did not have enough to eat |
| 2. Concerned food would run out[3] | | In the last 6 months, was there a time when you were concerned that you would run out of food for your household for the next month? (Yes/No) |
| 3. Food bought didn't last | Tell me if this statement applies to you most of the time, sometimes, or never: "The food that we bought did not last us and we didn't have money to buy more" | In the past 6 months, has it ever happened that the food you bought was not enough and you didn't have money to buy more? (Yes/No) |
| 4.Not enough of some foods[3] | Are there any foods you feel your family does not eat enough of?<br>(Yes/No) If yes, specify: | Were there any foods you feel your family did not eat enough of in the last 6 months? (Yes/No) If yes, specify: |
| 5.Cut size of meal[2] | In the past 6 months, did you or any other adult in your household ever cut the size of your meal because there was not enough food? (Yes, almost every month, yes, but not every month, yes in only 1 or 2 months, never) | In the past 6 months, did you or any other adult in your household ever cut the size of your meal because there was not enough food? (Yes/No) |
| 6.Skipped meal[2] | In the past 6 months, did you or any other household members ever skip a meal because there was not enough food? (Yes, almost every month, yes, but not every month, yes in only 1 or 2 months, never) | In the past 6 months, did you or any other household members ever skip a meal because there was not enough food? (Yes/No) |
| 7.Did not eat whole day or went to bed hungry[2] | In the past 6 months did you or any member in your household not eat for a whole day or go to bed hungry because there was not enough food? (Yes, almost every month, yes, but not every month, yes in only 1 or 2 months, never) | In the past 6 months did you or any member in your household not eat for a whole day or go to bed hungry because there was not enough food? (Yes/No) |

[1] Item 1 Coded as affirmative for all responses except the first.
[2]Items 5, 6, 7 Coded as affirmative for any of the three yes responses.
[3]Item 2, 4 Coded as affirmative for yes responses.

### 3.6.4.2. Sociodemographic characteristics of the household

First, the family structure of each household member was identified using the question inquiring about the relationship between each household member and the interviewee, and the age and sex for each member of the household. Households were categorized as food secure versus moderately and severely food insecure. The household sociodemographic and economic variables examined in this analysis are shown in **Table 3.9** and include GP with one or more chronic conditions and the mother's and father's age, employment status, and educational attainment.

Poverty status was also identified based on the expenditure questions. Researchers developed two poverty measures: 1) extreme poverty line, which reflected the cost of basic food and was defined by the International Community, and 2) non-extreme poverty line, which reflected the cost of minimal food and other living costs and was defined by the International Community. These two poverty lines were computed based on the 2008 UNRWA's Social Safety Net Programme and adjusted for inflation so that the poverty lines in 2010 were at 2.17$/day and 6$/day, respectively [74] and in 2015 $2.5/person/day and $6.8/person/day, respectively [75]. For this analysis, households were categorized as "poor" or "not poor" based on only the non-extreme poverty line for each survey ($6/person/day in 2010, and $6.8/person/day in 2015). Additionally, households receiving welfare assistance from the Special Hardship Assistance Program (SHAP) was also identified. SHAP is a program that delivers food aid and a cash subsidy to Palestinian refugees. Other household characteristics included household size, number of adults 18+ years, number of children aged 0-17 years, total household expenditure**,** household health expenditure, household food expenditure, and food-related assets,

which is the ownership of a refrigerator, freezer, oven, and microwave, each of which contributes one point to the scale of 4.

**Table 3.9: Household's demographic and socioeconomic characteristics.**

| Label | Variables | Questions | Coding |
|---|---|---|---|
| Household food security status | FS | Households were classified into 1) food secure<br>2) moderately food insecure<br>3) severely food insecure | 1 = food secure<br>2 and 3 = food insecure. |
| Age of all household members | HR05 | Please tell me your age. | Count<br>Missing will be excluded |
| Sex of all household members | HR04 | The sex is … | Men =1<br>Women =2 |
| grandparent with one or more chronic conditions | HHEALTH1 | 1) "Has (name) been diagnosed with a chronic conditions?" | After identifying grandmother and grandfather, we looked at the question inquiring about chronic conditions s:<br>Yes<br>No<br>Don't know and refused to answer ➔ missing = 999. |
| Employment status of mother and father | HEMP1<br>HEMP2<br>HEMP3 | "Did (name) work for wage (cash or in kind) even for one hour during last week?"<br>Follow up question to those who replied no: "Was (name) out and looking for work in the past week?"<br><br>If no, then follow up question was asked inquiring about why they are not looking for a job.<br><br>"What is/was (name)'s employment status?" | Yes = employed<br>No, worked without pay = unemployed<br>Don't know and refused to answer ➔ missing = 999<br><br>Yes = unemployed<br>No = follow up question; why?<br><br>If the respondents are not working because he/she was on vacation = employed.<br><br>Employer, working for government agencies, working for UNRWA, working for a non-governmental organization, and working in the private sector = "employed"<br><br>Self-employed or paid employee in family business = "employed".<br><br>Unpaid employee in family business = "unemployed" |
| Education attainment of | HEDU6 | "What is the highest level of schooling (name) has achieved?" | 1) Never Attended and Elementary not completed = "Illiterate/incomplete primary" |

| | | | |
|---|---|---|---|
| mother and father | | | 2) Elementary completed = "Completed primary education"<br><br>3) Preparatory - no Brevet, Preparatory - with Brevet, Secondary - without Baccalaureate, Secondary - with Baccalaureate, Vocational or Technical (no Certificate), Vocational or Technical (with Certificate: BT/ TS / Diploma), University (without Degree), University (with Degree: Licence, BSc, BA, etc.), and Post Graduate (Masters, PhD) = "Above primary education"<br><br>Don't Know and refuse to answer ➔ missing = 999 |
| Poverty status, Household | Poverty | This variable was calculated based on the total household expenditure | Live on less than US$ 6.8/person/day = "poor"<br>Live on US$ 6.8/person/day or more = "not poor." |
| Welfare assistance , household | SHC8 | "Are you a SHAP case?" | "Yes"<br>"No"<br>Don't know and refused to answer ➔ missing = 999 |
| Household size | HHsize | "How many people have lived with you in this house for more than 6 months (Including yourself)?" | Count<br>Missing = 999 |
| Number of children | Num_child | 1) "How many people have lived with you in this house for more than 6 months (Including yourself)?"<br>2) Age. | Those who are 0 to 17 years old will be counted and included as a total number of children in the household. |
| Number of adults | Num_adult | 1) "How many people have lived with you in this house for more than 6 months (Including yourself)?"<br>2) Age. | number of adults 18+ years |
| Household expenditure | HEXP20 | "How much does your household spend on the following?"<br>Rent, electricity, water service, drinking water, diapers, cooking gas, fuel for transport, coal/diesel, food, clothing, entertainment, education, general health care, hospitalization, medication, public transportation, school transportation, communications, tobacco, | Count |

| | | | |
|---|---|---|---|
| | | total. From this list, we will include the total expenditure. | |
| Household health expenditure | HEXP13<br>HEXP14<br>HEXP15 | From the previous question, we will include the total expenditures of general health care, hospitalization, and medication as the health expenditure | Count |
| Household food expenditure | HEXP04<br>HEXP06<br>HEXP09 | From the previous question, we will include the total expenditures of food, water, and cooking gas | Count |
| Food-related assets | HASSET25<br>HASSET26<br>HASSET27<br>HASSET28 | Do you or anyone in your household have the following:<br>Fridge<br>Freezer<br>Gas/ Electric Oven<br>Microwave | Scale of 1 to 4 will be created for each household using the following food-related assets: refrigerator, freezer, oven, and microwave |

### 3.6.4.3. Sociodemographic characteristics of the children

Children's characteristics used in this study were: age groups, sex, living in a poor household or not based on the poverty status of the household, school attendance, employment status, having health insurance, presence of chronic conditions, and the presence of acute disease within the last six months (**Table 3.10**).

**Table 3.10: Children's demographic and socioeconomic characteristics.**

| **Label** | **Variables** | **Questions** | **Coding** |
|---|---|---|---|
| Age groups | | | The age classified into groups<br>For health status<br>1 = 0-4<br>2 = 5-11<br>3 = 12-17<br>For school attendance<br>1 = 0-5 (Excluded)<br>2 = 6-12<br>3 = 13-17<br>For employment status<br>1 = 0-4 (excluded)<br>2 = 5-14<br>3 = 15-17 |
| **Child's well-being** | | | |
| School attendance | HEDU1 | "Did (name) enroll for the current school year?" | Enrolled and attend the school = yes<br>Enrolled but not attending, enrolled but dropped out, or not enrolled = no<br>Don't know and refuse ➔ missing = 999 |

| | | | |
|---|---|---|---|
| Child's employment status | HEMP1<br>HEMP2<br>HEMP3<br>HEMP6 | "Did (name) work for wage (cash or in kind) even for one hour during last week?"<br><br>Follow up question to those who replied no: "Was (name) out and looking for work in the past week?"<br><br>If no, then follow up question was asked inquiring about why they are not looking for a job?<br><br>"What is/was (name)'s employment status?" | Yes = employed<br>No, worked without pay = unemployed<br>Don't know and refused to answer ➔ missing = 999<br><br>Yes = unemployed<br>No = follow up question; why?<br><br>If the respondents are not working because he/she was on vacation = employed.<br><br>Employer, working for government agencies, working for UNRWA, working for a non-governmental organization, and working in the private sector = "employed for others"<br>Self-employed or paid employee in family business = "self-employed or working for the family"<br>Unpaid employee in family business = "unpaid employee in family business" |
| **Children's health status** | | | |
| Having chronic conditions s | HHEALTH1 | 1) "Has (name) been diagnosed with a chronic conditions?" | Yes<br>No<br>Don't know and refused to answer ➔ missing = 999. |
| Having acute illnesses | HHEALTH5 | 2) "Has (name) had an acute illness in the past 6 months?" | Yes<br>No<br>Don't know and refused to answer ➔ missing = 999. |
| Health insurance access | HHEALTH10 | "Did (name) have any kind of health insurance in addition to UNRWA coverage during the last year? | Yes<br>No<br>Don't know and refused to answer ➔ missing = 999 |

**<u>III-a:</u> Determine the demographic and socioeconomic characteristics of the households and the characteristics of children with and without a live-in grandparent.**

Household characteristics by the presence of grandparents were examined, and so were characteristics of children living with and without a live-in grandparent. The weighted mean and standard error were reported for continuous variables, while weighted

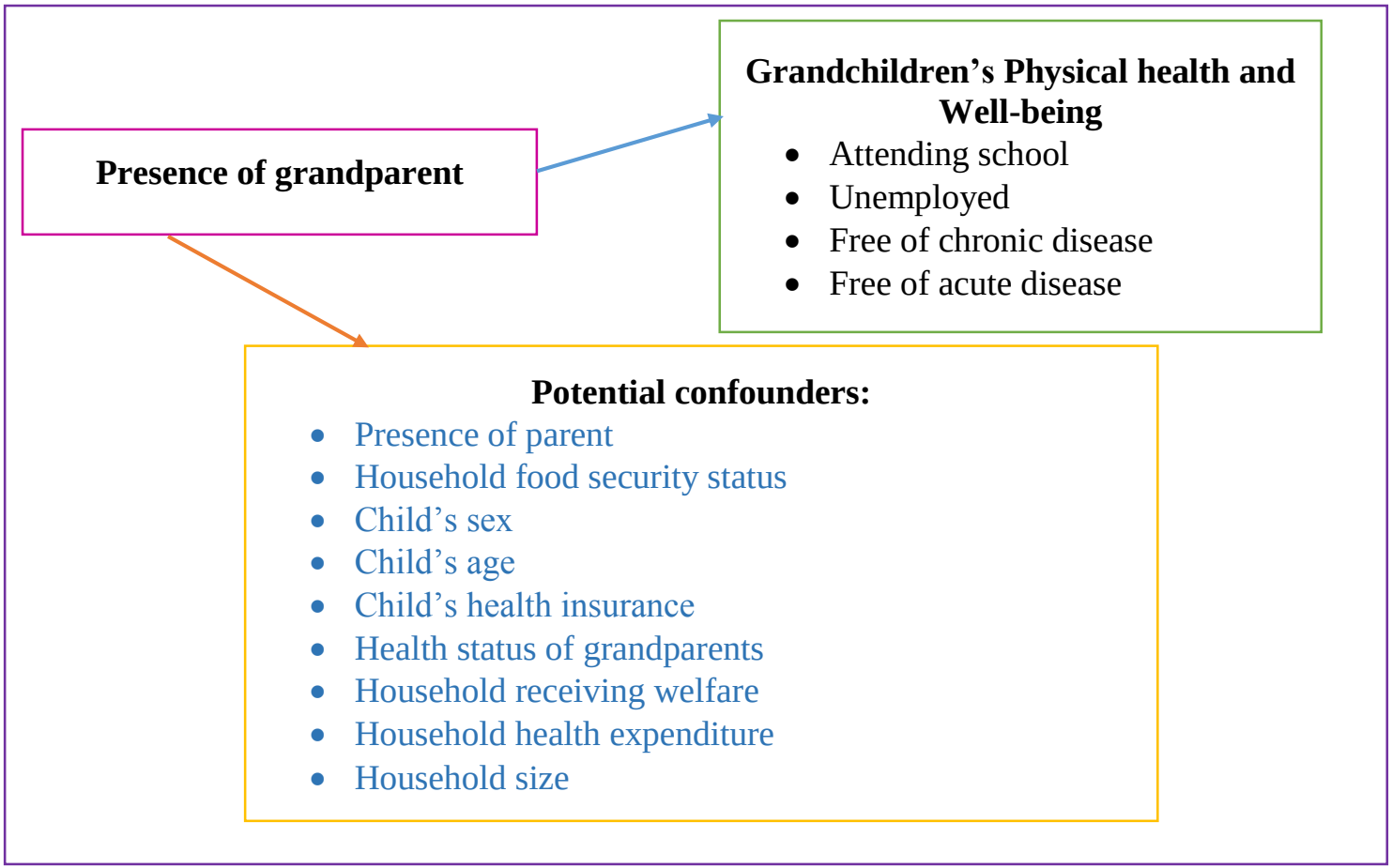
frequencies and percentages were reported for categorical variables. We assessed the differences between continuous variables using a t-test and categorical variables using chi-square test.

**III-b: To assess the association between living with grandparent and the health and well-being of grandchildren, controlling for household food security.**

We used logistic regression analysis to model binary outcome variables of children's health (presence of chronic conditions and/or acute disease) and well-being (school attendance and employment) to assess their association with live-in GP. Our exposure variable is the presence of a GP in the household. The presence of a GP in the household was determined using the household ID and the question inquiring about the relationship of household members. All models were adjusted for the following confounders: the presence of parents, household FS status, child's sex, child's age, child's health insurance, grandparents with chronic conditions s, household receiving welfare, health expenditure, and household size (**Table 3.9, 3.10, Figure 3.4)**.

The strength of the associations was determined based on the estimated odds ratios (OR) with 95% Confidence Intervals (CIs). We checked variables for multicollinearity and assessed whether the models were a good fit for the data through Hosmer and Lemeshow goodness-of-fit tests. The analysis was performed using SAS 9.4. We used the SURVEYLOGISTIC procedure, and adjusted for the survey year and the household ID as fixed effects using the cluster statement.

**Figure 3.4: Conceptual model of the association between the presence of grandparent and the grandchildren's health and well-being in the Palestinian refugees living in Lebanon controlling for household food security status.**



# Chapter 4: Results

## A) Validity of the Food Insecurity Experience Scale (FIES) for use in League of Arab States (LAS) and characteristics of food insecure individuals by Human Development Index (HDI)


### Abstract

**Background:** The Food Insecurity Experience Scale (FIES) is a UN FAO Voices-of–the-Hungry (FAO-VoH) experiential metric of food insecurity (FI). It was pilot tested in some countries but not in Arab speaking ones and validated using global data. Yet, its psychometric properties may vary in the League of Arab States (LAS) due to cultural and linguistic differences.

**Objectives:** 1) assess the validity of FIES for use in the LAS region, 2) determine the prevalence of FI, by gender, age group, and human development index (HDI), and 3) examine sociodemographic characteristics of severely FI individuals.

**Methods:** To assess the psychometric properties of FIES, Rasch modeling was applied to the 2014-2015 Gallop World Poll (GWP) in the LAS. Prevalence and characteristics of severely FI individuals were assessed using the 2014-2017 GWP data of 62,261 respondents.

**Results:** Overall, FIES met the Rasch model assumptions of equal discrimination and conditional independence. Infit statistics for FIES items, in most LAS countries, were <1.3, indicating good internal validity. In Syria and Sudan, the item "worried about not having enough food to eat" had infits >1.3. Outfit statistics >2.0, indicating erratic responses, were noted in 26% of the LAS countries. Significant correlations were found (≥ 0.4) between items in Algeria, Tunisia, and Lebanon. The overall prevalence of severe FI was 15.7%. At highest risk were those aged ≥50 years compared to younger adults (16.5% vs. 15.5%, respectively, p<0.02), women compared to men (17.6% vs. 14.1%,

respectively, p<0.0001), and those in countries with low HDI compared to high HDI (24.9% vs. 8.3%, respectively, p<0.0001).

**Conclusions:** Overall, FIES is valid for measuring FI in the LAS. Cognitive testing of items with high outfit statistics and omission of correlated ones may improve the scale. Populations vulnerable to severe FI include older adults and women. These populations should be examined further.

**Keywords:** Rasch modeling; Food insecurity; League of Arab States; Older adults; Younger adults; Gender; Human development index.

## Introduction

The LAS is a large geographic area consisting of 22 Arabic-speaking countries in the Middle East and Africa [30]. These countries share common environmental challenges such as limited agricultural resources, growing water scarcity, and climate change, but vary by levels of economic development [6]. In addition, many of these countries face rapid population growth, urbanization, high unemployment rates, food price volatility, violent conflict, and political turmoil, all of which exacerbate the risk of food insecurity (FI) [6], hence the need to monitor it in this region.

Assessing FI is challenging, therefore, several tools have been developed to measure its experiences [146]. These tools contain a series of questions that focus on a household's or individual's experience in reducing the quantity and/or quality of food intake over a specific period of time as a result of limited access to food or resources to obtain food. These tools vary from simple indicators that can be quickly and easily administered, to more complex measures that require more details and sophisticated analytics [35]. Several studies have examined FI in countries of the LAS region,

including Yemen [24], Palestinian Territories [147], Jordan [16], Syria [12], and Lebanon [25-27]. However, in these studies, different measures were used, which limit the comparability of results. One study measured income and food consumption [147] to report on FS while the others used select questions from the U.S. FS [148] To our knowledge, the only tool that has been validated for use in the LAS is the AFFSS [28], but its use has been limited. Also, except for Yemen which was a national survey, the other surveys were administered to select populations such as women in Northern Jordan [16] or Iraqi refugees in Jordan and Syria [12]. Other assessments of FI in this region used different geographical classifications, such as Near East and North Africa (NENA) which includes Iran but excludes Somalia, South Sudan, Palestine territories, Comoros, and Djibouti, [22] and Western Asia and North Africa (WANA), which includes Armenia, Azerbaijan, Cyprus, Georgia, Israel, and Western Sahara but excludes Mauritania, Somalia, and South Sudan [149]. The prevalence of FI at the regional level in other geographical classifications such as the Middle East and North Africa or the LAS has not been reported previously. The prevalence of FI increased in the NENA region and doubled from 1990-1992 to 2014-2016 [23].

To meet the need for a simple, flexible, broadly applicable, and cross-culturally comparable tool on a global scale, the Food and Agriculture Organization of the United Nations' Voices of the Hungry project (FAO-VoH) developed the Food Insecurity Experience Scale (FIES) in 2013 [150, 151]. It is the first tool developed to measure FI at the individual level, globally [152]. FIES was validated using the 2014 Gallup World Poll (GWP) data from more than 150 countries [39, 40]. However, since a global standard was used to validate the measure, there is a need for regional psychometric analysis of the tool

to determine its applicability. This tool has also been validated for sub-Saharan Africa and its applicability to that region of the world was determined but with several caveats [153]. The overall goal of this study is to define a standard metric for the LAS that can be used to identify common determinants of FI in its countries.

We, therefore, focused on Arabic speaking countries to minimize the variation in the language of the translated FIES. In addition, we used national indicators of human development index (HDI) and the Political Stability and the Absence of Violence and Terrorism (PSAVT) to control for the variability in the socioeconomic status and political unrest in the region. The specific objectives of this study were to 1) assess the internal validity of FIES for use in the LAS region, 2) assess the prevalence of FI, by age and gender, stratified by the HDI, and 3) determine the sociodemographic and economic characteristics of individuals with severe FI in that region.

## Methods

### *Study design*

Data for this analysis were obtained from the GWP surveys conducted in 19 LAS countries, areas, or territories. GWP is a series of complex cross-sectional surveys conducted annually in more than 150 countries. The target population from each country is a nationally representative civilian, non-institutionalized population of individuals aged 15 years and older. Data were collected through one-hour, face-to-face interviews, or 30-minute telephone calls from typically 1,000 respondents from each country per survey year using multi-stage probability sampling [154]. The difference in time allocated to the interviews is due to the additional questions administered to individuals during the face-to-face interviews than to those on the telephone calls. The 2014 and 2015 GWP data of

35,064 individuals, after excluding those less than 19 years old and those with missing age or missing responses to any questions of FIES were used in the psychometric analysis of FIES. The 2014-2017 GWP data were used to examine the prevalence of FI in the LAS countries and characteristics of the sample population in those 19 countries. The final analytical sample was composed of 62,261 individuals. Gallup works with global partners in data collection. The ethical approval for the survey was obtained from the GWP Ethics Office.

***Food insecurity assessment using Food Insecurity Experience Scale (FIES)***

Beginning in 2014, GWP started collecting the FS information using the FIES developed by FAO-VoH. FIES is composed of eight questions with simple dichotomous responses of "Yes or No" (**Table 4.1**). Respondents were asked if they at any time during the previous 12 months experienced different severity levels of FI. These questions range from "being worried about not having enough food to eat" to "going hungry for a whole day", due to lack of money or other resources. Responses to these FIES questions are aggregated, the total scores ranging from 0 to 8. For these analyses, the scores were classified into three categories based on the global standard; 1) food secure (0-3), 2) moderately FI (4-6), and 3) severely FI (7-8). The development of a regional and individual country's FI threshold is discussed below.

***Demographic and socioeconomic variables***

Demographic and socioeconomic variables included in this analysis were: age, household size, and number of children under age 15 years residing in the household, and these were examined as dichotomous and continuous variables. Whereas the variables gender, marital status (married and domestic partner vs. never married, divorced,

separated or widowed), area of residence (living in a rural area or on a farm, a small town or village, vs. a large city, and a suburb of a large city), and employment status (employed or self-employed full time, employed part-time do not want/want full-time work, vs. unemployed, out of workforce) were examined as dichotomous variables. After accounting for the diverse national classifications of education across countries and making them comparable, educational attainment was categorized as 1) eight years of primary education, 2) secondary or high school completion, and 3) one or more years of a college education.

To calculate income, the survey inquired about monthly household income from all sources, including wages and salaries, and, remittances in local currency from all family members. If respondents had difficulty answering this question, they were asked to select from an income range, and the midpoint of that range was used for analysis. Household income in local currency was converted to international dollars (ID) using the World Bank's purchasing power parity conversion factor to make income comparable across countries. The income per capita was then derived by dividing income in ID by household headcount [139, 154]. In this analysis, household income per capita was examined as income quintiles.

***Country-level variables***

**The Human Development Index (HDI)**

Economic and human development vary widely between LAS countries. These analyses were stratified by the HDI, which is a statistic composite of three dimensions related to human development: 1) a long and healthy life, measured by life expectancy at birth, 2) education, assessed by average years of schooling for adults aged 25 and over,

and expected years of schooling for children, 3) having a decent standard of living, measured by gross national income per capita [51]. In 2017 countries were classified by the United Nations Development Program as 1) Very High HDI (Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, United Arab Emirates), 2) High HDI (Algeria, Jordan, Lebanon, Libya, Tunisia), 3) Medium HDI (Egypt, Iraq, Morocco, Palestinian Territories), and 4) Low HDI (Comoros, Djibouti, Mauritania, Somalia, Sudan, South Sudan, Syria, Yemen) [141]. Data from very high and high HDI countries and those from low and very low were combined.

**Political Stability and the Absence of Violence and Terrorism (PSAVT)**

Considering the political unrest in some countries of the LAS, it was controlled for in these analyses using one of the World Bank's country-level indicators, PSAVT [142]. This measure captures the likelihood that the government will be destabilized under violence and the frequency of politically-motivated violence and terrorism. Generally, the performance score ranges from -2.5 to 2.5 and the highest score reflects the best situation [116]. In these analyses, the LAS countries were stratified into three categories based on tertiles of the PSAVT 2017 score: 1) high politically stable countries (Jordan, Kuwait, Mauritania, Morocco, United Arab Emirates, 2) medium politically stable countries (Algeria, Bahrain, Egypt, Saudi Arabia, Tunisia), and 3) low politically stable countries (Iraq, Lebanon, Libya, Palestinian Territories, Somalia, South Sudan, Sudan, Syria, Yemen) [116].

## Statistical analysis

### *The Rasch modeling*

Rasch modeling, which is a single-parameter logistic measurement model based on Item Response Theory, was used to assess the psychometric properties of the FIES. Rasch is a statistical technique used to develop and validate survey instruments by evaluating individual items and their functioning [155]. Rasch modeling was used to provide a theoretical basis to link the FIES responses to the measure of severity of FI and place responses to the items and the level of FI measured by the items on the same continuum scale [15, 143, 150]. The responses to the items are a logistic function of the difference between the severity of a respondent's FI status and the severity of FI measured by each item [41]. For example, if the respondent's level of severity of FI is lower than the severity of FI measured by the item, the probability of affirming that item is low. Individuals with missing responses to any of the eight FIES items were excluded from the Rasch analysis and in the computation of the prevalence rates. A high proportion of missing responses can indicate questions that are not easy to understand. The total score of the FIES ranges from 0-8. For these analyses, extreme scores of 0 and 8 were excluded to avoid potential bias due to the large proportion of these extreme values [150, 156].

We assessed adherence of the data from each country to the Rasch model's assumptions of 1) equal discrimination, meaning that the performance of all items included in the scale is consistently and equally related to food security; and 2) conditional independence and unidimensionality, which means that responses to the items are independent and only measure one latent trait, that is, FI. Also, the correlations

between items are entirely due to their common association with this latent trait; thus they should be uncorrelated after controlling for the latent trait [150]. Meeting the assumptions is a precondition to the FIES's validity and reliability to measure the severity of FI and make the raw scores a meaningful indicator of the severity level of FI [150, 156].

We assessed the assumption of equal discrimination using fit statistics (infit and outfit statistics) and overall model fit (reliability). Fit statistics are chi square-type statistics that compare observed and expected responses of each item [157]. Infit is mainly used to assess the assumption by checking the performance of the items in the scale, and outfits identify items that need improvement and those with erratic responses [39]. The ideal value of all Item-infit is 1.0, but values in the range of 0.7 to 1.3 are considered acceptable. Item-infit with a value higher than 1.3 indicates higher proportions of unexpected responses (misfit), implying weaker discrimination, which should be identified for further investigation [39, 157]. Elevated outfit value can occur if there are a few highly unexpected observations (denials of the least severe items but affirm the most severe ones), or if an item is highly discriminative, misunderstood, or miscoded. However, outfits are profoundly affected by a few random or erratic responses (outliers). Therefore, if the infit statistics are within the acceptable range, high outfits ($\geq 2$), are not usually criteria for eliminating items. These items need reasonable clarification to determine if there is an issue with the items [157]. In contrast, lower infits may indicate the presence of redundant items that measure the same level of FI [39, 156], which may undervalue the item in its contribution to the overall measure. To provide a more comparable measure of model fit across countries, the overall model fit of the FIES items was assessed through a modified Rasch reliability test, a measure of whether the

scale produces similar results under consistent conditions [158]. The acceptable level of reliability is ≥0.7, which means that the order of the items is consistent, and the responses to the items reflect the person's level of FS [151].

Conditional independence and unidimensionality of the items were assessed by calculating the residual correlation matrix of each pair of items. Responses to items were considered not independent of each other if the items were correlated with ≥0.40, while lower correlations (≥0.25 to <0.40) between 3 or more adjacent items indicate the presence of multidimensionality in the data [39, 158]. The order of item severity was also assessed in this study. Once raw scores were calculated, they were transformed into continuous data with equal interval units (logits) and their relative order examined. These intervals indicate the severity of FI measured by the total raw scores [41, 158]. It is expected that less severe items have more affirmative responses than more severe ones [39]. As the severity of the FIES items increase, the proportion of affirmative responses should decrease. Respondents with a lower level of FI would affirm items with lower severity parameters than items with higher severity parameters [39, 41]. If not, this could imply a misunderstanding of the item due to the languages, cultures, and livelihood arrangements and, in turn, the related experience, which could be problematic for cross-country comparisons [150, 151].

***Developing the FIES LAS-regional standard scale***

We developed a scale for each country of the LAS and a standard metric for the region using aggregated LAS data. Item severities of scales for each country were calibrated against the item severities of the LAS standard metric by equating their means and standard deviations and adjusting them to a common metric. The intention is to

represent similar FI experience across the LAS countries, which would allow for the comparison between and within the countries. However, during the adjustment procedure, we identified "unique" items that are not comparable with the LAS standard. Unique items can be identified by comparing the relative positions of item severity parameters of each country to the regional standard metric (**Table 4.2**). We allowed a maximum of 3 unique items to deviate in their severity parameters from the standard metric [41, 143]. All scales, except for Syria, had ≤3 unique items. Due to the higher number of unique items, and the small size of non-extreme responses from Syria, we excluded Syrian data in the construction of the final LAS standard metric. However, we computed the prevalence rates of FI in Syria using the overall FI thresholds estimated for the LAS. Raw score parameters for each country were then adjusted using the means and standard deviations of the adjusted item severity parameters after excluding unique items [151]. Finally, we specified the regional thresholds for moderate and severe FI following the FAO-VoH thresholds as food secure (raw score = 0-3), moderate FI (raw score = 4-6), and severe FI (raw score = 7-8). We then plotted raw score parameter estimates of each country against the regional one to determine moderate FI and severe FI thresholds for each country (**Table 4.3**).

Data were analyzed using the statistical software package R (version 3.2.3; R Foundation, Vienna, Austria), Excel 2010, and SAS (version 9.4; SAS Institute Inc., Cary, NC). Descriptive characteristics were weighted to adjust for complex survey design. To assess for differences in characteristics between the food secure and FI individuals by country's level of HDI, the t-test for continuous variables and chi-square for categorical variables were used and considered statistically significant at $p<0.05$. We

used logistic regression analysis to examine associations between FI and demographic and socioeconomic characteristics, accounting for the complex survey design, and controlling for country and survey year as fixed effects.

## Results

### *Characteristics of the study population*

Of the 62,261 respondents in this study, 19.1% were aged 50 years and older. Most survey respondents were men (54.3%), married or partnered (65.1%), urban residents (58.1%), had 8 years of education or less (40.9%), and about half of the respondents (48.8%) were unemployed. More than half of the population lived in very high/high HDI (55.4%) countries (**Table 4.4**). Mean household size consisted of 5.8 members and 2.2 children (data not shown).

### *Fit statistics and overall reliability of FIES*

The infit statistics of FIES items for all countries, except for Sudan and Syria, were within the acceptable range of 0.7 to 1.3 (**Table 4.5**). This indicates that the items met the model assumption of equal discrimination and that FIES measures the same underlying construct of FI, across the LAS. Sudan had the highest infit (1.48) for the item "worried," and Syria had the highest infit for the items "healthy," and "whlday" (1.51 and 1.44, respectively). Infit statistics in the range of 1.3 to 1.5 are not high enough to omit from a scale but indicate that the questions need improvement [150]. The lowest infit values were for the items "worried" and "runout" in Syria (0.61 and 0.63, respectively).

On the other hand, high or low outfit values indicate items that are consistently misunderstood by some respondents but may also reflect careless responses or error

recordings by the interviewers or data managers, such as affirming a severe item but denying one or more of the less severe items. Items with unusually high outfit statistics may present a cognition problem and/or may need improvement in translation [39]. Results showed high outfit values (≥2.0) for the item "worried" in Jordan and Sudan, and for the item "healthy" in Syria, Palestinian Territories, and Yemen. For the most severe item "whlday," Palestinian Territories showed the highest outfit value (4.34), followed by Yemen (3.19). In contrast, low outfit values (<0.7) were found for the item "worried" in Syria, the item "fewfood" in South-Sudan, the item "ateless" in Palestinian Territories, Somalia, South-Sudan, Sudan, and Tunisia, the item "runout" in Algeria, the item "hungry" in Bahrain, and for the item "whlday" in Lebanon (**Table 4.5**).

Finally, the overall model fit using Rasch reliability assessment was 0.71 for the LAS region. Countries had reliability values within an acceptable range of 0.70 to 0.80. The lowest Rasch reliability was 0.69 in Saudi Arabia, Somalia, South Sudan, and Syria, and the highest was 0.77 in Palestine territories and Yemen. These levels of reliability for a scale comprising of eight items reflect a reasonably good model fit [39] (**Table 4.6)**.

***Conditional Independence of the Items***

Overall, there were no significant correlations between the items in the combined LAS data. However, at the country level, high correlations (≥0.4) were found for the items "runout" and "hungry" in Algeria and Tunisia, and for the items "hungry" and "whlday" in Lebanon. There was, however, no indication of multi-dimensionality of the FIES, since there were no significant correlations between any three adjacent items of between 0.25 and 0.40 (**Table 4.7**).

***Severity order of FIES items***

The severity level of FI measured by the items was assessed through the proportions of respondents affirming each item, and by examining the relative order of the severity parameters of the items in logit scale. The overall LAS item severity parameters ranged from -0.83 to 1.90 (2.73 logits), and a similar range was found in most countries with few exceptions (**Table 4.8 and Figure 4.1**). The observed severity level of FI measured by items 1 - 5 was different from the level of FI they were designed to measure, which indicates disordering of the items in most of the countries, and in the aggregated LAS data. Items measuring more severe FI; "hungry" and "whlday," performed as expected in most cases. Since the relative disordering of the item severity was reasonably similar across the LAS countries, this indicates that severe FI was experienced similarly in the LAS.

Nevertheless, the proportion of respondents affirming items measuring more severe FI, items 6-8, were lower than the proportion of affirmative responses to items measuring less severe FI, except for Syria and Somalia (**Table 4.9 and Figure 4.2)**. As the severity of the item increased, the proportion of affirmative responses decreased. For instance, about 63% of the population reported being worried about having enough food, while 16% of the population reported going hungry for the whole day (**Figure 4.3)**. However, among the items measuring less severe FI, the item "fewfood" had the highest affirmative responses in most of the countries. Also, the order of severity of FI measured by the items "ateless" and "skipped" were reversed in some countries, and the items "skipped" and "ateless" were also reversed in some countries (**Figure 4.3)**.

It is worth mentioning that the proportions of missing responses to any of the eight FIES questions were less than 5% for all countries except for Syria. No single item stood out as having consistently higher proportions of missing responses. Having higher percentages of missing responses to any of the FIES items compared to others may indicate difficulty in understanding the question. Syria had the highest number of missing one or more of the FIES items (**Table 4.10, Figure 4.4**).

***Regional and countries threshold***

The robust calibration procedure of Rasch modeling indicated the raw scores to be meaningful measures of severity of FI in each country **(Figure 4.5)**. Subsequently, the raw scores were stratified into three categories: food secure (0-3), moderately FI (4-6), and severely FI (7-8). The thresholds of moderate and severe FI for each country are shown in **Figure 4.6** where each country's adjusted raw score parameter is plotted against the regional one. In most countries examined, the threshold for moderate FI was 4, but the threshold for severe FI was 7 except for Sudan, Syria, and Yemen, where the severe FI threshold was 8.

***Prevalence and characteristics of severe food insecure individuals by HDI***

Overall, 30.4% of respondents experienced moderate and severe FI, and 15.7% experienced severe FI. There was a wide variation in the prevalence of severe FI across the LAS countries, ranging from 1.8% in Lebanon to 83.1% in South Sudan **(Table 4.11 and Figure 4.7)**. Countries with political unrest had the highest prevalence of severe FI; including South Sudan, Somalia, Iraq, Sudan, and Palestinian Territories **(Figure 4.7)**. Adults aged 50 years and older were at significantly higher risk of severe FI than younger adults (6.5% and 15.5% respectively, $p<0.02$) and women higher than men (17.6% and

14.1%, respectively, p<0.0001) **(Table 4.12)**. Analyses stratified by HDI showed that countries with low HDI and low PSAVT score had the highest prevalence of severe FI (24.9% and 32.2%, respectively, p<0.0001) compared to countries with high HDI and high political score (8.3% and 6.8%, respectively, p<0.0001).

Overall, severe FI was significantly more prevalent among married individuals, rural residents, those with lower educational attainment, unemployed, lower income and larger households with more children and in low PSAVT countries (**Table 4.12**). These patterns were similar by HDI categories although the magnitudes of risks were higher in low HDI countries. Also, there were no significant differences in the prevalence of FI, by employment status, for individuals in countries with low HDI or marital status in countries with high HDI. The results of the logistic regression analysis showed that lower educational attainment, lower income, lower PSAVT score, and greater numbers of children were most significantly associated with severe FI in countries in both HDI levels. However, living in rural areas (compared to urban ones) was associated with severe FI in countries with high HDI only, while employment was associated with severe FI in low HDI countries (**Table 4.13)**.

**Discussion**

This study used Rasch modeling to assess the internal validity of FIES in measuring FI in the LAS. Overall, based on the reliability scores, the fit statistics, and the correlations of item residuals, the FIES met the assumption of equal discrimination and conditional independence; hence has satisfactory psychometric properties and is thus valid for use in the LAS region but with some caveats.

The high infits for the items "worried," in Sudan and the items "healthy," and "whlday" in Syria suggest that these items are weakly associated with FI in these countries. In contrast, the low infit for the items “worried” and “runout” in Syria highly indicate possible redundancy of one of these items, that is, they may be measuring the same level of FI. Nevertheless, the high and low infits in Sudan and Syria may be attributed to the small non-extreme sample sizes, which provide less precise estimates due to the potential to inflate margins of error of the infit statistic [39]. Thus, for these two countries, further testing is recommended in larger samples. Larger samples may decrease the effect of the erratic responses or measurement errors, and improve infit values for the specific problematic items [41, 150, 155]. Infit statistics in the range of 1.3 to 1.5, such as in Sudan, indicate that the item still can be used, but improvements are recommended [6]. Improvements can be made through cognitive testing to ensure that respondents understand the questions as intended.

High outfit values were observed for the item "whlday” in several countries. Similar results of high outfits for the item “whlday” were reported in the validation study for the FIES in SSA [153] and by FAO-VoH in the global 2014 GWP data [150]. This high outfit for the item “whlday” in these countries may have resulted from the high proportion of affirmed responses to going without food for the whole day, resulting in subsequent exclusion of these responses from the Rasch analysis, leading to less precise estimates [153]. These results suggest that some respondents gave unlikely responses for this item based on their answers to other items, meaning that they may not have been their real experiences. The item “whlday” may require cognitive testing in LAS. This is also true for the items "worried" and “healthy” in some countries, to ensure that the

questions are understood as intended, and to improve the wording of the questions, if necessary. Nevertheless, since high item outfits may be due to a small proportion of erratic responses, and given the observed good infit statistics for these items, these high outfits may not be indicative of any violation of the Rasch assumptions or cause a threat to the validity of the FIES.

Our results also show that the FIES is unidimensional, measuring the one construct of FI. The correlations between residuals of some items in Algeria, Tunisia, and Lebanon may be explained by the fact that these countries were highly food secure, with a large number of extreme values (zeros) and so the data were excluded from the Rasch analysis. Further testing should be done when more data become available, and cognitive testing may be required for these items to ensure that they do not measure the same experience.

Our results indicate that there are some inconsistencies in the conceptual order of the severity of FI measured by some items. In particular, a shift in the order of the three items measuring the less severe levels of FI. The item "fewfood" was found to measure the least severe level of FI instead of the item "worried" as conceptualized in FIES. A possible explanation for this finding may be related to religious and fatalistic beliefs of people in the LAS region that God will provide and so there is no need to worry. Similarly, the high response to the item eat "fewfood" may also represent cultural eating patterns in some countries of this region and may not necessarily be an indication of FI. Nevertheless, since all the LAS countries showed the same disordering of these items, it indicates consistency of FIES in measuring FI in this region. This disordering did not affect the overall measurement of FI in this study since the least three items were

categorized similarly as food secure. To overcome the limitation of the disordering of the items we examined the FI as a dichotomous variable as food secure and moderate FI versus severe FI. Nevertheless, these items also may need to be cognitively tested.

Our study found a high prevalence of severe FI in the LAS (15.7%) than in other geographical classification of the region. For example, using FIES, FAO report of the NENA region, showed a severe FI prevalence of 9.5% in 2014-2015 [22] and 10.3% in the WANA region in 2014-2015 [48]. These different prevalence rates may be due to the different countries that are included in these regional surveys. Our study found that the aggregated prevalence of severe FI from 2014 to 2017 is quite varied in individual countries of the LAS region. Additionally, the overall prevalence of FI in this region should be considered provisional and explained with caution since a wide variation in economic status characterizes the LAS region and also due to small samples in some countries. Different patterns of FI emerged when countries were grouped by economic level. Our study showed that as the level of income, HDI, or political score falls, the prevalence of severe FI increases. The same pattern was also reported in the 2018 and 2020 FAO report [49, 149].

Country-level prevalence of severe FI also varied by political stability, indicating a need for an in-depth assessment of the determinants of severe FI, tailored interventions, and continued monitoring of FI in this region. The politically unstable countries of Iraq, South Sudan, Somalia, and Syria had the highest prevalence of severe FI. Although assessing FI in real-time is difficult, such surveys may provide the best possible snapshot at the time of conflict; however, it might change in the course of new conflict dynamics. In this study, Yemen had a lower level of severe FI, which might be due to a sampling

error due to active conflict in the country; however, the prevalence of combined moderate and severe FI was quite high. These results may also be quite different in the present circumstances due to the ongoing war and pandemic. Similarly, the prevalence of combined moderate and severe FI was 46.7% and severe FI was 20% in Sudan. Therefore, the high prevalence of FI in this country might be due to the prolonged conflict, with resultant environmental degradation, and poverty that increases the risk of FI [159]. Sudan is one of the wealthiest countries in Africa in terms of natural resources, but the majority (80%) of the population depend on agricultural activity for their livelihood [160]. In conflict situations, many factors may exacerbate FI and malnutrition and their consequences. Conflict impacts access to and utilization of food, water, and health care, leading to malnutrition.

Individuals with severe FI were characterized by lower educational attainment, lower incomes, unemployment, rural residence, and having more than three children in the household. These findings were not surprising since these characteristics are associated with resource access and have been reported in previous studies conducted in different countries of the LAS region [12, 16, 22-24, 26-28, 99]. FI was more prevalent in women compared to men, irrespective of HDI. However, women in high HDI had a lower risk of severe FI compared to those living in low HDI countries, which might be due to better educational and employment opportunities and potentially due to social services available in high HDI countries. Estimates of FI in other regions of the world, by gender, also point to a gender gap according to the FAO report, and the prevalence of FI is higher among women in every continent [149]. Given the primary role women play in the households as caretakers, producing and preparing food, FI may hinder them from

having time for jobs outside of the home, leading to a vicious cycle of poverty and FI. Future studies of women and older adults of that region may inform policies targeted to these vulnerable groups.

The strengths of our study include the use of large nationally representative samples from 19 countries of the LAS, which allow for the generalizability of the results to that region. Also, using the same instrument to assess FS in this study allows for comparison across countries and populations and within countries over time. FIES is an easy tool to use which allows for real-time monitoring and generation of FS information that may guide actions and interventions. Limitations of this study are related to the cross-sectional study design which does not allow for inference of causality of FI and responses may be biased due to self-reported data. Qualitative studies can provide additional information to better understand the causes of FI in that region.

In conclusion, there exists a common threshold for severe FI for adults in LAS using FIES. These results indicate that FI is experienced similarly across the LAS with few exceptions, and it is comparable across countries and populations of that region. Cognitive testing is recommended for certain questions of the FIES tool to possibly guide the improvement of items that are correlated and those with high outfit statistics. Additionally, a closer examination of the order of FIES items for LAS is warranted. The disordering of the severity level of FI measured by some items observed in this study, indicates that the items may need to be reordered to better measure the least severe category of FI. At a regional level, FIES is recommended for use especially for comparative purposes to other regions of the world. However, country-based surveys may be better served by using locally developed and tested instruments.

## Table 4.1: Questions of the Food Insecurity Experience Scale (FIES).

| During the last 12 months, was there any time when … : | | | | |
|---|---|---|---|---|
| **Questions** | | **Label** | **Domains of FI construct** | **Assumed severity of FI** |
| Q1 | You were worried you would not have enough food to eat because of a lack of money or other resources? [a] | WORRIED | Uncertainty and worry about food | Mild |
| Q2 | You were unable to eat healthy and nutritious food because of a lack of money or other resources? | HEALTHY | Inadequate food quality | Mild |
| Q3 | You ate only a few kinds of foods because of a lack of money or other resources? | FEWFOOD | Inadequate food quality | Mild |
| Q4 | You had to skip a meal because there was not enough money or other resources to get food? | SKIPPED | Insufficient food quantity | Moderate |
| Q5 | You ate less than you thought you should because of a lack of money or other resources? | ATELESS | Insufficient food quantity | Moderate |
| Q6 | Your household ran out of food because of a lack of money or other resources? | RUNOUT | Insufficient food quantity | Moderate |
| Q7 | You were hungry but did not eat because there was not enough money or other resources for food? | HUNGRY | Insufficient food quantity | Severe |
| Q8 | You went without eating for a whole day because of a lack of money or other resources? | WHLDAY | Insufficient food quantity | Severe |

[a] "Other resources" is used in all the questions to make it suitable for respondents who usually acquire food in ways other than purchasing it with money. Interviewers are trained to emphasize the expression "because of a lack of money or other resources" to avoid receiving affirmative responses due to other reasons such as dieting or fasting [39].

**Table 4.2: Unique items after calibration procedure.**

| LAS Countries | Items | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | WORRIED | HEALTHY | FEWFOODS | SKIPPED | ATELESS | RUNOUT | HUNGRY | WHLDAY |
| **Algeria** | | | | | | FALSE | | FALSE |
| **Bahrain** | FALSE | | | FALSE | | | | |
| **Egypt** | FALSE | | | | | FALSE | | |
| **Iraq** | FALSE | FALSE | | | | FALSE | | |
| **Jordan** | | | | | | | | |
| **Kuwait** | FALSE | | | FALSE | | | | |
| **Lebanon** | FALSE | FALSE | | | FALSE | | | |
| **Libya** | FALSE | FALSE | | | | | | |
| **Mauritania** | FALSE | | FALSE | FALSE | | | | |
| **Morocco** | | | | | | | | |
| **Palestine territories** | | | | | | | | |
| **Saudi Arabia** | FALSE | FALSE | | FALSE | | | | |
| **Somalia** | FALSE | | | FALSE | | FALSE | | |
| **South Sudan** | FALSE | | | | | FALSE | FALSE | |
| **Sudan** | | | | FALSE | | | FALSE | |
| **Syria** | | FALSE | FALSE | | FALSE | FALSE | FALSE | FALSE |
| **Tunisia** | | | | | | FALSE | FALSE | FALSE |
| **United Arab of Emirates** | FALSE | FALSE | | | | | | |
| **Yemen** | | | | FALSE | | | | |

Note: FALSE is the unique items that was identified during the calibration procedure by comparing the relative positions of item severity parameters of each country to the regional standard metric.

**Table 4.3: Thresholds of food insecurity (FI) in each country of the League of Arab States (LAS).**

| LAS Countries | Level of FI | |
|---|---|---|
| | Moderate FI | Severe FI |
| Algeria | 4-6 | 7-8 |
| Bahrain | 4-6 | 7-8 |
| Egypt | 4-6 | 7-8 |
| Iraq | 4-6 | 7-8 |
| Jordan | 4-6 | 7-8 |
| Kuwait | 4-6 | 7-8 |
| Lebanon | 4-6 | 7-8 |
| Libya | 4-6 | 7-8 |
| Mauritania | 4-6 | 7-8 |
| Morocco | 4-6 | 7-8 |
| Palestine territories | 4-6 | 7-8 |
| Saudi Arabia | 4-6 | 7-8 |
| Somalia | 4-6 | 7-8 |
| South Sudan | 4-6 | 7-8 |
| Sudan | 4-7 | 8 |
| Syria | 4-7 | 8 |
| Tunisia | 4-6 | 7-8 |
| United Arab of Emirates | 4-6 | 7-8 |
| Yemen | 4-7 | 8 |

**Table 4.4: Sociodemographic and economic characteristics of respondents, Gallop World Poll (GWP) surveys 2014 to 2017.**

| Variables | n = 62,261 | Weighted percent |
|---|---|---|
| **Age** | | |
| Young adults (19-49 year) | 49,894 | 80.9 |
| Older adults (≥ 50 years) | 12,367 | 19.1 |
| **Gender** | | |
| Male | 33,958 | 54.3 |
| Female | 28,303 | 45.7 |
| **Education** | | |
| <9 years of education | 20,943 | 40.9 |
| High school education | 19,090 | 31.0 |
| ≥ 1 year of college | 22,116 | 28.1 |
| **Marital status** | | |
| Married or with a domestic partner | 41,553 | 65.1 |
| Single (never married, divorced, separated, widowed) | 20,640 | 34.9 |
| **Employment status** | | |
| Employed | 32,657 | 51.2 |
| Unemployed | 29,604 | 48.8 |
| **Residence** | | |
| Urban (live in a large city or suburb of a large city) | 36,786 | 58.1 |
| Rural (live in a rural area, in a farm, or in a small town or village) | 24,604 | 41.9 |
| **Household composition** | | |
| Households with ≤ 6 members | 43,316 | 66.1 |
| Households with > 6 members | 18,945 | 33.9 |
| Households with 0- 3 children | 50,249 | 80.6 |
| Households with ≥ 4 children | 12,012 | 19.4 |
| **Residents by Human development Index (HDI) categories** | | |
| Very High/High HDI countries | 34,072 | 55.4 |
| Low/Very Low HDI countries | 28,189 | 44.6 |
| **Food security status** | | |
| Secure or moderately insecure | 53,246 | 84.3 |
| Severely food insecure | 9,015 | 15.7 |

**Table 4.5: Item fit statistics[1, 2] by countries of the League of Arab States (LAS), Gallop World Poll (GWP) surveys 2014 and 2015.**

| | WORRIED | | HEALTHY | | FEWFOOD | | SKIPPED | | ATELESS | | RUNOUT | | HUNGRY | | WHLDAY | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Infit** | **Outfit** | **Infit** | **Outfit** | **Infit** | **Outfit** | **Infit** | **Outfit** | **Infit** | **Outfit** | **Infit** | **Outfit** | **Infit** | **Outfit** | **Infit** | **Outfit** |
| **LAS** | 1.13 | 1.37 | 1.06 | 1.10 | 0.95 | 1.01 | 1.00 | 1.03 | 0.85 | 0.78 | 0.95 | 0.95 | 0.82 | 0.77 | 1.15 | 1.68 |
| **Algeria** | 0.82 | 0.78 | 1.26 | 1.33 | 0.95 | 0.95 | 0.87 | 0.82 | 1.03 | 0.97 | 0.81 | 0.66 | 0.88 | 0.74 | 1.25 | **2.51** |
| **Bahrain** | 1.19 | 1.11 | 1.21 | 1.25 | 0.87 | 0.78 | 0.95 | 0.92 | 0.84 | 0.84 | 0.90 | 0.84 | 0.78 | 0.53 | 1.30 | **2.53** |
| **Egypt** | 1.02 | 1.02 | 1.09 | 1.42 | 0.97 | 1.21 | 0.97 | 0.98 | 0.93 | 0.89 | 0.99 | 1.22 | 0.90 | 0.90 | 0.99 | 1.01 |
| **Iraq** | 1.19 | 1.37 | 1.07 | 1.02 | 1.01 | 1.13 | 0.99 | 0.92 | 0.80 | 0.72 | 0.87 | 0.77 | 0.86 | 0.78 | 1.20 | 1.68 |
| **Jordan** | 1.03 | **2.79** | 1.01 | 0.80 | 0.92 | 0.93 | 1.01 | 1.04 | 0.87 | 0.83 | 0.93 | 1.23 | 0.83 | 0.75 | 1.20 | 0.90 |
| **Kuwait** | 1.16 | 1.28 | 1.15 | 1.23 | 0.96 | 1.02 | 0.95 | 0.96 | 0.83 | 0.78 | 1.06 | 1.15 | 0.88 | 0.85 | 0.93 | 0.79 |
| **Lebanon** | 1.12 | 1.35 | 1.00 | 1.11 | 1.06 | 1.01 | 1.02 | 1.02 | 1.03 | 1.01 | 0.99 | 0.91 | 0.80 | 0.82 | 0.84 | 0.57 |
| **Libya** | 1.13 | 1.17 | 1.04 | 1.11 | 0.97 | 1.01 | 0.93 | 0.91 | 0.98 | 0.96 | 1.00 | 1.02 | 0.87 | 0.78 | 1.10 | 1.05 |
| **Mauritania** | 0.93 | 0.85 | 1.08 | 1.18 | 1.21 | 1.44 | 1.06 | 1.01 | 0.91 | 0.83 | 0.77 | 0.75 | 0.91 | 0.79 | 1.13 | 1.01 |
| **Morocco** | 1.21 | 1.29 | 0.96 | 0.95 | 0.92 | 1.97 | 1.01 | 1.00 | 0.91 | 0.79 | 0.95 | 0.87 | 0.83 | 0.70 | 1.09 | 0.77 |
| **Palestine territories** | 1.04 | 0.84 | 1.03 | **2.85** | 0.94 | 0.71 | 0.96 | 0.86 | 0.87 | 0.66 | 1.07 | 0.93 | 0.80 | 1.21 | 1.12 | **4.34** |
| **Saudi** | 1.18 | 1.18 | 1.06 | 0.98 | 0.89 | 0.88 | 0.92 | 0.89 | 0.92 | 0.95 | 0.88 | 0.79 | 0.89 | 0.95 | 1.26 | 1.82 |
| **Somalia** | 1.03 | 1.03 | 1.14 | 1.23 | 1.01 | 0.95 | 0.95 | 0.90 | 0.79 | 0.68 | 0.97 | 0.95 | 0.88 | 0.79 | 1.23 | 1.61 |
| **South Sudan** | 1.21 | 1.33 | 0.97 | 0.81 | 0.77 | 0.52 | 1.17 | 1.34 | 0.78 | 0.69 | 1.00 | 1.01 | 0.92 | 0.88 | 1.07 | 1.16 |
| **Sudan** | **1.48** | **2.08** | 1.15 | 1.72 | 0.90 | 0.98 | 0.89 | 0.70 | 0.70 | 0.51 | 0.92 | 0.89 | 0.79 | 0.63 | 1.05 | 1.05 |
| **Syria** | 0.61 | 0.48 | **1.51** | **2.22** | 0.96 | 0.87 | 1.03 | 1.12 | 1.08 | 1.21 | 0.63 | 0.53 | 0.71 | 0.56 | **1.44** | 1.65 |
| **Tunisia** | 1.21 | 1.61 | 1.04 | 1.20 | 0.84 | 0.75 | 0.90 | 0.92 | 0.73 | 0.64 | 0.97 | 1.10 | 0.88 | 0.67 | 1.33 | **2.23** |
| **UAE[3]** | 1.06 | 1.14 | 1.02 | 0.94 | 0.88 | 0.91 | 1.01 | 0.96 | 0.80 | 0.71 | 1.07 | 1.15 | 0.92 | 0.76 | 1.29 | 1.86 |
| **Yemen** | 0.97 | 1.72 | 1.03 | **2.01** | 0.96 | 0.72 | 1.09 | 1.21 | 0.92 | 0.80 | 0.98 | 0.79 | 0.79 | 0.61 | 1.09 | **3.19** |

[1] *Infit* item-infit mean square statistic, *Bolded* Item-infit >1.4;
[2] *Outfit* item-outfit mean square statistic, *Bolded* item outfit >2.0 [3] UAE: United Arab Emirate

**Table 4.6: Non-extreme sample and the reliability of the Food Insecurity Experience Scale (FIES), Gallop World Poll (GWP) surveys 2014 and 2015.**

| | n (complete, non-extreme)[1] | Modified reliability |
|---|---|---|
| **Grouped sample** | | |
| LAS | 5,740 | 0.71 |
| **Individual countries** | | |
| Algeria | 207 | 0.71 |
| Bahrain | 277 | 0.70 |
| Egypt | 376 | 0.72 |
| Iraq | 535 | 0.70 |
| Jordan | 302 | 0.74 |
| Kuwait | 272 | 0.70 |
| Lebanon | 180 | 0.71 |
| Libya | 433 | 0.70 |
| Mauritania | 340 | 0.70 |
| Morocco | 432 | 0.75 |
| Palestine territories | 337 | 0.77 |
| Saudi Arabia | 370 | 0.69 |
| Somalia | 387 | 0.69 |
| South Sudan | 407 | 0.69 |
| Sudan | 345 | 0.73 |
| Syria | 225 | 0.69 |
| Tunisia | 162 | 0.71 |
| UAE[2] | 243 | 0.70 |
| Yemen | 568 | 0.77 |

[1] Sample size excluding those with FIES total scores 0 and 8
[2] UAE: United Arab Emirate

**Table 4.7: League of Arab States (LAS) countries with high residual correlations between FIES items.**

| Items | Country (r) | |
|---|---|---|
| | **HUNGRY** | **WHLDAY** |
| **RUNOUT** | Algeria (0.44)<br>Tunisia (0.42) | |
| **HUNGRY** | | Lebanon (0.42) |

**Table 4.8: The overall item severity parameters, and item fit statistics of the League of Arab States (LAS), Gallop World Poll (GWP) surveys 2014 to 2017.**

| Item | Severity ± SE[1] | Infit[2] | Outfit[3] |
|---|---|---|---|
| **WORRIED** | -0.83 ± 0.08 | 1.13 | 1.37 |
| **HEALTHY** | -0.82 ± 0.08 | 1.06 | 1.10 |
| **FEWFOOD** | -0.97 ± 0.08 | 0.95 | 1.01 |
| **SKIPPED** | -0.09 ± 0.08 | 1.00 | 1.03 |
| **ATELESS** | -0.34 ± 0.08 | 0.85 | 0.78 |
| **RANOUT** | 0.30 ± 0.08 | 0.95 | 0.95 |
| **HUNGRY** | 0.83 ± 0.10 | 0.82 | 0.77 |
| **WHLDAY** | 1.90 ± 0.14 | 1.15 | 1.68 |

[1] Severity parameter of the FIES items. The calibrations were estimated on a logit scale (with equal discrimination=1), mean set to 0, and SD of 1.

[2] Infit, item-infit mean square statistic

[3] Outfit, item-outfit mean square statistic

**Table 4.9: Weighted proportion of affirmative responses to the Food Insecurity Experience Scale (FIES) by countries.**

| Affirmative responses (weighted %)* | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **LAS Countries** | **WORRIED** | **HEALTHY** | **FEWFOOD** | **SKIPPED** | **ATELESS** | **RUNOUT** | **HUNGRY** | **WHLDAY** |
| **Algeria** | 117.4 | 100.8 | 119.6 | 59.2 | 74.96 | 26.1 | 29.1 | 28.7 |
| **Bahrain** | 18.96 | 19.8 | 23.4 | 19.2 | 18.6 | 16.7 | 10.7 | 7.5 |
| **Egypt** | 33.7 | 29.7 | 28.7 | 24.2 | 23.3 | 17.94 | 16.99 | 11.9 |
| **Iraq** | 45.7 | 46.5 | 50.9 | 44.99 | 44.99 | 43.6 | 36.9 | 20.3 |
| **Jordan** | 34.8 | 35.2 | 32.6 | 28.4 | 27.3 | 24.1 | 20.7 | 14.9 |
| **Kuwait** | 12.2 | 14.6 | 17.1 | 14.6 | 13.4 | 10.7 | 9.5 | 5.5 |
| **Lebanon** | 10.8 | 10.1 | 8.4 | 6.0 | 5.4 | 5.0 | 3.5 | 2.4 |
| **Libya** | 30.2 | 29.5 | 35.5 | 29.2 | 31.3 | 24.9 | 19.3 | 12.6 |
| **Mauritania** | 33.6 | 27.2 | 20.9 | 20.3 | 27.3 | 20.2 | 17.1 | 12.4 |
| **Morocco** | 37.2 | 35.8 | 39.9 | 27.4 | 28.7 | 20.2 | 12.1 | 5.9 |
| **Palestine Territories** | 37.8 | 37.3 | 38.4 | 30.6 | 30.7 | 27.3 | 17.2 | 10.8 |
| **Saudi Arabia** | 21.9 | 22.0 | 28.0 | 25.9 | 23.99 | 18.6 | 17.5 | 8.5 |
| **Somalia** | 42.8 | 48.4 | 44.9 | 34.7 | 45.3 | 44.8 | 37.8 | 28.1 |
| **South Sudan** | 87.4 | 89.2 | 89.7 | 85.5 | 87.2 | 82.9 | 85.6 | 78.0 |
| **Sudan** | 44.8 | 47.6 | 48.2 | 44.2 | 44.6 | 33.9 | 37.3 | 22.0 |
| **Syria** | 47.5 | 27.8 | 35.3 | 29.3 | 36.4 | 45.1 | 42.8 | 28.1 |
| **Tunisia** | 22.4 | 20.9 | 20.0 | 16.98 | 18.1 | 14.5 | 14.9 | 13.4 |
| **UAE** | 15.5 | 15.4 | 19.9 | 16.4 | 15.2 | 11.1 | 10.2 | 9.2 |
| **Yemen** | 56.1 | 58.1 | 57.4 | 32.8 | 44.9 | 33.7 | 22.4 | 10.6 |

* Percent affirmative responses (%) of all individuals
Abbreviation: UAE: United Arab of Emirates.

**Table 4.10: Proportion of missing responses of each Food Insecurity Experience Scale (FIES) items.**

| LAS Countries | Food Insecurity Experience Scale items | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | WORRIED | HEALTHY | FEWFOOD | SKIPPED | EATLESS | RUNOUT | HUNGRY | WHOLDAY |
| **Algeria** | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 | 0.0 | 0.1 |
| **Bahrain** | 0.2 | 0.4 | 0.2 | 0.2 | 0.4 | 0.5 | 0.3 | 0.2 |
| **Egypt** | 0.1 | 0.2 | 0.1 | 0.2 | 0.2 | 0.3 | 0.3 | 0.4 |
| **Iraq** | 0.5 | 0.7 | 0.4 | 0.6 | 0.8 | 0.4 | 0.5 | 0.4 |
| **Jordan** | 0.0 | 0.2 | 0.3 | 0.1 | 0.3 | 0.3 | 0.3 | 1.1 |
| **Kuwait** | 0.2 | 0.2 | 0.2 | 0.1 | 0.3 | 0.4 | 0.2 | 0.1 |
| **Lebanon** | 1.0 | 1.0 | 1.0 | 1.1 | 1.0 | 1.0 | 1.3 | 1.7 |
| **Libya** | 0.1 | 0.1 | 0.3 | 0.1 | 0.3 | 0.1 | 0.2 | 0.1 |
| **Mauritania** | 1.1 | 1.6 | 2.1 | 2.0 | 2.2 | 2.1 | 2.1 | 2.1 |
| **Morocco** | 0.2 | 0.8 | 0.3 | 0.2 | 0.3 | 0.2 | 0.1 | 0.0 |
| **Palestine territories** | 0.1 | 0.3 | 0.2 | 0.1 | 0.2 | 0.0 | 0.1 | 0.1 |
| **Saudi Arabia** | 0.4 | 0.3 | 0.5 | 0.1 | 0.2 | 0.6 | 0.5 | 0.4 |
| **Somalia** | 2.3 | 2.2 | 3.2 | 2.8 | 3.6 | 3.0 | 3.0 | 5.7 |
| **South Sudan** | 1.1 | 1.4 | 1.2 | 0.6 | 1.6 | 1.6 | 1.2 | 1.6 |
| **Sudan** | 4.1 | 3.8 | 3.8 | 4.5 | 5.0 | 4.2 | 4.2 | 4.4 |
| **Syria** | 15.4 | 35.1 | 33.8 | 37.7 | 25.9 | 18.4 | 26.5 | 37.0 |
| **Tunisia** | 0.6 | 1.2 | 1.3 | 1.0 | 2.0 | 0.9 | 1.3 | 1.7 |
| **UAE** | 0.2 | 0.2 | 0.2 | 0.2 | 0.4 | 0.5 | 0.4 | 0.6 |
| **Yemen** | 0.6 | 0.7 | 0.7 | 0.6 | 0.9 | 0.7 | 0.7 | 0.6 |

Abbreviation: UAE: United Arab of Emirates.

**Table 4.11: Prevalence of Severe Food Insecurity in Each Country of the League of Arab States.**

| LAS Countries | Prevalence of severe food insecurity (SFI) in each country | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 2014 | | 2015 | | 2016 | | 2017 | | 2014-17 | |
| | Total n | SFI (n/%) | Total n | SFI (n/%) | Total n | SFI (n/%) | Total n | SFI (n/%) | Total sample | Overall SFI (n/%) |
| **Egypt** | 898 | 99 (12.2) | 915 | 95 (12.4) | 927 | 133 (15.2) | 925 | 158 (15.7) | 3,665 | 485 (13.9) |
| **Morocco** | 903 | 129 (12.7) | 965 | 68 (6.2) | 915 | 89 (8.2) | 898 | 138 (14.6) | 3,681 | 424 (10.4) |
| **Lebanon** | 891 | 16 (2.3) | 914 | 16 (2.1) | 911 | 15 (1.9) | 951 | 8 (1.0) | 3,667 | 55 (1.8) |
| **Saudi Arabia** | 941 | 73 (10.5) | 930 | 60 (7.2) | 893 | 51 (7.6) | 961 | 81 (9.7) | 3,725 | 265 (8.8) |
| **Jordan** | 888 | 170 (20.3) | 860 | 163 (20.1) | 892 | 117 (14.4) | 888 | 163 (17.3) | 3,528 | 613 (18.0 |
| **Syria** | 0 | 0 | 241 | 27 (9.9) | 0 | 0 | 0 | 0 | 241 | 27 (9.94) |
| **Palestinian** | 874 | 126 (16.9) | 903 | 122 (15.9) | 892 | 100 (13.9) | 878 | 114 (15.8) | 3,547 | 462 (15.6) |
| **Mauritania** | 817 | 40 (5.7) | 824 | 80 (9.2) | 761 | 155 (22.1) | 755 | 128 (18.1) | 3,157 | 403 (13.5) |
| **Algeria** | 921 | 8 (0.8) | 0 | 0 | 899 | 103 (14.0) | 872 | 93 (12.2) | 2,692 | 204 (8.9) |
| **Bahrain** | 956 | 56 (7.1) | 946 | 59 (6.2) | 933 | 61 (7.3) | 1023 | 61 (6.9) | 3,858 | 237 (6.9) |
| **Iraq** | 934 | 145 (22.03) | 947 | 185 (25.5) | 954 | 175 (24.5) | 931 | 209 (27.5) | 3,766 | 714 (24.9) |
| **Kuwait** | 935 | 43 (4.6) | 953 | 30 (2.7) | 961 | 40 (4.9) | 970 | 37 (4.3) | 3,819 | 150 (4.1) |
| **Libya** | 0 | 0 | 971 | 90 (10.6) | 958 | 80 (11.9) | 945 | 127 (17.4) | 2,874 | 297 (13.2) |
| **Somalia** | 748 | 180 (25.3) | 835 | 289 (34.6) | 972 | 420 (41.3) | 0 | 0 | 2,555 | 889 (34.5) |
| **Sudan** | 867 | 154 (19.9) | 0 | 0 | 0 | 0 | 0 | 0 | 867 | 154 (19.9) |
| **Tunisia** | 934 | 88 (9.2) | 886 | 119 (13.6) | 903 | 144 (16.3) | 908 | 106 (11.8) | 3,631 | 457 (12.7) |
| **UAE** | 944 | 29 (3.4) | 1,815 | 92 (6.9) | 1,779 | 62 (4.7) | 1,740 | 47 (4.5) | 6,278 | 230 (5.1) |
| **Yemen** | 870 | 65 (6.8) | 877 | 80 (9.2) | 880 | 100 (13.2) | 848 | 60 (7.2) | 3,475 | 305 (9.1) |
| **South Sudan** | 789 | 575 (76.8) | 830 | 672 (83.6) | 801 | 707 (88.3) | 815 | 690 (83.7) | 3,235 | 2644 (83.1) |
| **Total** | 15,110 | 1996 (14.6) | 15,612 | 2247 (15.5) | 16,231 | 2552 (17.1) | 15,308 | 2220 (15.6) | 62,261 | 9015 (15.7) |

Abbreviation: UAE: United Arab of Emirates.

**Table 4.12: Sociodemographic and economic characteristics of severe Food Insecure (FI) respondents, by Human Development Index (HDI) and within-group comparisons[1], Gallop World Poll (GWP) surveys 2014 to 2017.**

| Characteristics | Overall | | High HDI[2] | | Low HDI[3] | |
|---|---|---|---|---|---|---|
| | n | weighted % | n | weighted % | n | weighted % |
| **Food insecurity** | 9,015 | 15.7 | 2,508 | 8.3*** | 6,507 | 24.9*** |
| **Age group** | | | | | | |
| Younger adult (19 years to 49) | 7,167 | 15.5* | 1,971 | 8.1* | 5,196 | 25.1 |
| Older adult (50+) | 1,848 | 16.5 | 537 | 9.3 | 1,311 | 24.1 |
| **Gender** | | | | | | |
| Men | 4,320 | 14.1*** | 1,330 | 7.6*** | 2,990 | 23.8** |
| Women | 4,695 | 17.6 | 1,178 | 9.4 | 3,517 | 25.9 |
| **Education** | | | | | | |
| <9 years of education | 5,811 | 26.9*** | 906 | 14.9*** | 4,905 | 32.1*** |
| High school education | 2,146 | 10.9 | 984 | 8.8 | 1,162 | 14.8 |
| ≥ 1 year of college | 1,034 | 4.8 | 614 | 4.3 | 420 | 6.8 |
| **Marital status** | | | | | | |
| Married or with a domestic partner | 6,331 | 16.9*** | 1,582 | 8.3 | 4,749 | 26.6*** |
| Single (never married, divorced, separated, widowed) | 2,677 | 13.6 | 922 | 8.4 | 1,755 | 21.2 |
| **Employment** | | | | | | |
| Employed | 3,976 | 13.2*** | 1,156 | 6.7*** | 2,820 | 24.9 |
| Unemployed | 5,039 | 18.3 | 1,352 | 8.7 | 3,687 | 24.8 |
| **Residence** | | | | | | |
| Urban (live in a large city or suburb of a large city) | 3,620 | 10.8*** | 1,564 | 7.2*** | 2,056 | 18.4*** |
| Rural (live in a rural area, in a farm, or in a small town or village) | 5,348 | 22.9 | 901 | 11.6 | 4,447 | 29.4 |
| **Household composition** | | | | | | |
| Households with ≤ 6 members | 5,317 | 12.5*** | 1,744 | 7.1*** | 3,573 | 22.0*** |
| Households with > 6 members | 3,698 | 22.0 | 764 | 12.3 | 2,934 | 28.2 |
| Household with 0- 3 children | 6,145 | 12.6*** | 2,071 | 7.7*** | 3,870 | 20.5*** |
| Household with ≥ 4 children | 3,074 | 28.5 | 437 | 13.8 | 2,637 | 35.0 |
| **Income quintile** | | | | | | |
| Lowest | 2,786 | 26.8*** | 962 | 17.8*** | 1,824 | 38.0*** |
| Second | 2,078 | 18.8 | 614 | 10.5 | 1,824 | 29.1 |
| Middle | 1,693 | 14.4 | 449 | 6.9 | 1,244 | 23.7 |
| Fourth | 1,375 | 11.1 | 283 | 4.1 | 1,092 | 19.7 |
| Highest | 1,083 | 7.8 | 200 | 2.6 | 883 | 14.2 |
| **Political score (PSAVT)[4]** | | | | | | |
| Low | 5,547 | 25.2*** | 352 | 6.8*** | 5,195 | 32.2*** |
| Medium | 1,648 | 10.2 | 1,163 | 9.3 | 485 | 13.9 |
| High | 1,820 | 9.3 | 993 | 8.0 | 827 | 11.8 |

[1] chi-square tests were used to evaluate the distributions

[2]High HDI includes Lebanon, Saudi Arabia, Jordan, Algeria, Bahrain, Kuwait, Libya, Tunisia, and United Arab Emirates.

[3]Low HDI includes Egypt, Morocco, Syria, Palestine Territories, Mauritania, Iraq, Somalia, Sudan, Yemen, and South Sudan.

[4]Political Stability and the Absence of Violence and Terrorism:

1) Low: Syria, Lebanon, Palestine Territories, Iraq, Somalia, Sudan, Libya, Yemen, and South Sudan.
2) Medium: Egypt, Saudi Arabia, Algeria, Bahrain, and Tunisia.
3) High: Morocco, Jordan, Mauritania, Kuwait, and the United Arab Emirates.

*Significantly different at $p \leq 0.05$

**Significantly different at $p \leq 0.01$

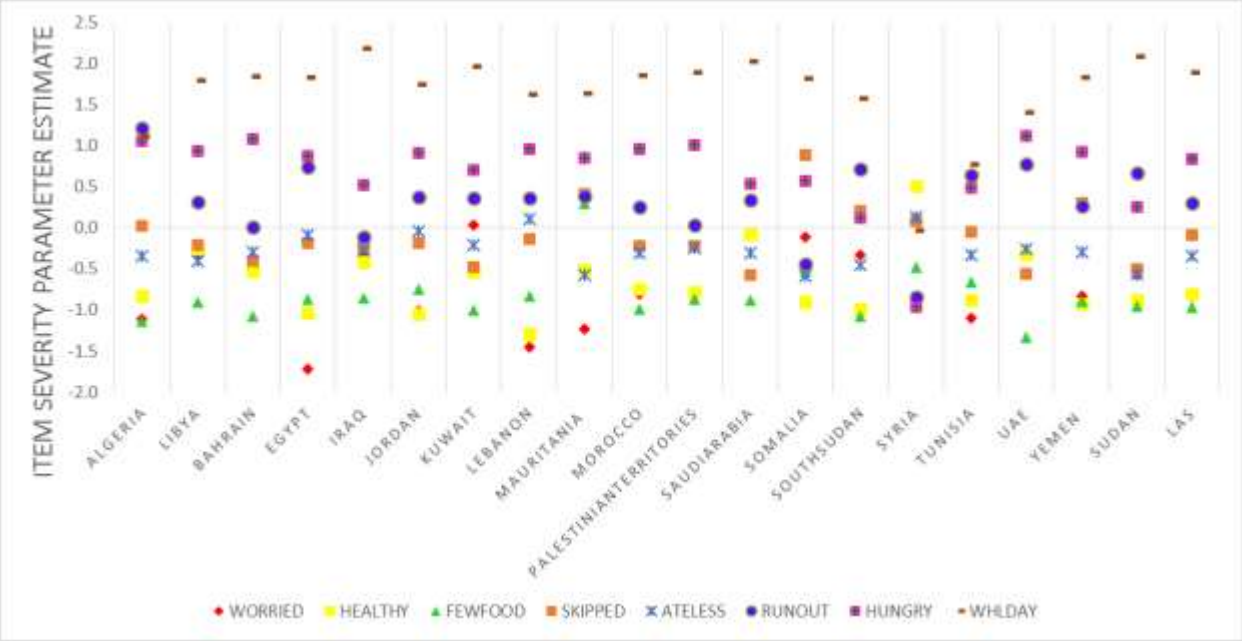
***Significantly different at $p \leq 0.0001$

**Table 4.13: Multivariate associations of sociodemographic and economic characteristics with severe Food Insecurity in League of Arab States (LAS) by Human Development Index (HDI).**

| Characteristics | High HDI countries[1] | | | Low HDI countries[2] | | |
|---|---|---|---|---|---|---|
| | Model 1[3] | Model 2[4] | Model 3[5] | Model 1[3] | Model 2[4] | Model 3[5] |
| | OR (95% CI) | | | OR (95% CI) | | |
| **Age** | | | | | | |
| Young adults (19-49 year) | 1 | | | 1 | | |
| Older adults (≥ 50 years) | 0.83 (0.75-0.93) | 1.05 (0.95-1.16) | 1.09 (0.98-1.21) | 0.97 (0.89-1.05) | 1.11 (1.02-1.19) | 1.13 (1.04-1.22) |
| **Gender** | | | | | | |
| Male | 1 | | | 1 | | |
| Female | 1.04 (0.96-1.12) | 1.00 (0.92-1.08) | 1.02 (0.94-1.10) | 1.05 (0.99-1.12) | 1.04 (0.97-1.11) | 1.13 (1.06-1.21) |
| **Marital status** | | | | | | |
| Married or with a domestic partner | 1 | | | 1 | | |
| Single (never married, divorced, separated, widowed) | 1.04 (0.95-1.13) | 0.98 (0.90-1.07) | 1.05 (0.96-1.15) | 1.04 (0.97-1.12) | 0.92 (0.85-1.00) | 0.96 (0.89-1.03) |
| **Place of Residence** | | | | | | |
| Urban (live in a large city or suburb of a large city) | 1 | | | 1 | | |
| Rural (live in a rural area, in a farm, or in a small town or village) | 1.53 (1.40-1.66) | 1.63 (1.50-1.77) | 1.38 (1.27-1.51) | 1.09 (0.92-1.17) | 1.25 (0.97-1.34) | 1.00 (0.93-1.07) |
| **Household composition** | | | | | | |
| Number of children | 1.04 (1.00-1.08) | 1.06 (1.02-1.10) | 1.11 (1.06-1.16) | 1.10 (1.05-1.16) | 1.11 (1.06-1.16) | 1.15 (1.09-1.21) |
| Number of adults | 0.99 (0.95-1.03) | 0.99 (0.95-1.03) | 1.05 (1.01-1.10) | 0.99 (0.95-1.04) | 0.99 (0.94-1.04) | 1.04 (0.98-1.09) |
| **Education** | | | | | | |
| <9 years of education | 1 | | | 1 | | |
| High school education | 1.99 (1.82-2.18) | | | 2.01 (1.81-2.23) | | |
| ≥ 1 year of college | 3.86 (3.43-4.33) | | | 3.63 (3.29-4.01) | | |
| **Employment status** | | | | | | |
| Employed | | | | | | |
| Unemployed | | 1.24 (0.93-1.34) | | | 1.39 (1.29-1.49) | |
| **Income quintile** | | | | | | |
| Poorest | | | 10.38 (8.89-12.12) | | | 9.51 (8.45-10.71) |
| Second | | | 5.22 (4.49-6.08) | | | 6.52 (5.82-7.32) |
| Middle | | | 3.28 (2.82-3.82) | | | 3.44 (3.08-3.84) |
| fourth | | | 1.87 (1.59-2.19) | | | 2.20 (1.97-2.45) |
| Highest | | | 1 | | | 1 |
| **Political score (PSAVT)[6]** | | | | | | |
| Low | 3.63 (2.94-4.49) | 4.86 (3.95-5.99) | 7.51 (6.01-9.38) | 3.62 (2.60-5.04) | 3.18 (2.35-4.29) | 5.00 (3.66-6.83) |
| Medium | 1.51 (1.21-1.89) | 2.77 (2.24-3.44) | 3.45 (2.75-4.32) | 1.40 (0.19-10.15) | 1.95 (0.32-11.77) | 1.21 (0.19-7.75) |
| High | 1 | 1 | 1 | 1 | 1 | 1 |

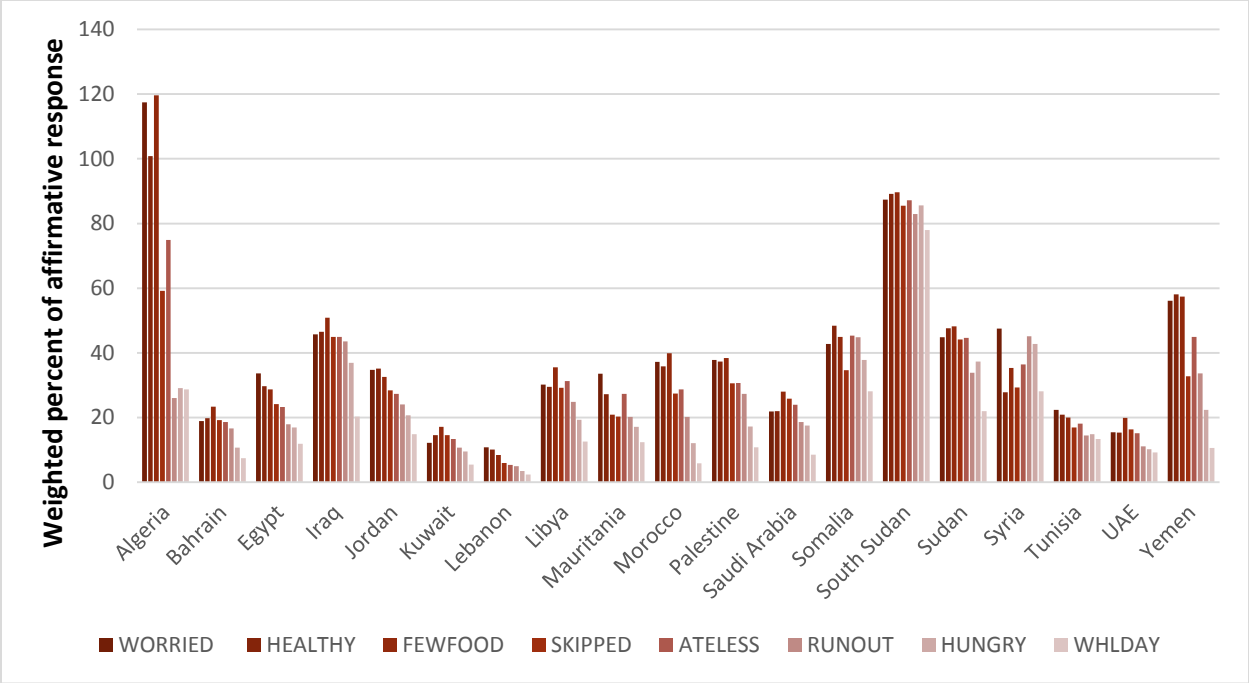
[1]High HDI includes Lebanon, Saudi Arabia, Jordan, Algeria, Bahrain, Kuwait, Libya, Tunisia, and United Arab Emirates.
[2]Low HDI includes Egypt, Morocco, Syria, Palestine Territories, Mauritania, Iraq, Somalia, Sudan, Yemen, and South Sudan.
[3]Model 1= Adjusted for age, gender, marital status, Place of residence, number of children, number of adults, education, and PSAVT
[4]Model 2= Adjusted for age, gender, marital status, Place of residence, number of children, number of adults, employment, and PSAVT
[5]Model 3= Adjusted for age, gender, marital status, Place of residence, number of children, number of adults, income quintile, and PSAVT
[6]Political Stability and the Absence of Violence and Terrorism:
1) Low: Syria, Lebanon, Palestine Territories, Iraq, Somalia, Sudan, Libya, Yemen, and South Sudan.
2) Medium: Egypt, Saudi Arabia, Algeria, Bahrain, and Tunisia.
3) High: Morocco, Jordan, Mauritania, Kuwait, and the United Arab Emirate.

**Figure 4.1: Relative severity order of the Food Insecurity Experience Scale (FIES) items in the League of Arab States (LAS) and individual countries, Gallop World Poll (GWP) surveys 2014 and 2015.**




Abbreviation: UAE: United Arab of Emirates.

**Figure 4.2: Weighted proportion of affirmative responses to the Food Insecurity Experience Scale (FIES) items by countries, Gallop World Poll (GWP) surveys 2014 and 2015.**




Abbreviation: UAE: United Arab of Emirates.

**Figure 4.3: Proportion of affirmative response to Food Insecurity Experience Scale (FIES) items in the League of Arab States (LAS) region, Gallop World Poll (GWP) surveys 2014 and 2015.**

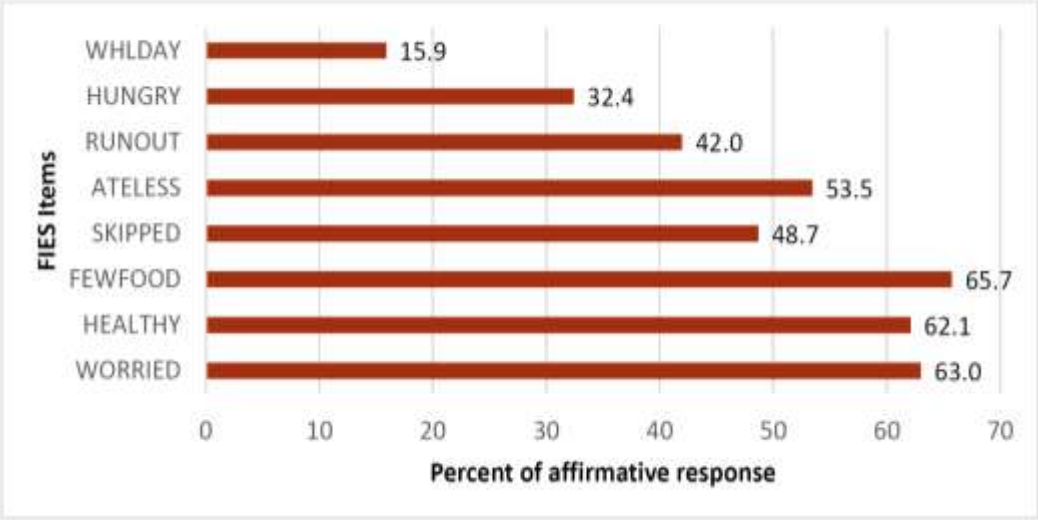
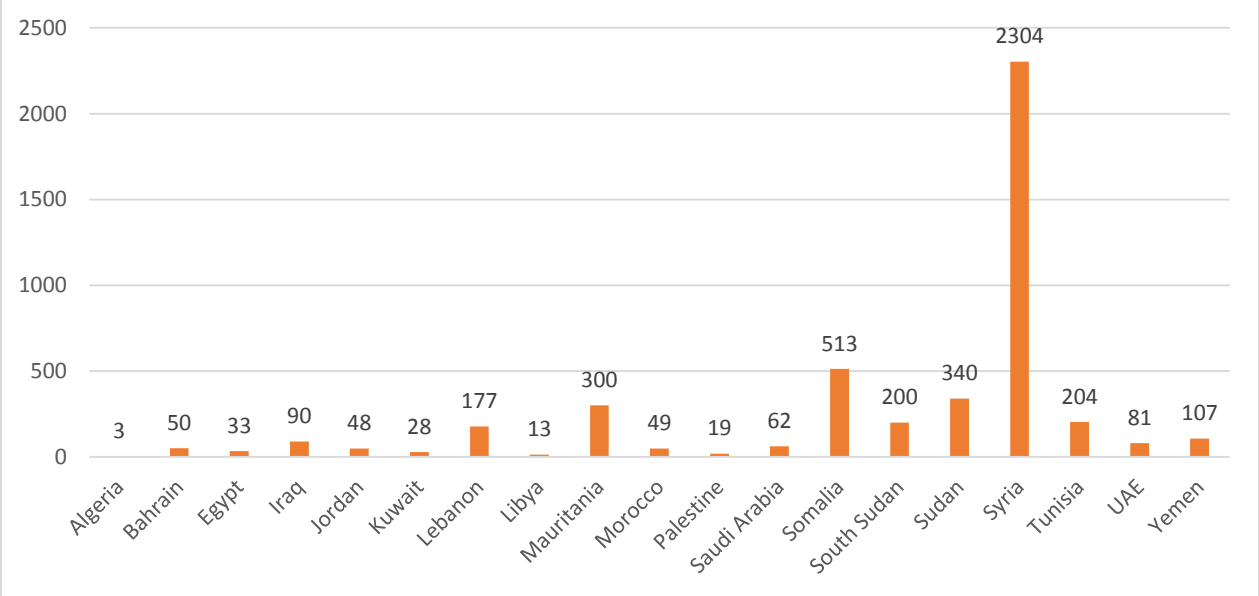
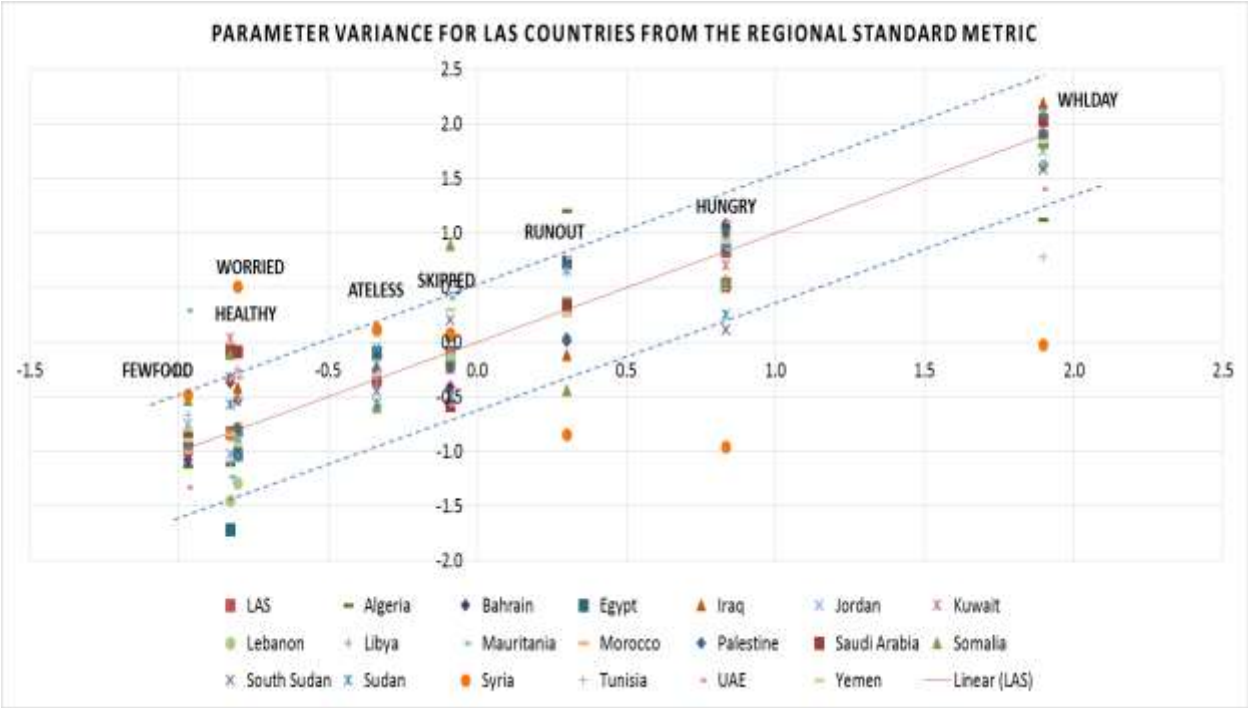



**Figure 4.4: Total number of missing one or more of the FIES items.**



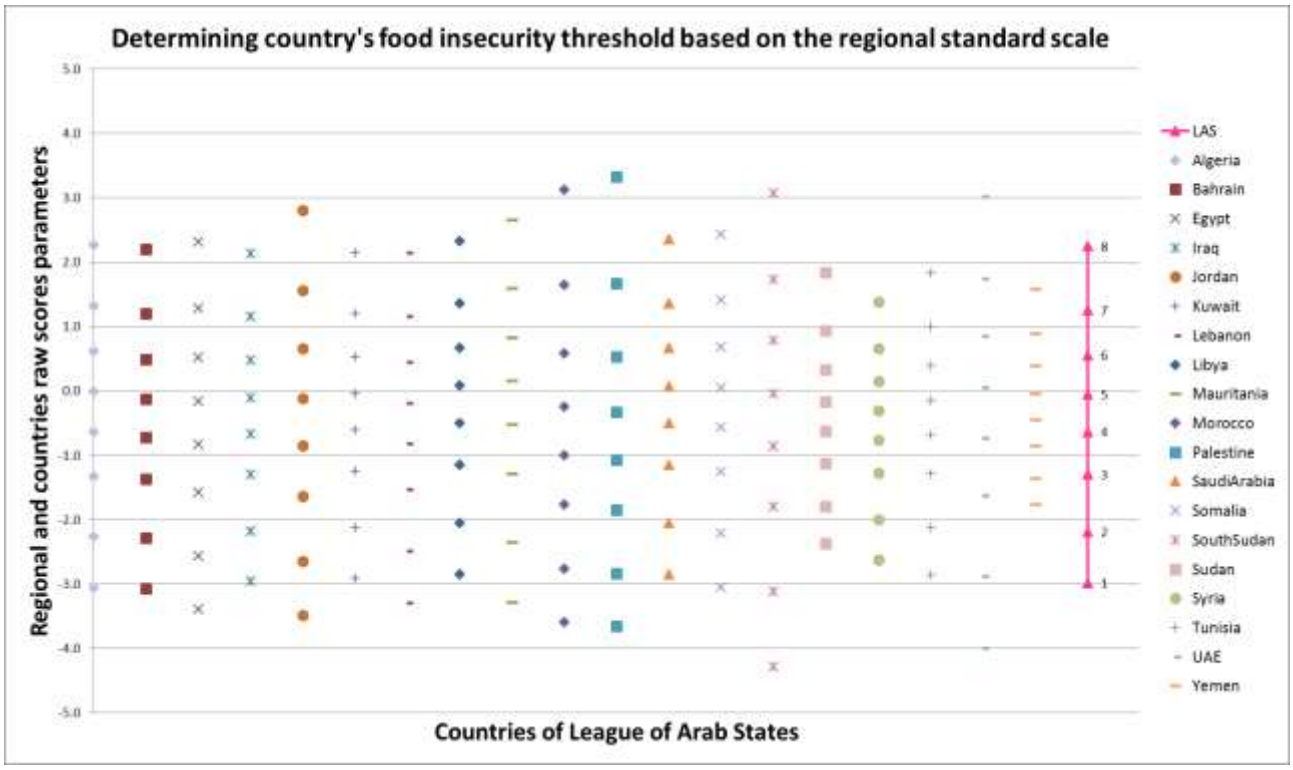

Abbreviation: UAE: United Arab of Emirates.

**Figure 4.5: Parameter variance for League of Arab States (LAS) Countries from the LAS regional Standard Metric.**



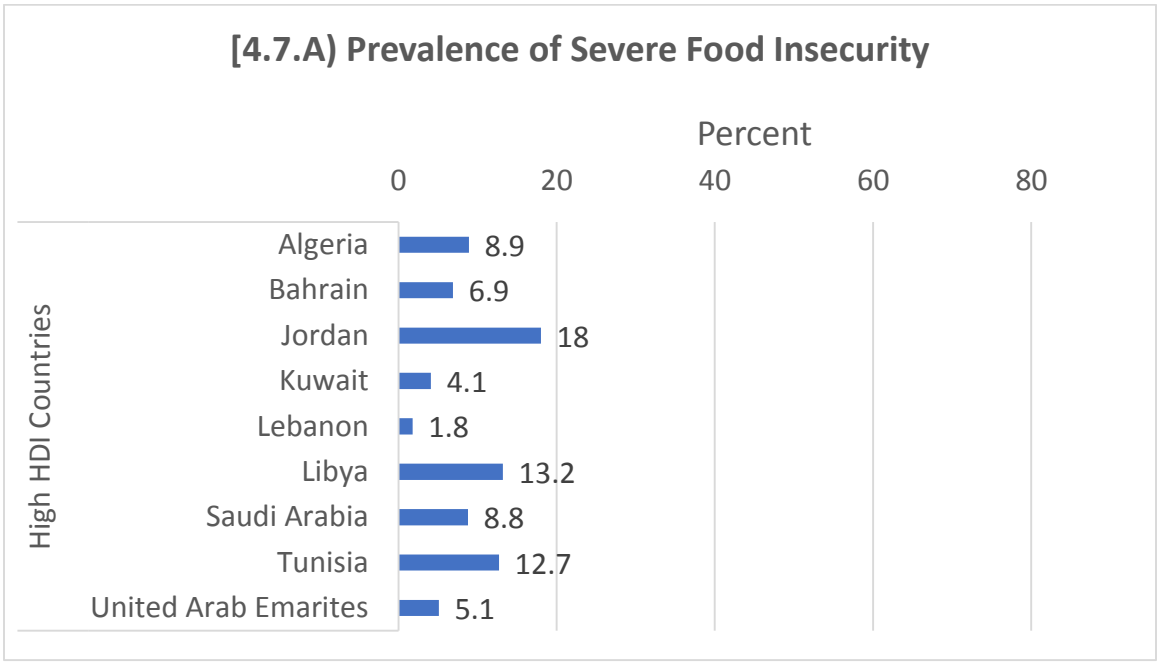

Abbreviation: UAE: United Arab of Emirates.

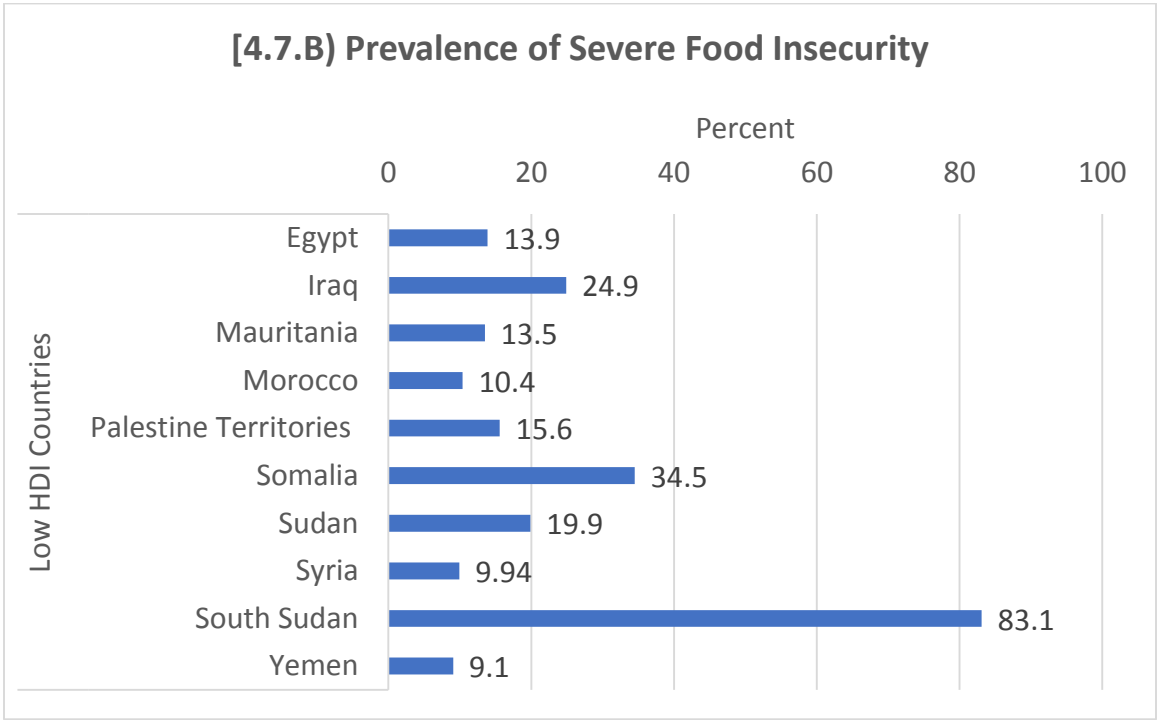
**Figure 4.6: Food Insecurity (FI) thresholds for each country of the League of Arab States (LAS) compared to the regional scale, Gallop World Poll (GWP) surveys 2014 and 2015.**




Abbreviation: UAE: United Arab of Emirates.

**Figure 4.7A and 4.7B: Country-based prevalence of severe Food Insecurity (FI) by Human Development Index (HDI) countries, Gallop World Poll (GWP) surveys 2014 to 2017. (A) Countries with high HDI, and (B) Countries with low HDI.**



## B) The Association between Food Security, Physical Health and Mental well-being in the League of Arab States.


**Abstract**

**Background** Food insecurity (FI) contributes to various stress-related physical and mental well-being issues, these associations have never been assessed in the League of Arab States (LAS).

**Objective** To 1) determine the relationship between FI, physical and mental well-being by sex, 2) stratified by gender inequality (GII), determine the relationship between FI, physical and mental well-being among women, controlling for social support.

**Methods** Gallup World Poll (GWP) 2014-2017 data of adults19 years and older (n=62,261) from 19 LAS countries were used in these analyses. Multivariate logistic regression was used to examine these associations, p value set at 0.05 significance level. To measure FI status we included data from the Food Insecurity Experience Scale (FIES). Physical health was assessed using the physical health index. The positive experience index and negative experience index were used as indicators for mental well-being. We classified seven social support items into emotional, and instrumental and embedded support using principal component analysis. The final model was stratified by the 2017 GII for each country.

**Results** Severe FI was more prevalent among women than men (17.6% versus 14.1%, respectively, $p<0.0001$). For both men and women, low income and high negative experience were positively associated with severe FI, while good physical health and high positive experience were negatively associated with severe FI. Older age, living in rural areas, and living in households with a high dependency ratio were also associated with higher odds of severe FI in women. For women in both high and low GII countries,

"having someone to count on" was associated with lower odds of severe FI, while "having opportunities to make friends" was associated with lower odds of FI for women in both high and low GII countries, when adjusting for positive experience. In high GII countries, "having someone to rely on" was associated with lower odds of severe FI, while receiving money or goods was associated with higher odds of severe FI in low GII countries.

**Conclusion** FI may lead to poor physical and mental well-being in both sexes. Social support appears to reduce the risk of FI in women and should be a component of assessment and monitoring. Given the limited evidence supporting specific social support interventions, future research is needed to better understand its important role in relation to physical health and mental well-being, particularly among food-insecure populations.

**Keywords:** The Food Insecurity Experience Scale; physical health; mental well-being; positive experience, negative experience, social support; Gallup World Poll; and League of Arab States, and women.

## Introduction

Food insecurity (FI), the lack of regular access to enough, safe and nutritious food [161], is a growing and persistent concern in the world [49]. The global prevalence of severe FI increased from 688.5 million people in 2016 to 750 million people in 2019 [48, 49]. FI is associated with a diverse set of nutrition- and non-nutrition-related health outcomes such as micronutrient insufficiency and poor physical health [25, 84, 87, 88, 90, 94-96, 99, 114, 162-164]. FI is also associated with poor mental well-being [16, 83, 86, 163-166], including depression, anxiety, and somatoform disorders [87, 115, 167-

169]. Additionally, feelings of anxiety about obtaining enough food may lead to negative psychological outcomes such as shame, stigma, isolation, and socially unacceptable food behaviors [84, 165, 170-172].

This is of particular concern in women as they tend to be at higher risk of FI, and poor mental health than men [16, 49, 166, 169, 173-175]. In 2014, women in Arab countries were 2.5 percentage points more likely than men to experience a moderate and higher level of FI [173]. The magnitude of the gender gap in FI may vary across regions, however, to our knowledge, this has not been examined in the LAS region.

Poor mental well-being and the vulnerability of women to FI may be attributed to gender inequality, such as, higher unemployment and lower educational attainment compared to men, conditions that are highly prevalent in Arab countries [111, 173]. To measure gender inequality, the Gender Inequality Index (GII), was developed by the United Nations Development Program (UNDP) to assess the loss in potential human development due to disparity between female and male achievements. The GII scores each country based on three dimensions; 1) reproductive health measured by maternal mortality rate, and adolescent fertility rate; 2) empowerment measured by the percentage of men and women aged 25 years and older with at least some secondary education, and the proportion of parliamentary seats occupied by women; and 3) labor market participation measured by the percentage of men and women aged 15 years and older in the labor force [111]. Compared to non-Arab countries, gender inequality in Arab countries was found to be highly variable due to large differences in per capita income [4].

Although poverty and gender inequality are underlying causes of FI, there are multiple complex conditions that may exacerbate or modify these associations. One such factor is social support, which may play an important role in the experience of FI. Social support can be examined as perceived and/or received support [176], categorized as intentionally or unintentionally provided, or categorized based on its function as emotional (reassurance, empathy, and listening), instrumental (material resources like money, tools, and goods), informational (advice, guidance), companionship (a sense of belonging), and validation (feedback about one's status in relation to others) [176]. A few studies have assessed this association between social support and FI but the variables and measurements used varied between studies. In the US, Martin *et al.* found that having someone to trust and good social networks were associated with lower household FI [128]. Similarly, in Zimbabwe, having a good social network and receiving remittances were found to be associated with lower household FI among older adults as head of households [177]. Another study conducted in Iran among rural households found that perceived social support measured using a 12-item Multidimensional Perceived Social Support Scale was found to be protective against FI [178]. In Texas, Dean *et.al.* found that both perceived social capital and perceived personal disparity, which measures the personal experience of respondent's well-being in relation to people within their community, were important and associated with lower FI regardless of area of residence [125]. However, these associations were never examined in the LAS region where there may be different cultural norms.

In this study, using a representative sample of individual-level data from 19 countries in the LAS region and collected across four years (2014-17), we 1) assessed FI

by sex 2) examined the associations between FI and physical health and mental well-being by sex, and 3) determined in a sub-sample of women in high versus low GII countries, whether these associations were attenuated by social support.

## Methods

### Study design

Data for this study were obtained from four years of GWP cross-sectional surveys (2014-2017). GWP is a survey of a civilian, non-institutionalized population of individuals aged ≥15 years. It has a complex survey design and is conducted annually in more than 150 countries and territories to obtain information on individual's perceptions, opinions, and experiences. Details of the surveys are available elsewhere [139]. In brief, data are collected using two-stage probability sampling. In the first stage, clusters of households are identified based on probabilities proportional to population size or random sampling, depending on the availability of population information. Then, these clusters are stratified by population size and geographic location. Households within each cluster and individuals within each household are then randomly selected in separate stages using age information and Kish's grid method. The questionnaire is administered through one-hour face-to-face interviews if the country has less than 80% telephone coverage; otherwise, 30-minute telephone calls are used from typically 1,000 respondents in each country per survey year [154]. This study, used data collected from 19 countries of the LAS. Excluding respondents aged less than 19 years (n= 5,852), those with missing age (n=24), and those with missing responses to any of the FIES questions (n=8,008), our sample was comprised of 62,261 individuals. An informed consent was

collected from each survey participants and the survey protocols were approved by the required governing bodies of each country [179].

## Measures

### *Socioeconomic variables*

The GWP questionnaire included information on sex, age (19-59 versus 60+ years), marital status (married and domestic partner versus never married, divorced, separated or widowed), area of residence (rural or small farm, small town or village versus large city or suburb of a large city), household size, and the number of children aged under 15 in the household. Also collected was education and employment. To account for the diverse national classifications of education across the countries and make them comparable, GWP categorized educational attainment as 1) eight years of primary education, 2) secondary or high school completion, and 3) one or more years of a college education. Employment status was categorized as employed or self-employed full time, or part-time, versus unemployed, or out of workforce. Household income per capita was collected by asking respondents to report their income from all sources in the local currency. Total household income was then converted into international dollars (ID) using the World Bank's purchasing power parity conversion factor [139, 154]. Finally, per capita income in ID was derived by dividing income by household headcount. Income was examined as a quintile. An independence ratio variable was created as the number of children aged under 15, relative to household size.

### *Food security variables*

The GWP also collected FS information using the Food Insecurity Experience Scale (FIES), developed by the Voices of the Hungry Project of the United Nations' Food

and Agriculture Organization (FAO) [180]. FIES is a psychometric scale composed of eight questions ranging from mild to severe indicators of FI with simple dichotomous responses of "Yes" or "No" (**Table 4.14**). Respondents were asked about FI ranging from whether they were "worried about not having enough food to eat" to whether they had gone "hungry for a whole day" due to lack of money or other resources at any time during the previous 12 months. Responses to the FIES questions yield a total score of 0 to 8. Based on calculated regional and country-based FI thresholds of the LAS region, the FS status of individuals in this study was classified into three categories: food secure, with scores 0-3; 2) moderate FI, with scores 4-6; and 3) severe FI, with scores 7-8 [181]. These scores were slightly different for Sudan, Syria, and Yemen in that the score for moderate FI was 4-7 and the score for severe FI was 8. In our study, FS and moderate FI were combined for the analysis.

***Physical health and mental well-being variables***

The GWP assessed physical health using the Physical Health Index (PHI). The PHI assesses the respondent's perception of their health status and is composed of five questions that inquire about whether the respondent has any health problems, feels well-rested, or experiences any physical pain, worry, or sadness. GWP also measured mental well-being status using two five-item scales. The first scale is the Negative Experience Index (NEI), which dichotomously measures the presence of physical pain, worry, sadness, stress, and anger (yes vs. no) experienced on the day preceding the interview. The other scale is the Positive Experience Index (PEI), which dichotomously assesses respondents' experienced well-being in terms of whether the respondent felt well-rested,

was treated with respect, smiled or laughed, learned or did something interesting, and felt enjoyment (yes vs. no) on the day before the survey.

All three indices were scored by giving a 1 to yes responses and a zero to all other responses, including "don't know" and "refused." The mean scores of the five questions were calculated and multiplied by 100 [10]. The final scores ranged from 0 to 100, in increments of 20, with a higher score (60-100) indicating good physical health, higher positive experience, and higher negative experience while a lower score (0-40) indicated poor physical health, lower positive experience, and lower negative experience. Experiencing low positive experiences and high negative experiences is an indication of poor mental well-being. Items with a missing response were excluded from the calculation and the index was calculated only if at least four out of five questions were answered.

***Social support variables***

Six questions administered by the GWP were used to capture aspects of social support, including whether the respondent 1) had relatives or friends to count on to help whenever they needed them and 2) was satisfied with the opportunities to meet people and make friends in the city or area where they lived. Two questions, which used a five-point Likert scale (from 1=strongly disagree to 5 = strongly agree) asked whether someone in their life 3) always encouraged them to be healthy and 4) gave them positive energy every day. Respondents were also asked if they 5) had relatives or friends living in another country on whom they could count on and 6) received help in the form of money or goods from another individual living inside the country, in another country, both, or neither in the past 12 months. All questions were treated as dichotomous

variables (yes or no); responses of "strongly agree" and "agree" were coded as "yes" while all the other responses as "no." Finally, using age and the number of adults in the household, we created a living arrangement variable, which classified individuals as living alone versus living with another adult (embedded social support) [**Table 4.15)**. Social support was collected only on a sub-sample of the population (n=11,393). The remaining sample had missing information on several of the social support questions from individuals in both high and low GII countries and from both phone and face-to-face interviews. To rule out bias due to missing data, we assessed the differences in characteristics between those with and without missing social support data and examined the associations between severe FI, and physical health and mental well-being among women in both groups.

***Gender inequality index (GII)***

Gender inequality was examined using country-level GII scores. The higher the GII score, the higher the gender inequality. Using the 2017 GII scores, mean GII scores were calculated for the LAS region excluding countries with missing values (Somalia, South Sudan, and Palestine territories). LAS countries with GII scores below the region's mean were classified as low GII and those with scores at or above the region mean were classified as high GII (**Table 4.16**). Countries with missing GII values were added to the high GII countries since some of the available indicators, such as maternal mortality, adolescent birth, the share of seats in parliament, and labor force participation, which were used in calculating the index, were relatively similar to the values of the countries classified as high GII countries. In 2017 Libya had the best score in the LAS (0.170), whereas Switzerland had the best score (0.037) internationally [111].

**Statistical analysis**

Differences in characteristics between men and women were tested using t-tests for continuous variables and chi-square tests for categorical variables. Multivariate logistic regression analysis, stratified by sex, were used to assess the associations of FI with physical health and mental well-being. In the sub-sample of women with social support data, multivariate logistic regression analysis were used to examine whether social support components (emotional, instrumental, and embedded), attenuated the observed relationships stratified by the high and low GII categories.

Principal component method was used as exploratory analysis to examine the clustering of the seven social support variables. Six of the social support variables were derived from the GWP dataset and one was created. This exploratory analysis showed significant clustering factors and indicated that the seven items measured two dimensions of social support based on the factor loading pattern as shown in **Figure 4.8**. Two of the item had a negative factor loading, however, since the analysis was not meant to calculate the score but to examine the clustering, these items are still considered to belong to that factor.

One of the dimensions was emotional support, which included the following items: 1) having opportunities to make friends, 2) having someone who encourages you to be healthy, 3) having someone giving you positive energy, and 4) having someone inside your country to count on. The second dimension was instrumental and embedded support, which included 1) having people out of the country to rely on, 2) receiving money or goods, and 3) living with other adults (**Table 4.15**).

Data were analyzed using SAS (version 9.4; SAS Institute Inc., Cary, NC). All the regression models were adjusted for potential confounding variables, including age, marital status, place of residence, independence ratio, and income quintile. All the analyses were adjusted for complex survey design using the sample weights, cluster and strata, and used country and survey year as fixed effects. All the associations were considered statistically significant at $p<0.05$.

## Results

### *Characteristics of the study population by sex*

The study included 28,303 (45.7%) women and 33,958 (54.3%) men. A significantly larger proportion of women lived in rural areas compared to men (44.1% versus 40.0%). Also, women lived in larger households than men (6.0 ± 0.02 versus 5.7 ± 0.02, respectively), and in households with a higher independence ratio compared to men. Women had significantly fewer years of education, higher unemployment (71.6% versus 29.7% for women and men, respectively), and significantly lower income (p-value <.0001). Compared to men, a significantly higher prevalence of women reported poor physical health (34.4% versus 26.6%, p-value <.0001), higher negative experience (35.8% versus 29.8%, p-value <.0001), and lower positive experience (67.0% versus 70.5%) (p-value <.0001). Severe FI was significantly more prevalent in women (17.6%) than men (14.1%), (p-value <.0001) (**Table 4.17**).

### *Sociodemographic, physical health, and mental well-being characteristics associated with severe FI among men and women.*

In sex-stratified multivariate logistic regression analysis adjusted for socioeconomic and demographic variables, older women compared to younger women

were at higher odds of severe FI (OR 1.28, 95% CI 1.09-1.51). This relationship remained significant when controlled for the positive and negative experience, but became insignificant once adjusted for physical health. In contrast, older men were at significantly lower odds of severe FI compared to younger men only when adjusted for physical health (OR 0.80, 95% CI 0.69-0.94). Women living in rural settings were at higher odds of severe FI compared to those living in urban ones, even after adjusting for confounders and physical health (OR 1.18, 95% CI 1.07-1.31) positive experience (OR 1.17, 95% CI 1.06-1.30), and negative experiences (OR 1.20, 95% CI 1.09-1.33). This relationship only approached significance in men. Women but not men, living in households with high independence ratios were also at significantly higher odds of being food insecure. Finally, in both sexes, severe FI increased monotonically with a decrease in income. When added to the models, men and women with high negative experience had higher odds of severe FI, while those with good health and high positive experience had lower odds of severe FI even when adjusting for all the sociodemographic variables (**Table 4.18**). The regression model indicated that more than 70% of the variance could be explained by the independent variables, which indicates good model fit.

***Sociodemographic and physical health, and mental well-being characteristics associated with severe food insecurity in a subpopulation of women by gender inequality***

In a sub-sample of the population with complete data on social support, the prevalence of severe FI was higher among women living in high GII compared to those living in low GII (21.0% versus 6.6%, respectively, p-value<.0001). For women living in both high and low GII countries, the odds of severe FI was lower among women with

good physical health (OR 0.39, 95% CI 0.33-0.46, versus OR 0.26, 95% CI 0.18-0.37, respectively), high positive experiences (OR 0.47, 95% CI 0.39-0.55, versus OR 0.58, 95% CI 0.41-0.82, respectively), while high negative experiences were associated with higher odds of severe FI (OR 2.83, 95% CI 2.39-3.35 versus OR 4.43, 95% CI 3.08-6.37, respectively) **(Table 4.19)**. Although the magnitude of the associations was lower in women in low GII countries compared to those in high GII countries for physical health and higher for the negative experience, the associations with FI remained significant even after adjusting for the emotional, instrumental and embedded social support variables.

The associations between severe FI and emotional, instrumental, and embedded support variables were significant among women in countries with both a high and a low GII, with few differences. Adjusting for sociodemographic characteristics, physical health, positive experiences, and negative experiences, in high GII countries, both "having opportunities to make friends" and "having someone to count on" were associated with lower odds of severe FI. Similar associations were seen in low GII countries, for "having someone to count on", and was significant or approached significance in the association between FI and "having opportunities to make friends." Women, in countries with a high GII, who had people out of the country to rely on had significantly lower odds of severe FI even after adjusting for all variables. However, in countries with low GII, women who reported receiving money or goods were at higher odds of severe FI. In addition, women in low GII countries and who lived alone had a higher likelihood of experiencing FI. All the associations remained significant even after adjusting for the social support variables as shown in model 4, **Table 4.19**.

Characteristics of women with and without data on social support did not differ significantly in age, area of residence, employment status, household size, number of children, number of adults, and independence ratio. However, women with missing data in low GII countries had significantly higher levels of education. Although there were significant differences in physical health, positive and negative experiences and FS between women in high and low GII countries, regression analysis show that the associations between severe FI and physical health, positive experience, and negative experience were similar in both groups of women.

## Discussion

Using data from nationally representative surveys of 19 LAS countries, we examined factors associated with severe FI including physical health and mental well-being, stratified by sex. We also assessed whether these associations were attenuated by social support that women received in countries with high and low GII scores. Our results show that severe FI, controlling for socioeconomic variables, was associated with poor physical health, low positive experience and high negative experience in both men and women. These results are similar to those reported in other previous studies with no sex stratification. Elgar *et al.* using GWP data from 2014-2019 found that FI was negatively associated with mental health symptoms, lower positive well-being, and lower life satisfaction [179]. Other investigators using the same dataset, albeit different years, found similar relationships globally, and regionally [171, 182]. Cross-sectional study conducted in East Africa [103], and another one in Canada [183] showed that FI was associated with symptoms of depression and anxiety and chronic conditions [167]. Martin *et al.* investigated perceived stress among Canadian adults and found that as the level of stress increased, the severity of FI increased [172]. Siefert *et al.* in a longitudinal study also

found an association between FI and poor health and anxiety disorder in both white and African American women independent of socioeconomic status [163]. Such consistency of the associations across global regions suggest that this relationship applies across cultures.

Our study also showed that in a sub-sample of women, emotional social support slightly attenuated the association between severe FI and physical health and mental well-being with a higher magnitude of the attenuation shown for the association with a high positive experience, while instrumental and embedded social support showed no attenuation effect. This finding is consistent with previous research which showed that the availability of emotional social support may be protective against FI [170, 172, 184-187]. In addition, we also found that these associations differ between women in high and low GII countries, suggesting that the types of social support may vary according to the individual's needs and living situation.

This is also supported by results from previous research showing that emotional social support may be associated with greater well-being, while instrumental social support may be linked to a variety of poor physical and mental health outcomes [176]. Another study found that instrumental, but not emotional social support had a moderating effect in HIV-infected women with moderate or severe FI [185]. In Tanzania, a study on rural women found that instrumental social support was significantly associated with severe FI and that emotional support appeared to be more protective among the wealthier communities than the poorer ones [188]. Another cross-sectional study conducted by Siefert *et al.* [163] indicated that the effect of food insufficiency on depression may be attenuated with the availability of instrumental social support, while Ajrouch *et al.* [186]

found that this protective effect was decreased when respondents experienced high levels of FI-related stress. In another large cross-sectional study using Canadian data, Martin *et al.* found that the risk of mental illness is higher among individuals experiencing FI. However, this association was negative among those with strong feelings of community belonging [172].

On the other hand, Frongillo found contradictory results where neither emotional nor instrumental support modified the relationship between FI and subjective well-being [43]. However, this could be due to different measures for subjective well-being used in the Frongillo study, including the daily experience index and life evaluation index. In addition, Frongillo classified social support differently as he referred to instrumental support using only the question of whether the respondents "have relatives or friends to count on to help whenever they need them or not." Also, he used the following two questions to measure emotional support "Someone in your life always encourages you to be healthy" and "Your friends and family give you positive energy every day." While in our study all of these questions were under emotional support based on the results of our PCA.

Our study also found that lack of emotional social support, such as having no opportunities to make friends and no one to count on, was significantly associated with higher odds of severe FI regardless of the country's GII. Having someone you can count on may reduce anxiety and worry over future food availability, encouraging different positive behaviors. Also, emotional social support may allow individuals to feel more able and confident to invest in education, entrepreneurship, and other long-term measures

to improve FS [189]. Perceiving that one has others to count on may also indirectly impact one's ability to obtain food, such as having childcare and/or transportation [190].

In our study, receiving money or goods was paradoxically associated with a higher odds of severe FI in low GII countries. This finding is supported by a review that showed that receiving such support had mixed effects on physical and mental well-being depending on the appropriateness of the match between the stressor, such as being food insecure, and the kind of support provided [190]. Additionally, this type of support is usually received when one is worse off, or else the positive impact of the support is negated by feelings of shame or stigma. Social support may have its greatest impact among people facing the most stressful conditions.

Our study showed a slight moderation effect from emotional support but not instrumental. Overall, the potential moderating effect of social support on FS may vary by sex, ethnicity, socioeconomic status, and needs. Based on the work by Uchino (2004), the link between emotional and instrumental support and FI is affected by numerous factors, including a person's hesitancy to ask for help or a mismatch between what the person needs and the social support received [191]. Furthermore, the cultural context is an important factor in this association. For example, it may be acceptable to request aid in some cultures, while in other cultures, providing support to those in need may be expected. This study did not collect such information, however, qualitative research may shed some important information on this topic.

Our study indicated that living alone was marginally associated with higher odds of severe FI among women in both high and low GII. This association was only significant among women with high negative experiences in low GII countries. Living

with someone, considered as embedded social support, may play an important role in supporting women emotionally and financially [184].This result is in line with previous studies indicating that living alone has a wide range of negative effects including a higher risk of FI especially among vulnerable populations such as women and older adults. For example, a study conducted among Korean older adults living alone in rural areas, found a high prevalence of FI. This high prevalence was due to financial issues and due to difficulties in physical food access. However, also in this study, those living alone but who have intangible support for food purchasing from family, such as transportation were less likely to be FI [192]. Another study conducted in Canada found that FI was more prevalent among those living alone compared to those living with a spouse or with others. Although this Canadian study found that the prevalence of FI was higher in women compared to men, the association between household income and FI in women became insignificant and was confounded by marital status and living arrangement [193]. This suggests that women may be more vulnerable to FI through economically-driven mechanisms, which can be overcome by embedded support. Similarly, other studies also showed that marital status and living arrangement were significantly associated with FI in older adults [194, 195]. A study conducted by Sahyoun et al. which found that among older vulnerable Palestinian refugees in Lebanon, those who lived in single households had a lower prevalence of poverty and FI. However in that study these results may be explained by the fact that older adults in single households were the highest recipients of welfare and remittances [196].

We also found that women were more likely to be severely food insecure than men. In the 2020 FAO report, the results showed that FI was slightly higher in women

than in men, globally and within every region of the world [49]. In our study, women living in rural areas, living in a household with more children than adults, in the lowest income quintile, having health problems, having a lower positive experience and higher negative experience scores, as well as, those with lower educational attainment, and who were unemployed were more likely to be severely FI. These findings are similar to those reported by other studies [12, 16, 23-27, 49, 114, 153, 162]. Poverty is generally recognized as an underlying cause of FI and poor households are more than twice as likely to be severely food insecure [26, 27, 38, 52, 53]. Conflicts and political unrest in some of the LAS regions tend to increase poverty and exacerbate the risk of FI [11]. Unrest in a country that is coupled with gender inequality, is highly associated with FI [197]. Most LAS countries with a high GII score are poorer and exhibit higher political instability compared to countries with low GII scores [142]. Societal power inequality and gender role identification may create barriers for women to access sufficient and nutritious food. In our study, women residing in urban versus rural places were at significantly higher risk of FI and this was also reported in studies conducted in the US and Tanzania [198, 199]. Ecker *et al.* in 2010, reported that in Yemen the number of food-insecure individuals living in rural areas was more than five times those who lived in urban areas [63]. Finally, unemployment among women is highly prevalent in the LAS region potentially because women are less educated and are thus unable to find well-paid or professional jobs; and there are limited culturally acceptable jobs for women in the region. In other words, in most cases, women can get culturally acceptable jobs only if they have a high level of education; otherwise, they tend to be unemployed and

have low income, which increases their vulnerability to FI. Culturally, men have more choices of jobs that do not require a higher level of education [72, 200].

This study has some limitations. The GWP surveys are cross-sectional, which allows the identification of associations but does not establish causality. The possibility of bidirectional relationships between well-being-related variables, social support, and FS status should also be considered. The GWP surveys consist of self-reported data, which may result in reporting bias. In addition, different reference periods were used for the physical health and mental well-being measures (the day before the survey), FS status, and social support (in the past 12 months), which may attenuate the associations due to the day-to-day variability of experiences linked to physical health and mental well-being. Measuring social support is challenging as the items used may not perfectly capture certain aspects of social support that could be crucial to understanding individual needs. For example, the question that asks about one's "satisfaction with opportunities to meet people and make friends" does not necessarily inform on the number of friends or the strength of the relationship. The question on received support does not allow us to understand whether this was received because an individual requested it, because they qualified for an aid program, or because someone gave it to them as a free act of charity. Knowing these details would be important for a more in-depth understanding of how people cope with harsh situations and guiding policymakers to tailored interventions.

This study has also many strengths. To our knowledge, this is the first study to examine relationships between FS status, physical health, mental well-being, and social support in the LAS region. Additionally, standardized measures of food security, physical health, and mental well-being, across the 19 countries were used. The FIES was validated

for use in that region and FI thresholds were generated specifically for that region and applied in this study [181]. Finally, this study analyzed data on a large sample which encompassed four years allowing for stratification by sex and by GII countries.

**Table 4.14: Questions in the FIES Survey Module for Individuals as Used in the Gallop World Poll (GWP).**

| During the last 12 months, was there any time when… | | | | |
|---|---|---|---|---|
| **Questions** | | **Label** | **Domains of FI construct** | **Assumed severity of FI** |
| Q1 | You were worried you would not have enough food to eat because of a lack of money or other resources? [a] | WORRIED | Uncertainty and worry about food | Mild |
| Q2 | You were unable to eat healthy and nutritious food because of a lack of money or other resources? | HEALTHY | Inadequate food quality | Mild |
| Q3 | You ate only a few kinds of foods because of a lack of money or other resources? | FEWFOOD | Inadequate food quality | Mild |
| Q4 | You had to skip a meal because there was not enough money or other resources to get food? | SKIPPED | Insufficient food quantity | Moderate |
| Q5 | You ate less than you thought you should because of a lack of money or other resources? | ATELESS | Insufficient food quantity | Moderate |
| Q6 | Your household ran out of food because of a lack of money or other resources? | RUNOUT | Insufficient food quantity | Moderate |
| Q7 | You were hungry but did not eat because there was not enough money or other resources for food? | HUNGRY | Insufficient food quantity | Severe |
| Q8 | You went without eating for a whole day because of a lack of money or other resources? | WHLDAY | Insufficient food quantity | Severe |

[a] "Other resources" is used in all the questions to make it suitable for respondents who usually acquire food in ways other than purchasing it with money. Interviewers are trained to emphasize the expression "because of a lack of money or other resources" to avoid receiving affirmative responses due to other reasons, such as dieting or fasting [39].

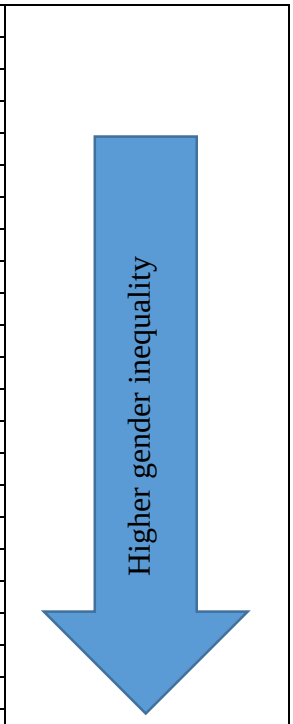
**Table 4.15: Classifications of social support questions using principal component analysis, 2014-2017 Gallup World Poll survey.**

| Social support types | Questions from Gallop World Poll (GWP) |
|---|---|
| **Emotional** | *In the city or area where you live, are you satisfied or dissatisfied with the opportunities to meet people and make friends?* |
| | *Please rate your level of agreement to having someone in your life always encourages you to be healthy* |
| | *Please rate your level of agreement about that your friends and family give you positive energy every day* |
| | *If you were in trouble, do you have relatives or friends you can count on to help you whenever you need them, or not?* |
| **Instrumental and Embedded** | *Do you have relatives or friends who are living in another country whom you can rely on to help you when you need them, or not?* |
| | *In the past 12 months, did this household receive help in the form of money or goods from another individual?* |
| | *Living arrangement "Living alone versus living with adults"*[1] |

[1]Living arrangement variable was created using the household size and all other variables were administered in Gallup World Poll survey.

**Table 4.16: Classification of the countries of the League of Arab States (LAS) by the 2017 gender inequality index (GII).**

| **LAS Countries** | **2017 GII[1]** |
|---|---|
| Mean for LAS | 0.419 |
| **Low GII (below the mean)** | |
| Libya | 0.170 |
| Bahrain | 0.222 |
| UAE | 0.232 |
| Saudi Arabia | 0.234 |
| Kuwait | 0.270 |
| Tunisia | 0.298 |
| Lebanon | 0.381 |
| **High GII (equal or above the mean)** | |
| Algeria | 0.442 |
| Egypt | 0.449 |
| Jordan | 0.460 |
| Morocco | 0.482 |
| Iraq | 0.506 |
| Syria | 0.547 |
| Sudan | 0.564 |
| Mauritania | 0.617 |
| Yemen | 0.835 |
| Palestine Territories[2] | ------ |
| Somalia[2] | ------ |
| South Sudan[2] | ------ |




[1]The source of the 2017 GII is the United Nations Development Programme [111].

[2]Palestine Territories, Somalia, and South Sudan have missing GII due to missing indicators, however, we classified them as high GII countries because the available indicators such as maternal mortality, adolescent birth, the share of seats in parliament, and labor force participation have similar values as the countries in high GII.

Abbreviation: UAE: United Arab of Emirates.

## Table 4.17: Characteristics of the study population by sex[1], [2014-2017 Gallup World Poll surveys).

| Characteristics | Men n=33,958 (54.3) | Women n=28,303 (45.7) | P-value |
|---|---|---|---|
| | Weighted (%) | | |
| **Age group** | | | |
| Young adults (19 to 59 years) | 91.2 | 92.4 | <.0001 |
| Older adults (60+ years) | 8.8 | 7.7 | |
| **Marital status** | | | |
| Single (never married, divorced, separated, widowed) | 35.2 | 34.5 | 0.1234 |
| Married or living with a domestic partner | 64.8 | 65.5 | |
| **Area of residence** | | | |
| Rural (farm, or in a small town or village) | 40.0 | 44.1 | <.0001 |
| Urban (large city or suburb of a large city) | 60.0 | 55.9 | |
| | | | |
| **Educational attainment** | | | |
| ≥ 1 year of college | 32.7 | 22.7 | <.0001 |
| 9-12 years high school education | 33.5 | 28.0 | |
| <9 years of education | 33.8 | 49.3 | |
| **Employment status** | | | |
| Employed | 70.3 | 28.4 | <.0001 |
| Unemployed | 29.7 | 71.6 | |
| **Income quintile** | | | |
| Lowest | 18.8 | 20.9 | <.0001 |
| Second | 19.1 | 20.7 | |
| Middle | 19.6 | 20.4 | |
| Fourth | 20.7 | 19.4 | |
| Highest | 21.8 | 18.6 | |
| **Physical health[2,5]** | | | |
| Good | 73.4 | 65.6 | <.0001 |
| Poor | 26.6 | 34.4 | |
| **Positive experience[3,5]** | | | |
| High | 70.5 | 67.0 | <.0001 |
| Low | 29.5 | 33.0 | |
| **Negative experience[4,5]** | | | |
| High | 29.8 | 35.8 | <.0001 |
| Low | 70.2 | 64.2 | |
| **Food security status** | | | |
| Secure or moderately food insecure | 85.9 | 82.4 | <.0001 |
| Severe food insecurity | 14.1 | 17.6 | |
| | | | |
| | Mean ± SE | | |
| **Household size** | 5.7 ± 0.02 | 6.0 ± 0.02 | <.0001 |
| **Number of adults aged above 15** | 3.9 ± 0.01 | 4.0 ± 0.01 | 0.0008 |
| **Number of children aged 15 and under** | 1.9 ± 0.01 | 2.1 ± 0.01 | <.0001 |
| **Independence ratio[6]** | 0.27 ± 0.0014 | 0.30 ± 0.0015 | <.0001 |

[1] Chi-square test and t-test were used to assess the difference of the categorical and continuous variables, respectively, between men and women.
[2]Physical Health: On the day before the survey, did you have any health problems, feel well-rested, or experience any physical pain, worry, or sadness?
[3]Positive experience: On the day before the survey, did you feel well-rested, treated with respect, smile or laugh, do something interesting, feel enjoyment?
[4]Negative experience: On the day before the survey, did you experience the following feelings: physical pain, worry, sadness, stress, and anger?
[5]For each index, the final score ranged from 0 to 100, with a higher score (60-100) indicating better physical health, higher positive experience, and higher negative experience while a lower score (0-40) indicated poor physical health, lower positive experience, and lower negative experience.
[6]Independence ratio: The number of children aged under 15 in the household relative to the household's size.

**Table 4.18: Associations between socioeconomic, physical health, mental well-being measures, and severe food insecurity by sex, using logistics regression analysis, (2014-2017 Gallup World Poll survey).**

| Characteristics | Men (n= 33958 (54.5%)) | | | | Women (n= 28303 (45.5%)) | | | |
|---|---|---|---|---|---|---|---|---|
| | Model 1 | Model 2 | Model 3 | Model 4 | Model 1 | Model 2 | Model 3 | Model 4 |
| | OR (95% CI) | OR (95% CI) | OR (95% CI) | OR (95% CI) | OR (95% CI) | OR (95% CI) | OR (95% CI) | OR (95% CI) |
| **Age** | | | | | | | | |
| Young adults (19-59 years) | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Older adults (60+ years) | 0.94 (0.80-1.09) | 0.80 (0.69-0.94) | 0.91 (0.78-1.06) | 0.90 (0.77-1.06) | 1.28 (1.09-1.51) | 1.06 (0.90-1.25) | 1.22 (1.04-1.43) | 1.20 (1.01-1.41) |
| **Marital status** | | | | | | | | |
| Married | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Single | 0.92 (0.83-1.03) | 0.96 (0.86-1.07) | 0.94 (0.85-1.05) | 0.93 (0.83-1.03) | 1.07 (0.97-1.19) | 1.10 (0.99-1.21) | 1.07 (0.97-1.19) | 1.10 (0.99-1.22) |
| **Area of Residence** | | | | | | | | |
| Urban | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Rural | 1.12 (1.01-1.24) | 1.10 (0.99-1.22) | 1.10 (0.99-1.22) | 1.11 (0.99-1.23) | 1.17 (1.05-1.29) | 1.18 (1.07-1.31) | 1.17 (1.06-1.30) | 1.20 (1.09-1.33) |
| **Independence ratio[1]** | 1.15 (0.93-1.41) | 1.20 (0.97-1.47) | 1.18 (0.96-1.45) | 1.20 (0.97-1.48) | 1.50 (1.21-1.86) | 1.53 (1.23-1.90) | 1.49 (1.20-1.84) | 1.46 (1.18-1.82) |
| **Income quintile** | | | | | | | | |
| Poorest | 6.59 (5.64-7.71) | 5.52 (4.70-6.48) | 5.93 (5.06-6.95) | 5.72 (4.87-6.72) | 6.76 (5.69-7.82) | 5.71 (4.86-6.71) | 6.14 (5.22-7.21) | 5.76 (4.89-6.78) |
| Second | 3.74 (3.19-4.38) | 3.24 (2.75-3.81) | 3.43 (2.92-4.02) | 3.32 (2.82-3.91) | 3.84 (3.27-4.52) | 3.40 (2.88-4.00) | 3.60 (3.05-4.24) | 3.43 (2.90-4.05) |
| Middle | 2.51 (2.13-2.96) | 2.29 (1.93-2.71) | 2.39 (2.02-2.82) | 2.34 (1.98-2.77) | 2.54 (2.15-2.99) | 2.36 (1.99-2.79) | 2.43 (2.06-2.87) | 2.39 (2.01-2.83) |
| Fourth | 1.54 (1.31-1.81) | 1.49 (1.26-1.76) | 1.49 (1.27-1.76) | 1.50 (1.26-1.77) | 1.77 (1.49-2.11) | 1.69 (1.42-2.01) | 1.75 (1.47-2.08) | 1.71 (1.44-2.04) |
| Richest | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| **Physical and mental well-being** | | | | | | | | |
| **Physical health[2,5]** | | | | | | | | |
| Good | | 0.33 (0.30-0.37) | | | | 0.38 (0.35-0.42) | | |
| Poor | | 1 | | | | 1 | | |
| **Positive Experience[3,5]** | | | | | | | | |
| High | | | 0.49 (0.45-0.55) | | | | 0.54 (0.49-0.59) | |
| Low | | | 1 | | | | 1 | |
| **Negative Experience[4,5]** | | | | | | | | |
| High | | | | 3.01 (2.73-3.33) | | | | 2.94 (2.66-3.24) |
| Low | | | | 1 | | | | 1 |

[1] Independence ratio: The number of children aged under 15 in the household relative to the household's size.

[2] Physical Health: On the day before the survey, did you have any health problems, feel well-rested, or experience any physical pain, worry, or sadness?

[3] Positive experience: On the day before the survey, did you feel well-rested, treated with respect, smile or laugh, do something interesting, feel enjoyment?

[4] Negative experience: On the day before the survey, did you experience the following feelings: physical pain, worry, sadness, stress, and anger?

[5]For each index, the final score ranged from 0 to 100, with a higher score (60-100) indicating poor physical health, higher positive experience, and higher negative experience while a lower score (0-40) indicated good physical health, lower positive experience, and lower negative experience.

Model 1 = adjusted for socioeconomic characteristics.

Model 2 = adjusted for socioeconomic characteristics and physical health.

Model 4 = adjusted for socioeconomic characteristics and positive experience.

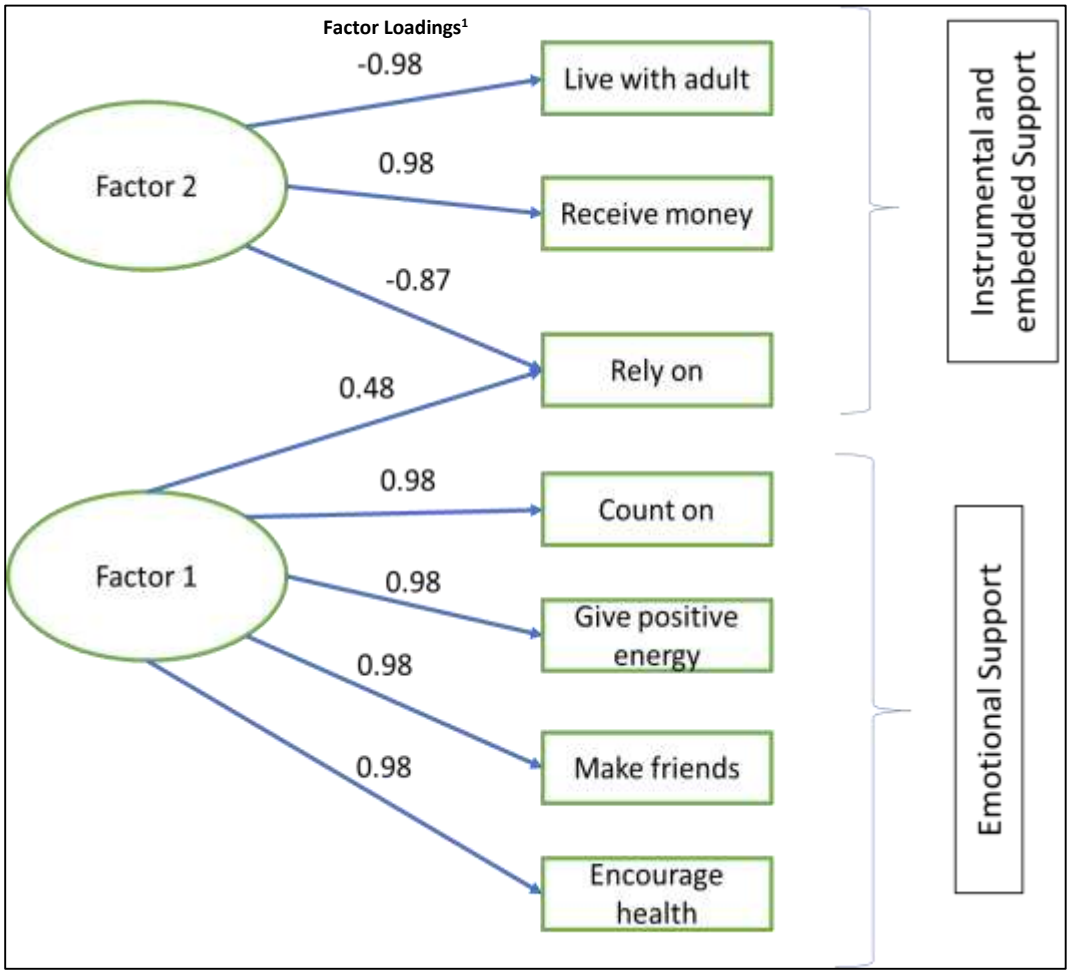
Model 5 = adjusted for socioeconomic characteristics and negative experience.

**Table 4.19: Associations between physical health, mental well-being measures, and severe food insecurity in a sub-sample of women by high and low gender inequality index (GII), controlled for socioeconomic factors and social support indicators, using logistics regression analysis (2014-2017 Gallup World Poll surveys).**

| Characteristics | High GII[1] (n= 7809 (68.5%) | | | | Low GII[2] (n= 3,584 (31.5%) | | | |
|---|---|---|---|---|---|---|---|---|
| | Model 1 | Model 2 | Model 3 | Model 4 | Model 1 | Model 2 | Model 3 | Model 4 |
| | **OR (95% CI)** | **OR (95% CI)** | **OR (95% CI)** | **OR (95% CI)** | **OR (95% CI)** | **OR (95% CI)** | **OR (95% CI)** | **OR (95% CI)** |
| **Physical health[3] (Good vs. Poor)** | 0.39 (0.33-0.46) | 0.43 (0.36-0.51) | 0.39 (0.33-0.46) | 0.43 (0.36-0.51) | 0.26 (0.18-0.37) | 0.30 (0.20-0.44) | 0.27 (0.19-0.39) | 0.31 (0.21-0.46) |
| **Emotional** | | | | | | | | |
| Having opportunities to make friends | | 0.72 (0.61-0.86) | | 0.72 (0.60-0.85) | | 0.71 (0.49-1.03) | | 0.70 (0.48-1.02) |
| Having someone encouraging you to be healthy | | 1.10 (0.91-1.33) | | 1.11 (0.92-1.34) | | 1.01 (0.67-1.51) | | 1.03 (0.68-1.55) |
| Having someone giving you positive energy | | 0.85 (0.71-1.02) | | 0.86 (0.71-1.03) | | 0.89 (0.60-1.32) | | 0.88 (0.59-1.31) |
| Having someone to count on | | 0.56 (0.47-0.67) | | 0.58 (0.49-0.70) | | 0.49 (0.33-0.73) | | 0.47 (0.31-0.70) |
| | | | | | | | | |
| **Instrumental and embedded** | | | | | | | | |
| Having people out of the country to rely on | | | 0.71 (0.60-0.85) | 0.79 (0.66-0.94) | | | 0.97 (0.66-1.43) | 1.12 (0.75-1.67) |
| Receiving money or goods | | | 0.97 (0.80-1.19) | 1.03 (0.84-1.27) | | | 1.81 (1.19-2.76) | 1.85 (1.21-2.84) |
| Living alone | | | 1.21 (0.89-1.66) | 1.17 (0.86-1.59) | | | 2.08 (0.95-4.57) | 2.14 (0.96-4.77) |
| | | | | | | | | |
| **Positive Experiences[4] (high vs. low)** | 0.47 (0.39-0.55) | 0.86 (0.71-1.03) | 0.47 (0.40-0.56) | 0.53 (0.44-0.63) | 0.58 (0.41-0.82) | 0.67 (0.47-0.95) | 0.58 (0.41-0.83) | 0.67 (0.47-0.96) |
| **Emotional** | | | | | | | | |
| Having opportunities to make friends | | 0.72 (0.61-0.85) | | 0.72 (0.60-0.85) | | 0.69 (0.48-0.98) | | 0.68 (0.47-0.99) |
| Having someone encouraging you to be healthy | | 1.11 (0.92-1.34) | | 1.12 (0.93-1.35) | | 1.03 (0.69-1.54) | | 1.04 (0.69-1.57) |
| Having someone giving you positive energy | | 0.86 (0.72-1.03) | | 0.87 (0.72-1.04) | | 0.91 (0.61-1.35) | | 0.90 (0.60-1.35) |
| Having someone to count on | | 0.54 (0.46-0.65) | | 0.56 (0.47-0.67) | | 0.41 (0.28-0.60) | | 0.39 (0.27-0.58) |
| | | | | | | | | |
| **Instrumental and embedded** | | | | | | | | |
| Having people out of the country to rely on | | | 0.72 (0.61-0.86) | 0.80 (0.67-0.95) | | | 0.98 (0.67-1.43) | 1.14 (0.77-1.68) |
| Receiving money or goods | | | 0.99 (0.81-1.21) | 1.05 (0.86-1.29) | | | 1.96 (1.29-2.97) | 1.98 (1.29-3.04) |
| Living alone | | | 1.29 (0.93-1.80) | 1.24 (0.90-1.70) | | | 2.18 (0.98-4.86) | 2.18 (0.96-4.95) |
| | | | | | | | | |
| **Negative Experience[5] (high vs. low)** | 2.83 (2.39-3.35) | 2.56 (2.15-3.04) | 2.82 (2.38-3.34) | 2.56 (2.16-3.05) | 4.43 (3.08-6.37) | 3.88 (2.64-5.70) | 4.31 (2.99-6.23) | 3.75 (2.54-5.54) |
| **Emotional** | | | | | | | | |
| Having opportunities to make friends | | 0.73 (0.61-0.86) | | 0.72 (0.61-0.85) | | 0.69 (0.48-1.00) | | 0.68 (0.46-0.99) |
| Having someone encouraging you to be healthy | | 1.10 (0.91-1.33) | | 1.11 (0.92-1.35) | | 0.97 (0.64-1.45) | | 0.99 (0.65-1.49) |
| Having someone giving you positive energy | | 0.85 (0.71-1.02) | | 0.86 (0.72-1.04) | | 0.92 (0.62-1.38) | | 0.91 (0.61-1.37) |
| Having someone to count on | | 0.57 (0.48-0.68) | | 0.60 (0.50-0.71) | | 0.51 (0.34-0.77) | | 0.50 (0.33-0.75) |
| | | | | | | | | |
| **Instrumental and embedded** | | | | | | | | |
| Having people out of the country to rely on | | | 0.71 (0.59-0.84) | 0.77 (0.65-0.92) | | | 0.91 (0.62-1.35) | 1.04 (0.70-1.54) |
| Receiving money or goods | | | 0.98 (0.80-1.19) | 1.03 (0.84-1.26) | | | 1.81 (1.18-2.77) | 1.85 (1.20-2.85) |
| Living alone | | | 1.27 (0.93-1.75) | 1.22 (0.90-1.66) | | | 2.21 (1.01-4.82) | 2.24 (1.00-5.02) |

[1] High GII countries: Algeria, Egypt, Jordan, Morocco, Iraq, Syria, Sudan, Mauritania, Yemen, Palestine Territories, Somalia, South Sudan.
[2] Low GII countries: Libya, Bahrain, United Arab of Emirates, Saudi Arabia, Kuwait, Tunisia, Lebanon.
[3] Physical Health: On the day before the survey, did you have any health problems, feel well-rested, or experience any physical pain, worry, or sadness?
[4] Positive experience: On the day before the survey, did you feel well-rested, treated with respect, smile or laugh, do something interesting, feel enjoyment?
[5] Negative experience: On the day before the survey, did you experience the following feelings: physical pain, worry, sadness, stress, and anger?
Model 1: controlling for age, marital status, area of residence, independence ratio (the number of children aged under 15 in the household relative to the household's size), income quintile, physical health, and negative or positive experience.
Model 2 = Model 1 + emotional support (opportunities to make friends, someone encourages you to be healthy, someone gives you positive energy, and someone to count on).
Model 3 = Model 1 + instrumental and embedded support (people out of the country to rely on, received money or goods, and live with adults).
Model 4 = Model 1 + all the social support items.

**Figure 4.8: Classification of social support items based on principle component analysis, (2014-2017 Gallup World Poll survey).**




[1]Factor loadings determine the factor that has the most influence on each item. Loadings close to -1 or 1 indicate that the factor strongly influences the item and those close to 0 indicate that the factor has a weak influence on the item [54].

## C) Relationship between live-in Grandparents and Grandchild's Health and Well-being in Palestinian Refugees in Lebanon.


**Abstract**

**Background:** Studies have shown that grandparents (GP) play influential roles in their grandchildren's health, behavior, and life in general. However, this relationship has not been examined in the Arab region.

**Objective:** To assess whether the presence of GP in the household is associated with their grandchildren's health and well-being, controlling for household food security status.

**Method:** Data used in this study were collected through surveys conducted in 2010 and 2015 of a representative sample of Palestinian refugees living in camps and gatherings in Lebanon. Multivariate logistic regression were used to examine the relationship between children health and well-being from households with and without a live-in GP. Health status was examined as a child experiencing acute or chronic conditions over the last 6 months, while well-being was measured as a child attending school or employed during the previous year.

**Results:** The regression models show that even after controlling for presence of parents and FI, the presence of GP in the household was associated with lower odds of experiencing acute diseases (OR 0.74 95% CI 0.62-0.92) and higher odds of attending school (OR 2.22 95% CI 1.28-5.33) among grandchildren. Food insecurity was also associated with higher odds of experiencing acute disease (OR 1.45 95% CI 1.17-1.80) chronic conditions (OR 1.56 95% CI 1.19-2.07) and child employment (OR 1.83 95% CI 1.30-2.78) but lower odds of attending school (OR 0.68 95% CI 0.35-0.71).

**Conclusion:** The presence of GP in the household may be protective to grandchildren's health status and encouraging to attend school.

**Keywords** Grandparents; grandchildren; mental well-being; health; acute disease; chronic conditions ; school attendance, child employment, and food insecurity.

## Introduction

Palestinian refugees constitute one of the world's largest displaced populations [121]. Even though they have been displaced since 1948 and have a long-standing presence in Lebanon, they are still considered a marginalized population due to their socio-economic deprivation, restrictions to their human rights, and their exclusion from main life aspects socially, politically, and economically [201]. This social isolation makes them vulnerable to inadequate access to health care, education, food, and so consequently they experience food insecurity (FI) [202]. This is especially true as Palestinian refugees in Lebanon require special work permits that are hard to obtain and they are restricted to certain non-professional or not well-paid employment [75]. They are also not allowed to run a business or own property and cannot access public services. Most Palestinian refugees living in camps depend to a great extent on humanitarian assistance from the United Nations Relief and Works Agency for Palestine Refugees in the Near East (UNRWA) [75, 121]. UNRWA is unique in terms of its long-standing commitment to one group of refugees whereby it provides human development and humanitarian services, encompassing education, primary health care, welfare relief and social services, infrastructure and camp improvement, microfinance, and emergency assistance [203].

Palestinian refugee children are especially at risk in the camps as they live in overcrowded quarters which lack resources and many are exposed to ongoing conflict, violence, and discrimination [74, 75]. Such circumstances compromise access and quality of essential services such as education and health care. Despite these challenging conditions, many families have lived there for more than 70 years in multigenerational families and settled into their own

lifestyle [196]. In refugee camps, several factors converge to contribute to the family structure which involves grandparent (GP) co-residence, such as gathering in close quarters and in specific camps, economic disparities and disruptions, health problems, and financial strain [75, 201]. The formation of multigenerational families is due to the rise in single-parent families and an increase in maternal employment which necessitates GP involvement in raising children and in participating in the health and well-being of their grandchildren [196, 204, 205]. A child's well-being means the quality of a child's life, measured using health status, educational attainment, and socio-economic status [206]. However, involvement of GP could positively or negatively impact grandchildren as they can serve as role models, discuss appropriate behavior, encourage academic and health-related activities, provide advice, financial or emotional support, and prepare food. Alternatively, GP could negatively impact their grandchildren by spoiling and indulging them [135], or GP could be in poor health which would place a financial burden on the family. There is no data in the Arab world on the number of grandchildren being raised by their GP. In the United States, more than 13 million children live in homes with their GP, and 2.5 million GP take primary responsibility for raising these children [207].

Previous studies mainly focused on the impact that raising grandchildren have on the health and well-being of GP [134, 208-212], but a few studies assessed the influence on grandchildren's health and well-being. A study conducted in England showed that a high level of grandparental involvement increased the well-being of children and decreased their emotional and behavioral problems [134]. A review by Dunifon showed mixed results of the influence of live-in GP on children's well-being. Some of those studies reviewed showed positive associations represented by prosocial behaviors, academic engagement, self-confidence, mental health, and maturity, while other studies showed more significant behavioral problems, lower

educational attainment, and physical and mental health issues among the grandchildren [135]. These relationships may be influenced by GP's educational attainment. [213].

Several other factors may also influence the relationship between GP with their grandchildren; such as poverty and household FI, and these in turn affect children's health and well-being. Ziliak *et al.* used longitudinal data from the 2001 to 2010 Current Population Survey in the U,S, and found that the prevalence of FI in families with a grandchild is at least two times higher compared to families without a grandchild [214]. It is also possible that children's health and well-being may be influenced by the GP's age, socio-economic status, family structure, child's gender, and the number of children in the household [215, 216]. It is also plausible that GP's good health status provides an impetus for taking care of grandchildren [211].

To our knowledge, the association between a live-in GP and grandchildren's health and well-being has never been assessed neither in the Arab population nor among refugees. Therefore, this study examines this association in Palestinian refugees in Lebanon.

## Methods

### *Study design*

Data for this study were obtained from two surveys conducted by the American University of Beirut and funded by UNRWA. The surveys were conducted in July-August 2010 and in April 2015 targeting Palestinian refugees living in the 12 official Palestinian refugee camps and gatherings outside the camps in Lebanon [74, 75]. The sampling frame for the 2010 survey was based on the Palestinian refugee's list from the UNRWA Refugee Registration and Information System, while the sampling frame for the 2015 survey used the list of Palestinian refugees in Lebanon compiled by the Palestinian Central Bureau of Statistics in 2010. In both surveys, a representative sample of households was obtained using a stratified multistage cluster

sampling and used a simple random approach for the data collected from camps and a snowball sampling technique for the data collected from non-camp gatherings [74, 75].

Data were collected using a questionnaire developed by the research team, and translated into Levantine Arabic dialect. The questionnaire was administered through face-to-face interviews with a proxy adult responsible for food preparation, preferably a woman in the selected household. If a woman was not present, any adult family member was interviewed and served as a proxy to collect information on all household members. The questionnaires used in both surveys were similar in terms of the information collected. The first section of the questionnaire collected information at the household level on the composition of the household, socio-demographic information, types of health care services, and other household expenditures, including expenditures on health and food, use of welfare programs, housing quality, crowding index, household assets, and food security status. The second part of the questionnaire was designed to obtain information on each household member, including age, marital status, relationship to the head of household, school attendance, educational attainment, employment, and medical history. Written or oral consent was obtained from individuals before participation in the survey. The studies were approved by the American University of Beirut Institutional Review Board.

For this study, the final analytical sample was composed of 2,707 households which included at least one child and with no missing information on household food security status. Also, the total number of children included in this study was 8,034 children between the ages of 0 and 17 years.

**Measures**

In this study, children's health status and well-being were used as outcome variables. The health status of children categorized by ages 0-4, 5-11, and 12-17 was assessed using two questions; 1) has a household member been diagnosed with a chronic condition? And 2) has a household member suffered from an acute illness? Children's well-being was assessed by inquiring about school attendance and employment using these two questions, 1) did the household member enroll for the current school year? And 2) did the household member work for wage (cash or in-kind) even for one hour during last week? School attendance was assessed for children ages 6-11 and 12-17, and for child employment ages 5-14 and 15-17 as recommended by the International Labour Organization [217]. Dichotomous responses of "Yes or No" were used for all health and well-being questions.

The main predictor for children's health and well-being was whether a child lived in a household with one or more live-in GP. This information was extrapolated from the question on household composition administered to the interviewee. Households with the presence of grandmother, grandfather, or both were classified as households with a live-in GP, or classified as households with no GP. A variable for the presence of one or both parents in the household was also created and used as a potential confounder.

Other variables used in this study were child sex and age, child health insurance, the prevalence of chronic conditions s among live-in GP, and receipt of welfare assistance by household. Household health expenditure was also derived from a question inquiring about money spent on health-related issues. A food-related asset scale was calculated based on the ownership of a refrigerator, freezer, oven, and microwave, each appliance contributing a point to the 0-4 scale.

Household food security was also collected, using a slightly different questionnaire in each survey year. In the 2010 survey, household FI experience was assessed using a 6-item scale with a reference period of 6 months, adapted from the US Food Security Survey Module and the Yemen National Food Security Survey [38, 148]. These questions included the following items: "inadequate quality of food," "foods bought did not last," "not enough of some foods," "cut the size of a meal," "skipped meal," and "did not eat a whole day or went to bed hungry." (**Table 4.20**). For the 2015 survey, the Arab Family Food Security Scale (AFFSS) was used. AFFSS consists of 7-items and is based on the 2010 questionnaire but with slight modifications (**Table 4.20**). The AFFSS includes an additional question "In the last 6 months, was there a time when you were concerned that you would run out of food for your household for the next month?" AFFSS and the 2010 food security questionnaire were validated, calibrated, and used to define FI thresholds [28]. For the 2010 survey, the total score was classified as food secure (0–1), moderately FI (2–4), and severely FI (5–6), while for the 2015 survey, the total score was classified as food secure (0–2), moderately FI (3–5), and severely FI (6–7) household.

**Statistical analysis**

Descriptive characteristics were stratified by households with and without live-in GP. T-test for continuous variables and chi-square for categorical ones were conducted to evaluate differences in characteristics of households and children with and without a live-in GP.

Multivariate logistic regressions were conducted to examine the relationship between children living with GP and the health and well-being-related variables of children. Health status was examined as a child experiencing acute or chronic conditions s over the last 6 months, while well-being was measured as school attendance and employment status during the previous year. All regression models were adjusted for potential confounding variables, including child's sex,

age group, child health insurance, and household food security, presence of a parent, grandparent with a chronic conditions, household receiving welfare, health expenditure per capita, and household size.

Data were analyzed using SAS (version 9.4; SAS Institute Inc., Cary, NC). All analyses were weighted to adjust for complex survey design. Household ID and survey year were added to the models as fixed effects. All associations were considered statistically significant at $p<0.05$.

**Results**

This study included data from 2707 households and 8,034 children between ages 0 to 17 years. Of these households, 214 (8.4%) had live-in GP while most children (90.9%) lived in households with no GP. Compared to households without GP, those with GP had significantly higher prevalence of FI (30.4% versus 23.6%, $p<0.0001$), poverty (71.1% versus 67.3%, $p=0.04$), received welfare (42.8% versus 39.7%, $p=0.012$), included younger mothers ($35.1 \pm 1.06$ versus $38.9 \pm 0.23$) and younger fathers ($39.9 \pm 0.92$ versus $44.2 \pm 0.25$) and fewer working mothers (34.7% versus 39.1%, $p<0.0001$) (**Table 4.21**). The mean household size, number of adults in the household, healthcare expenditure per capita, and food-related assets were all significantly higher for households with a live-in GP. The mean number of children and household food expenditure per capita were significantly lower for households with live-in GP.

Compared to children living in a household without a live-in GP, children living in a household with a live-in GP were younger ($8.0 \pm 0.2$ versus $9.5 \pm 0.08$ $p<0.0001$), lived in poorer household 74.7% versus 71.4% $p=0.039$), had lower levels of school attendance (5.2% versus 3.4%, $p=0.0006$) and higher employment (60.4% versus 49.1%, $p=0.0157$). Stratifying the children by age group showed that the prevalence of employment was highest among children aged 12-14 in both households with and without a live-in GP. Acute diseases were significantly

more prevalent among children living in households with a live-in GP compared to those in households without a live-in GP (48.9% and 43.6%, respectively, p<0.0001) (**Table 4.22**).

**Multivariate factors associated with child health and well-being**

The odds of a child with an acute disease were significantly lower in households with a live-in GP (OR 0.74, 95% CI 0.62-0.92) and in households with a parent (OR 0.73, 95% CI 0.40-0.93). Also, the odds were lower among female children than males (OR 0.87, 95% CI 0.82-0.93), and with increasing household size (OR 0.89, 95% CI 0.84-0.95) (**Table 4.23**). In contrast, the odds of having an acute disease was significantly higher for children aged 0-4 years compared to children 5-11 years (OR 1.35, 95% CI 1.16-1.57), in those living in food insecure households (OR 1.45, 95% CI 1.17-1.80), receiving welfare (OR 1.39, 95% CI 1.17-1.65), and was also higher in households with higher healthcare expenditure per capita (OR 1.42, 95% CI 1.18-1.26).

The odds of having a chronic conditions was also lower for female children (OR 0.75, 95% CI 0.65-0.87), children aged 0-4 years compared to children aged 5-11 years (OR 0.61, 95% CI 0.49-0.76), and decreased with increasing household size (OR 0.91, 95% CI 0.84-0.98). Similarly, the odds of having chronic conditions s was higher for children in food insecure households (OR 1.56, 95% CI 1.19-2.07), households receiving welfare (OR 1.54, 95% CI 1.22-1.94), and increased with increasing healthcare expenditure per capita (OR 1.45, 95% CI 1.14-1.86).

Children were more likely to attend school if they were from a household with a live-in grandparent (OR 2.22, 95% CI 1.28-5.33), a parent (OR 1.75, 95% CI 1.59-2.20), were female (OR 1.44, 95% CI 1.04-1.98), aged 6-12 years (OR 3.67 (2.41-4.64), and from households receiving welfare (OR 1.37, 95% CI 1.07-1.94). Children in food insecure households (OR 0.68,

95% CI 0.35-0.71) were less likely to attend school. Also, the odds of school attendance decreased with increasing healthcare expenditure per capita (OR 0.81, 95 % CI 0.66-0.99).

Children in food insecure households were more likely to be employed (OR 1.83, 95% CI 1.30-2.78). The likelihood of employment also increased with household size (OR 1.95, 95% CI 1.86-2.04). In contrast, the odds of employment was lower for children in households with a parent (OR 0.51, 95% CI 0.46-0.69), who were female (OR 0.72, 95% CI 0.59-0.89), aged 5-14 years (OR 0.27, 95% CI 0.18-0.41), and for those in households receiving welfare (OR 0.62, 95% CI 0.46-0.83) (**Table 4.24**).

## Discussion

This study assessed the relationship between the presence of a live-in GP in the household and grandchildren's health and well-being controlling for household food security status and the presence of parents. Results show that although households with a live-in GP were of lower socioeconomic status, with higher levels of FI than households without a live-in GP, the children in those households had significantly lower acute disease, higher levels of school attendance and lower child employment. The association between the presence of a GP in grandchildren’s lives and the children’s health status showed mixed results in previous studies. Although no studies examined acute disease as an outcome, a few studies examined the relationship between the presence of GP and various health outcomes in children. For example, a longitudinal study found that the involvement of maternal grandmothers was associated with lower mortality rates for children in rural Gambia [218]. In a cross-sectional study of 199 Hispanic American elementary-aged children, Pulgaron and colleagues found that having a GP involved in caretaking was associated with healthy BMI scores for grandchildren [219]. Moreover, a systematic review aimed at assessing the influence of GP on some health risk

factors associated with cancer, such as weight, diet, physical activity, and tobacco use found that overall GPs had a positive and beneficial impact on their grandchildren's cancer risk factors [220]. For psychological health outcomes, Ruiz and Silverstein used data from the second wave of the National Survey of Families and Households (NSFH) and also found that, among youth aged 18–23, grandchild-reported closeness with GP was associated with lower levels of depression [221]. Also, among Latino families living in the US, Hui Xie et al. found that GP encouraged their grandchildren to participate in various physical activities, which, in turn, improved grandchildren's physical and mental health [222].

On the other hand, other studies have found adverse health outcomes in children with GP involvement. For example, studies found an adverse effect between GP involvement and higher weight in children [223-227]. Also, in a cross-sectional study conducted in a Japanese rural town, Urita et al. found elevated rates of Helicobacter pylori transmission from live-in grandmothers to children [228]. Relatively few studies have examined the effects of GP involvement on children's health outcomes and, therefore, the degree of their influence remains unclear and differ by study design, outcomes measured, and cultural norms [229].

Our study also showed that grandchildren living in a household with GP tended to have higher levels of school attendance. These results support the findings by Zeng et al., who showed that in rural China, a live-in GP directly affected the educational attainment of their grandchildren compared to non live-in or deceased GP [230]. Another study found that in a sample of Muslim and Hindu families, children exhibited better behavioral adjustment when GP were involved in their care [231]. Other studies have shown no relationships or negative ones with a GP living in the household. For example, a longitudinal study using nationally representative survey data on three generations in the Netherlands found no associations between

grandchildren's educational attainment and  Grandparental involvement in their lives even after controlling for the strength of grandparental involvement [232]. Another cross-sectional study using data from a nationally-representative group of youth aged 14–19 in the US [133] found that GP had no influence on self-reported grades, risky behaviors such as smoking cigarettes, drinking alcohol or using marijuana, and on sexual behavior [133]. Finally, in a cross-sectional study of a large nationally representative sample of children aged 3 to 17, the results found that children raised by GP were more likely to have had adverse experiences such as child temperament, attention-deficit/hyperactivity disorder, and caregiver aggravation [233]. It is possible that in some of these studies, the outcomes examined were not those that can be influenced by GP involvement.

Our study showed that the presence of both parents in the household was independently and significantly associated with lower acute diseases, higher school attendance, and lower child employment. This result was expected as the main role of parents is to meet all the economic, psychological, and health needs of their children regardless of any external support [232]. This result is also in line with a previous longitudinal study which found that the parent's presence controlling for their sociodemographic characteristics were associated with their children's schooling but not necessarily the presence of GP [232]. In our study children living with a single mother was associated with lower odds of school attendance [data not shown]. This results is also supported by other studies that showed that living in a single-parent household was associated with lower educational achievement [234, 235].

Our study also found that children living in food insecure and poor households were at higher risk of acute and chronic conditions, and were less likely to attend school and more likely to be employed. The overall high poverty and unemployment rates in refugee's camps contribute

to the difficulties that food-insecure households face. Healthcare expenditures place an additional burden on the household budget. GP have a high prevalence of chronic conditions, which may further contribute to FI. These results are supported by previous findings that showed a negative association between FI and various adverse health outcomes [53, 87, 88, 91, 115]. Other studies found that FI was associated with low academic performance in children. For example, a systematic review of 23 peer-reviewed articles across western industrialized countries showed negative associations between FI and children's behavioral, academic, and emotional problems even after controlling for sociodemographic characteristics [236]. Child employment is highly prevalent in Lebanon due to high poverty and low income, especially among refugees and with the arrival of Syrian refugees in the Palestinian camps, leading to a higher prevalence of FI and a three-time increase in child labor compared to before the crisis [237].

There were no associations between GP with chronic conditions and children's health and well-being. Since GP with chronic conditions are less able to take care of their grandchildren, it was expected that having a live-in GP with chronic conditions would be negatively associated with children's health and well-being. This was shown in a review conducted by Grinstade et al. that older GP and those with poor health were negatively associated with their ability to take care of their grandchildren [212]. In addition, another two cross-sectional studies found that most of the caregivers who reported multiple diagnoses for chronic conditions such as hypertension, diabetes, heart disease and mobility issues had difficulties taking care of their grandchildren [238, 239]. The lack of the association in our study could be due to the high prevalence of GP with chronic conditions [88.8%), which might mask the association but explain the higher health expenditure in households with a living-in GP.

Our study showed that boys tended to be employed while significantly more girls attended school. Similar results were reported in the 2015 Child Labor Survey in Lebanon [237]. The percentage of employment is higher among boys than girls, while a higher percentage of girls are involved in household chores than boys [237]. Child labor in Lebanon is a serious problem considering that poverty is highly prevalent in Palestinian camps in Lebanon. Unfortunately, our study has no data to explore deeper issues in child labor. We also found that as the household size increased, the odds of acute and chronic conditions were lower, but the odds of child employment were higher, as a reflection of the higher financial needs of the household.

In our study, younger children living in refugee camps were more vulnerable to acute diseases than older children. This could be due to the weaker immune system of the children of this age generally and being exposed to potentially unclean water sources in the camps. These conditions may exacerbate their vulnerabilities to several acute diseases such as diarrhea and other infections [75, 240]. Also, as expected, younger children were more likely to attend school and less likely to be employed compared to older children. This may be true as older children contribute to household income, and UNRWA provides free schooling for Palestinian refugee children from grade 1 through 9. UNRWA offers limited free secondary education to Palestinian refugees in Lebanon, making going to school unaffordable for older children [237]. While job opportunities increase as children get older, children tend to work instead of going to school [237]. In our sample, more children in households that received welfare attended school, and fewer were employed. It is possible that having some financial support allowed for more funding for education for the children.

This is the first study to assess the relationship between live-in GP and the health and well-being of their grandchildren in the Arab world. The dataset used for this study contains information on all household members, which allowed us to examine relationships between members of the households. However, our study also has some limitations. These results may not be generalizable to other Arab countries as the Palestinian refugees are a vulnerable population whose living arrangements may not necessarily reflect those households in the Arab countries. Additionally, the intent of this survey was not to analyze the relationship between GP and their grandchildren and, therefore, the data did not contain information about the role of the GP in the household, which is as a caretaker or a caregiver. There was also not enough information about the quality of the GP-grandchild relationship. Such information may play an important role in the strength and the extent of the association between the presence of GP and the health and well-being of the grandchild [133]. Additionally, although relationships were observed in this study, it is possible that the outcomes examined here, such as experiencing acute or chronic conditions, school attendance, and child employment, may not be those that are most influenced by GP involvement. It remains to be seen whether a fuller set of grandchildren outcomes might be more influenced by grandparental involvement, and whether involvement plays a key role at different life course stages.

Because the role of GP in the lives of grandchildren is such an understudied topic, more work is needed to reinforce these findings and further illuminate the relationships examined here. This is of importance as older adults are living longer and take a more active role in the lives of their grandchildren and support the family as both parents work. GP have and continue to play an important role in grandchild rearing, as was witnessed in the last decades when mortality from AIDS/HIV was at its peak. Clearly, the types of relationships that exist and the impact of these relationships on grandchildren are culturally-driven and must be examined in such context. Additionally, the impact of these relationships may also affect the health and well-being of the GP as well.

**Table 4.20: Measurement tools used to assess food security among Palestinian refugees in 2010 and 2015 surveys.**

| Item label | Palestinian Refugee Survey 2010 | Arab Family Food Security Scale (AFFSS) 2015 |
|---|---|---|
| 1. Inadequate quality food (food sufficiency question)[1] | Which of these sentences applies the most to the food eaten by your household during the past 6 months?<br>• We had enough to eat of the kinds of food we wanted<br>• We had enough to eat but not always the kinds of food we wanted<br>• Sometimes we did not have enough to eat<br>• Often we did not have enough to eat | Which of these sentences applies the most to the food eaten by your household during the past 6 months?<br>• We had enough to eat of the kinds of food we wanted<br>• We had enough to eat but not always the kinds of food we wanted<br>• Sometimes we did not have enough to eat<br>• Often we did not have enough to eat |
| 2. Concerned food would run out[2] | | In the last 6 months, was there a time when you were concerned that you would run out of food for your household for the next month? (Yes/No) |
| 3. Food bought didn't last | Tell me if this statement applies to you most of the time, sometimes, or never: "The food that we bought did not last us and we didn't have money to buy more" | In the past 6 months, has it ever happened that the food you bought was not enough and you didn't have money to buy more? (Yes/No) |
| 4.Not enough of some foods[2] | Are there any foods you feel your family does not eat enough of?<br>(Yes/No) If yes, specify: | Were there any foods you feel your family did not eat enough of in the last 6 months? (Yes/No) If yes, specify: |
| 5.Cut size of meal[3] | In the past 6 months, did you or any other adult in your household ever cut the size of your meal because there was not enough food? (Yes, almost every month, yes, but not every month, yes in only 1 or 2 months, never) | In the past 6 months, did you or any other adult in your household ever cut the size of your meal because there was not enough food? (Yes/No) |
| 6.Skipped meal[3] | In the past 6 months, did you or any other household members ever skip a meal because there was not enough food? (Yes, almost every month, yes, but not every month, yes in only 1 or 2 months, never) | In the past 6 months, did you or any other household members ever skip a meal because there was not enough food? (Yes/No) |
| 7.Did not eat whole day or went to bed hungry[3] | In the past 6 months did you or any member in your household not eat for a whole day or go to bed hungry because there was not enough food? (Yes, almost every month, yes, but not every month, yes in only 1 or 2 months, never) | In the past 6 months did you or any member in your household not eat for a whole day or go to bed hungry because there was not enough food? (Yes/No) |

[1] Item 1 Coded as affirmative for all responses except the first.
[2] Item 2, 4 Coded as affirmative for yes responses.
[3] Items 5, 6, 7 Coded as affirmative for any of the three yes responses.

**Table 4.21: Sociodemographic and economic characteristics of households with and without a live-in grandparent (GP), (2010 and 2015 Socio-Economic Survey of Palestinian Refugees in Lebanon) [1]**

| Characteristics at the household level | Household with a live-in GP | Household without a live-in GP | P-value |
|---|---|---|---|
| Household with children (n/%) | **214 (8.4%)** | **2493 (91.6%)** | |
| Household with parent (n/%) | **66 (30.8%)** | **2493** | |
| | | | |
| **Household food security status**[2] (n/%) | | | |
| Food secure | 151 (69.6) | 1963 (76.4) | <.0001 |
| Food insecure | 63 (30.4) | 530 (23.6) | |
| **Grandparent with chronic health condition**[4] (n/%) | 194 (88.8) | N/A | |
| | | | |
| **Mother's age** (mean ±SE) | 35.1 ± 1.06 | 38.9 ± 0.23 | <.0001 |
| **Mother's Employment status**[5] (n/%) | | | |
| Employed | 46 (34.7) | 888 (39.1) | <.0001 |
| Unemployed | 92 (65.7) | 1569 (60.3) | |
| **Mother's Educational attainment** (n/%) | | | |
| Illiterate | 28 (22.9) | 571 (23.6) | <.0981 |
| Completed primary education | 10 (6.3) | 133 (5.7) | |
| Above primary education | 93 (70.8) | 1733 (70.7) | |
| | | | |
| **Father's age** (mean ±SE) | 39.9 ± 0.92 | 44.2 ± 0.25 | <.0001 |
| **Father's Employment status**[5] (n/%) | | | |
| Employed | 98 (81.3) | 1824 (79.4) | <.08021 |
| Unemployed | 21 (18.7) | 502 (20.6) | |
| **Father's Educational attainment** (n/%) | | | |
| Illiterate | 38 (33.5) | 726 (32.9) | 0.0200 |
| Completed primary education | 8 (8.0) | 148 (6.6) | |
| Above primary education | 70 (58.6) | 1429 (60.6) | |
| | | | |
| **Household Demographic and Socio-economic status** | | | |
| **Households in poverty**[3] (n/%) | | | |
| yes | 154 (71.1) | 1650 (67.3) | 0.0400 |
| No | 60 (28.9) | 843 (32.7) | |
| **Households receiving welfare** (n/%) | | | |
| Yes | 98 (42.8) | 980 (39.7) | 0.0120 |
| No | 115 (57.2) | 1497 (60.3) | |
| **Household size** (mean ±SE) | 6.2 ± 0.16 | 5.5 ± 0.04 | <.0001 |
| **Number of children** (mean ±SE) | 2.2 ± 0.10 | 2.5 ± 0.03 | 0.0087 |
| **Number of adults** (mean ±SE) | 4.1 ± 0.12 | 3.2 ± 0.04 | <.0001 |
| **Household health expenditure per capita in dollar** (mean ±SE) | 21.6 ± 3.00 | 13.6 ± 0.60 | <.0001 |
| **Household food expenditure per capita in dollar** (mean ±SE) | 52.8 ± 2.28 | 58.8 ± 0.76 | 0.0004 |
| **Food-related assets**[6] (mean ±SE) | 2.3 ± 0.05 | 2.2 ± 0.01 | 0.0255 |

[1]Significant differences in proportions were tested using the chi-square test for categorical variables and the t-test for continuous variables, with the Bonferroni method of correction for multiple comparisons.
[2]Household food security status classified as: score 0-4 food secure and moderately FI and 5-6 as severely FI for 2010 survey / 0-5 as food secure and moderately FI and 6-7 as severely FI for 2015 survey.
[3]Poverty status was based on household consumption expenditure equivalent to minimal food and non-food livelihood requirements per adult. The poverty line used was $6 per day [75].
[4]GP with chronic conditions s: any one of the grandparents who self-reported one or more chronic conditions.
[5]The large missing number in father characteristics is not only missing data but also a large number of household with no available father. Household with GP: missing =29 and no father = 104. Household without GP: missing = 53, no father = 114
[6]A food-related asset scale was calculated based on the ownership of refrigerator, freezer, oven, and microwave; each gives one point to the scale.

**Table 4.22: Sociodemographic and economic characteristics of children living in a household with and without a live-in grandparent (GP), (2010 and 2015 Socio-Economic Survey of Palestinian Refugees in Lebanon) [1]**

| Characteristics of Children | 2010 and 2015 (n=8034) | | |
|---|---|---|---|
| | Children living with GP | Children living without GP | P-value |
| **Number of children** | 715 (9.1%) | 7319 (90.9%) | |
| | | | |
| **Presence of GP only** | 210 (30.5) | N/A | <.0001 |
| **Presence of Parent** | 505 (69.5) | 7319 | |
| | | | |
| **Household food security status (n/%)** [2] | | | |
| Food secure | 479 (64.2) | 5094 (66.4) | 0.0002 |
| Food insecure | 236 (35.8) | 2225 (33.6) | |
| **Age (mean ±SE)** | 8.0 ± 0.2 | 9.5 ± 0.08 | <.0001 |
| **Age groups (n/%)** | | | |
| 0-4 years | 203 (28.2) | 1582 (21.1) | <.0001 |
| 5-11 | 317 (45.5) | 2792 (38.6) | |
| 12-17 | 195 (26.4) | 2956 (40.4) | |
| **Sex** (n/%) | | | |
| Boys | 346 (49.4) | 3685 (50.3) | 0.8059 |
| Girls | 369 (50.6) | 3626 (49.7) | |
| **Household poverty status (n/%)** | | | |
| Yes | 537 (74.7) | 5154 (71.4) | 0.0390 |
| No | 178 (25.3) | 2165 (28.6) | |
| **Attending school ages 6 and above**[3] | | | |
| Yes | 425 (94.8) | 5084 (96.5) | 0.0006 |
| No | 24 (5.2) | 189 (3.5) | |
| | | | |
| Age 6-12 attending school | 272 (93.1) | 2658 (94.8) | 0.0740 |
| Age 13-17 attending school | 153 (98.1) | 2426 (98.5) | |
| **Employment** [4] | | | |
| Employed | 240 (60.4) | 2448 (49.1) | 0.0157 |
| Unemployed | 145 (39.6) | 2240 (51.0) | |
| | | | |
| Age 5-14 employed | 183 (60.3) | 1550 (45.7) | <.0001 |
| Age 15-17 employed | 57 (60.6) | 898 (56.6) | |
| **Health status** | | | |
| **Having chronic conditions (**n/%) | | | 0.0410 |
| Yes | 81 (13.0) | 969 (14.0) | |
| No | 628 (87.0) | 6319 (86.0) | |
| **Having acute disease (within previous 6 months)** (n/%) | | | <.0001 |
| Yes | 369 (48.9) | 3380 (43.6) | |
| No | 337 (51.1) | 3890 (56.4) | |
| **Having health insurance** | | | |
| Yes | 355 (53.0) | 3657 (54.8) | 0.0447 |
| No | 346 (47.0) | 3566 (45.2) | |

[1]Significant differences in proportions tested using the chi-square test for categorical variables and the t-test for continuous variables, with Bonferroni method of correction for multiple comparisons
[2]Food security status: total raw score of 2-6 for 2010 survey and 3-7 for 2015 survey identified food insecure households
[3]School attendance included children aged 6 to 17 years old (n= 449 versus 5273)
[4] Child employment included children aged 5 to 17 years old (n=385 versus 4688) as suggested by the International Labour Organization [217].

**Table 4.23: Multivariate logistic regressions of factors associated with child's health (0-17 years) (2010 and 2015 Socio-Economic Survey of Palestinian Refugees in Lebanon) [1].**

| Characteristics | Acute | Chronic |
|---|---|---|
| | n=7472 | n=7501 |
| **Presence of Grandparent** | | |
| Yes | 0.74 (0.62-0.92) | 1.43 (0.46-2.45) |
| No | 1 | 1 |
| **Presence of Parent** | | |
| Yes | 0.73 (0.40-0.93) | 0.82 (0.42-1.63) |
| No | 1 | 1 |
| **Household food security status** | | |
| Food secure | 1 | 1 |
| Food insecure | 1.45 (1.17-1.80) | 1.56 (1.19-2.07) |
| **Child's gender** | | |
| Male | 1 | 1 |
| Female | 0.87 (0.82-0.93) | 0.75 (0.65-0.87) |
| **Child's age groups** | | |
| 0-4 | 1.35 (1.16-1.57) | 0.61 (0.49-0.76) |
| 5-11 | 1 | 1 |
| 12-17 | 1.02 (0.90-1.16) | 0.98 (0.82-1.17) |
| **Child has Health insurance** | | |
| Yes | 1.13 (0.81-1.57) | 0.87 (0.52-1.47) |
| No | 1 | 1 |
| **Grandparent with a chronic conditions [2]** | | |
| Yes | 1.58 (0.42-2.98) | 0.71 (0.21-2.38) |
| No | 1 | |
| **Household receiving welfare** | | |
| Yes | 1.39 (1.17-1.65) | 1.54 (1.22-1.94) |
| No | 1 | 1 |
| **Health Expenditure Per Capita/(per $50)** | 1.42 (1.18-1.26) | 1.45 (1.14-1.86) |
| **Household size** | 0.89 (0.84-0.95) | 0.91 (0.84-0.98) |

[1] All models were adjusted for survey year and household ID.

[2]GP with chronic conditions s: any grandparents who self-reported one or more chronic condition.

**Table 4.24: Multivariate logistic regressions of factors associated with child (5-17 years) well-being in Palestinian refugee camps in Lebanon[1].**

| Characteristics | School attendance | Child employment |
|---|---|---|
| | n=5353 | n=4682 |
| **Presence of Grandparent in household** | | |
| Yes | 2.22 (1.28-5.33) | 1.61 (0.73-2.16) |
| No | 1 | 1 |
| **Food security status** | | |
| Food security | 1 | 1 |
| Food insecurity | 0.68 (0.35-0.71) | 1.83 (1.30-2.78) |
| **Presence of parent in household** | | |
| Yes | 1.75 (1.59-2.20) | 0.51 (0.46-0.69) |
| No | 1 | 1 |
| **Child's gender** | | |
| Male | 1 | 1 |
| Female | 1.44 (1.04-1.98) | 0.72 (0.59-0.89) |
| **Child's age group for attending school** | | |
| **6-12** | 3.67 (2.41-4.64) | |
| **12-17** | 1 | |
| **Child age group for employment** | | |
| **5-14** | | 0.27 (0.18-0.41) |
| **15-17** | | 1 |
| **Grandparent with a chronic conditions [2]** | | |
| Yes | 0.84 (0.19-1.61) | 1.61(0.42-2.21) |
| No | 1 | 1 |
| **Household receiving welfare** | | |
| Yes | 1.37 (1.07-1.94) | 0.62 (0.46-0.83) |
| No | 1 | 1 |
| **Health Expenditure Per Capita/(per $50)** | 0.81 (0.66-0.99) | 1.10 (0.78-1.54) |
| **Household size** | 0.92 (0.82-1.04) | 1.95 (1.86-2.04) |

[1] All models were adjusted for survey year and household ID.
[2]GP with chronic conditions s: any grandparent who self-reported one or more chronic condition

# Chapter 5: Summary and Implications

This dissertation used data from the 2014, 2015, 2016, and 2017 Gallup World Poll (GWP) surveys, which includes the Food Insecurity Experience Scale (FIES), a metric of food insecurity (FI). The FIES was developed by the United Nations Food and Agriculture Organization - Voices of the Hungry project (FAO-VoH) to meet the need for a simple, flexible, broadly applicable, and cross-culturally comparable tool on a global scale [135, 136]. The GWP also collected data on sociodemographic factors, physical health, mental well-being, and social support, which were also examined in this dissertation. FIES was validated globally using the 2014 GWP data from more than 150 countries [138, 139]. However, since a global standard was used to validate the measure, there is a need for regional psychometric analysis of the tool to determine its applicability considering the cultural and linguistic differences in the LAS region. Limited studies have assessed the prevalence of FI and its determinants in the LAS region and those that have, used various measurement tools, which limit the comparability of the results [33, 141].

The overall goal of the first study was to define a standard metric for the LAS that could be used to identify the prevalence of FI by age groups 19-49 versus 50+ years, sex, the Absence of Violence and Terrorism score (PSAVT), the Human Development Index (HDI) of countries, and, to assess the common determinants of FI stratified by the 2017 country-level HDI. Thus, Rasch modeling was applied to the 2014-2015 GWP in the LAS to assess the regional validity of the FIES and determine its applicability as a measure of FI in that region. Also, the prevalence and characteristics of severely FI individuals were assessed using the 2014-2017 GWP data.

Our results showed that the FIES met the Rasch model assumptions of equal discrimination and conditional independence. The first assumption was assessed using fit statistics; infit is mainly used to assess the performance of the items in the scale, and outfits identify items that need improvement and those with erratic responses. In most LAS countries, infit statistics for the FIES items were in the acceptable range, indicating that the FIES items perform well in the scale and have good overall internal validity. The only exceptions with high infit were for the item "You were worried that you would not have enough food to eat" in Sudan and for the items "You were unable to eat healthy and nutritious food" and "You went without eating for a whole day" in Syria suggesting that these items are weakly associated with FI in these countries. On the other hand, high outfit statistics, can occur if there are a few erratic responses or unexpected observations (denials of the least severe items but affirm the most severe ones), which may be due to cognition problem and/or need improvement in translation. In this study, the high outfits was found for the item "You were worried that you would not have enough food to eat" in Jordan and Sudan, for the item "You were unable to eat healthy and nutritious food" in Syria, Palestinian Territories, and Yemen, and finally for the most severe item "You went without eating for a whole day" in Palestinian Territories and Yemen. Low outfit which signals possible redundant items in the country's scale was found for the item "You were worried that you would not have enough food to eat" in Syria, the item "You ate only a few kinds of foods" in South-Sudan, the item "You ate less than you thought you should" in Palestinian Territories, Somalia, South-Sudan, Sudan, and Tunisia, the item "You ran out of food" in Algeria, the item "You were hungry but did not eat" in Bahrain, and for the item "You went without eating for a whole day" in Lebanon.

The second assumption was assessed by examining the correlation between items. Overall, there were no significant correlations between the items in the combined LAS data except for the items "You ran out of food" and "You were hungry but did not eat" in Algeria and Tunisia and for the items "You were hungry but did not eat" and "You went without eating for a whole day" in Lebanon. However, this association was not high enough to indicate substantial measure distortion. There was also no indication of multi-dimensionality of the FIES since there were no significant correlations between any three adjacent items. However, improvements can be made through cognitive testing to ensure that respondents understand the questions as intended. Cognitive testing would also help determine whether the correlated items measured the same FI level. If they are correlated, one of the items may need to be eliminated when used in these countries.

Our results did show a disordering of the items 1 to 5 that differed from the level of FI they were designed to measure in most countries and the aggregated LAS data. The item "You ate only a few kinds of foods" had the highest affirmative responses in most countries and in the aggregated data. Also, the FI severity order measured by the items "You had to skip a meal" and "You ate less than you thought you should" were reversed in some countries. However, items measuring the more severe FI, "You were hungry but did not eat" and "You went without eating for a whole day," performed as expected. Since the relative disordering of the item severity was reasonably similar across the LAS countries, indicating that the severity level was experienced similarly in the LAS region. This disordering has no impact on determining the FI severity level since the items “You ate only a few kinds of foods," "You had to skip a meal," and "You ate less than you thought you should" were all classified as moderate FI. However, closer examination of

the FIES items order for LAS is necessary using a cognitive test to reorder the items and to better measure the least severe category of FI. Measuring the most severe FI is not problematic.

In conclusion, although some findings from our Rasch modeling analysis did not meet all the recommended assumptions for some countries and for some items, we can conclude that the overall fit of the FIES is acceptable for measuring FI in the LAS. However, applying some accommodations to the tool may improve its psychometric properties to better assess the severity of FI and recognizing how to interpret this tool in countries of the LAS region is essential.

Based on the Rasch analysis, we determined the threshold item for severe FI to be the items "You were hungry but did not eat" and "You went without eating for a whole day" in most countries, apart from Sudan, Syria, and Yemen, where the severe FI threshold was "You went without eating for a whole day." Applying these thresholds to the 2014-2017 GWP data, we found that 30.4% of respondents experienced moderate and severe FI, and 15.7% experienced severe FI. Severe FI was more prevalent among adults aged 50 years and older compared to younger adults 19-49 years, among women compared to men, in countries with low HDI and low political scores compared to countries with high HDI and high political scores. Additionally, severe FI was significantly more prevalent among married individuals, rural residents, those with lower educational attainment, unemployed, lower-income, larger households with more children under 15 years, and in low PSAVT countries. Our logistic regression analysis stratified by country's HDI showed that lower educational attainment, lower income, lower PSAVT score, and greater numbers of children were most significantly associated

with severe FI in countries in both HDI levels. However, living in rural areas was associated with severe FI in countries with high HDI, while employment was associated with severe FI in low HDI countries. FIES is recommended for use at a regional level, especially for comparative purposes to other regions of the world. However, country-based surveys may be better served using locally developed and tested instruments.

Given that the findings from the first study showed that FI was more prevalent in women compared to men, we examined the determinants of FI by sex to assess differences. Therefore, our second study determined the relationship between FI, physical health, and mental well-being stratified by sex. Physical health was assessed using the Physical Health Index (PHI), which measures the respondent's perceptions of their health status. It is composed of five questions about whether the respondent has any health problem, feels well-rested, or experiences any physical pain, worry, or sadness. Mental well-being was assessed using two five-item scales; Positive Experience Index (PEI) and Negative Experience Index (NEI). The PEI measures whether the respondent considers the day before the survey to be an overall positive experience with five questions as follows: 1) feeling well rested, 2) being treated with respect, 3) smiling or laughing, 4) learning or doing something interesting, and 5) experience of enjoyment. The NEI measures whether the respondent perceives the day prior to the survey as an unpleasant experience with five questions as follows: 1) physical pain, 2) worry, 3) sadness, 4) stress, and 5) anger. Our results showed that high negative experience and low income were positively associated with severe FI for both men and women, while good physical health and high positive experience were inversely associated with severe FI. Additionally, older age, living in rural areas, and living in households with a high

dependency ratio were associated with higher odds of severe FI for women but not men. The data were also examined among a sub-sample of women stratified by gender inequality index (GII) and controlling for social support. We found that the prevalence of severe FI was significantly higher among women living in countries with high versus low GII. For women in both high and low GII countries, good physical health and high positive experiences were associated with lower odds of severe FI, while high negative experiences were associated with higher odds of severe FI. These associations with FI remained significant even after adjusting for the emotional, instrumental, and embedded social support variables.

Adjusting for sociodemographic characteristics, physical health, positive experiences, and negative experiences showed that women in high GII countries who "have opportunities to make friends" and "have someone to count on" have lower odds of severe FI. Similar associations were seen in low GII countries for "having someone to count on" and only approached significance with "having opportunities to make friends." "Women in countries with a high GII, who had "people out of the country to rely on," had significantly lower odds of severe FI even after adjusting for all variables. However, women who reported "receiving money or goods" in countries with low GII were at higher odds of severe FI. In addition, women in low GII countries who lived alone had a higher likelihood of experiencing FI. This study also found that high negative experiences and poor physical health were associated the most with increasing the risk of FI. Nevertheless, since these associations are bi-directional, these findings still indicate that social support may reduce the risk of FI.

These findings suggest that more attention should be given to women and older adults since FI is highly prevalent in these groups. This implies the necessity to continue to monitor the food security status of women and target appropriate policies and interventions, such as providing suitable educational and job opportunities.

Social support was also negatively associated with FI. Therefore, more studies should be conducted to better define social support and assess it in a cultural context and in its association with FI. An intervention study that would provide services based on needs would clarify the role of instrumental versus emotional support.

Women in the LAS may need a wide range of social protection services, including pension plans to promote better economic access to food and health. There is a need to develop programs targeted to the interest and needs of women to integrate and participate in the communities. Interventions to promote social participation may include policies to promote greater political participation by women, at all levels of government. Addressing these factors may contribute to better food security and improved well-being, especially among women at risk of FI. Also, our results show that multiple complex risk factors contribute to FI and to poor physical health and mental well-being, therefore, a multidimensional approach is warranted to promote sustainable holistic intervention programs to promote food security and health in the LAS. Tools measuring physical health, mental well-being, and social support should be tailored and validated for use in the LAS region.

In this dissertation, we found that household composition and social support were both associated with FI, suggesting that more attention should be given to family structure and its association with FI and examine the emotional or financial support that

they may provide to children. Therefore, our third study used data collected by the American University of Beirut, Lebanon and UNRWA in 2010 and 2015 from a representative sample of Palestinian refugees living in Palestinian camps in Lebanon, to examine characteristics of households with and without a live-in GP and the impact of such a family structure on the health and well-being of grandchildren.

The results showed that children living in food-insecure households were more likely to have chronic diseases, acute diseases, and be employed and less likely to attend school. However, despite the higher percentage of FI among families with a live-in GP. The presence of a GP, independently of the presence of a parent in the household, was associated with lower odds of the grandchildren having an acute disease and higher odds of their attending school. The presence of parents, but not GP, was associated with lower odds of the children being employed.

The extent of GP involvement should be defined and used in collecting information needed to assess their potential influence on children's health and well-being. There is no definition for GP involvement in their grandchildren's life as these standards may vary according to cultural norms and the child's age. The concept of involvement is a complex construct since it may be interpreted in many ways. For example, it could be understood as having full childcare responsibilities as in case of custody, or child care while parents are at work, or even providing occasional care as needed. Future research needs to distinguish better the specific role of a GP in the lives of their grandchildren.

Limitations arise from the cross-sectional study design for both datasets used in this dissertation, which does not allow for inference of causality of FI or of children's health and well-being. Also, the limitations of self-reported data are well-known and may

lend themselves to bias. Consideration should also be given to the possibilities of bidirectional relationships between food security and other main predictors. This applies to all three manuscripts in this dissertation. Additionally, it is not possible from the survey to know whether the live-in grandparents are in a caregiver or caretaker role within the household. Longitudinal studies and the utilization of mixed methods, both qualitative and quantitative data are needed to better understand the determinants of FI and assess the extent of GP involvement and influence in the lives of their grandchildren. Finally, although the same tools were used to measure regionally physical health, mental well-being, and social support, these tools need to be cognitively tested and tailored for use for the population in LAS countries, considering customs and cultural differences.

Strengths of this dissertation include having a large dataset on FI at the individual level for a region that had limited data availability. This offers important information to inform policy in the fight to reduce FI. This study provided information on women in the LAS, an understudied population. Another strength is using a large nationally representative sample from 19 LAS countries, which supports the generalizability of the results. Additionally, standardized food security measures, physical health, mental well-being, and social support were used across the 19 LAS countries, making prevalence rates and associations comparable across countries and populations and within countries over time. This study is the first to examine relationships between food security, physical health, well-being, controlling for social support in the LAS region. Also, it is the first study to assess the relationship between live-in GP and the health and well-being of grandchildren in the Arab world. The UNRWA datasets contain information on all household members, which allowed us to examine relationships between members of the

households. Also, having the household FI information provides an added dimension to the associations when assessing health outcomes.

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