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# FOOD INSECURITY AND MENTAL HEALTH IN A CONFLICT-AFFECTED POPULATION: A CROSS-SECTIONAL STUDY OF ADULTS IN GAZA


by
## FARAH GHAZI ALI


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submitted in partial fulfillment of the requirements
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# AMERICAN UNIVERSITY OF BEIRUT

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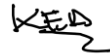
by
### FARAH GHAZI ALI

Approved by:

_____

Dr. Hala Ghattas, Associate Research Professor      Advisor
Department of Epidemiology and Population Health

_____

Dr. Monique Chaaya, Associate Dean
Department of Epidemiology and Population Health      Member of Committee

_____

Dr. Khalil El Asmar, Assistant Professor
Department of Epidemiology and Population Health      Member of Committee

Date of thesis defense: April 26, 2023

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# ABSTRACT
# OF THE THESIS OF

Farah Ghazi Ali       for       Master of Science
                                              Major: Epidemiology

Title: Food Insecurity and Mental Illness in a Conflict-Affected Population: A Cross-Sectional Study of Adults in Gaza

***Background:*** Gaza has endured military occupation for more than 13 years. This occupation has been accompanied by complete siege (sea, land and air), violence and conflict. The conflict has significantly increased the vulnerability of the Gazan population and there are reports of high burdens of both food insecurity and mental health disorders. Although the magnitude of the burdens of food insecurity and poor mental health have been investigated in the context of Gaza, little is known about the association between food insecurity and the manifestation of mental health disorders in this context. ***Objectives:*** This study aims to investigate the dual burden of food insecurity and poor mental health in the adult population of Gaza, and understand the impact of receiving aid on this association. ***Methods***: Data from a representative cross-sectional survey of 4520 adults aged 40 years and above residing in Gaza were used. The survey used the 2017 Population and Housing Census sampling frame and recruited individuals using a multistage stratified cluster sampling approach. Descriptive, bivariate and multivariable logistic regression analyses were conducted to assess the association between food insecurity and poor mental health and determine the moderating effect of receiving assistance on this association. ***Results***: Approximately 55% of the participants have poor mental health, and 57% of them are food insecure. Food insecurity was statistically significantly associated with poor mental health. Receiving in-kind food, and food vouchers as assistance did not modify the association between food insecurity and poor mental health. Cash assistance was found to moderate the association between food insecurity and poor mental health differentially in moderately food insecure as compared to severely food insecure adults.
***Conclusion:*** Further studies are needed to understand the role of different types, duration, intensity and amounts of assistance in moderating the association between food insecurity and poor mental health in the context of Gaza, as well as, consider other social determinants of both food insecurity and poor mental health to design appropriate interventions to alleviate these in Gaza.

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# CHAPTER I
# BACKGROUND

## A. Context of Gaza

Gaza, lying on the coast of the Mediterranean Sea with an area of 365 square kilometers, is an area of the occupied Palestinian territories [1, 2]. It is a densely populated area with approximately 2.1 million people and more than 1.4 million Palestinian refugees, according to the UN Relief and Works Agency for Palestine Refugees (UNRWA)[3]. Gaza has been under Israeli political and military occupation since 1967 (more than five decades) and has endured a complete blockade since 2007[4-6]. The violence perpetrated against the Gaza population between 1987 and 2000 led to 6,200 deaths, more than 60,000 injuries, and more than 65,000 detainments, followed by a blockade that led to the isolation of Palestinian cities and villages. Since then, Israel has conducted several severe military attacks along with the prolonged siege that has involved sea, land, and air restrictions. The most intense attacks took place in 2006, 2008, 2012, and 2014 and resulted in thousands of deaths, injuries, and disability. Gazans have experienced constant human rights violations and political violence, threatened lives and destruction of homes and lands[1, 3, 6]. The policies that Israeli authorities have used have led to the systematic oppression of Palestinians and include punitive home demolitions and broad movement restrictions against entire areas or communities based on the actions of a few people, according to Human Rights Watch[7]. In addition, being stringently closed and isolated by walls and fences, Gaza has suffered further devastation of the economic situation, limited access to resources, damage to health infrastructures, and food shortages creating an ongoing chronic food insecurity crisis, triggered mental health disorders, high rates of unemployment, and

widespread poverty[4, 5]. Thus, the conflict has placed formidable challenges on the population of Gaza at various levels, forming a chronic humanitarian crisis.

## B. Food Insecurity in Gaza

Food security, as defined by the United Nations World Food Summit held in 1996, is when "all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food that meets their food preferences and dietary needs for an active and healthy life"[8]. Conversely, the absence of adequate and sufficient nutritious food needed to ensure human well-being is food insecurity[9], a condition which is amplified in settings that are subjected to armed conflicts. The impact of armed conflicts goes beyond human and property damage to disrupting food systems in various ways including: destruction of agricultural lands and theft of crops, reduction of domestic food production and limiting imports, limiting food diversity, and increasing food prices. This food system destruction leads to a continuous cycle that increases food insecurity status and vulnerability of populations. Globally, according to the Food and Agriculture Organization of the United Nations, in 2021, approximately 193 million people were categorized as acutely food insecure among which around 40 million people are facing Emergency or worse conditions[10]. There is an endogenous relationship between conflict and severe food crisis, with an average of 1.4-4.4% points higher share of severe food crisis in conflict-affected low and middle-income countries than the other countries in the low and middle-income that are not affected by conflict [11, 12]. In addition, political, economic, and agricultural austerity are significantly associated and through numerous pathways in exacerbating the food insecurity status of the population in conflict-affected settings[13]. The aforementioned determinants are

significantly magnified in the context of Gaza, where due to the construction of the separation barrier, restriction of movement of food, and destruction of livelihoods, the economy was severely deteriorated, affecting the employment sector and eroding food security through the unavailability of food in markets[14]. All the aforementioned factors force Gazans to being tapped in a vicious cycle of poverty, unemployment, and food insecurity [13, 15]. According to the report published by the Palestinian Central Bureau of Statistics in 2020, >60% of the households in the Gaza strip experience moderate to severe food insecurity [15, 16], with approximately 80% dependent on humanitarian aid for survival [13, 15, 17]. Poverty and unemployment constitute the key drivers of food insecurity. In 2021, over half the workforce in Gaza was unemployed (scoring one of the highest unemployment rates in the world), 83% of the workers received less than the minimum wage [18], and poverty levels have reached 53% despite humanitarian assistance [14, 17]. The conflict in Gaza has thus adversely affected the food security status of the population and increased the reliance on food aid to live up to a socially acceptable living standard [19, 20]

**C. Mental Health in Gaza**

Compelling epidemiological evidence shows that the burden of mental health in conflict-affected areas is higher as compared to areas with no conflict[21]. With the rise of armed conflicts and violence globally, especially in low and middle-income countries, it is estimated that more than 170 million people are being affected, among which 82.4 million people were forcibly displaced [22-24]. Prolonged exposure to armed conflicts, with its detrimental impact on the economy, employment, social life, forced displacement, and lack of feeling safe and secure altogether jeopardizes the

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mental health of populations, significantly increasing the risk of psychosocial distress and the prevalence of mental health disorders (including depression, anxiety, post-traumatic stress disorder, bipolar disorder, and schizophrenia)[1, 23]. According to a release by the World Health Organization (WHO) in 2019, approximately one in five people in post-conflict settings suffer from depression, disorder, post-traumatic stress disorder, bipolar disorder, or schizophrenia [25]. Focusing on the context of Gaza, years of chronic political violence and traumatic experiences, continuous conflict, and stringent blockade have had a substantial detrimental impact on the mental health of the people in Gaza. Albeit families in Gaza are resorting to coping mechanisms to alleviate the effect of this situation, high levels of poverty and unemployment have placed strains on the families' resilience, hence increasing the risk of mental health disorders among them [26]. Cases of mental health disorders are usually under-treated or unreported. According to a study, several psychological sequelae were reported among adolescents in Gaza: 68.9% have been exposed to post-traumatic stress disorder, 40% have developed moderate to severe levels of depression and 94.9% have developed severe anxiety [21]. In addition, high rates of unemployment exacerbate the mental health status of households in Gaza as they are not able to sustain their basic living needs.

## D. International Literature on the Association between Food Insecurity and Mental Health

The association between food security and mental health has been increasingly investigated recently [27]. With more conflicts and military occupations evolving globally, both food security and mental health disorders have been increasing in these settings, requiring an understanding of the wider spectrum of determinants of both and their context. Food insecurity has been shown to be associated with poor mental health

in various contexts, with proposed mechanisms acting through nutrient intake, dietary patterns, or BMI [9, 27, 28]. Not being able to afford and access healthy and diverse diets in sufficient quantities, creates psychological distress including anxiety and depression. In addition, the socioeconomic disparities in the communities and the need to feed the family might force the individual to acquire food in socially unacceptable ways, hence, inducing feelings of deprivation, alienation, and shame; all of which are associated with depression [29-31]. This strong relationship between food insecurity and mental illness persists even after adjusting for possible confounding determinants of both [9]. This finding was reported in New Zealand [32], the United States [33], Bangladesh [34], and Canada [35], and is consistent with earlier studies in low and middle-income countries [28]. A study reported that psychological distress in both men and women has increased significantly due to moderate and severe food insecurity and that this effect is moderated by age [36]. Another study reported that gender also modifies the association between mental health outcomes and food insecurity where females are more likely to develop mental health disorders due to food insecurity than males [37].

Analyzing this relationship from a physiological perspective, food insecurity can lead to an increase in the consumption of cheap, low quality diets which could result in a range of issues including energy or micronutrient deficiencies, or obesity and chronic diseases in turn leading to a myriad of psychological problems [38-41].

## E. Assistance

In conflict-affected areas such as Gaza, food insecurity and mental illness are intertwined issues that pose a significant burden on individuals and communities. The prolonged conflict and economic crisis in Gaza have eroded coping mechanisms and

exacerbated pre-existing vulnerabilities, leading to high poverty, food insecurity, and unemployment rates. In addition, access to arable land and livelihood opportunities is limited, constraining refugees' ability to be self-sufficient [42]. In response to this situation, humanitarian organizations have increased the implementation of assistance programs, including cash assistance, vouchers, hygiene kits, and food parcels, to alleviate the burden created by conflict and to reduce resorting to harmful coping strategies. Approximately 80% of people in Gaza are dependent on humanitarian aid for survival [13, 15]. Food assistance programs are one part of the humanitarian response and they aim to improve and safeguard food security and nutrition [42]. Food assistance programs include in-kind food assistance, cash transfers, and school feeding. Food assistance may not only impact food insecurity status but also the mental health status of an individual. For example, receiving food aid may alleviate hunger and reduce stress related to food insecurity, but it may also be stigmatizing and reduce feelings of autonomy and self-efficacy. Cash transfers, on the other hand, may provide more flexibility and choice in meeting basic needs, but may also lead to feelings of guilt or shame if the assistance is not perceived as legitimate or earned. Providing more people with benefits through nutrition assistance programs, increasing benefit amounts, and addressing unemployment may help reduce food insecurity and hunger, which, in turn, may improve mental health outcomes. Therefore, continued humanitarian assistance represents a fundamental safety net and is necessary to address the food insecurity and mental health challenges faced by conflict-affected populations in Gaza.

### F. Literature Gap

Although of the magnitude of the burdens of food insecurity and poor mental health have been investigated in the context of Gaza, little is known about the association between food insecurity and the manifestation of mental health disorders in this context. In fact, studies elsewhere have shown associations between common mental health disorders (depression, anxiety, and stress), food insecurity, BMI and poor diets [27]. The majority of studies on this topic were from high income countries such as the United States, Australia, and United Kingdom, and only 25% of the studies were carried out in low and middle-income countries with dearth of these types of studies in Arab countries [27]. In addition, it is likely that a set of common underlying structural factors and determinants link food insecurity and poor mental health, including poverty, unemployment, condition of conflict and instability, and these are important to investigate.

### G. Rationale and Objectives of the Study

In this study, we aim to investigate and quantify the dual burden of or co-occurrence of food insecurity and poor mental health in the adult population of Gaza, and assess the effect of varying types of assistance on the association between food insecurity and the manifestation of poor mental health among these individuals. Two hypotheses were developed accordingly:

**Hypothesis 1:** Food insecurity is associated with mental health disorders in the adult population of Gaza.

**Hypothesis 2:** Receipt of assistance attenuates the association between food insecurity and mental health

This study will inform public health interventions and policies that can target or address both, food insecurity and poor mental health.

# CHAPTER 2
# METHODS

## A. Study Design and Sampling

This study uses data from a cross-sectional study of adults conducted in Gaza in 2020. The study sample included 4576 individuals aged 40 years and above residing in Gaza for at least one year before data collection had started. The aim of the study was to assess chronic disease risk factors and identify a set of cost-effective interventions to support the prevention and control of non-communicable diseases (NCDs) in Gaza. The study used a multistage stratified cluster sampling approach to recruit participants: where households were identified through the 2017 Population and Housing Census sampling frame and included urban and rural areas, and refugee camps. Data were collected through a structured household questionnaire administered face-to-face. The questionnaire included modules on socio-demographics, food security, assistance, psychosocial health, history of non-communicable diseases, health behaviors, physical measurements and nutrition. The primary study was approved by the Imperial College Research Ethics Committee (20IC5733), the American University of Beirut Institutional Review Board (SBS-2020-0103), and the Gaza Helsinki Committee (PHRC/HC/483/19). For our study, we used de-identified data governed by a confidentiality agreement.

## B. Concepts and Measurements

### 1. Outcome (dependent variable)

In the original study, the 12-item General Health Questionnaire (GHQ-12) was used to detect psychological disorders. This questionnaire is an abridged version from

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the GHQ-60 item questionnaire, valid and reliable questionnaire, and was adopted by the World Health Organization (WHO) to screen for general (non-psychotic) mental health problems among primary care patients [43].GHQ-12 item questionnaire includes 12 items that are an equal number of positively and negatively phrased items and asked in the time frame of "in the last two weeks": 1) "Been able to concentrate on what you're doing?", 2) "Lost much sleep over worry?", 3) "Felt you were playing a useful part in things?", 4) "Felt capable of making decisions about things?", 5) "Felt constantly under strain?", 6) "Felt you couldn't overcome your difficulties?", 7) "Been able to enjoy your normal day-to-day activities?", 8) "Been able to face up to your problems?", 9) "Been feeling unhappy and depressed?", 10) "Been losing confidence in yourself?", 11) "Been thinking of yourself as a worthless person?", 12) "Been feeling reasonably happy, all things considered". The responses are then usually rated on a 4-point Likert scale: for positively phrased items "Better than usual", "Same as usual", "Worse than usual" and "Much worse than usual" whereas for negatively phrased items "Not at all", "Less than usual", "Same as usual" and "More than usual" and scored [44]. However, the response options in this survey were shortened and rated as binary response format "0=No" and "1=Yes", instead of the original Likert scale. The usual scoring methods [bimodal GHQ scoring method (0-0-1-1), Likert scoring method (0-1-2-3) and the C-GHQ scoring method] were therefore not applicable. A modified scoring method was adopted, and the maximum total score that could be received is 12. We considered 3 as the cut-off point (as per the international cut-offs): those who scored from 0-3 are considered to have "Good Mental Health", and those who scored from 4-12 are considered to have "Poor Mental Health". Good Mental Health is defined by the World Health Organization (WHO) as "a state of mental well-being that enables people to cope

with the stresses of life, realize their abilities, learn well and work well, and contribute to their community" [45].

## 2. Main Exposure (independent variable)

Food insecurity was assessed using Food Insecurity Experience Scale (FIES), a reliable assessment tool developed by the Food and Agriculture Organization Voices of the Hungry Project (FAO-VoH) to measure the experiences of household or individual food security levels and valid in the Arab context. FIES consists of 8 questions asked in the time frame of "during the last year", and responses are dichotomized into "Yes" or "No" [46, 47]. Food insecurity was therefore measured using the sum of affirmative responses to the 8 questions. FIES scores are then computed by summing the score of each question item, and the total scores obtained range from 0-8. Based on the global standard, the scores were categorized into 3 groups: 1) Food Secure (scores range from 0-3), 2) Mild to Moderately Food Secure (scores range from 4 to 6) and 3) Severely Food Insecure (scores range from 7 to 8) [46].

## 3. Sociodemographic and Other Covariates

Sociodemographic information was collected at the individual level (from the respondent). Age was treated as a categorical variable.

Marital status was categorized into several categories, however, for the purpose of this study it was categorized as not married and engaged/married. Refugee status was recorded as refugee or not a refugee. Additionally, information on employment status was reported as "Did you work during the past 30 days", and the responses were taken as "Yes" and "No". To reflect poverty, income of the households was collected as the

Net Income Share (NIS), and then the NIS responses were grouped into five income quintiles (each quintile contains approximately 20% of the study participants) ranking the participants from the poorest to the wealthiest; a way to describe inequality in the income distribution. Furthermore, crowding index variable was generated as representative of household density, and it is based on a calculation involving the number of household members and the number of rooms used for dwelling purposes. The purpose of generating the crowding index variable goes back to the fact that crowding is viewed as indicator of low socioeconomic status and due to the evidence of relationship between crowding and physical and mental health outcomes [48, 49].

## 4. *Effect Modifier/Moderator*

Receipt of assistance is treated as a moderator in the association between food insecurity and poor mental health. The types of assistance that are considered in this study are food, cash and food voucher because of the direct effect between these categories and our main independent variable "food security". The three categories were treated as binary "Yes" or "No". In addition, to capture the potential moderation effect of receiving multiple forms of assistance in the association between food insecurity and poor mental health, a new dummy variable was created, "intensity of assistance", by summing up the binary variables for in-kind food, cash, and food voucher assistance. This variable will help account for the possible additive effect of receiving multiple types of assistance, and will allow for a more nuanced analysis of how assistance affects the association between food insecurity and mental health.

## C. Sample Size

The sample size of this study is pre-determined by that of the initial study given that this study is based on a secondary data; the initial study included 4,520 participants.

## D. Statistical Analysis

### 1. Descriptive Analysis (Univariate analysis)

Descriptive data analysis was conducted to examine the distribution and variability of all individual variables using STATA software version 13.0. Variables were summarized using frequencies and percentages in the total sample (Table 1).

### 2. Bivariate Analysis

Chi-squared tests were conducted to determine the distribution of the covariates across the mental health outcome as well as to understand and interpret the statistically significant associations between the mental health outcome and all the other covariates. The threshold taken for consideration in this study is defined as alpha level was 20%, and unadjusted odds ratios (OR), 95% confidence intervals (CI), standard errors and corresponding p-values were tabulated (Table 2).

### 3. Multivariable Logistic Regression

Multivariable logistic regression analysis was carried out to assess the association between food insecurity and mental health outcome in the presence of all covariates (as a saturated model). Then, Backward Stepwise Logistic Regression approach was conducted to gradually eliminate the statistically not significant variables from the regression model, and hence, reaching a reduced model explaining the best the association between food insecurity and mental health outcome accounting for possible

confounders. To understand the moderating effect of receiving assistance on the association between our dependent and independent variables, stratified analysis was carried out. The threshold taken for consideration in this study is defined as alpha level was 5%.

**** Given that in each household, two individuals were interviewed one eligible male and one eligible female older than 40 years old, it important to mention that all the bivariate and multivariable logistic regression analyses were adjusted for the household cluster effect; thus, avoiding possible homogeneity in the responses of the individuals from the same household and maintaining statistical power.

# CHAPTER 3
# RESULTS

## A. Descriptive Analysis

| Table 1: Descriptive analysis of sociodemographic characteristics, dependent variable (food security status), outcome (mental health status) and effect modifier (assistance) | | | |
|---|---|---|---|
| **Covariates** | | **N** | **% Among Respondents** |
| **Sociodemographic Characteristics** | | | |
| **Sex** | Male | 2,103 | 45.96 |
| | Female | 2,473 | 54.04 |
| **Age** | 40-49 | 1,289 | 28.17 |
| | 50-59 | 1,575 | 34.42 |
| | 60-69 | 1,091 | 23.84 |
| | 70-79 | 509 | 11.12 |
| | 80+ | 112 | 2.45 |
| **Refugee Status** | Refugee | 3,136 | 68.53 |
| | Not a refugee | 1,440 | 31.47 |
| **Marital Status** | Not married | 446 | 9.75 |
| | Engaged/married | 4,130 | 90.25 |
| **Educational Background** | Basic education | 637 | 13.92 |
| | Intermediate education | 2,034 | 44.45 |
| | Plus-education | 1,905 | 41.63 |
| **Employed during the past 30 days** | No | 3,757 | 82.14 |
| | Yes | 817 | 17.86 |
| **Type of Employment** | Employer | 47 | 5.75 |
| | Self-employed/own account worker | 163 | 19.95 |
| | Works with regular wage | 492 | 60.22 |
| | Works with irregular wage | 105 | 12.85 |
| | Works for family without pay | 7 | 0.86 |
| | Other | 3 | 0.37 |
| **Crowding index** | <=1 person/room | 1,298 | 28.51 |
| | 2-3 people/room | 1,961 | 43.07 |
| | >3 people/room | 1,294 | 28.42 |
| **Quintiles of monthly income** | 1 | 1,050 | 24.69 |
| | 2 | 772 | 18.16 |
| | 3 | 892 | 20.98 |
| | 4 | 736 | 17.31 |
| | 5 | 802 | 18.86 |
| **Have health insurance** | Yes | 3,831 | 83.81 |
| | No | 740 | 16.19 |
| **Assistance** | **In kind food** | | |
| | No | 1,739 | 38 |
| | Yes | 2,837 | 62 |
| | **Cash** | | |
| | No | 2,487 | 54.35 |
| | Yes | 2,089 | 45.65 |
| | **Food Voucher** | | |
| | No | 3,625 | 79.22 |
| | Yes | 951 | 20.78 |
| **Intensity of Assistance** | Receive No Assistance | 1,091 | 23.84 |
| | Receive 1 Type of Assistance | 1,437 | 31.4 |
| | Receive 2 Types of Assistance | 1,704 | 37.24 |

| | | | |
|---|---|---|---|
| | Receive 3 Types of Assistance | 344 | 7.52 |
| **Food Security Status** | | | |
| | Food secure | 1,961 | 42.93 |
| | Mild to moderate food insecure | 2,348 | 51.4 |
| | Severely food insecure | 259 | 5.67 |
| **Mental Health Status** | | | |
| | Good Mental Health | 2,051 | 45.13 |
| | Poor Mental Health | 2,494 | 54.87 |

**Table 1** presents the frequency distribution of the sample's characteristics. The study included 4,576 participants, with 45.96% males and 54.04% females. Participants were categorized into five age groups, with the majority (34.42%) falling into the 50-59 age group. Of the participants, 68.53% were refugees in Gaza, 90.25% were married, and most had intermediate education (44.45%). The majority (82.14%) reported not working in the past 30 days. In terms of crowding index, 43.07% had 2-3 persons dwelling per room, and 24.62% belonged to the first quintile of monthly income (0-500 Shekel). Three types of assistance were considered (in-kind food, cash and food vouchers), where 62% of the participants reported receiving in-kind food assistance, 45.65% reported receiving cash as type of assistance and 20.78% reported receiving food vouchers. In addition, only 23.84% of the participants receive no assistance, whereas 31.4% of the participants receive one type of assistance (in-kind, food voucher or cash assistance) and 44.76% receive 2 or three types of assistance (regardless of the combination of the types of assistance). Regarding food security status, most of the participants (51.4%) fell into the "mild to moderate food insecure" category and only 5.67% were placed in the "severely food insecure" category.

Finally, and with respect to the mental health status, 54.87% of the participants were classified as having "poor mental health".

## B.  Bivariate and Logistic Regression Analysis

| Covariates | N | % | Mental Health Status | |
|---|---|---|---|---|
| **Table 2: Bivariate Analysis of the outcome (mental health status) and all other covariates considered in the study. Percentages represent the percent distribution of covariates among good and poor mental health outcome** | | | | |
| | | | Good Mental Health | Poor Mental Health |
| | | | N (%) | N (%) |
| **Sex** | | | | |
| Male | 2,103 | 45.96 | 974 (46.54) | 1119 (53.46) |
| Female | 2,473 | 54.04 | 1077 (43.92) | 1375 (56.08) |
| **Age** | | | | |
| 40-49 | 1,289 | 28.17 | 574 (44.95) | 703 (55.05) |
| 50-59 | 1,575 | 34.42 | 706 (45.03) | 862 (54.97) |
| 60-69 | 1,091 | 23.84 | 530 (48.89) | 554 (51.11) |
| 70-79 | 509 | 11.12 | 205 (40.51) | 301 (59.49) |
| 80+ | 112 | 2.45 | 36 (32.73) | 74 (67.27) |
| **Refugee Status** | | | | |
| Refugee | 3,136 | 68.53 | 1409 (45.26) | 1704 (54.74) |
| Not a refugee | 1,440 | 31.47 | 642 (44.83) | 790 (55.17) |
| **Marital Status** | | | | |
| Not married | 446 | 9.75 | 185 (41.76) | 258 (58.24) |
| Engaged/married | 4,130 | 90.25 | 1866 (45.49) | 2236 (54.51) |
| **Educational Background** | | | | |
| Basic education | 637 | 13.92 | 198 (31.43) | 432 (68.57) |
| Intermediate education | 2,034 | 44.45 | 845 (41.83) | 1175 (58.17) |
| Plus-education | 1,905 | 41.63 | 1008 (53.19) | 887 (46.81) |
| **Employed during the past 30 days** | | | | |
| No | 3,757 | 82.14 | 1611 (43.18) | 2120 (56.82) |
| Yes | 817 | 17.86 | 440 (54.19) | 372 (45.81) |
| **Type of Employment** | | | | |
| Employer | 47 | 5.75 | 29 (61.7) | 18 (38.3) |
| Self-employed/own account worker | 163 | 19.95 | 80 (49.38) | 82 (50.62) |
| Works with regular wage | 492 | 60.22 | 277 (56.65) | 212 (43.35) |
| Works with irregular wage | 105 | 12.85 | 49 (47.12) | 55 (52.88) |
| Works for family without pay | 7 | 0.86 | 3 (42.86) | 4 (57.14) |
| Other | 3 | 0.37 | 2 (66.67) | 1 (33.33) |
| **Crowding index** | | | | |
| <=1 person/room | 1,298 | 28.51 | 662 (51.2) | 631 (48.8) |
| 2-3 people/room | 1,961 | 43.07 | 881 (45.3) | 1064 (54.7) |
| >3 people/room | 1,294 | 28.42 | 495 (38.55) | 789 (61.45) |
| **Quintiles of monthly income** | | | | |
| 1 | 1,050 | 24.69 | 342 (32.82) | 700 (67.18) |
| 2 | 772 | 18.16 | 292 (38.17) | 473 (61.83) |
| 3 | 892 | 20.98 | 390 (44.12) | 494 (55.88) |
| 4 | 736 | 17.31 | 397 (54.01) | 338 (45.99) |
| 5 | 802 | 18.86 | 472 (59.3) | 324 (40.7) |
| **Have health insurance** | | | | |
| Yes | 3,381 | 83.81 | 330 (44.72) | 408 (55.28) |
| No | 740 | 16.19 | 1719 (45.21) | 2083 (54.79) |
| ***In kind food Assistance*** | | | | |
| No | 1,739 | 38 | 889 (51.39) | 841 (48.61) |
| Yes | 2,837 | 62 | 1162 (41.28) | 1653 (58.72) |
| ***Cash Assistance*** | | | | |
| No | 2,487 | 54.35 | 1281 (51.84) | 1190 (48.16) |
| Yes | 2,089 | 45.65 | 770 (37.13) | 1304 (62.87) |
| ***Food Voucher Assistance*** | | | | |
| No | 3,625 | 79.22 | 1688 (46.91) | 1910 (53.09) |
| Yes | 951 | 20.78 | 363 (38.33) | 584 (61.67) |
| **Intensity of Assistance** | | | | |
| Receive No Assistance | 1,091 | 23.84 | 628 (57.88) | 457 (42.12) |
| Receive 1 Type of Assistance | 1,437 | 31.4 | 672 (47.12) | 754 (52.88) |
| Receive 2 Types of Assistance | 1,704 | 37.24 | 630 (37.23) | 1,062 (62.77) |
| Receive 3 Types of Assistance | 344 | 7.52 | 121 (25.38) | 221 (64.62) |

| Food Security Status | | | | |
|---|---|---|---|---|
| Food secure | 1,961 | 42.93 | 1217 (62.47) | 731 (37.53) |
| Mild to moderate food insecure | 2,348 | 51.4 | 794 (34.03) | 1539 (65.97) |
| Severely food insecure | 259 | 5.67 | 38 (14.84) | 218 (85.16) |

**Table 2** represents the results of the bivariate analysis *(in percentages)* and

**Table 3** represents the unadjusted odds ratios (ORs), 95% confidence intervals (CIs),

and p-values resulting from the bivariate logistic model between the main outcome,

poor mental health and other covariates. Sex, age, marital status, educational

background, employment status, crowding index, quintiles of monthly income, the three

types of assistance, and food security status were associated with poor mental health at

an alpha level of 20% (p-values < 0.2).

Females had 1.11 higher odds of having poor mental health than males

(OR=1.11, 95% CI: 1.003-1.23). Similarly, in terms of age, participants aged 80+ years

had 1.678 greater odds of having poor mental health than those aged 40-49 (OR=1.678,

95% CI: 1.108-2.542). As age increases, the odds of having poor mental health also

increase (except for the age category 60-69 years). Employed participants had lower

odds (OR=0.642, 95% CI: 0.551 – 0.748) of having poor mental health than those who

were not employed. The 5th quintile of monthly income had the lowest odds of having

poor mental health in reference to the 1st quintile and compared to other quintiles

($OR_{2nd\,quintile}$=0.791, $OR_{3rd\,quintile}$=0.618, $OR_{4th\,quintile}$=0.415, $OR_{5th\,quintile}$=0.335).

Moving to receiving assistance, and among the three types of assistance (in-kind food,

cash, and food voucher), participants who received assistance were at higher odds of

having poor mental health as compared to those who didn't receive assistance [$OR_{cash\,assistance}$=1.429, $OR_{in-kind\,food}$= 1.221 & $OR_{food\,vouchers}$=1.208]. Furthermore, those who

receive two types of assistance or more have higher

| Table 3: Bivariate logistic regression analysis of the outcome (poor mental health) and other covariates without adjusting for any covariate (unadjusted ORs). | | | | | | |
|---|---|---|---|---|---|---|
| Covariates | n | % | Unadjusted OR | CI for unadjusted OR (95%) | Std. Err | p-value |
| **Sociodemographic characteristics** | | | | | | |
| **Sex** | | | | | | 0.0429* |
| Male | 2,103 | 45.96 | Ref. | --- | --- | |
| Female | 2,473 | 54.04 | 1.11 | [1.003 - 1.23] | 0.057 | |
| **Age** | | | | | | 0.0027* |
| 40-49 | 1,289 | 28.17 | Ref. | --- | --- | |
| 50-59 | 1,575 | 34.42 | 0.996 | [0.856 - 1.16] | 0.077 | |
| 60-69 | 1,091 | 23.84 | 0.853 | [0.718 - 1.013] | 0.074 | |
| 70-79 | 509 | 11.12 | 1.198 | [0.967 - 1.486] | 0.131 | |
| 80+ | 112 | 2.45 | 1.678 | [1.108 - 2.542] | 0.355 | |
| **Refugee Status** | | | | | | 0.8061 |
| Refugee | 3,136 | 68.53 | Ref. | --- | --- | |
| Not a refugee | 1,440 | 31.47 | 1.0174 | [0.885 - 1.117] | 0.072 | |
| **Marital Status** | | | | | | 0.1568* |
| Not married | 446 | 9.75 | Ref. | --- | --- | |
| Engaged/married | 4,130 | 90.25 | 0.859 | [0.696 - 1.06] | 0.092 | |
| **Educational Background** | | | | | | 0.0000* |
| Basic education | 637 | 13.92 | Ref. | --- | --- | |
| Intermediate education | 2,034 | 44.45 | 0.637 | [0.524 - 0.775] | 0.063 | |
| Plus-education | 1,905 | 41.63 | 0.403 | [0.333 - 0.491] | 0.0408 | |
| **Employed during the past 30 days** | | | | | | 0.0000* |
| No | 3,757 | 82.14 | Ref. | --- | --- | |
| Yes | 817 | 17.86 | 0.642 | [0.551 - 0.748] | 0.0500 | |
| **Type of Employment** | | | | | | 0.2839 |
| Employer | 47 | 5.75 | Ref. | --- | --- | |
| Self-employed/own account worker | 163 | 19.95 | 1.651 | [0.847 - 3.219] | 0.562 | |
| Works with regular wage | 492 | 60.22 | 1.233 | [0.665 - 2.284] | 0.387 | |
| Works with irregular wage | 105 | 12.85 | 1.808 | [0.891 - 3.667] | 0.652 | |
| Works for family without pay | 7 | 0.86 | 2.148 | [0.429 - 10.74] | 1.763 | |
| Other | 3 | 0.37 | 0.805 | [0.067 - 9.553] | 1.016 | |
| **Crowding index** | | | | | | 0.0000* |
| <=1 person/room | 1,298 | 28.51 | Ref. | --- | --- | |
| 2-3 people/room | 1,961 | 43.07 | 1.267 | [1.08 - 1.481] | 0.1 | |
| >3 people/room | 1,294 | 28.42 | 1.672 | [1.408 - 1.985] | 0.146 | |
| **Quintiles of monthly income** | | | | | | 0.0000* |
| 1 | 1,050 | 24.69 | Ref. | --- | --- | |
| 2 | 772 | 18.16 | 0.791 | [0.638 - 0.981] | 0.086 | |
| 3 | 892 | 20.98 | 0.618 | [0.505 - 0.757] | 0.063 | |
| 4 | 736 | 17.31 | 0.415 | [0.337 - 0.513] | 0.044 | |
| 5 | 802 | 18.86 | 0.335 | [0.272 -0.412] | 0.035 | |
| **Have health insurance** | | | | | | 0.8281 |
| Yes | 3,381 | 83.81 | Ref. | --- | --- | |
| No | 740 | 16.19 | 0.98 | [0.817 - 1.175] | 0.0907 | |
| **Assistance** | | | | | | |
| *In kind food* | | | | | | 0.0000* |
| No | 1,739 | 38 | Ref. | --- | --- | |
| Yes | 2,837 | 62 | 1.5037 | [1.314 - 1.719] | 0.103 | |
| *Cash* | | | | | | 0.0000* |
| No | 2,487 | 54.35 | Ref. | --- | --- | |
| Yes | 2,089 | 45.65 | 1.823 | [1.597 - 2.08] | 0.122 | |
| *Food Voucher* | | | | | | 0.0000* |
| No | 3,625 | 79.22 | Ref. | --- | --- | |
| Yes | 951 | 20.78 | 1.421 | [1.205 - 1.677] | 0.119 | |
| **Intensity of Assistance** | | | | | | |
| Receive No Assistance | 1,091 | 23.84 | Ref. | --- | --- | 0.0000* |
| Receive 1 Type of Assistance | 1,437 | 31.4 | 1.541 | [1.295 – 1.835] | 0.136 | |
| Receive 2 Types of Assistance | 1,704 | 37.24 | 2.316 | [1.951 – 2.749] | 0.202 | |
| Receive 3 Types of Assistance | 344 | 7.52 | 2.509 | [1.905 – 3.306] | 0.353 | |
| **Food Security Status** | | | | | | 0.0000* |
| Food secure | 1,961 | 42.93 | Ref. | --- | --- | |
| Mild to moderate food insecure | 2,348 | 51.4 | 3.226 | [2.827 - 3.683] | 0.217 | |
| Severely food insecure | 259 | 5.67 | 9.55 | [6.667 - 13.675] | 1.749 | |

*Indicates significant association between the covariate and outcome at p<0.2

odds of having poor mental health as compared to those who didn't receive any type of assistance [OR $_{receive\ 2\ types\ of\ assistance}$ = 2.316, 95% CI: 1.951 – 2.749; OR $_{receive\ 3\ types\ of\ assistance}$ = 2.509, 95% CI: 1.905 – 3.306].. Lastly, poor mental health was the highest among those who were severely food insecure (with being "food secure" as reference) (OR=7.541, 95% CI: 4.428-12.853).

**E. Multivariable analysis**

**Table 4** represents the multivariate logistic regression model (full model) assessing the association between poor mental health outcome, sociodemographic covariates and food security status; in the absence of assistance and before applying the backward stepwise logistic regression analysis. Not forgetting to mention that the sociodemographic covariates that are considered in this model are the ones that were had a p-value <0.2 in the bivariate logistic analysis (Table 3).

**Table 4: Multivariate logistic regression model assessing the association between poor mental health outcome, significant sociodemographic variables and food security status exposure**

| Covariates | Adjusted OR | CI for Adjusted OR (95%) | Std. Err | p-value[a] |
|---|---|---|---|---|
| **Food Security Status** | | | | |
| Food secure | Ref. | ---- | ---- | ---- |
| Mild to moderate food insecure | 2.768 | [2.387-3.21] | 0.209 | 0.000* |
| Severely food insecure | 7.135 | [4.883-10.426] | 1.38 | 0.000* |
| **Sociodemographic characteristics** | | | | |
| **Sex** | | | | |
| Male | Ref. | ---- | ---- | ---- |
| Female | 1.114 | [0.97-1.279] | 0.078 | 0.125 |
| **Age** | | | | |
| 40-49 | Ref. | ---- | ---- | ---- |
| 50-59 | 1.091 | [0.921-1.293] | 0.094 | 0.311 |
| 60-69 | 0.947 | [0.771-1.162] | 0.098 | 0.603 |
| 70-79 | 1.405 | [1.085-1.819] | 0.185 | 0.01* |
| 80+ | 2.20 | [1.308-3.716] | 0.587 | 0.003* |
| **Marital Status** | | | | |
| Not married | Ref. | ---- | ---- | ---- |
| Engaged/married | 0.976 | [0.76-1.254] | 0.124 | 0.854 |
| **Educational Background** | | | | |
| Basic education | Ref. | ---- | ---- | ---- |
| Intermediate education | 0.799 | [0.639-1] | 0.091 | 0.05 |
| Plus-education | 0.671 | [0.533-0.845] | 0.078 | 0.001* |
| **Employed during the past 30 days** | | | | |
| No | Ref. | ----- | ----- | ---- |
| Yes | 0.907 | [0.746-1.103] | 0.09 | 0.33 |
| **Crowding index** | | | | |
| <=1 person/room | Ref. | ---- | ----- | ---- |
| 2-3 people/room | 1.196 | [1.005-1.424] | 0.106 | 0.043* |
| >3 people/room | 1.362 | [1.117-1.661] | 0.137 | 0.002* |
| **Quintiles of monthly income** | | | | |
| 1 | Ref. | ---- | ---- | ---- |
| 2 | 0.793 | [0.633-0.992] | 0.09 | 0.043* |
| 3 | 0.784 | [0.632-0.972] | 0.086 | 0.027* |
| 4 | 0.615 | [0.49-0.771] | 0.071 | 0.000* |
| 5 | 0.612 | [0.487-0.769] | 0.071 | 0.000* |

*Indicates significant association between the covariate and outcome at p<0.05
[a]All p-values resulted from multiple logistic regression test
OR=Odds Ratio, CI=Confidence Interval

Both levels of food insecurity (mild to moderate and severe food insecurity) are statistically significantly associated with poor mental health at p-value<0.05 (p-value<0.0001). In fact, the odds of having poor mental health was 2.768 times among those who were mildly to moderately food insecure and 7.135 times among those who are severely food insecure compared to those who were food secure. As for the sociodemographic covariates, only age, educational background, crowding index and

quintiles of monthly income were statistically significantly associated with poor mental health outcome at p-value<0.05.

After conducting backward stepwise regression, and gradually eliminating from each model the statistically not significant predictors which have the highest p-value (marital and employment status), a final reduced model was obtained **(Table 5)**.

| Table 5 (Model 1): Multivariable logistic regression analysis of the poor mental outcome and food security status exposure adjusting for all significant covariates (after backward stepwise logistic regression) | | | |
|---|---|---|---|
| Covariates | Model 1 OR‡ | CI for Adjusted OR (95%) | p-value |
| **Food Security Status** | | | |
| Food secure | Ref. | ---- | ---- |
| Mild to moderate food insecure | 2.769 | [2.388-3.21] | 0.000* |
| Severely food insecure | 7.127 | [4.877-10.416] | 0.000* |
| **Socio demographic characteristics** | | | |
| **Sex** | | | |
| Male | Ref. | ---- | ---- |
| Female | 1.149 | [1.016-1.299] | 0.026* |
| **Age** | | | |
| 40-49 | Ref. | ---- | ---- |
| 50-59 | 1.092 | [0.922-1.294] | 0.305 |
| 60-69 | 0.964 | [0.788-1.178] | 0.721 |
| 70-79 | 1.443 | [1.124-1.851] | 0.004* |
| 80+ | 2.27 | [1.361-3.789] | 0.002* |
| **Educational Background** | | | |
| Basic education | Ref. | ---- | ---- |
| Intermediate education | 0.795 | [0.637-0.993] | 0.044* |
| Plus-education | 0.662 | [0.527-0.831] | 0.000* |
| **Crowding index** | | | |
| <=1 person/room | Ref. | ---- | ---- |
| 2-3 people/room | 1.195 | [1.004-1.422] | 0.044* |
| >3 people/room | 1.364 | [1.12-1.662] | 0.002* |
| **Quintiles of monthly income** | | | |
| 1 | Ref. | ---- | ---- |
| 2 | 0.79 | [0.631-0.989] | 0.04* |
| 3 | 0.778 | [0.627-0.964] | 0.022* |
| 4 | 0.607 | [0.485-0.76] | 0.000* |
| 5 | 0.601 | [0.48-0.753] | 0.000* |

*Indicates significant association between the covariate and outcome at p<0.05
[a]All p-values resulted from multiple logistic regression test
OR=Odds Ratio, CI=Confidence Interval
‡ Model is adjusted for employment status and marital status

Adding the intensity of assistance to the previous model, a new model **(Table 6)** was produced assessing the association between food insecurity and poor mental health in the presence of assistance varying by its intensity (number of assistances received). ****The effect of the **type** of assistance on the association between food insecurity and poor mental health was also studied separately, the receipt of the three types of assistance was added to the final reduced model, and three new models **(Appendix A)** were produced.

| Table 6 (Model 2): Multivariable logistic regression analysis of the poor mental outcome and food security status exposure adjusting for all significant covariates and including intensity of assistance | | | |
|---|---|---|---|
| Covariates | Adjusted OR‡ | 95% CI of Adjusted ORs | P-value |
| **Food Security Status** | | | |
| Food Secure | Ref. | ---- | ---- |
| Mild to Moderate Food Insecure | 2.751 | [2.368 – 3.195] | 0.000* |
| Severely Food Insecure | 7.040 | [4.816 – 10.291] | 0.000* |
| **Intensity of Assistance** | | | |
| Receive No Assistance | Ref. | ---- | ---- |
| Receive 1 Type of Assistance | 0.948 | [0.773 – 1.163] | 0.614 |
| Receive 2 Types of Assistance | 1.073 | [0.861 – 1.338] | 0.528 |
| Receive 3 Types of Assistance | 1.066 | [0.771 – 1.474] | 0.698 |

*Indicates significant association between the covariate and outcome at p<0.05
OR=Odds Ratio, CI=Confidence Interval
‡ Model is adjusted for sex, age, educational background, crowding index and quintiles of monthly income

The findings demonstrate that the association between food security status and mental health outcome remained significant even after adjusting for the intensity of assistance and other significant predictors (p-value=0.000<0.05). Remarkably, the ORs of food security status categories remained largely unchanged in the model, similar to those in Model 1 [in Model 1 (absence of assistance): OR $_{mild\,to\,moderate\,food\,insecure}$=2.769 and OR $_{severely\,food\,insecure}$=7.135, in Model 2 (receive assistance at various intensities): OR $_{mild\,to\,moderate\,food\,insecure}$=2.751 and OR $_{severely\,food\,insecure}$=7.040]. It is important to note that the association between the intensity of assistance and poor mental health outcome, was found to be statistically non-significant (p-values>0.05 and ORs~1 indicating no association), after controlling for all other variables in the model. Additionally, the

degree to which the interaction between food insecurity levels and the receipt of different intensities of assistance modify the association between food insecurity level and poor mental health outcome was also estimated, and a separate model was developed **(Table 7)** with the computation of interaction coefficient.

| Table 7 (Model 3): Multivariable logistic regression analysis of the poor mental health outcome and food security status exposure adjusting for all significant covariates and including receipt of assistance at various intensities | | | |
|---|---|---|---|
| **Covariates** | **Adjusted OR** | **95% CI of Adjusted ORs** | **P-value** |
| **Food Security Status** | | | |
| Food Secure | Ref. | ---- | ---- |
| Mild to Moderate Food Insecure | 4.272 | [3.104 – 5.879] | 0.000* |
| Severely Food Insecure | 3.957 | [1.859 – 8.419] | 0.000* |
| **Intensity of Assistance** | | | |
| Receive No Assistance | Ref. | ---- | ---- |
| Receive 1 Type of Assistance | 1.133 | [0.865 – 1.483] | 0.364 |
| Receive 2 Types of Assistance | 1.277 | [0.951 – 1.717] | 0.104 |
| Receive 3 Types of Assistance | 1.584 | [0.918 – 2.737] | 0.098 |
| **Intensity of Assistance*Food Insecurity Status** | | | |
| Receive 1 type of Assistance * mild to moderate food insecurity | 0.592 | [0.397 – 0.883] | 0.01* |
| Receive 1 type of Assistance * severe food insecurity | 1.442 | [0.481 – 4.206] | 0.524 |
| Receive 2 type of Assistance * mild to moderate food insecurity | 0.591 | [0.397 – 0.883] | 0.01* |
| Receive 2 type of Assistance * severe food insecurity | 2.189 | [0.863 – 5.552] | 0.099 |
| Receive 3 type of Assistance * mild to moderate food insecurity | 0.440 | [0.231 – 0.84] | 0.013* |
| Receive 3 type of Assistance * severe food insecurity | 2.243 | [0.393 – 12.777] | 0.363 |

*Indicates significant association between the covariate and outcome at p<0.05
OR=Odds Ratio, CI=Confidence Interval
‡ Model is adjusted for sex, age, educational background, crowding index and quintiles of monthly income

An examination of potential modifying factors (interaction analysis) showed that there was a statistically significant interaction between the three intensity levels (those who receive 1, 2 & 3 types of assistance) and mild to moderate food insecurity level (p-value<0.05) and that might modify the association between food insecurity and poor mental health outcome: the odds of poor mental health outcomes were 0.592 times lower among those who receive one type of assistance and are mildly to moderately food insecure, 0.591 times lower among those who receive two types of assistance and are mildly to moderately food insecure and 0.44 times lower in those who receive three

types of assistance. However, there was no evidence of modification on the association between severe food insecurity status and poor mental health outcome by the three intensities of assistance (p-value>0.05).

To know which type of assistance has the significant moderation effect on the association between food insecurity and poor mental health outcome, three separate models were produced **(Appendix B)**. Results revealed that there was a statistically significant interaction between cash assistance and mild to moderate food insecurity level (p-value<0.05): the odds of poor mental health outcomes were 0.735 times lower for individuals who received cash assistance and were mildly to moderately food insecure (95% CI: 0.55-0.982). However, there was no evidence of modification of the association between food insecurity status and poor mental health outcome by receipt of in-kind food or food vouchers as assistance (p-value>0.05).

Since the interaction terms for the three intensities of assistance x food insecurity level were significant, we further explored these effect modifications, by stratifying the data by the intensities of assistance. Accordingly, four separate models were produced **(Table 8)**. Additionally, and given that the only significant interaction term was for cash assistance x food insecurity level, we stratified the data by the receipt of cash assistance **(Appendix D)**.

| Table 8 (Model 4, 5, 6 & 7): Multivariable logistic regression analysis of the poor mental health outcome and food security status exposure adjusting for all significant covariates and stratifying by the intensity of assistance | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Covariates** | **Model 4: Receive 0 type of assistance** | | | **Model 5: Receive 1 type of assistance** | | | **Model 6: Receive 2 types of assistance** | | | **Model 7: Receive 3 types of assistance** | | |
| | **Adjusted OR** | **95% CI of Adjusted ORs** | **P-value** | **Adjusted OR** | **95% CI of Adjusted ORs** | **P-value** | **Adjusted OR** | **95% CI of Adjusted ORs** | **P-value** | **Adjusted OR** | **95% CI of Adjusted ORs** | **P-value** |
| **Food Security Status** | | | | | | | | | | | | |
| **Food Secure** | Ref. | ---- | ---- | Ref. | ---- | ---- | Ref. | ---- | ---- | Ref. | ---- | ---- |
| **Mild to Moderate Food Insecure** | 4.364 | [3.126 – 6.092] | 0.000* | 2.698 | [2.094 – 3.475] | 0.000* | 2.522 | [1.956 – 3.252] | 0.000* | 1.864 | [1.028 – 3.381] | 0.04* |
| **Severely Food Insecure** | 3.477 | [1.513 – 7.989] | 0.003* | 6.205 | [2.865 – 13.438] | 0.000* | 8.423 | [4.81 – 14.75] | 0.000* | 9.251 | [1.76 – 48.627] | 0.009* |

*Indicates significant association between the covariate and outcome at p<0.05

OR=Odds Ratio, CI=Confidence Interval

‡ Model is adjusted for sex, age, educational background, crowding index and quintiles of monthly income

Among the individuals who did not receive any type of assistance, the ORs of poor mental health outcome were 4.364 for mild to moderate food insecurity (95% CI: 3.126-6.092) and 3.477 for severe food insecurity (95% CI: 1.513-7.989), both statistically significant at p<0.05. Concerning the individuals who receive one, two and three types of assistance, the ORs of poor mental health in those who are mildly to moderately food insecure decreased by the increase in the intensity of assistance; however, the ORs of poor mental health in those who are severely food insecure increased by the increase in the intensity of assistance: all of were statistically significant at p-value<0.05: For those who receive one type of assistance: the ORs of poor mental health were 2.698 for mild to moderate food insecurity (95% CI: 2.094-3.475) and 6.205 for severe food insecurity (95% CI: 2.865-13.438); For those who receive two types of assistance: the ORs of poor mental health were 2.522 for mild to moderate food insecurity (95% CI: 1.956-3.252) and 8.423 for severe food insecurity (95% CI: 4.81-14.75); For those who receive three types of assistance: the ORs of poor mental health were 1.864 for mild to moderate food insecurity (95% CI: 1.028-3.381) and 9.251 for severe food insecurity (95% CI: 1.76-48.627). Reflecting on the results of

the stratification analysis by cash assistance, and among individuals who did not receive cash assistance, the ORs of poor mental health outcome were 3.339 (95% CI: 2.279-4.085) for mild to moderate food insecurity and 4.683 (95% CI: 2.654-8.261) for severe food insecurity, both statistically significant at $p<0.05$. In contrast, among individuals who received cash assistance, the ORs of poor mental health outcome were 2.347 (95% CI: 1.871-2.943) for mild to moderate food insecurity and 8.967 (95% CI: 5.343-15.048) for severe food insecurity, also statistically significant at $p<0.05$.

# CHAPTER 4
# DISCUSSION

### A. Key Results

This study adds to the growing body of evidence on the high prevalence of food insecurity and poor mental health in a context of conflict and siege. [4, 13]. Results from this research revealed that 54.78% of Gazan adults have poor mental health outcome, and 57.07% of the participants are food insecure. The high prevalence of both poor mental health and food insecurity were presumed. Although the prevalence was higher in literature [1, 21], this could be attributed to the heterogeneity of assessment tools of mental health and food insecurity. The results of our study are consistent with the existing literature that shows high prevalence of food insecurity and poor mental health in a context of conflict. A systematic review of 22 studies on the mental health consequences of war and political violence in the Middle East and North Africa region reported a high prevalence of post-traumatic stress disorder, depression, and anxiety among affected populations [50]. The review also highlighted the role of displacement, loss of family members, and exposure to violence as contributing factors to the mental health burden of conflict-affected individuals [50]. The impact of conflict on food security is also well-documented. A study conducted in the occupied Palestinian territory reported that the prolonged siege and military conflicts have led to the disruption of agricultural production and increased import restrictions, which resulted in a significant decline in food security status among the Palestinian population [13]. In addition, a recent report by the United Nations Office for the Coordination of Humanitarian Affairs (OCHA) indicated that conflict and displacement have led to a significant increase in food insecurity in Yemen, South Sudan, and Syria [51-53]. Additionally, in a study conducted on the food insecurity and youth mental health in the

context of "state fragility", results revealed that state of fragility is a social determinant of youth mental health, and that the rise of food insecurity in these areas contributed to the rise of mental health symptoms [54].

The current research provides further evidence for the strong association between food insecurity and poor mental health outcomes in the context of Gaza, independent of potential sociodemographic and economic confounding factors. Our findings reveal that the prevalence of poor mental health outcomes among individuals who are mildly to moderately food insecure and severely food insecure is 65.97% and 85.16%, respectively. These results are consistent with numerous studies that have investigated the relationship between food insecurity and mental health outcomes [55-58], including studies that highlight the role of food insecurity as a neglected social determinant of mental health [59]. For example, a systematic review and meta-analysis conducted in low and middle-income countries found a significant association between food insecurity and common mental disorders, such as depression and anxiety [60]. This review also revealed a dose-response relationship between the severity of food insecurity and the risk of poor mental health outcomes, where individuals who are severely food insecure are more likely to experience poor mental health outcomes compared to those who are mildly to moderately food insecure [60]. This trend is consistent with a global analysis of 149 countries on food insecurity and mental health status, including data from the Middle East and North Africa (MENA) region, which found that severe food insecurity was associated with the highest odds of poor mental health outcomes among all categories of food insecurity [61]. One potential explanation for the observed dose-response relationship is that food insecurity amplifies psychosocial stressors that lead to mental health disorders. For example, individuals

who are food insecure may experience worry and stress about securing food, which can lead to negative coping mechanisms and can result in feelings of shame and low self-esteem, as well as poor mental health outcomes [9, 40, 61, 62]. Our study supports this hypothesis, as a large proportion of our participants (67.72%) reported being concerned about running out of food for their household in the previous year and struggling to afford nutritious food. Two qualitative studies, conducted in the United States [40] and Burkina Faso [29], further supported this hypothesis and showed consistent results regarding the association between food insecurity and negative mental health outcomes. Similarly, a study conducted in Lebanon found that Syrian refugee women experienced high levels of food insecurity, which was associated with symptoms of depression and anxiety [63]. Participants reported feeling worried, stressed, anxious, and ashamed about their inability to provide enough food for their families, as well as the need to stretch their limited resources. The impact of food insecurity on mental health was reported as including feelings of hopelessness, depression, and symptoms of anxiety. These findings suggest that food insecurity is a significant stressor that contributes to poor mental health outcomes, especially in low-income and conflict-affected settings. Another mechanism that could explain the association between food insecurity and poor mental health outcome could be a physiological pathway, acting through diet. Food insecure households have lower diet diversity, including lower intake of fruits, dairy and meat, all micronutrient rich foods. Micronutrient deficiencies could therefore affect the proper functioning of the nervous system [such as, B vitamins, zinc and magnesium], leading to inflammation increases and the risk of developing mental health disorders, such as depression [64-66]. Antioxidant deficiencies, are also associated with the development of psychiatric disorders. Recent study shows that the incidence of

depression and suicide is reduced upon following a healthy eating pattern [64]. This means that having a healthy and balanced diet is shown to have a protective effect against mental illness[66]. Another diet-moderated mechanism is through the gut-brain axis, which involves the complex interplay between the gut microbiome and the brain [67]. A diet rich in fiber, probiotics, and prebiotics can promote a healthy gut microbiome, which has been linked to improved mental health outcomes.

In determining the impact of assistance on the association between food insecurity and poor mental health, our study indicates that this association is independent of the intensity and type of assistance received. The association between food insecurity and poor mental health remains strong even after adding the intensity of assistance to the model and adjusting for it. Similar results were obtained when the three types of assistance were added to the model. Interestingly, the bivariate associations between the intensity of the three types of assistance and poor mental health were significant; but these were no longer significant, after adjusting for covariates, suggesting that the intensity and types of assistance are not independently associated with mental health outcomes. However, it is important to note that while the intensity and the three types of assistance may not have a direct impact on mental health outcomes, they are still crucial in addressing food insecurity, which in turn can indirectly improve mental health outcomes.

Our results indicate that assistance is well targeted to food insecurity in this context, and that the more food insecure, the more likely individuals are to receive different types of assistance. In this context, receiving more assistance moderated the association between food insecurity and poor mental health in those who were moderately food insecure, but the strength of the association between food insecurity

and poor mental health was increased in the severely food insecure. The moderating effect of the intensity and types of assistance on the association between food insecurity and poor mental health was deduced from the interaction analyses, specifically, the ORs of having poor mental health in those who:

a. Are mildly to moderately food insecure and severely food insecure

b. received one, two or three types of assistance

c. received in-kind food or cash assistance

were attenuated, indicating a potential protective effect of receiving assistance. This study demonstrated that receiving one or more types of assistance can benefit participants who are mildly to moderately food insecure, and reduce the likelihood of experiencing poor mental health. Specifically, cash assistance was found to have a significant protective effect against poor mental health outcomes in this group. However, for participants who are severely food insecure and receiving one or more types of assistance, the association with poor mental health persists, although to a lesser extent compared to those who do not receive any assistance. Furthermore, for those who are severely food insecure and receiving cash assistance, the odds of having poor mental health are still high, but the magnitude of the association is less compared to those who do not receive any assistance at all. However, it is important to note that the interaction effect between severe food insecurity and i. any of the assistances' intensities and ii. cash assistance did not reach statistical significance at the $p<0.05$ level. This could be due to the relatively small sample size of those who are severely food insecure in the sample.

Results from the stratification analysis indicated that individuals who are severely food insecure and receive more than one type of assistance still have higher

odds of poor mental health, and there are several possible explanations for that. Firstly, receiving multiple types of assistance may indicate a more chronic and severe level of food insecurity, which can be associated with increased stress, anxiety, and depression. Secondly, the types of assistance that are commonly available, such as in-kind food, cash, and food vouchers, may not address the root causes of food insecurity, such as poverty, unemployment, or lack of access to nutritious foods. Thus, individuals who receive multiple types of assistance may still experience food insecurity and related stressors, leading to poor mental health outcomes. Thirdly, the experience of receiving multiple types of assistance may also be a source of stress and anxiety for some individuals. For example, navigating multiple assistance programs, dealing with paperwork, and managing the logistics of receiving different forms of assistance can be time-consuming and challenging, adding to the burden of individuals who are already struggling with food insecurity.

When we investigated type of assistance, we found cash assistance to be the only type of assistance that moderated the association between food insecurity and poor mental health, and in specific for those who are mildly to moderately food insecure. The latter may be more likely to benefit from the flexibility and autonomy that cash assistance provides and more able to effectively utilize the cash assistance to purchase food and meet their basic needs, thereby reducing the stress and anxiety associated with food insecurity [68]. Conversely, those who are severely food insecure may face a host of other challenges, such as lack of access to healthcare, education, and employment opportunities, that cannot be addressed by cash assistance alone and have more complex needs and may require more comprehensive interventions to address the complex and multifaceted nature of their food insecurity and its impact on mental health. Moreover,

the negative impact of cash assistance may also be related to the psychological stress that can accompany financial insecurity. Receiving cash assistance may increase feelings of shame or inadequacy for those who are already struggling to meet their basic needs. Furthermore, cash assistance may be seen as a temporary solution that does not address the root causes of food insecurity and may lead to feelings of hopelessness or despair. Further longitudinal and intervention studies are needed to better understand the relationship between receiving multiple types of assistance and their effect on both food insecurity status and poor mental health.

In this context, the literature on impact of in-kind food and cash assistance has focused on their effect on food insecurity rather than on mental health. [69-72]. In-kind food assistance refers to the provision of actual food items to the recipients, while cash and food vouchers provide individuals with the means to purchase food. Research has shown that in-kind food assistance has a significant impact on reducing food insecurity among vulnerable populations. However, cash and food vouchers have also been found to be effective in improving food security, particularly in areas where there is a well-functioning market system. Moreover, the effectiveness of different types of assistance may vary depending on the context and the needs of the population. For example, in a study conducted in a rural area of Bangladesh, cash transfers were found to be more effective in reducing food insecurity than in-kind food assistance [71]. However, in an urban setting like Gaza, in-kind food assistance and cash transfers have been found to be more effective in reducing food insecurity, as they provide more immediate relief to the population [73]. It is also important to note that the amount and frequency of assistance provided can affect its impact on food security.

Overall, our results suggest that food insecurity is a significant risk factor for poor mental health outcomes, and this association persists even after receiving assistance of different intensities and types, and while the receipt of assistance does not directly improve mental health outcomes, certain types of assistance, such as cash assistance, may be more effective for those who are mildly to moderately food insecure. The results of the interaction analysis highlight the need for targeted and context-specific approaches to addressing food insecurity and poor mental health outcomes. Programs that provide cash assistance may be particularly effective in improving mental health outcomes for those who are mildly to moderately food insecure, while other interventions may be needed to address the complex challenges faced by those who are severely food insecure.

To the best of our knowledge, there are no published studies that investigate the moderating effect of assistance on the association between food insecurity and mental health, rather the effect of assistance is studied separately on each aspect.

## B. Strengths

This data used for this analysis are derived from a large representative survey of 40+ year old adults in Gaza and investigate for the first time the link between food insecurity and poor mental health in this context. The study also stands out for its emphasis on the social determinants that underlie both food insecurity and poor mental health outcomes. By accounting for a multitude of co-variates, the study provides a more comprehensive understanding of the relationship between food insecurity and poor mental health. Furthermore, the inclusion of three types of assistance - in-kind food, cash, and food vouchers - as effect modifiers adds an important dimension to the

analysis, as it highlights the potential of specific interventions on mitigating the negative effects of food insecurity on mental health. This research is particularly valuable as it provides insight into how public health interventions and policies can be targeted to address both food insecurity and poor mental health, particularly in conflict-affected settings like Gaza.

## F. Limitations

Although this study provides important insights into the association between food insecurity and poor mental health outcomes in a conflict-affected setting, there are several limitations that should be considered. Firstly, the cross-sectional design of this study limits the ability to establish causality or temporality in the relationship between food insecurity and poor mental health outcomes. Secondly, the modified GHQ-12 questionnaire used to assess mental health status lacked an internationally adopted cut-off point, which may have resulted in misclassification bias. Additionally, the questionnaire provides a general interpretation of mental health status and does not allow for the identification of specific mental health disorders such as depression, anxiety, or stress. This may limit the comparability of our results with other studies. The potential for underreporting of mental health status due to the use of the GHQ-12 questionnaire should also be considered. The study only considered sociodemographic factors as potential confounders, which may limit the ability to account for other important confounding factors such as non-communicable diseases, physical activity, and smoking. Furthermore, recall bias may be present, as the responses for the Food Insecurity Experience Scale (FIES) were collected based on a one-year time-frame. Finally, the lack of a theoretical framework that provides a theory-driven approach and

helps in analyzing multiple variables and managing measurement error is a limitation of this study. Future research should consider addressing these limitations to further enhance our understanding of the association between food insecurity and poor mental health outcomes.

## G. Research Implications

The prevalence of poor mental health among participants in Gaza is relatively high, highlighting the need for further investigation of common mental health disorders in the region, such as depression, stress, and anxiety. Depression is a major contributor to disability-adjusted life years (DALYS) worldwide, with a prevalence that could be significant in Gaza. Future research should broaden the focus beyond social risks such as education and employment to consider other determinants of poor mental health, including non-communicable diseases, individual behaviors, and smoking. Moreover, screening for food insecurity should be a critical component of any study on mental health outcomes given the strong association between the two. Observational studies and systematic reviews, along with theoretical frameworks and structural equation modeling, should be utilized to determine the direction of the association between food insecurity and mental health outcomes. It is crucial that public health practitioners design multilevel interventions that address the social determinants of both food insecurity and mental health outcomes and promote well-being to reduce social inequalities at the policy and aid-program level. In summary, further research and policy interventions are necessary to address the high prevalence of poor mental health in Gaza and to develop effective strategies to reduce its impact on individuals and communities.

**H. Conclusion**

The Israeli occupation in Gaza has had devastating effects on the population, including complete siege and violence. The isolation has led to severe economic and health infrastructure damage, limited access to resources, and widespread poverty, resulting in a chronic food insecurity crisis. As a result, the vulnerability of Gazans has significantly increased, and the risk factors for both food insecurity and mental health disorders have been exacerbated. This analysis was able to confirm the first hypothesis demonstrating a statistically significant association between food insecurity and poor mental health. However, our second hypothesis, that assistance would moderate the relationship between food insecurity and mental illness was only partially demonstrated showing differential interactions between cash assistance and food insecurity in the association with mental health. To address the dual burden of food insecurity and mental illness, further research is necessary on the impact of assistance on the association between food insecurity and poor mental health.

It will be essential to support effective interventions that address the high burdens of food insecurity and mental illness, to help improve the overall health and well-being of the Gazan population.

# APPENDIX

A.

| Table 9 (Model 8, 9 & 10): Multivariable logistic regression analysis of the poor mental outcome and food security status exposure adjusting for all significant covariates and including the receipt of three types of assistance (in-kind food, food voucher & cash assistance; each in a separate model) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Covariates** | **Model 8: X = In-kind food** | | | **Model 9: X = Food Voucher** | | | **Model 10: X = Cash Assistance** | | |
| | **Adjusted OR‡** | **95% CI of Adjusted ORs** | **P-value** | **Adjusted OR‡** | **95% CI of Adjusted ORs** | **P-value** | **Adjusted OR‡** | **95% CI of Adjusted ORs** | **P-value** |
| **Food Security Status** | | | | | | | | | |
| **Food Secure** | Ref. | ---- | ---- | Ref. | ---- | ---- | Ref. | ---- | ---- |
| **Mild to Moderate Food Insecure** | 2.759 | [2.378 - 3.2] | 0.000* | 2.745 | [2.367 – 3.185] | 0.000* | 2.772 | [2.39 – 3.214] | 0.000* |
| **Severely Food Insecure** | 7.14 | [4.887 – 10.43] | 0.000* | 7.045 | [4.817 – 10.303] | 0.000* | 7.134 | [4.88 – 10.427] | 0.000* |
| **Receipt of X type of assistance** | | | | | | | | | |
| **No** | Ref. | ---- | ---- | Ref. | ---- | ---- | Ref. | ---- | ---- |
| **Yes** | 1.05 | [0.899 – 1.227] | 0.533 | 1.088 | [0.922 – 1.283] | 0.317 | 0.981 | [0.817 – 1.179] | 0.844 |

*Indicates significant association between the covariate and outcome at p<0.05
OR=Odds Ratio, CI=Confidence Interval
‡ Model is adjusted for sex, age, educational background, crowding index and quintiles of monthly income

B.

| Table 10 (Model 11, 12 & 13): Multivariable logistic regression analysis of the poor mental health outcome and food security status exposure adjusting for all significant covariates including receival of three types of assistance (in-kind food, food voucher & cash assistance; each in a separate model as well as the interaction between food security status and each type of assistance) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Covariates** | **Model 11: X = In-kind Food** | | | **Model 12: X = Food Voucher** | | | **Model 13: X = Cash Assistance** | | |
| | **Adjusted OR** | **95% CI of Adjusted ORs** | **P-value** | **Adjusted OR** | **95% CI of Adjusted ORs** | **P-value** | **Adjusted OR** | **95% CI of Adjusted ORs** | **P-value** |
| **Food Security Status** | | | | | | | | | |
| **Food Secure** | Ref. | ---- | ---- | Ref. | ---- | ---- | Ref. | ---- | ---- |
| **Mild to Moderate Food Insecure** | 3.102 | [2.444 – 3.937] | 0.000* | 2.921 | [2.479 – 3.442] | 0.000* | 3.172 | [2.608 – 3.858] | 0.000* |
| **Severely Food Insecure** | 5.597 | [3.279 – 9.552] | 0.000* | 7.234 | [4.656 – 11.237] | 0.000* | 4.594 | [2.607 – 8.093] | 0.000* |
| **Receipt of X type of Assistance** | | | | | | | | | |
| **No** | Ref. | ---- | ---- | Ref. | ---- | ---- | Ref. | ---- | ---- |

| | OR | 95% CI | P-value | OR | 95% CI | P-value | OR | 95% CI | P-value |
|---|---|---|---|---|---|---|---|---|---|
| **Yes** | 1.135 | [0.91 – 1.414] | 0.26 | 1.165 | [0.861 - 1.576] | 0.32 | 1.27 | [0.996 – 1.619] | 0.053 |
| **X type of assistance*Food Security Status** | | | | | | | | | |
| **Yes*Mild to moderate food insecurity** | 0.832 | [0.619 – 1.118] | 0.224 | 0.769 | [0.537 – 1.099] | 0.15 | 0.735 | [0.55 – 0.982] | 0.038* |
| **Yes*Severe food Insecurity** | 1.488 | [0.712 – 3.107] | 0.29 | 0.891 | [0.383 – 2.071] | 0.789 | 1.94 | [0.903 – 4.165] | 0.089 |

*Indicates significant association between the covariate and outcome at p<0.05

OR=Odds Ratio, CI=Confidence Interval

‡ Model is adjusted for sex, age, educational background, crowding index and quintiles of monthly income

C.

| Table 11 (Model 14 & 15): Multivariable logistic regression analysis of the poor mental health outcome and food security status exposure adjusting for all significant covariates and stratifying by receipt of cash assistance | | | | | | |
|---|---|---|---|---|---|---|
| **Covariates** | **Model 15: Receipt of Cash Assistance = No** | | | **Model 16: Receipt of Cash Assistance = Yes** | | |
| | **Adjusted OR** | **95% CI of Adjusted ORs** | **P-value** | **Adjusted OR** | **95% CI of Adjusted ORs** | **P-value** |
| **Food Security Status** | | | | | | |
| **Food Secure** | Ref. | ---- | ---- | Ref. | ---- | ---- |
| **Mild to Moderate Food Insecure** | 3.339 | [2.279 – 4.085] | 0.000* | 2.347 | [1.871 – 2.943] | 0.000* |
| **Severely Food Insecure** | 4.683 | [2.654 – 8.261] | 0.000* | 8.967 | [5.343 - 15.048] | 0.000* |

*Indicates significant association between the covariate and outcome at p<0.05

OR=Odds Ratio, CI=Confidence Interval

‡ Model is adjusted for sex, age, educational background, crowding index and quintiles of monthly income

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