

**Food and nutrition security and associated health
aspects of Syrian refugee mothers and their offspring:
A mixed-method study in Greater Beirut, Lebanon**

**Dissertation for Obtaining the Doctoral Degree of Natural Sciences
(Dr. rer. nat.)**

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Dedicated to

my loving husband,

our caring family,

and all those denied education opportunities.

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Twin-Ph.D. Project

The mixed-methods research project was elaborated in the scope of a twin-Ph.D. research project of Ms. Joana Abou-Rizk and Ms. Theresa Jeremias, working on the title: “Maternal and child nutrition among refugees in Greater Beirut, Lebanon: a focus on anemia”. All research data are jointly collected in the field, entered, analyzed, and interpreted by Joana Abou-Rizk and Theresa Jeremias related to their underlying Ph.D. projects, respectively.

List of Publications included in the Cumulative Dissertation

1. **Abou-Rizk, J.,** Jeremias, T., Nasreddine, L., Jomaa, L., Hwalla, N., Tamim, H., Frank, J., & Scherbaum, V. (2021). Anemia and Nutritional Status of Syrian Refugee Mothers and Their Children under Five Years in Greater Beirut, Lebanon. *International Journal of Environmental Research and Public Health*, 18(13), 6894. <https://doi.org/10.3390/ijerph18136894>
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Contributions to Publications

M.Sc. Joana Abou-Rizk conceptualized the Twin-PhD research project and led the maternal nutrition and breastfeeding parts of the study; designed the study applications and sought after the ethics approval; was actively involved in the funds acquisition; secured approval from the Ministry of Public Health and directors of primary healthcare centers; organized, implemented, and supervised of the project during data collection and entry; performed all statistical analyses and interpretation of the results in Chapters 3, 4, and 5; conceptualized and wrote the original draft of the manuscripts in Chapters 3, 4, and 5; and was the first and corresponding author for all three publications.

PD. Dr. Veronika Scherbaum conceptualized the Twin-PhD research project; supported the implementation of the study; was involved in the ethics approval; participated in the interpretation of the results in Chapters 3, 4, and 5; reviewed and edited all manuscripts in Chapters 3, 4, and 5; and supervised the doctoral thesis.

M.Sc. Theresa Jeremias conceptualized the Twin-PhD research project and led the complementary feeding part of the study; designed the study applications and sought after the ethics approval; was actively involved in the funds acquisition; participated in securing approvals from directors of primary healthcare centers; organized, implemented, and supervised of the project during data collection and entry; participated in the interpretation of the results in Chapters 3, 4, and 5; and reviewed and contributed to the editing of all manuscripts in Chapters 3, 4, and 5.

Prof. Dr. Jan Frank reviewed all manuscripts in Chapters 3, 4, and 5; and provided significant advice during the doctoral thesis.

M.Sc. Georgiana Cocuz contributed to the entry of dietary data; conducted partly the statistical analyses in Chapter 4; and was involved in the original draft of the manuscript in Chapter 4.

Dr. Lara Nasreddine provided support in the design of the research project and the implementation phase; was involved in the ethics approval and in the funds acquisition; secured approval from the Ministry of Public Health; and reviewed all manuscripts in Chapters 3, 4, and 5.

Dr. Lamis Jomaa provided support in the design of the research project and in the implementation phase; secured approval from the Ministry of Public Health; and reviewed all manuscripts in Chapters 3, 4, and 5.

Dr. Nahla Hwalla provided support in the design of the research project and in the implementation phase; and reviewed all manuscripts in Chapters 3, 4, and 5.

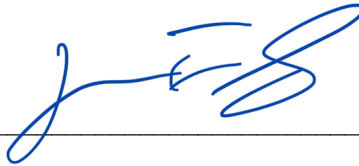
Dr. Hani Tamim provided support in biostatistics during the initial stage of the project and assisted through the Medical Research Volunteer Program (MRVP) program during data collection.

Stuttgart, Germany, April 28, 2023



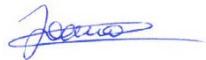
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Summary

Nutrition during the first 1000 days of life – from conception to two years of age – lays the foundation for optimal health, cognitive and social development, and well-being of children and mothers. Malnutrition and hidden hunger in mothers and their offspring during the perinatal period can have long-lasting and irreversible consequences on human capital and increase the risk to non-communicable diseases among adulthood through intergenerational effects. Since the *Arab Spring* in 2011, the Syrian humanitarian crisis has escalated to become the world's largest by the end of 2018, forcing 6.7 million to flee, mainly to neighboring countries. In 2015, Lebanon was the host of more than 1.5 million refugees and displaced persons from Syria, reaching the highest per capita concentration of refugees worldwide. The protracted crisis has increasingly weakened Lebanon, in turn exposing vulnerable groups, especially women of reproductive age and children below five years, to increased risks of inadequate nutrition and health status.

To date, there has been a lack of studies among refugees that examine the nutritional and health situation and investigate the underlying and immediate determinants of malnutrition among women of reproductive age and children below five years. Therefore, knowledge gaps regarding the prevalence of anemia and nutritional status of Syrian refugee mothers and children were identified as important research areas in this dissertation. Assessing the food security and mental health of Syrian refugee mothers, examining the dietary intake and infant feeding practices, and investigating their respective determinants and associated risk factors were also important areas of focus. This research project was conducted between July and October 2018 in collaboration with the American University of Beirut in primary healthcare centers in the Greater Beirut area in Lebanon using quantitative and qualitative surveys (mixed-methods survey) among Syrian refugee mothers and their child aged below five years of age. This work comprises a total of three research articles that have been published in peer-reviewed international journals.

The first article (Chapter 3) describes the prevalence of anemia and the nutritional status of mothers and children below five years of age and indicates a moderate public health significance among Syrian refugees in the Greater Beirut area, Lebanon. The existence of the so-called double burden of malnutrition and hidden hunger (micronutrient deficiencies) has been documented, as mothers and children from the same household were affected by undernutrition, overnutrition, and / or anemia. A strong association between maternal and child anemia in the same household and an association between anemia and overweight / obesity among mothers has also been demonstrated. Analysis of the 24-hr dietary recalls of pregnant, lactating, non-pregnant non-lactating mothers revealed inadequate dietary intake and nutrient deficiencies during pregnancy and lactation.

The second article (Chapter 4) presents data on the prevalence of food insecurity, low dietary diversity, and poor mental health among Syrian refugee mothers in Greater Beirut, Lebanon. A significant association between food insecurity and low dietary diversity as well as poor mental health status was found. Low household monthly income and a high household crowding index were significantly associated with low dietary diversity and food insecurity. In addition, the results showed that low-income households consumed monotonous diets, characterized by a high consumption of refined starchy staples and grains.

The third paper (Chapter 5) focused on the nutritional and health status of infants under six months. Overall, the public health significance for anemia and wasting was moderate. Inadequate infant feeding practices, such as the intake of pre-lacteal feeding and liquids, were demonstrated in newborns, which in turn contributed to delayed initiation of breastfeeding and low rates of exclusive breastfeeding. Factors supporting infant feeding practices included proper knowledge on maternal nutrition and exclusive breastfeeding and support from healthcare professionals or family during breastfeeding. Identified barriers included cultural practices such as the early introduction of foods, breastmilk substitutes, and giving water or herbal tea to infants under six months of age. Maternal health issues and social factors such as misinformation from family members and violations of the Code of Marketing of Breastmilk Substitutes also affected breastfeeding.

A conceptual framework was also developed in this dissertation to provide a comprehensive understanding of the linkages and pathways between the enabling, underlying, and immediate determinants and the nutritional and health outcomes in the context of humanitarian crises. Based on this conceptual framework, three principal pathways were identified to explain the following associations: (1) from the enabling determinants to anemia and nutritional status, (2) from socio-economic status and host country resources to food consumption and diets, and (3) from pre-resettlement experiences and dietary acculturation to food consumption and diets. In addition, the concluding discussion (Chapter 6) presented the role of maternal mental health status and health services and their impact on maternal nutrition and anemia status as well as infant feeding.

In summary, this dissertation contributes to the knowledge about the anemia and nutritional status of Syrian refugee women and children as well as on the food security and mental health status of mothers living in an urban setting of a protracted humanitarian crisis in Lebanon. It also provides insights into the emergence of malnutrition among women and children in the context of refugees and shows the pathways between different levels of determinants of nutrition and health. Implications for practice can be drawn from this dissertation, such as the development or strengthening of evidence-based culture-specific nutritional interventions that are targeted to the refugee context. Priorities for future research were also identified, including the need to improve the effectiveness of nutritional interventions in conflict settings.

Zusammenfassung

Die Ernährung während der ersten 1000 Tage des Lebens - von der Schwangerschaft bis zum Ende des 2. Lebensjahres - legt den Grundstein für optimale Gesundheit, kognitive und soziale Entwicklung sowie das Wohlbefinden von Kindern und Müttern. Mangelernährung und versteckter Hunger bei Müttern und deren Nachkommen während der perinatalen Phase können langfristige und irreversible Auswirkungen auf das Humankapital haben und das Risiko von nichtübertragbaren Krankheiten im Erwachsenenalter auch durch generationsübergreifende Effekte erhöhen. Seit dem *Arabischen Frühling* im Jahr 2011 stieg die humanitäre Krise in Syrien bis Ende 2018 weltweit am stärksten an und zwang schließlich 6,7 Millionen Menschen zur Flucht, hauptsächlich in die Nachbarländer. Bereits im Jahr 2015 beherbergte Libanon mehr als 1,5 Millionen Flüchtlinge und Vertriebene aus Syrien und erreichte damit die höchste pro-Kopf-Konzentration von Flüchtlingen weltweit. Libanon wurde durch die lang anhaltende Krise zunehmend geschwächt, was wiederum gefährdete Gruppen, insbesondere Frauen im gebärfähigen Alter und Kinder unter fünf Jahren, einem erhöhten Risiko von unzureichendem Ernährungs- und Gesundheitsstatus aussetzte.

Bis heute gibt es vor allem unter Flüchtlingen einen Mangel an Studien, die die Ernährungs- und Gesundheitssituation erforschen und die zugrundeliegenden und unmittelbaren Determinanten von Mangelernährung bei Frauen im gebärfähigen Alter und Kindern unter fünf Jahren untersuchen. Daher war es ein Anliegen dieser Dissertation Wissenslücken hinsichtlich der Prävalenz von Anämie und des Ernährungszustandes von syrischen Flüchtlingsmüttern und ihren Kindern zu schließen. Auch die Bewertung der Ernährungssicherheit und der mentalen Gesundheit von syrischen Flüchtlingsmüttern, die Erforschung der Nahrungsaufnahme und der Praktiken bei der Ernährung von Säuglingen unter sechs Monaten sowie die Untersuchung ihrer jeweiligen Determinanten und zugehörigen Risikofaktoren stellten wichtige Schwerpunkte dar. Dieses Forschungsvorhaben wurde zwischen Juli und Oktober 2018 in Zusammenarbeit mit der American University of Beirut in den Primärversorgungszentren im Großraum Beirut im Libanon mit Hilfe von quantitativen und qualitativen Erhebungen (Mixed-Methoden-Umfrage) unter syrischen Flüchtlingsmüttern mit einem ihrer Kinder unter fünf Jahren durchgeführt. Die vorliegende Arbeit umfasst insgesamt drei Forschungsartikel, die in internationalen Fachzeitschriften mit Begutachtungsverfahren veröffentlicht wurden.

Der erste Artikel (Kapitel 3) beschreibt die Prävalenz von Anämie und den Ernährungszustand von Müttern und Kindern unter fünf Jahren und zeigt ein mittelschweres Risiko für die öffentliche Gesundheit bei syrischen Flüchtlingen im Großraum Beirut, Libanon, auf. Das Vorhandensein der sogenannten Zweifachen Belastung von Mangelernährung und verstecktem Hunger (Mikronährstoffmangel) wurde

dokumentiert, da manche Mütter und Kinder aus demselben Haushalt von Unter- und Überernährung und/oder Anämie betroffen waren. Auch wurde eine starke Assoziation zwischen mütterlicher und kindlicher Anämie im selben Haushalt sowie eine Assoziation zwischen Anämie und Übergewicht / Fettleibigkeit bei Müttern nachgewiesen. Die Analyse der 24-Stunden Ernährungsprotokolle von schwangeren, stillenden, nicht schwangeren und nicht stillenden Müttern ergab eine unzureichende Nahrungsaufnahme und Nährstoffmängel besonders während der Schwangerschaft und Stillzeit.

Der zweite Artikel (Kapitel 4) präsentiert Daten zur Prävalenz von Ernährungsunsicherheit, geringer Nahrungsmitteldiversität und eingeschränkter psychischer Gesundheit unter syrischen Flüchtlingsmüttern im Großraum Beirut, Libanon. Eine signifikante Assoziation zwischen Ernährungsunsicherheit und geringer Nahrungsmitteldiversität sowie verminderte psychische Gesundheit wurden festgestellt. Ein niedriges monatliches Haushaltseinkommen und ein hoher Gedrängtheitsindex im Wohnbereich waren ebenfalls signifikant mit geringer Nahrungsmitteldiversität und Ernährungsunsicherheit assoziiert. Darüber hinaus zeigten die Ergebnisse, dass Haushalte mit niedrigem Einkommen eine eintönige Ernährung konsumierten, die durch einen hohen Konsum von raffinierten stärkehaltigen Grundnahrungsmitteln und Getreide gekennzeichnet war.

In der dritten Arbeit (Kapitel 5) wurde der Fokus auf den Ernährungs- und Gesundheitsstatus von Säuglingen unter sechs Monaten gelegt. Insgesamt ergab sich ein mittelschwere öffentliche Gesundheitsrelevanz in Bezug auf Anämie und Auszehrung. Besonders bei Neugeborenen wurden inadequate Ernährungspraktiken aufgezeigt, wie die Zufuhr von prälaktalen Nahrungsmitteln und Flüssigkeiten, was wiederum zu einem verzögertem Stillbeginn und einer niedrigen Rate an ausschließlichem Stillen beigetragen hatte. Zu den unterstützenden Faktoren für die Ernährungspraktiken von Säuglingen zählten das Wissen über mütterliche Ernährung und ausschließliches Stillen sowie die Unterstützung durch Gesundheitsfachkräfte oder der Familie während der Stillzeit. Identifizierte Hindernisse stellten kulturelle Praktiken dar wie die frühzeitige Einführung von Lebensmitteln und Muttermilchersatzprodukten sowie das Geben von Wasser oder Kräutertee an Säuglinge unter 6 Monaten. Auch mütterliche Gesundheitsprobleme und soziale Faktoren wie Fehlinformationen durch Familienmitglieder sowie Verstöße gegen den Kodex für die Vermarktung von Milchersatzprodukten beeinträchtigten das Stillverhalten.

In dieser Dissertation wurde ein konzeptioneller Rahmen entwickelt, um ein umfassendes Verständnis für die Zusammenhänge und Wege zwischen den ermöglichenden, zugrundeliegenden und unmittelbaren Determinanten und den ernährungs- und gesundheitsbezogenen Ergebnissen im Kontext humanitärer Krisen zu schaffen. Basierend auf diesem Konzept wurden drei Hauptwege identifiziert, um die folgenden Zusammenhänge zu erklären: (1) von den ermöglichenden Determinanten zu Anämie und

Ernährungszustand, (2) vom sozioökonomischen Status und den Ressourcen des Gastlandes zu Nahrungsmittelverbrauch und Diäten und (3) von vorherigen Umsiedlungserfahrungen und Ernährungsakkulturation zu Nahrungsmittelverbrauch und Diäten. Zusätzlich wurde in der abschließenden Diskussion (Kapitel 6) die Rolle der mentalen Gesundheit der Mutter und der Gesundheitsdienste sowie deren Auswirkungen auf die Ernährung/Anämie bei Müttern und auf die Säuglingsernährung dargestellt.

Zusammenfassend trägt diese Dissertation wesentlich zum Kenntnisstand über Anämie- und Ernährungszustand syrischer Flüchtlingsfrauen und -kinder sowie über die Ernährungssicherheit und den mentalen Gesundheitszustand von Müttern in einer humanitären Krise im Libanon bei. Sie liefert auch Erkenntnisse über die Entstehung von Fehlernährung bei Frauen und Kindern im Kontext von Flüchtlingen und zeigt die Verbindungen zwischen verschiedenen Ebenen von Determinanten der Ernährungs- und Gesundheitssituation auf. Aus dieser Dissertation lassen sich praktische Implikationen ableiten, wie die Entwicklung oder Stärkung von evidenzbasierten, kulturspezifischen Ernährungsinterventionen, die auf den Kontext von Flüchtlingen ausgerichtet sind. Schwerpunkte für zukünftige Forschungen wurden ebenfalls aufgezeigt, einschließlich der Notwendigkeit, die Wirksamkeit von Ernährungsinterventionen in Konfliktsituationen zu verbessern.

Stuttgart, Germany, April 28, 2023



Place and date, PD. Dr. Veronika Scherbaum

Stuttgart, Germany, April 28, 2023



Place and date, Prof. Dr. Jan Frank

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List of Abbreviations

AI	Adequate Intake
AMDR	Acceptable Macronutrient Distribution Range
ANC	Antenatal Care
AOR	Adjusted Odds Ratios
AUB	American University of Beirut
BAZ	BMI-for-age Z-scores
BCFN	Barilla Center for Food and Nutrition
BMI	Body Mass Index
BMZ	German Federal Ministry for Economic Cooperation and Development
CI	Confidence Interval
CITI	Collaborative Institutional Training Initiative
DAAD	German Academic Exchange Service
DRI	Dietary Reference Intake
EAR	Estimated Average Requirement
EBF	Exclusive Breastfeeding
EI	Energy Intake
FAO	Food and Agriculture Organization of the United Nations
FEKI	Freiburger Independent Ethics Committee
FFQ	Food Frequency Questionnaire
FGD	Focus Group Discussion
FI	Food Insecurity
FIES	Food Insecurity Experience Scale
HAZ	Length/Height-for-age Z-scores
IPAQ-SF	International Physical Activity Questionnaire - Short Form
IPC	Integrated Food Security Phase Classification
IRB	Institutional Review Board
IYCF	Infant and Young Child Feeding
LBP	Lebanese Pounds
LDD	Low Dietary Diversity
LM	Non-Pregnant Lactating Mothers
LMICs	Low- and Middle-Income countries
MDD-W	Minimum Dietary Diversity Score for Women

MENA	Middle East and North Africa
MET	Metabolic Equivalent of Task
MoPH	Ministry of Public Health
MRVP	Medical Research Volunteer Program
MUAC	Mid-Upper Arm Circumference
MUFA	Monounsaturated Fatty Acids
NGO	Non-Governmental Organization
NPNLM	Non-Pregnant Non-Lactating Mothers
OR	Odds Ratio
PHC	National Primary Health Care
PHCC	Primary Health Care Centers
PHQ-9	Patient Health Questionnaire-9
PM	Pregnant Mothers
PTSD	Post-Traumatic Stress Disorder
PUFA	Polyunsaturated Fatty Acids
RDA	Recommended Dietary Allowance
SD	Standard Deviation
SDG	Sustainable Development Goals
SFA	Saturated Fatty Acids
SPSS	Statistical Package for Social Sciences
TFA	Trans-Fatty Acids
UN	United Nations
UNHCR	United Nations High Commissioner for Refugees
UNICEF	United Nations International Children's Emergency Fund
UNOCHA	United Nations Office for the Coordination of Humanitarian Affairs
USD	United States Dollar
USDA	United States Department of Agriculture
VIF	Variance Inflation Factors
WAZ	Weight-for-age Z-scores
WC	Waist Circumference
WFP	World Food Programme
WHO	World Health Organization
WHR	Waist–Hip Ratio
WHZ	Weight-for-length/height Z-scores

1

Chapter 1

General Introduction

I. General Introduction

1.1. Introduction

Malnutrition in early life has long-lasting consequences on growth and development of the offspring. Maternal nutrition and the nutritional status of the child in early life and adulthood have been linked through intergenerational effects [1–3]. Suboptimal maternal and child nutrition across the first 1000 days of life have been identified as central underlying factors of cognitive and social development and diet-related non-communicable diseases among adults, including the metabolic syndrome, coronary heart disease, and type-2 diabetes [4,5]. During this window of opportunity, the nutritional status of women of reproductive age and children under five years is at increased risk of deterioration due to their higher nutrient requirements and suboptimal nutrition [6,7]. Fetal growth can be hindered by maternal undernutrition and obesity alike, resulting in higher odds of low birthweight, underweight, stunting, and micronutrient deficiencies among children [3].

The impact of maternal and child malnutrition can be detrimental on the child's growth and development and could result in various forms of malnutrition (under- and overnutrition), leading to an increased vulnerability to infections and micronutrient deficiencies, especially anemia [3,5]. The coexistence of undernutrition (i.e., underweight, stunting, wasting), overnutrition (overweight and obesity), and micronutrient deficiencies within populations, households, and individuals characterizes the double burden of malnutrition mostly affecting low-income and middle-income countries [8]. Nowadays, the term “triple burden of malnutrition” is used to reflect the hidden hunger and malnutrition of the 21st century and describe the complex and evolving burden on societies [9,10].

Paradoxically, undernutrition and overweight can both emerge from food insecurity and poverty [11,12]. Low socio-economic status and low wages are interrelated with food insecurity and food-related coping mechanisms [13]. The causal relationship between poverty, hunger, and malnutrition and rural-urban migrations in search for better livelihoods has been evident since 1996 [14]. Therefore, both food insecurity and hunger may have a dual role in conflicts and protracted crises, as a cause and a consequence [15]. According to the United Nations High Commissioner for Refugees (UNHCR), most forced migrations may evolve into protracted crises as it was found that the average duration of displacement for a refugee is 26 years. In other words, refugees may spend more than two decades being displaced, impacting present and future generations on the long term [16].

During emergencies, whether natural or man-made, there is a drastic threat for communities to be uprooted. People often forcibly migrate leaving behind their social circles and assets to become refugees in foreign, and sometimes hostile, environments. Harsh living conditions, such as crowded and unsanitary

spaces, may expose children to malnutrition and infections, which are the leading cause of childhood mortality during emergencies [17]. Therefore, protecting, promoting, and supporting breastfeeding as well as controlling and avoiding the use of breastmilk substitutes during large-scale migration becomes challenging and can lead to early cessation of breastfeeding [17,18]. Following forced migrations and exposure to conflicts, women of reproductive age and mothers may be at increased risk of suffering from multiple forms of malnutrition due to the consumption of predominantly monotonous diets, inadequate in diversity and quality, and poor mental health, affecting infant and young child feeding and care practices [19–21].

In 2015, the United Nations developed the Sustainable Development Goals (SDG) with the goal to end poverty and hunger, protect the planet, and ensure prosperity and justice by 2030. The SDG 2 “end hunger, achieve food security and improve nutrition, and promote sustainable agriculture” has the aim to end hunger and all forms of malnutrition, especially among children under five years of age and women with increased nutritional needs, such as during pregnancy and lactation. The General Assembly also stated that countries undergoing conflicts require special attention to alleviate food insecurity and combat malnutrition [22]. Therefore, the aim of this dissertation is to improve maternal and child nutrition among refugees and displaced persons following the largest humanitarian crisis up-to-date.

This dissertation is structured as follows: **Chapter 1** begins with a summarized introduction on the topic, followed by a description of the state-of-the-art about the nutrition in the first 1000 days with a focus on maternal and infant nutrition, the intergenerational cycle of malnutrition, food insecurity and malnutrition, and nutrition and infant feeding practices in emergencies are described. The relevance of the topic, theoretical framework, hypothesis, and objectives are also presented. **Chapter 2** describes in detail the general methodology of this research project, setting of the study, and materials used. **Chapter 3** presents the prevalence of anemia and describes the nutritional status of Syrian refugee mothers and their children under five years in Greater Beirut, Lebanon. **Chapter 4** describes the prevalence of food insecurity, low dietary diversity, and poor mental health and their associations among Syrian refugee mothers living in vulnerable areas of Greater Beirut, Lebanon. **Chapter 5** reveals infant feeding practices, nutrition, and associated health factors during the first six months of life among Syrian refugees in Greater Beirut, Lebanon using mixed research methods. In **Chapter 6**, the findings of this dissertation are synthesized and discussed simultaneously. **Chapter 7** presents a general conclusion with prospective recommendations and potential implications. A list of general references and supplementary materials are found at the end of this document.

1.2. Background

1.2.1. Nutrition in the first 1000 days

The first 1000 days, or the window of opportunity, is defined as the period spanning between conception and the child's second birthday that is key to the foundation of optimum health, growth, and wellbeing [23]. Fetal development and infancy are characterized by rapid growth and development of organs, making them vulnerable to any variations in the quantity and quality of nutrients received in the pre- and periconceptual period. "Nutritional programming" in early life refers to the permanent adaptations and changes made to physiology in response to environmental stimuli or triggers via epigenetic mechanisms during the critical phases of development. Programming can influence brain and neurocognitive development and determine lifelong physiological and metabolic function and diet-related non-communicable disease risk in adulthood. Inadequate maternal nutrition and poor early feeding practices may result in long-lasting consequences and affecting more than a generation through intergenerational cycles [1–3]. The role of maternal and child nutrition in early life in optimal cognitive, social, and behavioral development and in the prevention of chronic diseases and malnutrition has been well elicited. There is an extensive literature on the role of early life nutrition in the brain development [4,24], intellectual functioning and mental health [25], human microbiome and child growth [26,27], cardiometabolic health [28], development of obesity [29], non-communicable diseases [30], allergic diseases [31], and prevention of anemia and iron deficiency [32].

1.2.1.1. Maternal nutrition during pregnancy and lactation

It is well established that nutrition is fundamental before and during pregnancy, lactation, and first two years of life and can have long-lasting effects on the growth and development of offspring. Nutritional requirements during pregnancy and lactation increase compared to those of non-pregnant non-lactating women of reproductive age to support maternal physiological adaptations during delivery and breastfeeding and to ensure the normal and healthy development of the fetus [33]. In fact, nutrition during the preconception period is as crucial since it allows mothers to replenish their stores. Existing maternal nutrient deficiencies can be corrected during pregnancy, but the adverse effects on the child's development may be already irreversible [34]. During pregnancy, micronutrients and omega-3 fatty acids are essential for many cellular and metabolic activities and can be mainly provided by a balanced and diverse diet or by supplementations [33,35]. The critical micronutrients include iron, calcium, magnesium, iodine, zinc, vitamins A, D, E and C, and B-vitamins. During lactation, a mother also provides all the hydration and nutrients the infant requires [33]. The success of lactation is based on the appropriate weight gain of the

breastfed child [33]. The components of human milk are derived primarily from the maternal diet, maternal macro- and micronutrient stores, and production of nutrients - i.e., milk fat globules in the lactocytes [26]. Maternal micronutrient deficiencies or a poor maternal diet during lactation may compromise the breast milk content of certain micronutrients, especially the water-soluble vitamin C and the B-vitamins [36–38]. It is therefore recommended for breastfeeding mothers to remain vigilant about their dietary intake and to use dietary supplementation when the maternal diet is deficient [38].

Numerous studies investigated the dietary diversity and micronutrient adequacy among pregnant and lactating women in low- and middle-income countries. Most of the pregnant women in Jordan did not meet their nutritional needs from diet alone for protein, iron, iodine, zinc, and vitamins D and E. Micronutrient intakes were significantly higher in the third trimester compared to those in the first and second trimesters with the use of dietary supplements [39]. Lactating and non-lactating women in rural Zambia had low dietary diversity and poor nutrient adequacy. Lactating women were also found not to have higher intakes of macro- and micronutrients compared to non-lactating women, creating a larger gap between their intake and dietary requirements due to increased needs [40]. Similarly, a majority of pregnant and lactating women in Ethiopia did not meet the minimum dietary diversity and had poor dietary practices. Diets had a monotonic nature and were based on starchy staples. Organ meats, dairy, eggs, flesh foods were among the least consumed groups. Due to food taboos, nutritious food groups such as milk, nuts, green vegetables were avoided for various beliefs [41]. In addition, Kang *et al.*, (2019) found a relationship between household food insecurity and low dietary diversity among pregnant and lactating women in rural Malawi. Food insecure women had a higher risk of not consuming animal-source foods such as eggs, meat, poultry, and fish. These findings highlight a monotonous diet and an increased risk of micronutrient deficiencies [42]. Recent studies demonstrated that the consumption of pulses, fruits, and the dietary intake of selenium (from foods or supplements) reduced the risk of small-for-gestational-age [43], whereas the poor consumption of dairy, dark green leafy vegetables, and fruits increased the risk of adverse pregnancy outcomes [44].

1.2.1.2. Infant nutrition during the first six months of life

Infancy is characterized as a critical period of growth as it sets the foundations for long-term health in adulthood. Infants have high requirements of nutrients because of rapid physical growth as well as cognitive and emotional development, classifying them as a vulnerable group [45]. Malnutrition during this critical period leads to long-term impairments and irreversible damage to human capital, contributing to shorter adult height, decreased cognitive development, and reduced adult income [46]. The role of breastfeeding in the prevention of malnutrition in infancy and childhood has been well noted in the literature

[37,47]; therefore, breastfeeding emerged as an ideal target for nutrition specific interventions and programs to improve maternal and child nutrition in low- and middle-income countries [3,5,7]. Human breast milk is a dynamic and multi-functional food as it provides tailored compositions of macro- and micronutrients, in addition to bioactive components, over the span of different stages of lactation. The bioactive components of breast milk have a beneficial impact on the development of the immune system, microbiota and gut health, and central nervous system development in early life. It is primarily composed of human milk oligosaccharides, breast milk microbiota, and milk fat globule membranes. Therefore, human breast milk is considered the gold standard for newborns and infants [26,48].

Accordingly, the World Health Organization (WHO) strongly recommends the early initiation of breastfeeding, within the first hour of birth, and exclusive breastfeeding for six months from birth, with the timely introduction of complementary feeding and continued breastfeeding thereafter, for optimal growth and development [49,50]. Early initiation of breastfeeding has a decisive role in the establishment of exclusive breastfeeding as it limits the possibility of pre-lacteal feedings [51] and secures that the newborn is receiving colostrum [52]. The “first milk”, or colostrum, is produced during the first stage of lactation, typically 1 to 5 days postnatally, and is very rich in immunoglobulins, lactoferrin, leukocytes, growth factors, vitamins A and E, and proteins. It is known for its effect on the immune system development [26,52]. The direct benefits of breastfeeding include the protection effect against diarrhea and respiratory infection as well as the reduction of morbidity and mortality [53]. Breast milk is safe, especially in environments with inadequate sanitation and drinking water. Long-term benefits of breastfeeding for mothers and infants are also well-documented, covering multiple aspects from nutritional and immunological to wellbeing. In fact, breastfeeding has the potential to reduce the risk of non-communicable diseases and increase intelligence in the offspring and to protect against breast and ovarian cancer, post-partum depression, and other chronic diseases among mothers [47,54–56]. The success of breastfeeding remains continuously threatened by numerous barriers, including pre-lacteal feedings [51], bottle feeding [57], early introduction of complementary feeding [58], and the violations to the Code of Marketing of Breastmilk Substitutes [59]. Other challenges may be associated with pre-term delivery [60], caesarian deliveries [51], maternal obesity [61], and psychosocial factors [62], but also with workplace barriers and societal constraints affecting women’s economic power [63].

1.2.2. The intergenerational cycle of malnutrition

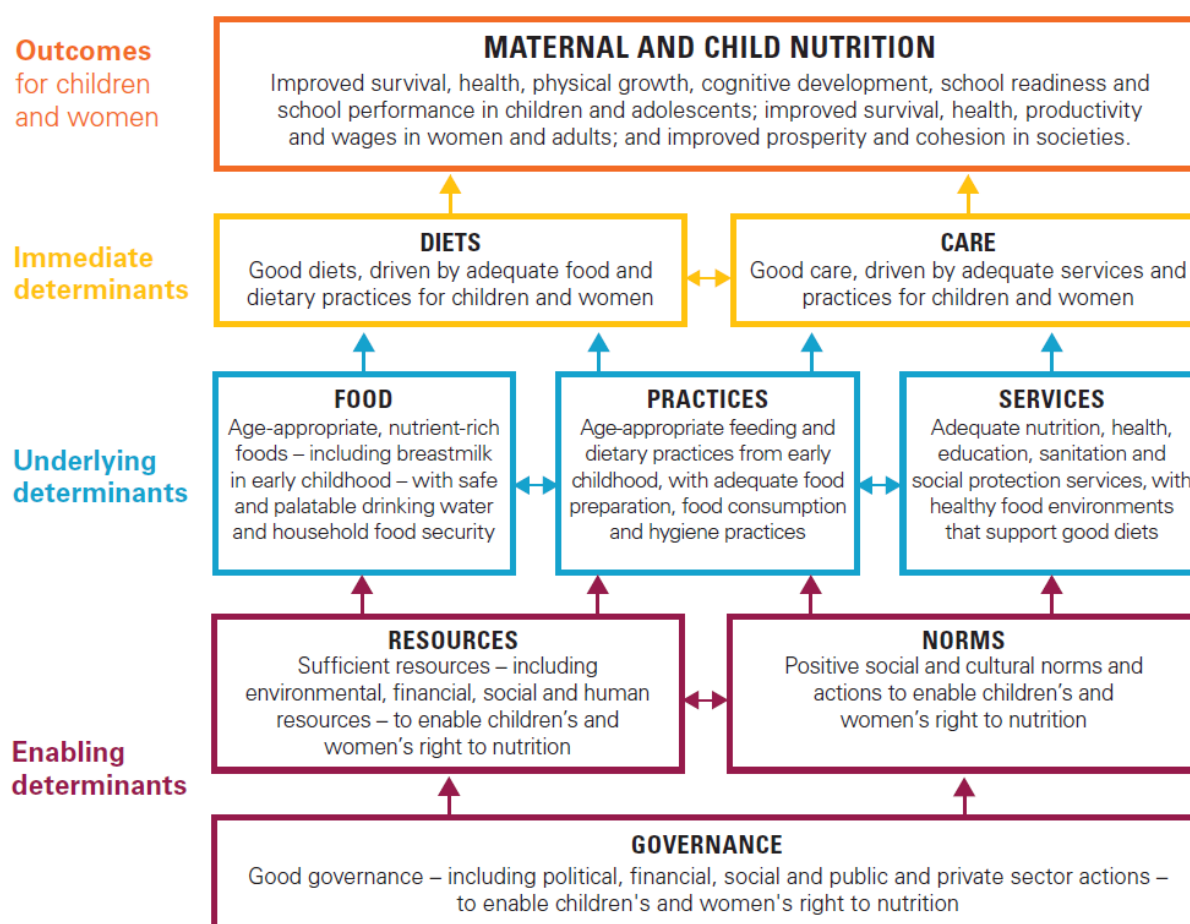
Malnutrition is manifested in many forms and includes undernutrition (underweight, stunting, wasting), overnutrition (overweight, obesity), and micronutrient deficiencies, consequently resulting in diet-related non-communicable diseases [64].

The coexistence of multiple forms of malnutrition, including undernutrition along with overnutrition or diet-related non-communicable diseases, characterizes the double burden of malnutrition. This phenomenon can occur at the individual, community, and / or national level and is a growing global health concern affecting mostly low- and middle-income countries [8,65]. Recently, the United Nations International Children's Emergency Fund (UNICEF) acknowledged the evolving challenge of child malnutrition and referred to the co-occurrence of stunting and wasting, widespread micronutrient deficiencies, and growing prevalence of overweight and obesity as the “triple burden of child malnutrition” to describe the growing challenge affecting children from poor households in low-, middle-, and high-income countries [9].

The UNICEF Conceptual Framework on the Determinants of Maternal and Child Nutrition (**Figure 1**) describes the enabling, underlying, and immediate determinants contributing to maternal and child nutrition. The framework highlights the role of good diets and care, that are composed of age-appropriate and nutrient-rich foods and are driven by adequate practices and access to services. At the base of the framework, the role of good governance and norms is emphasized to enable women's and children's right to nutrition. The vertical and horizontal interconnectedness of the different layers of determinants is also accentuated [66]. All forms of malnutrition share common drivers linked to food insecurity, socio-economic disadvantage, and poverty. In addition, rapidly changing food environments, often in the context of globalization and urbanization, resulted in a rapid nutrition transition, especially in low- and middle-income countries [3,8,65]. Through this rapid shift in dietary patterns, the number of people exposed to different forms of malnutrition simultaneously, during their life course and in the same household, has increased sharply and contributed to the intergenerational cycle of malnutrition [3].

Maternal nutrition during pregnancy and lactation presents a critical window in early life as the maternal phenotype “imprints” the intrauterine growth and the growth and development of their offspring [3]. The intergenerational effects occur through multiple causal pathways, including epigenetic and metabolic mechanisms, genetics, and environmental factors [67]. Undernourished women have an increased risk of having low birthweight infants and transmitting childhood stunting, underweight, and micronutrient deficiencies, mostly due to diets with inadequate energy and nutrient composition. Maternal undernutrition in early life increases the predisposition to a short stature and low body mass index in adulthood as well as of developing non-communicable diseases and abdominal obesity. Equally relevant, maternal obesity is associated with macrosomia due to elevated maternal glucose and insulin concentrations or gestational diabetes [3,68]. Subsequently, exposure to overnutrition in early life, including excessive gestational weight gain, higher birthweight, or rapid postnatal weight gain, is considered a predictor to obesity and insulin resistance in adult life [3].

Globally, the most common micronutrient deficiencies affecting pregnant women and children include iron, vitamin A, iodine, folate, and zinc deficiencies, influencing their growth, development, and survival [5,69]. Anemia, with iron deficiency being its primary contributor, can have severe health consequences for both pregnant women and their offspring. During pregnancy, low iron store and intake were implicated as risk factors for preterm delivery, low birthweight, intrauterine growth retardation, and stillbirth. Their offspring may be subjected to an increased risk of cognitive and behavioral deficits and inadequate psychomotor development, leading to poor school performance [32,70]. The maternofetal iron deficiency is a serious global burden due to the irreversible damage it can cause to the developing brain structures of the offspring [34]. Long-term consequences for families and communities include reduced work productivity, decreased income, and increased health-care expenditures [70].



UNICEF Conceptual Framework on the Determinants of Maternal and Child Nutrition, 2020.
A framework for the prevention of malnutrition in all its forms.

Figure 1: UNICEF Conceptual Framework on the Determinants of Maternal and Child Nutrition (Source: UNICEF, 2020)

1.2.3. Food and nutrition security

Since 1996, the Rome Declaration on World Food Security and World Food Summit Plan of Action declared food security as a human right and that it “exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life” [14]. Food security was based on four pillars, classified as availability, access, utilization, and stability [71]. The concept of nutrition security emerged in the 1990s and was elaborated to include adequate caring practices and access to health services coupled with a sanitary environment in addition to dietary adequacy [72]. Food security and nutrition security are tightly interlinked; one cannot be achieved without the other. Hence, the term Food and Nutrition Security emerged to combine both concepts and emphasize on the importance of achieving optimal nutrition, but also of health services and environmental conditions [73,74].

It has been acknowledged that food security alone is not enough to achieve an optimal nutritional status and that nutritional security cannot be met without being food secure. As shown in **Figure 2**, the conceptual framework of food and nutrition security has depicted nutritional status as the outcome of food intake and health status, also referred to as the immediate causes. The underlying causes of food intake and health status were based on four determinants, including food availability, caring capacity, health services, and environmental conditions. This framework also supported in visualizing and distinguishing both concepts of food security and nutrition security and their role in manifesting an optimal nutritional status [73].

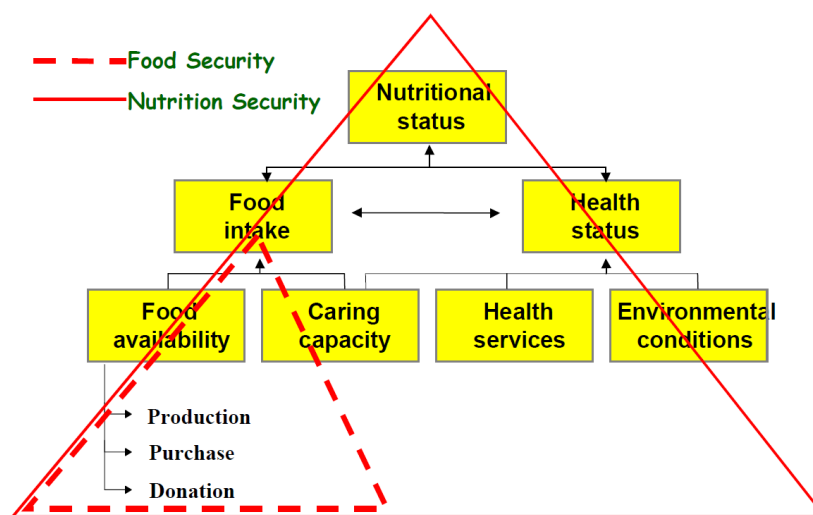


Figure 2: Conceptual Framework of the Nutritional Status at Household Level (Source: Gross et al., 2000)

Households and individuals may resort to coping strategies when faced with moderate to severe food insecurity, such as the sale of assets, reliance on savings, or reduction of food consumption [75]. Food-related coping strategies are used to manage household food shortages by skipping meals, reducing portion sizes and variety, or restricting the consumption of adults for the sake of children [76]. Maternal buffering by limiting her own food intake seems probable to ensure availability for children and other members in extended households, most likely by the youngest daughter-in-law [77,78]. The latter highlights gender inequalities within societies and the role of women within households, indicating a need to assess food insecurity at the individual level since the household measure of food insecurity may mask the intra-household differences in food allocation and choices [12,79].

1.2.3.1. Food insecurity and malnutrition

A strong relationship between food insecurity and multiple forms of malnutrition has been well established [11,12,80,81]. Two principal pathways exhibited the link between food insecurity and undernutrition, overnutrition, and micronutrient deficiencies, as shown in **Figure 3** [11].

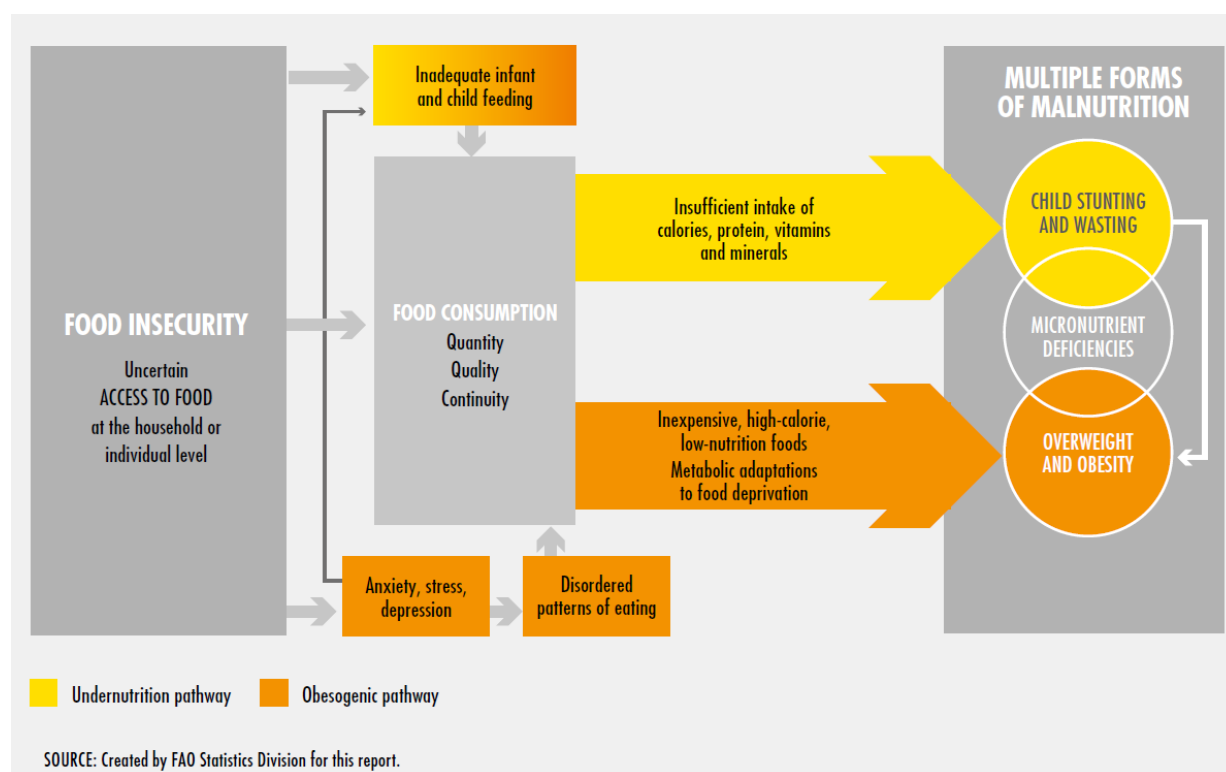


Figure 3: Pathways from Inadequate Food Access to Multiple Forms of Malnutrition (Source: FAO, 2018)

1.2.3.2. Undernutrition

The undernutrition pathway is deemed to be more straightforward as it is characterized by the insufficient intake of macro- and micronutrients. It can directly impact the child's growth and development and contribute to child stunting and wasting. Maternal diets among women of reproductive age can also be compromised when the recommended nutrient requirements are not met. Consequently, maternal undernutrition may lead to a higher risk of low birthweight, contributing to child stunting [11]. Numerous studies documented the link between food insecurity, dietary diversity, and stunting among children worldwide [82–84]. Child wasting was also recorded among food-insecure households in low- and middle-income countries [85,86]. As an indicator of acute malnutrition, child wasting is often the result of other factors such as infections and diseases [11], but also acute shocks such as the abrupt cessation of breastfeeding and high stress levels due to conflicts and humanitarian crises [87].

Infant and young child feeding practices can also be negatively affected by food insecurity, compromising the nutrition of infants [11]. Lower rates of exclusive breastfeeding and shorter duration of continued breastfeeding were found among infants of food-insecure households [88,89]. This can be explained by the association between food insecurity and maternal depression, which in return negatively impacts the initiation and duration of breastfeeding [81]. Maternal psychological distress, such as depression or anxiety, may impair the release of oxytocin and delay the onset of lactogenesis, thus reducing breastfeeding outcomes [62]. Emerson *et al.*, (2017) also argued that mothers experiencing psychological distress may experience low appetite and weight loss, leading to a poor maternal nutritional status and in return to perceived insufficient breast milk and difficulty to breastfeed [90].

Mothers with low-income were found to perceive poor maternal diet and high stress to adversely affect their breastfeeding practices in fear of transmitting the maternal stress through breast milk. These mothers also resorted to coping mechanisms such as limiting healthy foods and portion sizes, which could be also explored as a potential mechanism linking food insecurity and obesity-promoting feeding styles and practices [91]. Recent studies showed that good breastfeeding practices can potentially prevent stunting and anemia in children in low- and middle-income countries [92,93].

1.2.3.3. Overnutrition

The obesogenic pathway, on the other hand, demonstrates a relationship between food insecurity and overweight and obesity that may appear to be a paradox [11,94]. Several potential mechanisms could explain this phenomenon [95]. Food insecurity has been linked to poverty, low wages, and poor socio-economic status. Households may resort to reducing the quality and diversity of their diet and may consume

less of their preferred foods. Other coping mechanisms may include skipping meals and limiting food budgets [13]. According to Darmon and Drewnowski (2015), food choices remain to be driven greatly by food prices. The higher cost of a healthy diet may be a significant barrier to financially constrained individuals. Lean meats, fish, and fresh produce are more expensive food sources compared to grains, fats, and sweets [96]. The consumption of foods high in energy density, often less expensive, instead of the more nutrient-rich foods has become a common practice - or coping mechanism - among low-income groups, increasing their risk to micronutrient deficiencies and excessive energy intake [97]. Multiple studies have shown that food insecurity is associated with poor dietary diversity in low- and middle-income countries and upper-income countries alike [98–100]. Another potential mechanism is related to the metabolic adaptation to food deprivation through the intergenerational cycle of malnutrition. It is argued that “metabolic imprinting” occurs when maternal and early child nutrition are compromised, especially in the first 1000 days, increasing the risk of obesity and non-communicable diseases in later adult life [11].

Poor mental health has also been explored as a plausible mechanism leading from food insecurity to overnutrition [81]. A strong association between food insecurity and depression, anxiety, and sleep disorders has been established [101]. Studies suggest that stress and depression may lead to eating disorders such as bingeing or overeating and may increase the consumption of highly palatable food items, mostly with a high energy density [81]. Keenan *et al.*, (2021) demonstrated that household food insecurity was indirectly associated with a higher body weight via greater distress and eating to cope with distress. It also showed that food insecurity was directly associated with poor dietary quality, but could not justify this relationship via distress and eating to cope [102]. Sparling *et al.*, (2020) also found that food insecurity and poor household food consumption were positively associated with depression among women of reproductive age and pregnant women [103]. In addition, excessive stress and distress may also impact infant and young child feeding practices, especially breastfeeding, affecting the nutritional status of children [21,62]. Studies found that women suffering from post-traumatic stress disorder (PTSD) were less likely to breastfeed [104,105] and maternal depression was associated with reduced exclusive breastfeeding and nonresponsive feeding styles [106,107]. In addition, studies showed that maternal obesity was associated with reduced lactogenesis and breastfeeding initiation, duration, and exclusivity [61,108].

1.2.3.4. Micronutrient deficiencies

The relationship between food insecurity and micronutrient deficiencies can be explained via both pathways. It is often the result of either the lack of dietary intake or overconsumption of foods high in energy density and poor in nutrient-density [11]. Yang *et al.*, (2019) showed that food insecurity was associated with stunting, anemia, and low dietary diversity among children aged 3 to 5 years [83]. Kehoe

et al., (2021) also found that the prevalence of anemia and food insecurity was similar across different body mass index (BMI) categories among non-pregnant women. Findings also showed that food insecure women had the least diverse diets and food insecurity was inversely associated with diet quality. The authors suggested that underweight and obesity often co-exist with micronutrient deficiencies, such as anemia, and may be the outcome of poor dietary quality and diversity due to common underlying causes [98].

1.2.4. Nutrition and infant feeding in emergencies

During natural or man-made crises, infants and children are classified among the most vulnerable groups [17,18]. Malnutrition among children is a major threat to their lives during emergencies and large-scale migrations. Like otherwise disadvantaged groups, the risk of mortality is increased with malnutrition and acute infections (e.g., diarrhea and respiratory infections), often due to crowded and unsanitary spaces. Long-lasting consequences, such as diminished quality of life and reduced productivity, continue to follow the fate of these children, even after surviving malnutrition, due to irreversible impacts on their cognitive and social development [17]. Exposure to wars and conflict can trigger intergenerational effects on the health and development of children and offspring via four primary pathways: violence, infections, mental health conditions, and maternal and child malnutrition [109]. In the context of large-scale migrations, breastfeeding has a life-saving role as it presents the safest way to protect against infant malnutrition [110]. Therefore, major global efforts have jointly been advocating for the protection, promotion, and support of breastfeeding and for the control of the use of breastmilk substitutes during emergencies [17,18].

The major barrier to establishing good breastfeeding practices was found to be the violation of the International Code of Breastmilk Substitutes in local settings of emergencies, such as the uncontrolled and untargeted distribution of formula milk. Mothers also faced numerous barriers, including the lack of private spaces and support to breastfeed, in addition to exposure to malnutrition and high stress [21,111]. Studies have shown that breastfeeding practices decline during humanitarian crises [112,113], leading to an increased risk of early cessation of breastfeeding and malnutrition among infants [114,115]. A recent systematic review captured a high prevalence of stunting, underweight, and anemia as well as overweight and obesity among children and adults, portraying the double burden of malnutrition among refugees [19]. The dietary intake of refugees and asylum seekers was primarily characterized by monotonous diets and insufficient macro- and micronutrient intakes. The nutritional status can be further exacerbated due reduced diet quality and poor dietary diversity [19,20]. In addition, stress related to conflicts and maternal depression can interfere with breastfeeding practices and accelerate the weaning process among refugees and displaced persons [17,113,115]. It has been well documented that maternal depression or psychological

distress may reduce breastfeeding outcomes via numerous mechanisms that may impair the release of oxytocin, delay the onset of lactogenesis, and dysregulate the hormones implicated in lactation [62].

1.3. Relevance of topic

The 21st century has witnessed remarkable transformations and a series of events up-to-date. Globally in 2020, the burden of malnutrition remains unresolved and the rates of global hunger and food insecurity are on the rise again due to numerous drivers, including conflicts, climate change, economic shocks, increasing gaps in inequality, and the COVID-19 pandemic [75]. Consequently, a new face of malnutrition has emerged in low- and middle-income countries and is manifesting itself as a triple burden: underweight, hidden hunger, and overweight on an individual, community, and global levels alike [9,10].

Globally, the number of moderately or severely food insecure people escalated from around 1.5 billion in 2014 to 2.3 billion in 2021, representing 29.3% of the world's population. In 2020, it was estimated that around 150 million (22%) of children under five years were stunted, 45 million (6.7%) wasted, and 39 million (5.7%) overweight. In addition, adult obesity affected nearly 13.1% of the population in 2016 [75]. According to the World Health Organization (WHO), nearly one-third (29.9%) of women of reproductive and two-fifth (39.8%) of children under five were affected by anemia in 2019, mostly in low- and middle-income countries [116,117]. Furthermore, the prevalence of early initiation of breastfeeding (51.9%) and exclusive breastfeeding under six months (45.7%) in 2010-2018 were still behind the WHO recommendations globally, despite their steady improvement since 2000-2009 [118].

Furthermore, it is evident that conflicts have become one of the major drivers of food insecurity in the 21st century [15]. Food insecurity and the burden of malnutrition were found to be linked [11,81], entering a vicious cycle with the interplay of the intergenerational effects of malnutrition and conflicts [3,67,109]. According to the United Nations High Commissioner for Refugees, the number of forcibly displaced people worldwide increased from 65.3 million in 2015 to 89.3 million in 2021, with the majority being women (26%) and children (41%) [119]. Women of reproductive age, infants, and children under five years are at a greater risk of one or more forms of malnutrition due to their increased nutrient requirements [6,7].

Almost a decade ago, the *Arab Spring* surged in the Middle East and North Africa (MENA) with poverty and food insecurity being the main drivers. In the first half of 2011, uprisings spilled over almost the entire Arab world resulting in intense violence and conflicts [120–122]. Syria has witnessed the longest and most intense conflict of the *Arab Awakening* resulting in the largest refugee crisis globally, exceeding 6.7 million by the end of 2018. The majority of Syrian refugees fled to neighboring countries in the MENA

region, including Turkey, Lebanon, Jordan, Egypt, and Iraq [123]. Lebanon reached and continues to host the highest per capita concentration of refugees worldwide, one out of four people in Lebanon is a displaced person from Syria since 2015 [124,125]. Most forced migrations are prolonged with 26 years being the average duration of displacement among refugees. Consequently, refugees are subject to increasing vulnerabilities associated to their legal status, mobility, access to services, and limited employment opportunities [16].

It is estimated that more than 1.5 million Syrian displaced people lived in Lebanon with nearly one million registered with the UN High Commission on Refugees (UNHCR) as refugees by May 2016, with 79% being women and children [125]. Greater Beirut, defined as the urban agglomeration of Beirut and adjacent districts of Mount Lebanon governorate, is the melting pot of the country with more than half of the Lebanese population and over 305,000 refugees [125,126]. With few informal settlements in these areas, the vast majority of refugees were living in rented accommodation [127] and were suffering from high costs of living, household debts and dependency on food vouchers. High unemployment rates and scarce resources were increasing vulnerability of both Lebanese host communities and Syrian refugees [126]. Despite large-scale assistance programs targeting Syrian refugees in Lebanon, about half of households were living in extreme poverty [128].

Numerous international and national non-governmental organizations have reported on Syrian refugees in Lebanon since 2011. For instance, the Vulnerability Assessment of Syrian Refugees in Lebanon has been providing a yearly update and a multisectoral overview on the vulnerable situation of Syrian refugee households since 2013, including household food insecurity, food consumption score, and child health and nutrition [128]. Survey results showed that 93% of the Syrian refugee population were estimated to have some degree of food insecurity in 2016 (marginally, moderately, or severely food insecure). In fact, the food insecurity trend from 2016 until 2019 maintained an overall narrow range of 90-93% with the highest rates being recorded in North Lebanon and Mount Lebanon and a decrease was observed in moderately and severely food insecurity from 35% to 29%. Poor food consumption and household dietary diversity scores were also recorded among Syrian refugees in Lebanon, with Beirut and Mount Lebanon experiencing the worst scores and a drawback despite the nationwide improvement in 2019 [128]. Since 2019 until 2021, the situation has worsened following the financial crisis in Lebanon and the pandemic among Syrian refugee households in Lebanon [129].

Furthermore, only one report was found on the nutritional assessment among Syrian refugees in Lebanon with objectives to examine infant and young child feeding practices, undernutrition, and anemia among children and women, with no mention of overweight and obesity [130]. Prevalence rates of anemia among children under five ($Hb < 11$ g/dL) were reported to be 21.0% for Syrian refugee children (from 6

to 59 months of age) and 26.1% among women of reproductive age. Stunting rates reached 18.6% among these children, whereas global acute malnutrition was low (2.2%) in 2014 [130]. Other studies also documented a high prevalence of anemia and a low prevalence of undernutrition among children under five and women of Syrian refugees in Jordan [131]. As for infant feeding practices, only 31.3% of children under two were breastfed within the first hour from birth and 25.0% were exclusively breastfed during the first six months of age (25.0%) among Syrian refugees in Lebanon [130]. Furthermore, high rates of maternal depression (88.6%) were found among Syrian refugee women in Lebanon [132] and more than a quarter of Syrian refugee adults living in the Beqaa region in Lebanon were found to suffer from post-traumatic stress disorder (lifetime prevalence of PTSD of 35.4% and a point prevalence of 27.2%) [133].

A recent systematic review by Khuri *et al.*, (2022) summarized the evidence from studies published from 2009 to 2020 on the dietary intake and nutritional status of refugees in host countries worldwide. Poor dietary intake and inadequate nutrient intake was documented across numerous studies. Evidence also documented high rates of stunting, underweight, and anemia, especially among children, and pointed towards the presence of the double burden of malnutrition among this vulnerable population in different host countries [19]. Asylum seekers tend to eat fewer meals as a coping strategy to reduce food consumption [20]. Up-to-date, there is a lack of studies assessing maternal nutrition during pregnancy and lactation among refugees in the literature. Food insecurity and dietary diversity were commonly assessed at the household level and no studies have examined them at the individual level of the women or mother in the household. Despite the rare data on anemia among children and women refugees, no data was available on infants under six months among the refugee population. In addition, scarce studies looked at the relationship between maternal mental health and the nutritional status and infant feeding practices among refugees.

1.4. Conceptual framework

As highlighted in Chapter 1, food and nutrition security, malnutrition, and the nutritional status of women and children share common determinants and root causes. Therefore, the conceptual framework of this thesis (**Figure 4**) aims to take into consideration the original concepts of food security and nutrition security as well as the well-known conceptual frameworks of malnutrition and the nutritional status at the household level [66,73]. The conceptual framework of this thesis was developed largely on the basis of the IPC Integrated Food Security and Nutrition Conceptual Framework as it already expands on the UNICEF Conceptual Framework of Malnutrition [66,134]. It was adapted to include other significant factors as explained below. This developed conceptual framework also supports visualizing the linkages between concepts of food security, nutrition security, and food and nutrition security.

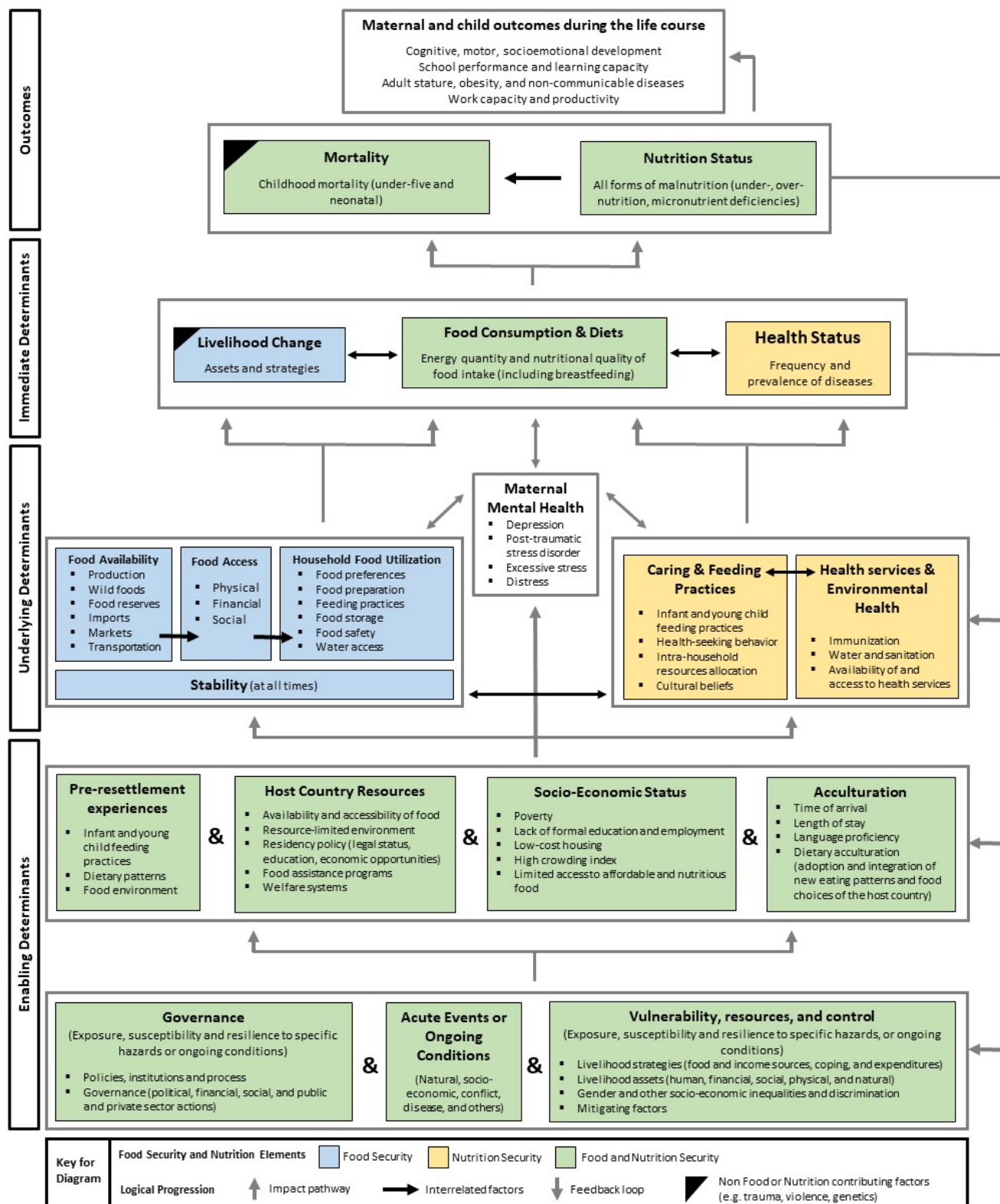


Figure 4: Conceptual framework linking food and nutrition security, determinants of malnutrition, maternal mental health, and factors related to refugees in host countries to maternal and child outcomes (Adapted from: IPC Global Partners, 2021)

At the base of the framework, the enabling determinants, or the basic causal factors of food insecurity and malnutrition, are presented at two levels. The first-level (level-1) enabling determinants (or causal factors) includes the current governance (policies and institutions), exposure to hazards or ongoing conditions (conflicts or natural disasters), and existing vulnerabilities, resources, and control (livelihood strategies and assets, inequalities, and other factors) [66,134]. These level-1 causal factors interact with each other and impact the second level (level-2) of enabling determinants, that primarily impact refugees and asylum seekers in host countries. The level-2 causal factors include pre-settlement experiences (eating habits, feeding practices, and food environment), host country resources available to refugees (residency policy, food assistance programs, and food resources), socio-economic status of refugees (poverty, education, employment, and purchasing power), and acculturation (language skills, length of stay, and adaptability) [19].

The enabling determinants (first- and second-level) are identified as the key drivers to food insecurity, poor maternal mental health, inadequate caring and feeding practices, compromised availability and / or access to health services, and poor environment health. These mid-level factors are referred to as the underlying determinants and can also interact with each other. Maternal mental health was linked to food security, caring and feeding practices, food consumption and dietary quality, health services, and environmental health as a result of pre-existing conditions or as an outcomes of the causal factors, especially in the context of conflicts and violence [81,101–103,109].

The impact of the underlying and enabling determinants mostly affects the outcomes on two recognized levels. The first-level outcomes, also described as the immediate determinants, include the livelihood change, food consumption and diets, and health status. The second-level outcomes represent the nutritional status and mortality rates of the studied population [66,134]. These relationships were characterized as complex and the pathways linking food insecurity, food consumption, and nutritional status have been described in Chapter 1. Ultimately, the nutritional status have an impact on the maternal and child outcomes during the life course, determining their cognitive, motor, and socioemotional development, school performance, work productivity, and their health status in adulthood [5].

1.5. Hypothesis and Objective of the Study

1.5.1. Hypotheses

Based on the conceptual framework and the identified gaps in the relevance of topic, the following hypotheses were developed for this thesis:

1. Syrian refugee women and children under five are affected by anemia and multiple forms of malnutrition, including maternal obesity and child stunting. Maternal and child anemia are associated.
2. Women with higher nutrient needs (pregnant and lactating women) are not meeting at least two-thirds of the dietary requirements, particularly of hematinic nutrients.
3. Food insecurity among mothers is associated with poor dietary diversity, poor mental health, and anemia.
4. Poor breastfeeding practices are associated with maternal depression and obesity among Syrian refugees as well as diverse social factors such as misinformation or common local habits.

1.5.2. Objectives of the study

The aim of this dissertation was to test three primary research questions, as follows:

1. What are the prevalence and determinants of anemia in pregnant women, lactating mothers, and women of reproductive age and children under five years among Syrian refugees in an urban setting of a humanitarian crisis? Are maternal and pediatric anemia associated?
2. What are the associations between food security, nutritional status, dietary intake, anemia, and mental health status of women of reproductive age?
3. What are the factors associated to breastfeeding practices and nutritional status of infants under six months, with focus on relationships to maternal mental health and traditional, social and cultural infant feeding practices?

Therefore, the general aims of this thesis were outlined into three core objectives, as follows:

Paper 1: The objectives were (1) to assess the prevalence of anemia and the nutritional status of Syrian refugee mothers and children under five in Greater Beirut, Lebanon, (2) to examine the nutritional adequacy of pregnant, lactating, non-pregnant non-lactation mothers, and (3) to explore the associated factors with anemia.

Paper 2: The objectives were to (1) assess the prevalence of food insecurity, low dietary diversity, and poor mental health among Syrian refugee mothers, (2) explore their associated factors including their relationship with anemia and nutritional status, and (3) examine the consumption of different food groups according to the household monthly income among Syrian refugees in Greater Beirut, Lebanon.

Paper 3: The objectives were to (1) assess the prevalence of anemia and the nutritional status of infants under six months and characterize their infant feeding practices and related health aspects, (2) identify factors associated with early initiation of breastfeeding and exclusive breastfeeding, and (3) investigate supporting factors and barriers to early breastfeeding practices among Syrian refugees in Greater Beirut, Lebanon.

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2

Chapter 2

General Methodology

2. General Methodology

2.1. Study area

Lebanon, officially the Republic of Lebanon, is a small country in Southwestern Asia with a total size of 10,452 square kilometers. It is located on the eastern shore of the Mediterranean Sea and is part of the Levant region in the Middle East [1]. Lebanon is divided into eight governorates: Akkar, Baalbeck-Hermel, Beirut, Bekaa, Mount Lebanon, Nabatiyeh, North Lebanon, and South Lebanon, displayed in **Figure 5** [2]. The total population was estimated at 5.9 million (estimated in 2016), of which more than 1.7 million were refugees and displaced people from Syria and Palestine, with 88.6% of the population living in the urban area and 11.4% in the rural area [1,2].



Figure 5: Reference map of Lebanon (Source: Government of Lebanon, 2021)

The governorates of Beirut (20 square kilometers) and Mount Lebanon (1,984 square kilometers) hold more than half of the Lebanese population (1.9 million) and over 305,000 Syrian refugees. The Greater Beirut area is considered the melting pot of the country and contains the urban agglomeration of the capital Beirut (also referred to as Beirut Governorate) and the adjacent districts of Mount Lebanon Governorate

[3–5]. According to the United Nations Office for the Coordination of Humanitarian Affairs (UNOCHA), the multi-deprivation index was used as the primary indicators to generate the Most Vulnerable Localities based on the deprivation level scoring of households in five critical dimensions (access to education, water and sanitation, and health services, income levels, and housing conditions), the Lebanese population database, and refugee population figures. Overall, two Most Vulnerable Localities were identified in Beirut governorate and seven in Mount Lebanon governorate, as shown in **Figure 6** [6]. Therefore, the study area was defined by the areas classified as the Most Vulnerable Localities in Greater Beirut.

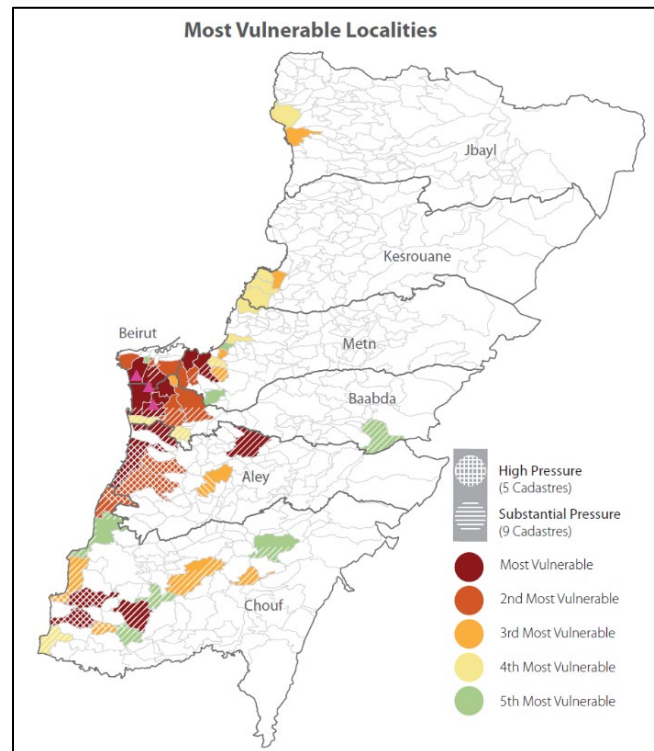


Figure 6: Most Vulnerable Localities of Beirut and Mount Lebanon governorates, Lebanon (Source: OCHA, 2016)

2.2. Study design

A cross-sectional study was conducted among women of reproductive age (15-49 years old) and their children (0-59 months old) of Syrian refugees and displaced persons attending primary healthcare centers from July to October 2018 in the Greater Beirut area in Lebanon using a mixed-method design.

Quantitative data was collected using a culture-specific multi-component questionnaire through face-to-face interviews in a private setting on the premises of the primary healthcare centers. Data was

gathered on the characteristics of the household, socio-economic status, maternal lifestyle, and health status of the mother and child. The dietary intake assessment of the mother and child was completed using the quantitative multiple-pass 24-hours recall and food frequency questionnaire methods [7,8]. Mental health status of the mothers was assessed using the Patient Health Questionnaire (PHQ-9) to measure depression and the Mini International Neuropsychiatric Interview (M.I.N.I.) to measure post-traumatic stress disorder (PTSD) [9,10]. The food security status was measured at the individual level for the mother using the Food Insecurity Experience Scale (FIES) [11]. Infant and young child feeding practices were assessed based on the 2008 and 2021 Infant and Young Child Feeding indicators [12–14]. Data on local food habits, food taboos, and knowledge related to nutrition and anemia were also collected. Anemia and nutritional status were assessed by collecting anthropometric measurements and hemoglobin concentrations using calibrated equipment and standardized protocols [15,16].

Qualitative data was collected by conducting focus group discussions (FGDs) and in-depth interviews with mothers of children aged zero to 59 months, in addition to secondary caregivers and other family members (including grandmothers or mothers-in-law). Topics on perceived barriers and coping mechanisms to infant and young child feeding practices in relationship with mental health, maternal nutritional status, infant formula use, and traditional practices were explored.

2.3. Sampling strategy and recruitment sites

Recruitment sites were identified using a two-step purposeful sampling strategy. As a first step, based on the study area defined for this study, a total of six areas classified as the Most Vulnerable Localities in Greater Beirut were selected for this research project (**Figure 7**). In Beirut governorate, two localities were classified as the Most Vulnerable Localities (Mazraa foncière and Msaytbé foncière) and were included in the sampling strategy. In the governorate of Mount Lebanon, four out of seven Most Vulnerable Localities were included in the sampling strategy as they covered the perimeter of Beirut governorate (Baouchriyé, Bourj el Barajneh, Bourj Hammoud, and Chiyah). The remaining three Most Vulnerable Localities were excluded due to security reasons or for being away from the perimeter of Beirut governorate [6]. As a second step, a total of seven primary healthcare centers in the selected localities were identified as the recruitment sites, with the guidance of the Ministry of Public Health in Lebanon (**Picture 1**). The catchment area of the selected primary healthcare centers covers the urban agglomeration of Greater Beirut, including the capital city of Beirut and extends to the adjacent districts of Mount Lebanon Governorate.

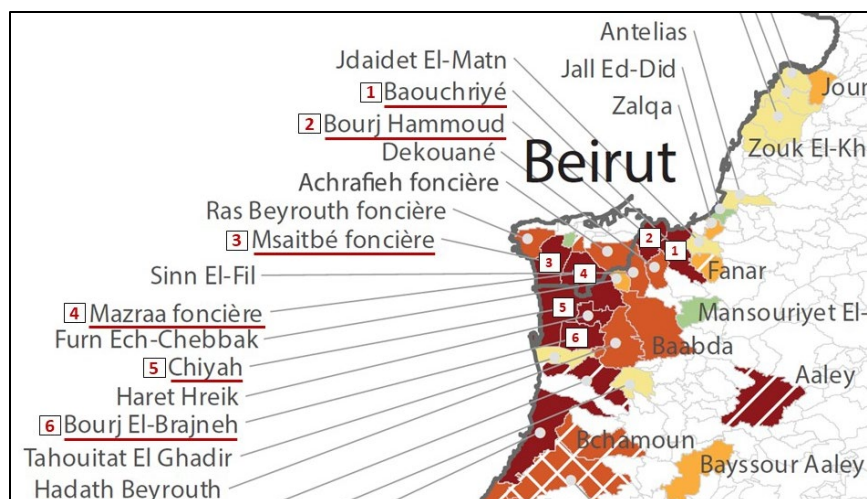


Figure 7: Map showing the selected Most Vulnerable Localities in Greater Beirut for the study area (Adapted from: OCHA, 2015)



Picture 1: Main entrance of some of the selected primary healthcare centers in Greater Beirut (Abou-Rizk, 2018)

2.4. Recruitment strategy

For the quantitative survey, mothers with children under five years were identified using three recruitment strategy: (1) through the nurse or healthcare worker, (2) by direct contact from the enumerators in the waiting rooms of the recruitment sites, and (3) by posting flyers with a brief description of the study in the premises of the primary healthcare centers. Women were assured by the enumerators that participation in the study was completely voluntary, granting the women their right to accept or decline participation on their own and their child's behalf.

The first strategy sought the assistance of the nurse or healthcare worker. It required the nurse or healthcare worker to identify and approach the mother regarding the study, as an established trust relationship already existed between the healthcare provider and the patient. However, this approach could become a burden on the nurses and healthcare workers as they may be overwhelmed with competing responsibilities. Therefore, the second strategy was considered as fundamental to alleviate the workload and to continue inviting the mothers to participate in the study on a regular basis. It consisted of identifying potential participants by direct contact from the trained enumerators in the waiting rooms of the primary healthcare centers (**Picture 2**). Using an oral script, the study was briefly introduced, and the eligibility criteria were checked. The third strategy consisted of hanging flyers with a short description of the study and contact information of the research team on the primary healthcare center premises, allowing interested participants to reach out. When contacted, the research assistant will re-introduce the study and check the eligibility criteria prior moving forward with the recruitment process. After having identified potential mother-child dyads and checked their eligibility criteria, a written informed consent was sought from the mother if she agreed to participate and prior to enrollment in the study.



Picture 2: Waiting areas in selected primary healthcare centers (Abou-Rizk, 2018)

As for the qualitative study, mothers of children aged zero to 59 months were identified from the pool of participants on the quantitative survey. Those that consented to be contacted for future research were invited to participate in the FGDs and / or in-depth interviews. Mothers were encouraged to invite secondary caregivers and other family members (including grandmothers or mothers-in-law) to the qualitative study. An additional written informed consent was obtained from all participants in the FGDs and / or in-depth interviews.

When the mother was aged between 15 and 18 years old, parental consent was sought from the parents or legal guardians, followed by an informed assent from the mother herself. It was also possible to seek parental permission by phone in the presence of a witness in case the parents or legal guardians were out of physical reach. A copy of the signed informed consent form or parental consent and assent forms were provided to the participants. In case of illiteracy, the consent forms were sought in the presence of a witness in the primary healthcare center (i.e., nurse on duty, healthcare worker) who signed on behalf of the participant, after having read and explained the contents.

2.5. Samples size calculation

The sample size calculations were based on previous estimates of anemia levels among Syrian refugee women of reproductive age (26.1%) and children aged six to 59 months (21.0%) from 2013 in Lebanon [17]. The higher prevalence recorded among women was used to estimate a sample size of 296 mothers at a 95% confidence interval and with a 5% margin of error (power = 80, alpha = 0.05, and margin of error = 0.05). To adjust for the two-step sampling strategy, an estimated design effect of 1.5 was applied, increasing the sample size to 444 mothers. The consideration of an estimated non-response rate of 15% and a dropout rate of 10% resulted in a total sample size of 555 mother-child dyads for this study.

2.6. Study population

The study population included a convenient sample of all eligible women of reproductive age (15-49 years old) and children under five (0-59 months old) attending primary healthcare centers in Greater Beirut, Lebanon. When multiple children under five years were eligible within one family, one child was selected randomly. To be eligible for this study, inclusion criteria were set for women of reproductive age and their children. Women had to hold the Syrian citizenship with or without an official refugee status, be aged between 15 and 49 years old, and have a child aged between zero and 59 months. Their selected child had to hold the Syrian citizenship as well and not suffer from any inborn errors of metabolism or physical malformations.

Out of the 665 women approached at the recruitment sites, 590 mother-child dyads were eligible to participate, and 489 mothers consented to the survey. The non-response rate reached 17.1% and dropout rate 11.4%. A total of 433 mother-child dyads completed the interview and were included in this study. The flowchart of the subjects' recruitment in the study is represented in **Figure 8**.

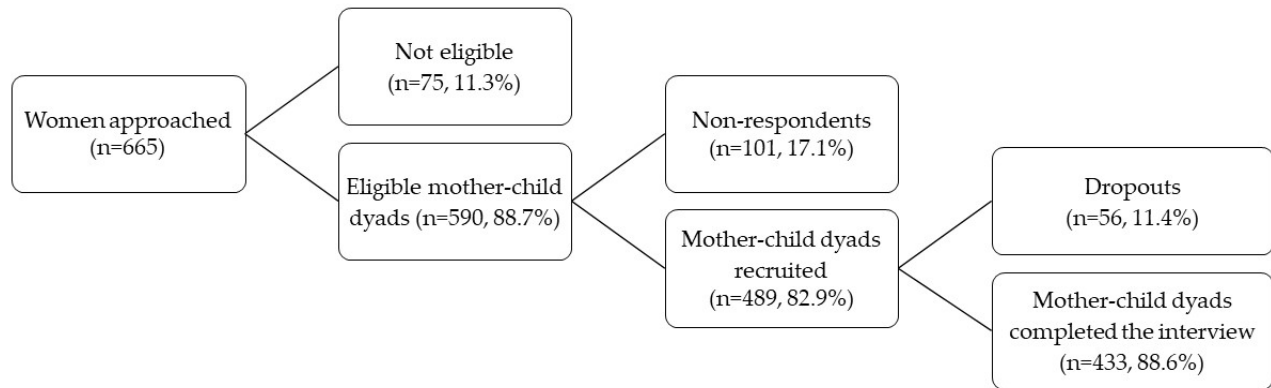


Figure 8: Flowchart of the recruitment of subjects into the study

As for the quantitative study, a total of 201 mothers provided consent to be contacted for future research, of which 183 were invited to the qualitative assessments. Overall, 30 mothers participated in the FGDs along with 13 Syrian female relatives, including sisters, mothers, and mothers-in-law, reaching a total of 43 participants in the qualitative study. Participants were assigned to FGDs according to their availability and access to primary healthcare centers. The number of participants in FGDs varied from two to nine and data saturation was reached after 11 FGDs.

2.7. Data collection

Data collection for the quantitative survey was conducted from July to September 2018 in a total of seven primary healthcare centers located in six Most Vulnerable Localities in Greater Beirut, Lebanon. Face-to-face interviews were conducted by trained enumerators in a private setting on the premises of the recruitment sites using the multi-component culture-specific questionnaire in Levantine Arabic, spoken by the natives of Lebanon and Syria (**Pictures 3 and 4**). The duration of the interviews lasted around 40 minutes. Data collection tools included the standardized reference portions and the 2D food portion visual to facilitate and standardize the collection of dietary data [18].

Anthropometric measurements included the weight, height, mid-upper arm circumference, and waist circumference of the mothers and the weight, length/height, mid-upper arm circumference, and the head circumference of the child. Self-reported data on weight, length, and gestational age at birth were also collected (**Picture 5**). In addition, the hemoglobin concentrations of the mother and child were measured using the ‘HemoCueHb301 System’ by obtaining a small drop of blood for the finger for women and children (6-59 months) or the heel for infants (0-6 months) (**Picture 6**). Paper-based questionnaires were used on field and data entry was performed on KOBOToolbox Technology provided by the Harvard Humanitarian Institute [19].



Picture 3: Research team conducting interviews on the premises of recruitment sites (Abou-Rizk, 2018)



Picture 4: Allocated space for the anthropometric station on the premises of recruitment sites (Abou-Rizk, 2018)



Picture 5: Assessment of anthropometric measurements of a mother and her child using standardized protocols and calibrated equipment (Abou-Rizk, 2018)



Picture 6: Measurement of hemoglobin concentration using the “HemoCue Hb301 System” (Abou-Rizk, 2018)

When cases of severe anemia, moderate to severe malnutrition, minor to major depression, and / or a current state of post-traumatic stress disorder were detected, participants were referred to immediate medical care at the recruitment site or to the nearest health facility that provides psychosocial support services. In addition, a brochure containing general information on healthy diets and dietary recommendations for mothers and children was given and explained to mothers at the end of the interview or when the mother decided to discontinue her participation in the study.

As for the qualitative assessment, data collection took place between September and October 2018 on the premises of the recruitment sites (**Picture 7**). The discussions were conducted in Levantine Arabic and lasted between 20 and 70 minutes. Discussions were also recorded using a digital voice recorder, in addition to note taking. A topic guide was prepared to guide the discussion and probe for specific research areas of focus. The recorded discussions were transcribed into Latin Arabic and then translated to English prior to the initiation of the thematic content analysis.

2.8. Data quality control

All members of the research team completed the Social and Behavioral Research certification provided by Collaborative Institutional Training Initiative (CITI) and participated in an intensive and vigorous one-week training prior to the initiation of field work. The training sessions covered the

recruitment strategies, oral script, consent forms, the culture-specific multi-component questionnaire, and anthropometric measurements. The formation was crucial to ensure a non-judgmental and neutral attitude, decrease potential social desirability bias, and minimize intra-observer measurement errors during data collection. Standardized protocols were used to collect anthropometric measurements using calibrated equipment and an average of two measurements was recorded to the nearest decimal [15,16].



Picture 7: Research team and participants of a focus group discussion (Abou-Rizk & Jeremias, 2018)

Two sub-teams underwent more specialized trainings for the biochemical and dietary data assessments, independently. The biochemical team underwent training on proper micro-technique blood collection for pediatrics and adults to measure hemoglobin concentrations using the “HemoCue Hb301 System”. Control solutions were routinely used to ensure the accuracy of the measurement of hemoglobin. The dietary team was composed of nutritionists who underwent a rigorous training on the dietary data collection using a quantitative multiple-pass 24-h dietary recall method and a food frequency questionnaire using a 2D food portion visual and standardized reference portions [18]. Their use facilitated the collection of dietary data and ensured standardization. The advantages of the five-step multiple pass recall method include the reduction of bias, provision of accurate estimates of food intake at the population level, and capture of preparation methods. It is also known for not putting a burden on the memory, not affecting food choices, and not relying on the participant’s literacy level [7,20,21].

Quality assurance was conducted on a continuous basis to reduce the risk of reporting bias and to increase the accuracy of the data. Completed questionnaires were checked daily to ensure high quality of data upon return from the field. Identification of data errors was discussed with the enumerators within one or two days for corrections and missing data were flagged for justification. Measures were employed to improve the quality of data collection; for instance, follow-up sessions were conducted on a regular basis to reinforce the training and maintain the quality of measurements among all enumerators.

2.9. Ethical approvals

Ethical approvals were granted by the Institutional Review Board (IRB) of the Freiburger Independent Ethics Committee (FEKI) in Germany (FEKI code: 017/1434) on June 12, 2017, and by the Institutional Review Board for Social and Behavioral Studies at the American University of Beirut in Lebanon (IRB ID: SBS-2017-0294) on June 14, 2018. An approval letter for the research project was issued on December 11, 2017, by the Primary Health Care Department of the Ministry of Public Health in Lebanon granting the permission to access primary healthcare centers in Greater Beirut which are part of the National Primary Healthcare Network overseen by the Ministry of Public Health, Lebanon. Approval letters were granted by the directors of primary healthcare centers prior to accessing their premises and initiation of data collection. Measures were taken to keep the collected data strictly confidential, including the assignment of random identifiers to participants, the use of codes instead of names in the transcription of audio recordings, and granting access to the collected data only to the investigators.

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Chapter 3

Anemia and Nutritional Status of Syrian Refugee Mothers and Their Children under Five Years in Greater Beirut, Lebanon

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Article

Anemia and Nutritional Status of Syrian Refugee Mothers and Their Children under Five Years in Greater Beirut, Lebanon

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Abstract: The objective was to assess the prevalence of anemia and nutritional status of mothers and children under five years among Syrian refugees in Lebanon and to identify nutritional deficiencies among pregnant, lactating, and non-pregnant non-lactating (NPNLM) mothers. A cross-sectional study was conducted among Syrian refugee mothers with children under five years in Greater Beirut, Lebanon ($n = 433$). Data on socio-economic status, maternal health, lifestyle characteristics, dietary intake, anthropometric measurements, and hemoglobin concentrations were collected. The prevalence of anemia was 21.7% among mothers and 30.5% among children. NPNLM with overweight/obesity and an at-risk waist circumference (WC) had 14.7-times and 10.9-times higher odds of anemia than mothers with normal WC and weight. Children of anemic mothers had 2.7-times and 4.4-times higher odds of total and mild anemia than those of non-anemic. Higher odds of mild anemia were found among children of lactating mothers than of NPNLM. A high percent energy intake of total fat and sugar was found among all mothers. Nutritional inadequacy was identified in higher proportions of lactating and pregnant mothers than NPNLM. Our findings highlighted the co-existence of overnutrition and anemia among Syrian refugee mothers and undernutrition among children from the same household. Culture-specific interventions are needed to support maternal nutrition, to ensure the health and wellbeing of their offspring.

Keywords: anemia; obesity; maternal nutrition; nutritional inadequacy; pregnancy; lactation; children under five years; Syrian refugees; Lebanon



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1. Introduction

The burden of malnutrition remains a worldwide challenge [1]. Globally, nearly two billion adults are estimated to be overweight or obese and more than 140 million children to be stunted [1,2]. According to the World Health Organization (WHO), over half a billion women of reproductive age and 269 million children under five years suffer from anemia [3]. The coexistence of undernutrition (wasting, underweight, stunting, and micronutrient deficiencies), overnutrition (overweight and obesity), and non-communicable diseases within populations, households, and even individuals characterizes the double burden of malnutrition, mostly affecting low- and middle-income countries [4]. Poor economic development and rapid nutrition transition are exposing a growing proportion of the population to unhealthy environmental stressors and health consequences in low- and middle-income countries. Malnutrition in early life has long-lasting effects, such as chronic inflammation, dysbiosis, obesity, non-communicable diseases, stunting, and birth complications [5].

Maternal nutritional status at the time of conception and during pregnancy as well as early nutrition during the first two years of life determine to a great extent the health of

the offspring, influencing more than a generation through intergenerational cycles [6–8]. Optimum maternal and child nutrition during the first 1000 days of life is crucial for brain development and for the prevention of chronic diseases and obesity at later stages of life [7,9,10]. Maternal malnutrition and micronutrient deficiencies may lead to permanent consequences on nutritional programming that can influence children's growth, development, and survival [6,8,10]. Inadequate quantity and quality of nutrients in the maternal diet can expose women and children to various forms of malnutrition and to increased vulnerability to infections and deficiencies, especially anemia [5,7,10]. Serious health consequences may affect pregnant women and their offspring as a result of anemia, including prematurity, low birth weight, poor health and development, and reduced work productivity [11–13].

In the Middle East and North Africa region, food security is deteriorating rapidly, primarily driven by conflicts and political instability [14]. Poverty and food insecurity lead to both undernutrition and overnutrition concomitantly [15]. The Eastern Mediterranean Region has been witnessing rapid changes in food consumption habits coupled with a high burden of micronutrient deficiencies, increasing obesity rates, and a persistent burden of undernutrition. Women and girls are particularly prone to various forms of malnutrition in this region [16–18].

Syria has witnessed the longest and most intense conflict of the *Arab Awakening* resulting in the largest refugee crisis globally, exceeding 6.7 million by the end of 2018. It is estimated that more than 1.5 million Syrian displaced people live in Lebanon with nearly one million who were registered as refugees with the UN High Commission on Refugees (UNHCR) by November 2018, of whom more than half are women and children [19,20]. Lebanon continues to host the highest per capita concentration of refugees worldwide; one out of four people in Lebanon is a displaced person from Syria [21,22]. The conflict in Syria has exacerbated pre-existing development constraints and political instability in Lebanon, in response Syrian refugees have become even more vulnerable. Despite extensive humanitarian assistance, UN reports showed that more than half of Syrian refugee households were still unable to meet survival needs of food, health, and shelter; and one-third remained moderately to severely food insecure in 2018 [23].

Even though numerous assessments were conducted by international and national non-governmental organizations (NGOs) on Syrian refugees in Lebanon, there are limited studies measuring the prevalence of anemia and examining the nutritional status of refugees following a humanitarian crisis. Findings were relevant to the undernutrition and anemia status of children and women among Syrian refugees in Lebanon, yet overnutrition and nutritional inadequacies were overlooked [24,25]. Therefore, the objectives of this study were to (1) assess the prevalence of anemia and the nutritional status of Syrian refugee mothers and children under five years, (2) examine the dietary intake of pregnant, lactating, and non-pregnant non-lactating mothers of children below five years of age, and (3) examine associations between anemia, nutritional status, and socio-economic characteristics among Syrian refugee mothers living in Greater Beirut, Lebanon.

2. Materials and Methods

2.1. Study Design and Sampling Method

A cross-sectional survey was conducted among mothers and one of their children below five years in the Greater Beirut area in Lebanon. Mother–child dyads were recruited through the Primary Health Care Centers (PHCC), which are part of the National Primary Health Care (PHC) Network overseen by the Ministry of Public Health (MoPH), in 6 vulnerable localities of Greater Beirut, between July and September 2018. A two-step purposeful sampling was used to select recruitment sites located in the most vulnerable areas of Greater Beirut. The catchment area of PHCC located in Greater Beirut encompasses the urban agglomeration of the capital city of Beirut and adjacent districts of Mount Lebanon Governorate. Greater Beirut is the melting pot of the country as its inhabitants consist of more than half of the Lebanese population and over 305,000 refugees [22,26]. The districts

were selected according to the highest vulnerability level of localities [27]. The survey areas included in this project are as follows: Baouchriyeh, Bourj Barajneh, Bourj Hammoud, Chiyah, Mazraa, and Mousaytbeh. The identification of PHCC and access to recruitment sites were carried out with the support of the Primary Health Care Department of the MoPH in Lebanon. Selected PHCC from these areas were approached with the approval letter from the MoPH.

Previous estimates of the anemia prevalence among Syrian refugee women (26.1%) and children under five in Lebanon (21.0%) were used for the calculations of the sample size [25]. Based on the highest prevalence found among women, a required sample of 296 mothers was estimated at a 95% confidence interval (95% CI) with a 5% margin of error. The sample size was adjusted with an estimated design effect of 1.5 for the sampling design ($N = 444$). Considering an estimated non-response rate of 15% and a dropout rate of 10%, a total of 555 mother–child dyads were targeted for the survey. Inclusion criteria for women of reproductive age to participate in this study were: (1) to hold the Syrian nationality, (2) to be between 15 and 49 years old, (3) to have a child aged between 0 and 59 months, (4) for the child to hold the Syrian nationality, and (5) for the child not to suffer from any inborn errors of metabolism or physical malformations. A convenience sample was used to recruit all eligible mothers at the selected centers. When multiple children under five years were eligible within one family, one child was selected randomly. Figure 1 represents the flowchart of the subjects' recruitment into the survey depicting a non-response rate of 17.1% and a dropout rate of 11.4%. Of the completed interviews, all Syrian pregnant, lactating, and non-pregnant non-lactating mothers with one child below the age of five years were selected for this study ($N = 433$).

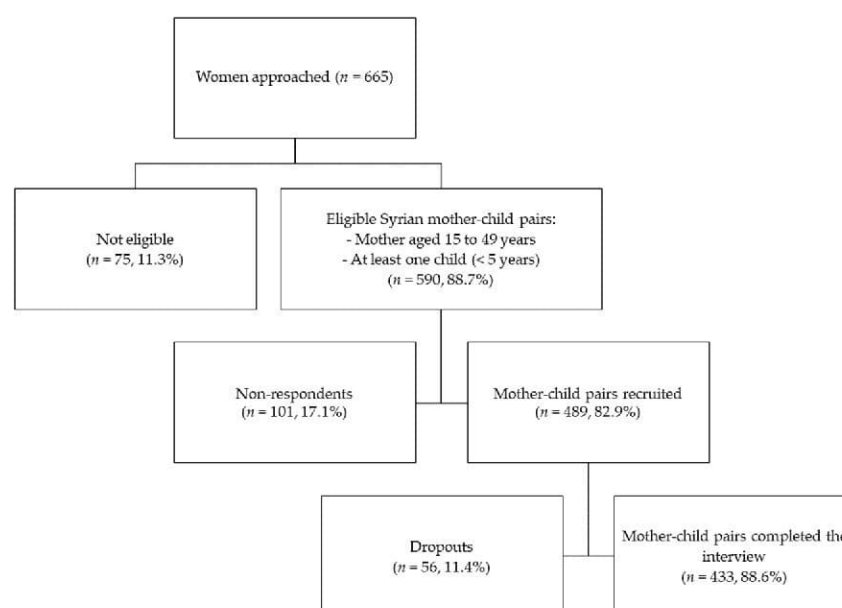


Figure 1. Flowchart of the recruitment subjects in the survey.

2.2. Recruitment Strategy

The recruitment strategy included identifying mothers of children under five years through three approaches: (1) via the assistance of nurses at PHCC, (2) by direct approach from the research assistant in the waiting rooms, or (3) by posting flyers with a short description of the survey in the PHCC premises. The first approach occurred through the nurse or staff who has an established relationship with the mother. The second strategy was deemed necessary given that nurses could be overwhelmed with responsibilities and may not be able to approach and invite mothers to the survey on a regular basis. The third strategy allowed participants to reach out, if interested. Using a developed oral script, nurses and research assistants briefed the potential participant on the content of the survey,

checked for the mother and child's eligibility criteria, and obtained the mother's informed written consent.

2.3. Data Collection

Face-to-face interviews took place in a private setting at the PHCC premises by Collaborative Institutional Training Initiative (CITI) certified and trained research assistants using a culture-specific multi-component questionnaire. Research assistants underwent an intensive and vigorous one-week training prior to the initiation of field work. This was necessary to obtain a nonjudgmental and neutral attitude, decrease potential social desirability bias, and minimize intra-observer measurement errors. Follow-up training sessions were conducted on a regular basis to maintain the quality of measurements among all enumerators. Data quality control, as well as random cross-checks during data entry, were conducted on questionnaires on a continuous basis, to reduce the risk of reporting bias and to increase the accuracy of the data. Information was collected on characteristics of the household, socio-economic status, maternal lifestyle, and health status. Household monthly income was classified as either being $\leq 750,000$ Lebanese Pounds (LBP) or $> 750,000$ LBP, which was the equivalent of 500 US dollars (USD) at the time of data collection. This classification was based on the legal minimum wage in Lebanon, approximately 675,000 LBP (equivalent to 450 USD in 2018) [27]. The crowding index was used as a proxy measure for the socio-economic status. It was computed as the total number of co-residents per household divided by the number of rooms excluding kitchens, bathrooms, hallways, balconies, and garage according to the American Crowding Index definition [28]. The International Physical Activity Questionnaire Short Form (IPAQ-SF) was used to measure physical activity levels [29].

2.4. Anthropometric Assessment

Anthropometric measurements were taken by trained research assistants using standardized protocols [30,31] and calibrated equipment. An average of two measurements was recorded to the nearest decimal. Height and weight were measured using a portable mechanical stadiometer (SECA 213) and electronic 2-in-1 weighing scale (SECA 876) with light clothing and bare feet or stockings. Measuring mats (SECA 417) were used to measure the length for children under two years. Mid-upper arm, waist, and hip circumferences were measured for mothers with light clothing using a non-elastic measuring tape (SECA 201). For all mothers, including pregnant mothers, the mid-upper arm circumference (MUAC) score was defined as: < 23.0 cm (underweight), 23.0 – 27.9 cm (normal weight), 28.0 – 30.9 cm (overweight), and ≥ 31.0 cm (obese) [32–35]. Pre-pregnancy weight was not collected from pregnant mothers. For non-pregnant mothers, the nutritional status was evaluated using three indicators: body mass index (BMI), waist circumference (WC), and waist-hip ratio (WHR) as per the WHO classifications. BMI was calculated as the ratio of weight (kg) to height squared (m^2). Nutritional status was defined as: underweight ($\text{BMI} < 18.5 \text{ kg/m}^2$), normal weight ($\text{BMI} 18.5$ – 24.9 kg/m^2), overweight ($\text{BMI} 25.0$ – 29.9 kg/m^2), and obese ($\text{BMI} \geq 30.0 \text{ kg/m}^2$) [36]. WHR was computed as the ratio of waist circumference by hip circumference. The cut-off points of $\text{WC} > 80$ cm and $\text{WHR} \geq 0.85$ cm were used to identify “at-risk WC” and “substantially increased risk WHR”, respectively [37]. WC and WHR were used as an indication of increased risk of metabolic complications and abdominal obesity among mothers. For children, the nutritional status was defined using the WHO child growth standards. Length/Height-for-age Z-scores (HAZ) were used to classify children as stunted ($\text{HAZ} < -2$) and not stunted ($\text{HAZ} \geq -2$). Weight-for-age Z-scores (WAZ) were used to classify children as underweight ($\text{WAZ} < -2$) and not underweight ($\text{WAZ} \geq -2$). Weight-for-length/height Z-scores (WHZ) were used to classify children as wasted ($\text{WHZ} < -2$) and not wasted ($\text{WHZ} \geq -2$). BMI-for-age Z-scores (BAZ) were used to classify children as wasted ($\text{BAZ} < -2$), normal weight ($-2 \leq \text{BAZ} \leq 2$), and overweight or obese ($\text{BAZ} > +2$) [38]. The WHO Anthro Survey Analyzer was used to derive the z-scores [39].

2.5. Biochemical Assessment

Members of the research team underwent training on proper micro-technique blood collection for pediatrics and adults in order to measure hemoglobin concentrations (Hb) using the “HemoCue Hb301 System”. Control solutions were routinely used to ensure the accuracy of the measurement. Trained research team members conducted a finger prick on mothers and children (6–59 months) and a heel prick on infants (0–5 months) to collect a small drop of blood. The WHO cut-offs at sea level for determining total anemia were used for lactating and non-pregnant non-lactating mothers as Hb < 12.0 g/dL, and for pregnant mothers and children aged 6 to 59 months as Hb < 11.0 g/dL. Anemia was further classified as mild, moderate, and severe for non-pregnant mothers (11.0–11.9 g/dL, 8.0–10.9 g/dL, and <8.0 g/dL, respectively) and for pregnant mothers and children (6–59 months) (10.0–10.9 g/dL, 7.0–9.9 g/dL, and <7.0 g/dL, respectively) [40]. For infants aged zero to five months, total anemia was defined as Hb < 10.5g/dL, according to Marques et al. (2014) [41] and given the lack of WHO criteria for classifying the severity of anemia for this age group [40].

2.6. Dietary Assessment

Trained nutritionists within the research team collected data on dietary intake and daily meal patterns. The 2D food portion visuals [42] and standardized reference portions were used to facilitate and standardize the collection of the dietary data. The dietary intake of the mother was measured using the quantitative multiple-pass 24-h dietary recall method. The five-step multiple-pass method starts with the quick uninterrupted listing of foods by the interviewee, proceeds to probing for forgotten foods list and collecting the time and occasion, then a comprehensive description of foods and amounts eaten is gathered in the detailed cycle, and ends with a final probe review [43,44]. Dietary data from the 24-h recalls were analyzed with the NutriSurvey 2007 using the United States Department of Agriculture (USDA) database (SR 28, version: May 2016) [45]. Local single food items were added to the database from local food composition tables [46]. Standardized recipes were used to analyze composite and traditional dishes.

Dietary intake of the mothers was compared to the Dietary Reference Intakes (DRIs) for energy and nutrients, as recommended by the Institute of Medicine. DRIs refer to the Recommended Dietary Allowances (RDAs), Adequate Intakes (AIs), and Acceptable Macronutrient Distribution Ranges (AMDRs) for energy, macro- and micronutrients [47,48]. Intakes of monounsaturated fatty acids (MUFA), polyunsaturated fatty acids (PUFA), saturated fatty acids (SFA), and trans-fatty acids (TFA) were analyzed based on the FAO recommendations [49]. Cholesterol intake was assessed based on the criteria established by the National Institutes of Health [50]. The reference intake of total sugar was based on the WHO recommendation [51]. Appendix A displays the DRIs for macro- and micronutrients (Table A1) according to their reproductive status. Macronutrients' intakes were expressed as percent total energy intake (%EI). In addition, the average energy and key macro- and micronutrient intakes were analyzed for mothers, according to their reproductive status. The nutritional inadequacy represents the proportion of mothers not meeting 2/3rd of the RDA or AI for key macro- and micronutrient according to their age group and reproductive status.

2.7. Statistical Analysis

Data were entered using Kobo Technology provided by Harvard Humanitarian Institute [52]. Data analysis was carried out using the Statistical Package for Social Sciences, version 27.0 (SPSS Inc., Chicago, IL, USA). Descriptive statistics were performed for continuous and categorical variables. The number of subjects and percentages (*n*, %) represented nominal variables, whereas mean and standard deviation (mean ± SD) were used to represent continuous variables. The reproductive status of the mother was defined as pregnant mothers (PM), non-pregnant lactating mothers (LM), and non-pregnant non-lactating (NPNLM) mothers. Associations were investigated between the reproductive

status of the mother and socio-economic and maternal health and lifestyle characteristics, nutritional status of mother and children as well as daily meal patterns of mothers using chi-square analysis for categorical variables and one-way ANOVA test to compare means across groups. Simple and multiple multinomial logistic regressions were used to examine associations of the mother's reproductive status (dependent variable) with socio-economic and maternal health characteristics, anemia and nutritional status of mothers and children. Logistic regressions were also used to examine the association between maternal anemia (dependent variable) and the nutritional status of mothers and children. Results from the logistic regressions were expressed as OR for crude odds ratios and aOR for adjusted odds ratios with a 95% confidence interval. The significance of each regression model was evaluated using R-squared, the overall percentage, and Hosmer and Lemeshow test. Multicollinearity was measured between all the independent variables within regression models using correlation coefficients, tolerance, variance inflation factors (VIF), and the condition index. Statistical significance was defined as p -value < 0.05 . Associations close to statistical significance were also reported to improve the interpretation of results [53,54].

3. Results

Nearly half of the study sample consisted of LM (47.1%) followed by NPNLM (35.1%) and PM (17.8%). The mean age of mothers was 27.4 years (± 5.9) and of children 16.8 months (± 14.3). On average, NPNLM were significantly older and LM had the youngest children. The majority of mothers in the study sample were married (98.8%), housewives with no paid job (97.2%) and nearly half of the fathers had no job or a part-time job (48.7%). More than half of the parents had completed primary or intermediate school (mothers: 58.1%; fathers: 68.4%), while 16% were found to be illiterate. Two-thirds of the households (65.5%) had a monthly income below or equal to 750,000 LBP, approximately equal to the legal minimum wage in Lebanon. The majority of the mothers were registered as refugees with the UNHCR (82.1%), of which only 8.9% received food assistance (e-vouchers) from the World Food Programme (WFP). One mother reported receiving food assistance from another source while she was not registered with the UNHCR. Overall, 13.5% of all mothers reported receiving cash or food assistance from the UNHCR or other sources. About half of the respondents lived in nuclear and extended families (52.7% and 47.3%, respectively). A high proportion of households had the father or family-in-law as head of the family (96.2%); in contrast, only 3.8% were headed by the mother or both parents. A mean crowding index score of 3.7 (± 1.6) and a mean of three children under five years per household (2.7 ± 1.5) were recorded in our study sample. A significantly higher proportion of PM had one to two children under five years old as compared to LM and NPNLM (Table 1).

Healthcare service utilization and maternal health characteristics are shown in Table 2. Most mothers were uninsured (93.7%) and about two-thirds of them usually visited public healthcare facilities (69.4%). Overall, 62.1% of the mothers had at least four antenatal care (ANC) visits while 16.6% of the mothers had zero ANC visits during their pregnancy with the child participating in the study. However, PM had the highest proportion of zero ANC visits than LM and NPNLM (21.1%, 16.1%, 15.1%, respectively). A small proportion of the mothers received health and nutrition messages from healthcare professionals exclusively (13.9%) or multiple sources (22.9%), while the majority relied mainly on family, friends, and/or a media platform (63.2%).

In addition, self-reported previous diagnosis of anemia was highest among PM, who also suffered from higher incidences of flu as compared to other mothers ($p < 0.05$). Thirty percent of the mothers reported using nutritional supplements, of which the majority were PM (62.3%) followed by LM (27.1%) and NPNLM (17.8%). The most consumed supplements were iron and iron-folic acid (65.9%). Vitamin D was significantly more consumed by NPNLM as compared to LM and PM ($p < 0.001$). The reported compliance rate to the use of micronutrient supplements was overall high (80.2%), with the highest being among PM (89.3%).

Table 1. Socio-economic and household characteristics by the reproductive status of Syrian refugee mothers.

Variables ^a	PM <i>n</i> = 77	LM <i>n</i> = 204	NPNLM <i>n</i> = 152	Total ^b <i>n</i> = 433	<i>p</i> -Value ^c
Socio-economic characteristics					
Age of the mothers (years)	27.0 ± 5.2	26.7 ± 5.8	28.7 ± 6.1	27.4 ± 5.9	
<25 years	32 (41.6)	90 (44.1)	48 (31.8)	170 (39.4)	0.005 0.013
25 to 29 years	18 (23.4)	59 (28.9)	41 (27.2)	118 (27.3)	
30 to 34 years	22 (28.6)	39 (19.1)	35 (23.2)	96 (22.2)	
≥35 years	5 (6.5)	16 (7.8)	27 (17.9)	48 (11.1)	
Age of the children (months)	23.0 ± 13.0	7.6 ± 6.3	25.9 ± 15.1	16.7 ± 14.3	
<6 months	4 (5.2)	100 (49.0)	10 (6.6)	114 (26.3)	<0.001 <0.001
6 to 23 months	41 (53.2)	99 (48.5)	75 (49.3)	215 (49.7)	
24 to 59 months	32 (41.6)	5 (2.5)	67 (44.1)	104 (24.0)	
Child's sex					
Male	35 (46.1)	107 (52.5)	85 (55.9)	227 (52.5)	0.372
Female	41 (53.9)	97 (47.5)	67 (44.1)	205 (47.5)	
Marital status of the mother					
Engaged/ Divorced/Widowed	1 (1.3)	2 (1.0)	2 (1.3)	5 (1.2)	0.948
Married	75 (98.7)	202 (99.0)	150 (98.7)	427 (98.8)	
Mother's education level					
No schooling/Illiterate	9 (11.7)	35 (17.2)	26 (17.4)	70 (16.3)	0.519
Primary, Intermediate school	44 (57.1)	122 (60.1)	83 (55.7)	249 (58.1)	
Secondary school and higher	24 (31.2)	46 (22.7)	40 (26.8)	110 (25.6)	
Father's education level					
No schooling/Illiterate	10 (13.0)	30 (14.9)	31 (20.4)	71 (16.5)	0.401
Primary, Intermediate school	52 (67.5)	140 (69.7)	102 (67.1)	294 (68.4)	
Secondary school and higher	15 (19.5)	31 (15.4)	19 (12.5)	65 (15.1)	
Mother's employment status					
No paid job/Housewife	75 (97.4)	192 (97.0)	147 (97.4)	414 (97.2)	0.969
Paid job (daily/part-/full-time)	2 (2.6)	6 (3.0)	4 (2.6)	12 (2.8)	
Father's employment status					
No job/Part-time job	39 (52.7)	91 (46.4)	73 (49.7)	203 (48.7)	0.627
Full-time job/ Self-employed	35 (47.3)	105 (53.6)	74 (50.3)	214 (51.3)	
Monthly household income					
≤750,000 LBP	51 (71.8)	123 (63.7)	95 (64.6)	269 (65.5)	0.455
>750,000 LBP	20 (28.2)	70 (36.3)	52 (35.4)	142 (34.5)	
Length of stay in Lebanon (years)	3.2 ± 1.9	4.0 ± 3.8	4.0 ± 2.2	3.8 ± 3.0	0.130
UNHCR refugee registration status					
No	18 (23.7)	35 (17.4)	23 (15.5)	76 (17.9)	0.313
Yes	58 (76.3)	166 (82.6)	125 (84.5)	349 (82.1)	
If yes, received WFP food assistance (e-vouchers) *					
No	53 (91.4)	151 (91.5)	112 (90.3)	316 (91.1)	0.784
Yes	5 (8.6)	14 (8.5)	12 (9.7)	31 (8.9)	
Receipt of any cash or food assistance					
No assistance	68 (88.3)	180 (88.7)	125 (82.8)	373 (86.5)	0.243
Any type of assistance	9 (11.7)	23 (11.3)	26 (17.2)	58 (13.5)	
Reliance on savings or subsidies					
No reliance	76 (98.7)	192 (94.6)	147 (96.7)	415 (96.1)	0.251
Any type of savings/subsidies	1 (1.3)	11 (5.4)	5 (3.3)	17 (3.9)	
Perception of safety					
Very to reasonably safe	60 (77.9)	151 (75.1)	95 (62.5)	306 (71.2)	0.012
Somewhat to very unsafe	17 (22.1)	50 (24.9)	57 (37.5)	124 (28.8)	

Table 1. Cont.

Variables ^a	PM <i>n</i> = 77	LM <i>n</i> = 204	NPNLM <i>n</i> = 152	Total ^b <i>n</i> = 433	<i>p</i> -Value ^c
Household characteristics					
Household type					
Nuclear family	37 (48.1)	102 (50.0)	89 (58.6)	228 (52.7)	0.187
Extended family	40 (51.9)	102 (50.0)	63 (41.4)	205 (47.3)	
Decision-making/Head of household					
Father/ Family-in-law	75 (97.4)	194 (97.5)	141 (94.0)	410 (96.2)	0.199
Mother/ Both parents	2 (2.6)	2 (2.5)	9 (6.0)	16 (3.8)	
Crowding index score	4.0 ±2.0	3.6 ±1.6	3.7 ±1.5	3.7 ±1.6	0.189
Number of children < 5 years per household	2.4 ±1.8	2.7 ±1.5	2.8 ±1.5	2.7 ±1.5	
1 to 2	53 (68.8)	104 (51.2)	75 (49.7)	232 (53.8)	0.327
3 to 4	14 (18.2)	76 (37.4)	54 (35.8)	144 (33.4)	
≥5	10 (13.0)	23 (11.3)	22 (14.6)	55 (12.8)	

PM: Pregnant mothers; LM: Lactating mothers; NPNLM: Non-pregnant non-lactating mothers; ^a Categorical variables are expressed as *n*(%) and continuous variables are expressed as mean ± SD. ^b Lack of corresponding sum of frequencies with total sample size is due to missing data. ^c Significantly different at *p*-value < 0.05 (in bold); *p*-value was derived using one-way ANOVA test for continuous variables and chi-square analysis for categorical variables. * One mother reported receiving food assistance from another source and was not registered with the UNHCR.

As for daily meal patterns (Table 3), a significantly lower proportion of NPNLM had a daily breakfast as compared to PM and LM. On the other hand, LM consumed on average a significantly higher number of main meals per day as compared to the other groups of mothers. Coffee and tea consumption were higher during a meal versus between meals among mothers. It was also seen that more LM consumed coffee and tea during a meal compared to the other mothers. A significantly higher proportion of LM had a low-intensity physical activity level, while NPNLM had more high-intensity activity level and higher rates of smoking compared to LM and PM.

The prevalence of anemia among mothers was 21.7%, with 15.4% being mild and 6.3% moderate cases (Table 4). Children aged zero to 59 months showed a higher prevalence of anemia (30.5%), with 24.2% being mild and 9.8% moderate cases. Severe anemia was not detected among both mothers and children. The highest prevalence of total anemia among mothers was observed with NPNLM (26.5%), followed by LM (19.4%) and PM (18.2%). Mild anemia was found the highest among NPNLM (18.5%) and moderate anemia among PM (10.4%). In contrast, the highest prevalence of anemia among children aged zero to 59 months was observed in households of LM (35.6%), followed by NPNLM (27.8%) and PM (22.1%). In addition, mild and moderate anemia among children aged 6 to 59 months were highest among children of LM (37.5% and 12.5%, respectively) as compared to children of PM and NPNLM. A significant association between the reproductive status and the classification of anemia among mothers and children was found, but not with total anemia. As for the nutritional status, overweight and obesity rates were found to be high according to the BMI of non-pregnant mothers (31.2% and 29.5%, respectively) and the MUAC classification among all mothers (26.9% and 34.6%, respectively). In addition, nearly two out of three non-pregnant mothers were found to have an at-risk waist circumference (65.2%). Yet, 9.0% of their children were found to be stunted (HAZ < −2), 4.4% underweight (WAZ < −2), 5.1% wasted (WHZ < −2), and 4.4% overweight or obese (BAZ > +2).

Further analysis showed that moderate- and high-intensity activity levels of mothers were significantly associated with the age of the mother and child and having more children under the age of five years (*p* < 0.05). No association was found between overweight and obesity and their physical activity levels (data not shown).

Table 2. Healthcare service utilization and health characteristics by the reproductive status of Syrian refugee mothers.

Variables ^a	PM <i>n</i> = 77	LM <i>n</i> = 204	NPNLM <i>n</i> = 152	Total ^b <i>n</i> = 433	<i>p</i> -Value ^c
Healthcare service utilization					
Health insurance					
Uninsured	70 (92.1)	190 (93.6)	143 (94.7)	403 (93.7)	0.493
Public insurance	2 (2.6)	3 (1.5)	0 (0.0)	5 (1.2)	
Other	4 (5.3)	10 (4.9)	8 (5.3)	22 (5.1)	
Type of healthcare usually sought					
Public healthcare only	51 (66.2)	147 (73.1)	99 (66.0)	297 (69.4)	0.287
Public, private, and/or other healthcare	26 (33.8)	54 (26.9)	51 (34.0)	131 (30.6)	
Number of antenatal care visits					
0 times	16 (21.1)	32 (16.1)	23 (15.1)	71 (16.6)	0.699
1 to 3 times	17 (22.4)	40 (20.1)	34 (22.4)	91 (21.3)	
≥4 times	43 (56.6)	127 (63.8)	95 (62.5)	265 (62.1)	
Sources of health and nutrition messages					
Healthcare professionals exclusively ^d	13 (16.9)	30 (14.7)	17 (11.3)	60 (13.9)	0.538
Family, friends, media, and/or other	51 (66.2)	126 (61.8)	96 (63.6)	273 (63.2)	
Multiple sources ^e	13 (16.9)	48 (23.5)	38 (25.2)	99 (22.9)	
Maternal health characteristics					
Self-reported previous diagnosis with anemia					
No	16 (21.1)	66 (32.8)	57 (37.7)	139 (32.5)	0.040
Yes	60 (78.9)	135 (67.2)	94 (62.3)	289 (67.5)	
Suffering from a flu (self-reported)					
No	66 (88.0)	178 (88.6)	145 (96.0)	389 (91.1)	0.030
Yes	9 (12.0)	23 (11.4)	6 (4.0)	38 (8.9)	
Suffering from symptoms ^f					
No	10 (13.0)	29 (14.3)	16 (10.8)	55 (12.9)	0.438
1 to 2 symptoms	24 (31.2)	77 (37.9)	47 (31.8)	148 (34.6)	
≥3 symptoms	43 (55.8)	97 (47.8)	85 (57.4)	225 (52.6)	
Health problems during previous pregnancy ^g					
No health problem	45 (58.4)	100 (49.5)	86 (57.0)	231 (53.7)	0.537
1 health problem	26 (33.8)	82 (40.6)	50 (33.1)	158 (36.7)	
≥2 health problems	6 (7.8)	20 (9.9)	15 (9.9)	41 (9.5)	
Mother's use of micronutrient supplements					
No	29 (37.7)	145 (72.9)	125 (82.2)	299 (69.9)	<0.001
Yes	48 (62.3)	54 (27.1)	27 (17.8)	129 (30.1)	
If yes, what kind of supplement?					
Iron/Iron-folic acid	33 (68.8)	32 (62.7)	18 (66.7)	83 (65.9)	0.816
Multivitamins	14 (29.2)	8 (15.7)	8 (29.6)	30 (23.8)	0.210
Calcium	9 (18.8)	15 (29.4)	2 (7.4)	26 (20.6)	0.068
Vitamin D	1 (2.1)	3 (5.9)	6 (22.2)	10 (7.9)	0.006
Other	6 (12.5)	4 (7.8)	3 (11.1)	13 (10.3)	0.234
If yes, in what frequency?					
Not compliant	3 (10.7)	11 (25.6)	3 (20.0)	17 (19.8)	0.307
Weekly or daily	25 (89.3)	32 (74.4)	12 (80.0)	69 (80.2)	

PM: Pregnant mothers; LM: Lactating mothers; NPNLM: Non-pregnant non-lactating mothers; ^a Categorical variables are expressed as *n*(%). ^b Lack of corresponding sum of frequencies with total sample size is due to missing data. ^c Significantly different at *p*-value < 0.05 (in bold); *p*-value was derived chi-square analysis for categorical variables. ^d Healthcare professionals included physicians, nurses, dietitians, and pharmacists. ^e Multiple sources include family, friends, media, other, and healthcare professionals. ^f Symptoms: headache (59.3%), fatigue (58.4%), dizziness (45.8%), loss of appetite (32.0%), insomnia (31.8%), shortness of breath (26.9%), difficulty concentrating (29.2%), pale skin (15.9%). ^g Health problems: anemia (23.5%), hypertension (10.5%), hemorrhage (5.6%), diabetes (3.0%), other problems (14.2%).

Table 3. Maternal lifestyle characteristics by the reproductive status of Syrian refugee mothers.

Variables ^a	PM <i>n</i> = 77	LM <i>n</i> = 204	NPNLM <i>n</i> = 152	Total ^b <i>n</i> = 433	<i>p</i> -Value ^c
Maternal daily meal pattern					
Have breakfast every day					0.022
No	20 (26.0)	51 (25.2)	57 (38.3)	128 (29.9)	
Yes	57 (74.0)	151 (74.8)	92 (61.7)	300 (70.1)	
Main meals per day	2.1 ± 0.6	2.2 ± 0.6	2.0 ± 0.6	2.1 ± 0.6	0.018
Snacks per day	1.5 ± 1.1	1.3 ± 1.0	1.2 ± 1.0	1.3 ± 1.0	0.155
Drinks coffee/tea between meals ^d					0.065
No	55 (72.4)	118 (59.3)	84 (56.8)	257 (60.8)	
Yes	21 (27.6)	81 (40.7)	64 (43.2)	166 (39.2)	
Drinks coffee/tea during a meal ^e					0.122
No	33 (43.4)	75 (37.7)	72 (48.6)	180 (42.6)	
Yes	43 (56.6)	124 (62.3)	76 (51.4)	243 (57.3)	
Lifestyle characteristics					
Physical activity ^f					0.033
Low-intensity activity	27 (35.1)	85 (41.7)	40 (26.3)	152 (35.1)	
Moderate-intensity activity	21 (27.3)	56 (27.5)	44 (28.9)	121 (27.9)	
High-intensity activity	29 (37.7)	63 (30.9)	68 (44.7)	160 (37.0)	
Currently smoking cigarettes or shisha					0.001
No	68 (88.3)	171 (83.8)	105 (70.5)	344 (80.0)	
Yes	9 (11.7)	33 (16.2)	44 (29.5)	86 (20.0)	
Currently drinking any type of alcohol					0.260
No	77 (100.0)	194 (96.5)	144 (97.3)	415 (97.4)	
Yes	0 (0.0)	7 (3.5)	4 (2.7)	11 (2.6)	

PM: regnant mothers; LM: Lactating mothers; NPNLM: Non-pregnant non-lactating mothers; ^a Categorical variables are expressed as *n* (%) and continuous variables are expressed as mean ± SD. ^b Lack of corresponding sum of frequencies with total sample size is due to missing data. ^c Significantly different at *p*-value < 0.05 (in bold); *p*-value was derived chi-square analysis for categorical variables. ^d Between meals is defined as two hours before or after a meal. ^e During the course of a meal is defined as during or one hour before or after a meal. ^f Physical activity was measured using the IPAQ short form. Low-intensity was based on no reported activity or some activity not enough to meet the moderate- or high-intensity. Moderate-intensity was calculated as five or more days of any combination of walking, moderate- or vigorous-intensity activities achieving a minimum of at least 600 MET-minutes/week. High-intensity was calculated as seven or more days of any combination of walking, moderate- or vigorous-intensity activities accumulating at least 3000 MET-minutes/week [29].

Table 4. Anemia and nutritional status of Syrian refugee mothers and their children by the reproductive status.

Variables ^a	PM <i>n</i> = 77	LM <i>n</i> = 204	NPNLM <i>n</i> = 152	Total ^b <i>n</i> = 433	<i>p</i> -Value ^c
Anemia among mothers					
Hemoglobin concentration (g/dL)	11.8 ± 1.3	12.9 ± 1.1	12.7 ± 1.3	12.6 ± 1.3	<0.001
Total anemia ^d					
Not anemic	63 (81.8)	162 (80.6)	111 (73.5)	336 (78.3)	0.199
Anemic	14 (18.2)	39 (19.4)	40 (26.5)	93 (21.7)	
Classification of anemia ^e					
Not anemic	63 (81.8)	162 (80.6)	111 (73.5)	336 (78.3)	0.043
Mild anemia	6 (7.8)	32 (15.9)	28 (18.5)	66 (15.4)	
Moderate anemia	8 (10.4)	7 (3.5)	12 (7.9)	27 (6.3)	
Anemia among children					
Hemoglobin concentration (g/dL)	11.7 ± 1.3	11.3 ± 1.2	11.6 ± 1.2	11.4 ± 1.3	0.008
Total anemia (0–59 months) ^d					
Not anemic	60 (77.9)	130 (64.4)	109 (72.2)	299 (69.5)	0.060
Anemic	17 (22.1)	72 (35.6)	42 (27.8)	131 (30.5)	

Table 4. Cont.

Variables ^a	PM <i>n</i> = 77	LM <i>n</i> = 204	NPNLM <i>n</i> = 152	Total ^b <i>n</i> = 433	<i>p</i> -Value ^c
Classification of anemia (6–59 months; <i>n</i> = 318) ^e					
Not anemic	57 (78.1)	52 (50.0)	101 (71.6)	210 (66.0)	0.001
Mild anemia	10 (13.7)	39 (37.5)	28 (19.9)	77 (24.2)	
Moderate anemia	6 (8.2)	13 (12.5)	12 (8.5)	31 (9.8)	
Nutritional status of mothers					
MUAC (cm)	28.6 ± 3.9	29.4 ± 4.1	29.9 ± 4.8	29.4 ± 4.4	0.148
Classification of malnutrition using MUAC					
Undernourished (<23.0 cm)	2 (2.6)	8 (3.9)	10 (6.6)	20 (4.6)	0.056
Normal weight (23.0–27.9 cm)	32 (42.1)	72 (35.5)	42 (27.6)	146 (33.9)	
Overweight (28.0–30.9 cm)	25 (32.9)	54 (26.6)	37 (24.3)	116 (26.9)	
Obese (≥31.0 cm)	17 (22.4)	69 (34.0)	63 (41.4)	149 (34.6)	
Nutritional status of non-pregnant mothers ^f					
BMI					
Underweight (<18.5 kg/m ²)	-	2 (1.0)	7 (4.6)	9 (2.5)	0.142
Normal weight (18.5–24.9 kg/m ²)		76 (37.3)	55 (36.2)	131 (36.8)	
Overweight (25.0–29.9 kg/m ²)		68 (33.3)	43 (28.3)	111 (31.2)	
Obese (≥30.0 kg/m ²)		58 (28.4)	47 (30.9)	105 (29.5)	
Waist circumference					
Normal (≤79 cm)	-	67 (32.8)	57 (37.5)	124 (34.8)	0.362
At-risk (>80 cm)		137 (67.2)	95 (62.5)	232 (65.2)	
Waist–hip ratio					
Normal (<0.85 cm)	-	94 (46.1)	85 (55.9)	179 (50.3)	0.066
Substantially increased risk (≥0.85 cm)		110 (53.9)	67 (44.1)	177 (49.7)	
Nutritional status of the children (0–59 months)					
Length/Height-for-age Z-score (L/HAZ)					
No stunting (L/HAZ ≥ −2)	69 (90.8)	189 (92.6)	135 (88.8)	393 (91.0)	0.458
Stunting (L/HAZ < −2)	7 (9.2)	15 (7.4)	17 (11.2)	39 (9.0)	
Weight-for-age Z-score (WAZ)					
No underweight (WAZ ≥ −2)	73 (96.1)	192 (94.1)	148 (97.4)	413 (95.6)	0.327
Underweight (WAZ < −2)	3 (3.9)	12 (5.9)	4 (2.6)	19 (4.4)	
Weight-for-length/height Z-score (WHZ)					
No wasting (WHZ ≥ −2)	69 (90.8)	191 (94.1)	149 (98.0)	409 (94.9)	0.050
Wasting (WHZ < −2)	7 (9.2)	12 (5.9)	3 (2.0)	22 (5.1)	
BMI-for-age Z-score (BAZ)					
Wasting (BAZ < −2)	7 (9.2)	13 (6.4)	2 (1.3)	22 (5.1)	0.086
Normal weight (−2 ≤ BAZ ≤ +2)	66 (86.8)	181 (88.7)	144 (94.7)	391 (90.5)	
Overweight/obese (BAZ > +2)	3 (3.9)	10 (4.9)	6 (3.9)	19 (4.4)	

PM: Pregnant mothers; LM: Lactating mothers; NPNLM: Non-pregnant non-lactating mothers; ^a Categorical variables are expressed as *n* (%) and continuous variables are expressed as mean ± SD. ^b Lack of corresponding sum of frequencies with total sample size is due to missing data. ^c Significantly different at *p*-value < 0.05 (in bold); *p*-value was derived using one-way ANOVA test for continuous variables and chi-square analysis for categorical variables. ^d Total anemia was defined as hemoglobin (Hb) < 12.0 g/dL for LM and NPNLM, <11.0 g/dL for PM and children (6–59 months), and <10.5 g/dL for infants (0–5 months). ^e Anemia was classified as mild and moderate for LM and NPNLM (Hb 11.0–11.9 g/dL and 8.0–10.9 g/dL, respectively) and for PM and children aged 6 to 59 months (Hb 10.0–10.9 g/dL and 7.0–9.9 g/dL, respectively). ^f Non-pregnant mothers include lactating mothers and non-pregnant non-lactating mothers.

Multinomial logistic regression analysis (Table 5) showed that PM were more likely to be younger compared to NPNLM, while LM were more likely to have younger children. Higher odds of self-reported anemia and suffering from the flu were found among PM as compared to NPNLM. PM and LM had 12-times and 2-times higher odds of using micronutrient supplements than NPNLM (*p* < 0.05). PM and LM also had higher odds of consuming a daily breakfast and lower odds of smoking were found when compared to NPNLM. Regression analysis showed that the risk of mild anemia was significantly lower

among PM (aOR = 0.26, 95% CI: 0.08–0.82); in contrast, the risk of moderate anemia was greater among PM even though it did not reach statistical significance. As for children, the odds of mild anemia were three-times higher among children of LM in comparison to those of NPNLM ($p < 0.05$), while the odds of being wasted (BAZ z-score < -2) were higher for children of PM as compared to those of NPNLM (aOR = 5.90, 95% CI: 1.02–34.18). The odds of total anemia among children (zero to 59 months) were two-times higher among children of LM than those of NPNLM, only after adjusting for confounders.

Table 6 displays the descriptive characteristics of Syrian refugee mothers by anemia status and their associations with maternal anemia (anemic vs. not anemic) using simple and multiple logistic regressions. Significant associations were found between anemia and the crowding index, WFP food assistance (e-vouchers), and the total number of children using the simple logistic regressions. However, these associations lost their statistical significance after adjusting for confounders. As for the health characteristics, higher odds of self-reported previous diagnosis of anemia were found among anemic mothers as compared to non-anemic mothers (aOR = 2.27, 95% CI: 1.14–4.52). Receiving health and nutrition messages from family, friends, and/or media or from multiple sources was significantly associated with lower odds of anemia. Simple and multiple logistic regressions showed that the odds of total anemia among children aged zero to 59 months increased by nearly 3-folds (aOR = 2.67, 95% CI: 1.42–5.02) among anemic mothers as compared to non-anemic. Mild anemia among children was associated with anemia among mothers only after adjusting for confounders. As for the nutritional status of mothers, non-pregnant mothers with an at-risk waist circumference were 3-times more likely to be anemic (aOR = 3.05, 95% CI: 1.34–6.92) as compared to not anemic non-pregnant mothers. Remarkably, the odds of an at-risk WC and of being overweight or obese were 11-times and 15-times higher among anemic NPNLM compared to non-anemic NPNLM, respectively ($p < 0.01$). The odds of being underweight were 13-times higher among anemic NPNLM as compared to those with normal weight, only after adjusting for socio-economic characteristics. The additional analysis did not find any associations between the consumption of coffee and tea and anemia status among mothers.

Table 7 presents the dietary intake and nutritional inadequacy ($<2/3$ rd of DRIs) of macro- and micronutrients of PM, LM, and NPNLM among Syrian refugees from vulnerable areas of Greater Beirut. The percent energy intake (%EI) of carbohydrates, protein, linoleic and linolenic acid, saturated and trans-fatty acids, and dietary intake of cholesterol were within the AMDRs, even though, on average, all mothers did not meet their energy intake requirement. On the other hand, the %EI of total fat, polyunsaturated fatty acids, and total sugar exceeded on average the recommendations for women. Significant differences in dietary intake and nutritional inadequacy were observed among mothers according to their reproductive status. Despite a significantly higher intake of carbohydrate (g/d) among PM and LM, a higher proportion of PM and LM (20.8% and 29.4%) did not meet $2/3$ rd of the RDA for carbohydrate intake as compared to NPNLM (13.8%). Similarly, a significantly larger proportion of PM and LM fell below $2/3$ rd of the RDA for protein than NPNLM (59.7%, 59.3%, and 38.2%, respectively; $p < 0.05$). On the other hand, LM had a higher proportion of nutritional inadequacy for dietary fibers as compared to PM and NPNLM (72.5%, 66.2%, and 70.9%, respectively; $p < 0.05$).

With regards to micronutrients, at least three out of four mothers (75.0% to 93.5%) did not meet $2/3$ rd of the RDA or AI for potassium, vitamin A, calcium, vitamin E, folate, pantothenic acid, vitamin B12, and vitamin B6. Furthermore, at least half of mothers had intakes of zinc (71.8%), magnesium (69.2%), iron (63.9%), vitamin C (63.0%), and riboflavin (50.5%) below $2/3$ rd of the RDAs. Interestingly, all mothers did not consume at least $2/3$ rd of the RDA for vitamin D with an average intake of 0.64 $\mu\text{g/d}$. A significantly higher proportion of LM did not meet $2/3$ rd of the RDAs or AIs for potassium, vitamin A, vitamin E, vitamin B6, pantothenic acid, zinc, copper, and manganese, compared to PM and NPNLM. On the other hand, a higher proportion of PM, followed by NPNLM, did not reach $2/3$ rd of the RDA for iron as compared to LM (81.8%, 80.1%, and 45.1%, respectively;

$p < 0.05$) despite the highest intake of total iron being observed among PM (PW: 10.2 ± 9.8 ; LW: 8.2 ± 6.2 ; NPNLM: 8.5 ± 7.0 mg/d).

Table 5. Odds ratio of anemia, nutritional status, and age by the reproductive status of mothers.

Variables	OR (95% CI) ^a		aOR (95% CI) ^b	
	Reference Group: NPNLM		Reference Group: NPNLM	
	Pregnant mothers	Lactating mothers	Pregnant mothers	Lactating mothers
Age				
Age of the mother (years)	0.95 (0.91–0.99) *	0.94 (0.91–0.98) **	0.92 (0.86–0.99) *	0.97 (0.91–1.05)
Age of the children (months)	0.99 (0.97–1.00)	0.83 (0.79–0.86) ^α	1.01 (0.98–1.03)	0.82 (0.78–0.86) ^α
Health and lifestyle characteristics				
Self-reported previous diagnosis with anemia				
No	1.0	1.0	1.0	1.0
Yes	2.27 (1.20–4.32) *	1.24 (0.80–1.93)	2.60 (1.21–5.55) *	1.75 (0.90–3.40)
Suffering from the flu (self-reported)				
No	1.0	1.0	1.0	1.0
Yes	3.30 (1.13–9.64) *	3.12 (1.24–7.87) *	3.66 (1.08–12.42) *	2.63 (0.72–9.58)
Mother's use of supplements				
No	1.0	1.0	1.0	1.0
Yes	7.66 (4.12–14.26) ^α	1.72 (1.02–2.90) *	12.47 (5.64–27.55) ^α	2.37 (1.05–5.35) *
Have breakfast every day				
No	1.0	1.0	1.0	1.0
Yes	1.77 (0.96–3.24)	1.83 (1.16–2.90) **	2.14 (1.05–4.40) *	2.28 (1.14–4.56) *
Currently smokes cigarettes or shisha				
No	1.0	1.0	1.0	1.0
Yes	0.32 (0.14–0.69) **	0.46 (0.28–0.77) **	0.34 (0.14–0.83) *	0.41 (0.20–0.86) *
Anemia and nutritional status of mothers				
Classification of anemia ^c				
Not anemic	1.0	1.0	1.0	1.0
Mild anemia	0.38 (0.15–0.96) *	0.78 (0.45–1.37)	0.26 (0.08–0.82) *	1.09 (0.43–2.71)
Moderate anemia	1.18 (0.46–3.03)	0.40 (0.15–1.05)	2.75 (0.70–10.84)	0.93 (0.20–4.45)
Classification of malnutrition using MUAC				
Normal weight (23.0–27.9 cm)	1.0	1.0	1.0	1.0
Undernourished (<23.0 cm)	0.26 (0.05–1.28)	0.47 (0.17–1.27)	0.26 (0.05–1.50)	0.36 (0.09–1.48)
Overweight (28.0–30.9 cm)	0.89 (0.45–1.76)	0.85 (0.48–1.50)	0.82 (0.36–1.86)	0.94 (0.41–2.16)
Obese (≥31.0 cm)	0.35 (0.18–0.72) **	0.64 (0.38–1.06)	0.25 (0.10–0.60)**	0.86 (0.39–1.92)
Anemia and nutritional status of children				
Total anemia (0–59 months) ^c				
Not anemic	1.0	1.0	1.0	1.0
Anemic	0.74 (0.39–1.40)	1.44 (0.91–2.27)	0.66 (0.30–1.45)	2.11 (1.07–4.17) *
Classification of anemia (6–59 months) ^d				
Not anemic	1.0	1.0	1.0	1.0
Mild anemia	0.63 (0.29–2.49)	2.70 (1.50–4.88) **	0.75 (0.21–2.62)	2.98 (1.26–7.04) **
Moderate anemia	0.89 (0.32–1.40)	2.10 (0.90–4.94)	0.52 (0.20–1.36)	2.67 (0.83–8.57)
BMI-for-age Z-score (BAZ) (0–59 months)				
Normal weight ($-2 \leq \text{BAZ} \leq +2$)	1.0	1.0	1.0	1.0
Wasting ($\text{BAZ} < -2$)	7.64 (1.54–37.76) *	5.17 (1.15–23.28) *	5.90 (1.02–34.18) *	2.37 (0.44–11.90)
Overweight/obese ($\text{BAZ} > +2$)	1.09 (0.26–4.50)	1.33 (0.47–3.73)	3.01 (0.54–16.79)	0.58 (0.07–4.82)

NPNLM: Non-pregnant non-lactating mothers; * $p < 0.05$, ** $p < 0.01$, ^α $p < 0.001$; ^a Odds Ratio (OR) of the dependent variable (NPNLM vs. Pregnant mothers and Lactating mothers) are presented with 95% CI using simple logistic regression. ^b Adjusted OR (aOR) are presented with 95% CI using multiple logistic regression analysis. Model 1: adjusted for age of the mother and child, crowding index, and the total number of under-five children per household as continuous variables and for the sex of the child, education levels of the mother and father, employment status of the father, household monthly income, UNHCR registration status, head of household, household type, perception of safety, receipt of cash or food assistance, reliance on savings, and healthcare type as categorical variables. ^c Total anemia was defined as hemoglobin (Hb) < 12.0 g/dL for LM and NPNLM, <11.0 g/dL for PM and children (6–59 months), and <10.5 g/dL for infants (0–5 months). ^d Anemia was classified as mild and moderate for LM and NPNLM (Hb 11.0–11.9 g/dL and 8.0–10.9 g/dL, respectively) and for PM and children aged 6 to 59 months (Hb 10.0–10.9 g/dL and 7.0–9.9 g/dL, respectively).

Table 6. Key characteristics and nutritional status indicators according to total anemia among Syrian refugee mothers.

Variables ^a	Not Anemic	Anemic	Maternal Anemia	
Socio-economic and household characteristics (<i>n</i> = 433)	<i>n</i> = 334	<i>n</i> = 93	OR (95% CI) ^b	aOR (95% CI) ^c
Crowding index score	3.6 ±1.5	4.1 ±2.0	1.2 (1.03–1.34) *	1.09 (0.88–1.35)
Receipt of WFP food assistance (e-vouchers)				
No	311 (94.0)	77 (87.5)	1.0	1.0
Yes	20 (6.0)	11 (12.5)	2.22 (1.02–4.83) *	1.56 (0.55–4.44) ^d
Number of children < 5 years per household				
1 to 2	188 (56.0)	41 (45.1)	1.0	1.0
3 to 4	115 (34.2)	28 (30.8)	1.12 (0.66–1.90)	0.62 (0.28–1.39)
≥5	33 (9.8)	22 (24.2)	3.06 (1.62–5.78)**	1.73 (0.58–5.10)
Health characteristics of mothers (<i>n</i> = 433)	<i>n</i> = 334	<i>n</i> = 93	OR (95% CI) ^b	aOR (95% CI) ^c
Self-reported previous diagnosis with anemia				
No	118 (35.6)	20 (21.5)	1.0	1.0
Yes	213 (64.4)	73 (78.5)	2.02 (1.17–3.48) *	2.27 (1.14–4.52) *
Sources of health and nutrition messages				
Healthcare professionals exclusively ^e	38 (11.3)	22 (23.9)	1.0	1.0
Family, friends, media, and/or other	219 (65.2)	52 (56.5)	0.41 (0.22–0.75) **	0.42 (0.19–0.94) *
Multiple sources ^f	79 (23.5)	18 (19.6)	0.39 (0.19–0.82) *	0.23 (0.08–0.66) **
Anemia status among children (0–59 months) (<i>n</i> = 433)	<i>n</i> = 333	<i>n</i> = 93	OR (95% CI) ^b	aOR (95% CI) ^c
Total anemia (0–59 months) ^g				
Not anemic	239 (71.8)	56 (60.2)	1.0	1.0
Anemic	94 (28.2)	37 (39.8)	1.68 (1.04–2.71) *	2.67 (1.42–5.02) **
Classification of anemia (6–59 months) (<i>n</i> = 318)	<i>n</i> = 242	<i>n</i> = 75	OR (95% CI) ^b	aOR (95% CI) ^c
Classification of anemia (6–59 months) ^h				
Not anemic	165 (68.2)	44 (58.7)	1.0	1.0
Mild anemia	55 (22.7)	22 (29.3)	1.50 (0.83–2.72)	4.40 (1.79–10.80) ^α
Moderate anemia	22 (9.1)	9 (12.0)	1.53 (0.66–3.57)	2.39 (0.72–7.97)
Nutritional status of non-pregnant mothers ⁱ (<i>n</i> = 356)	<i>n</i> = 273	<i>n</i> = 79	OR (95% CI) ^b	aOR (95% CI) ^j
Waist circumference				
Normal	104 (38.1)	20 (25.3)	1.0	1.0
At-risk (>80 cm)	169 (61.9)	59 (74.7)	1.82 (1.03–3.19) *	3.05 (1.34–6.92) **
Nutritional status of NPNLM (<i>n</i> = 152)	<i>n</i> = 111	<i>n</i> = 40	OR (95% CI) ^b	aOR (95% CI) ^k
Waist circumference				
Normal	49 (44.1)	8 (20.0)	1.0	1.0
At-risk (>80 cm)	62 (55.9)	32 (80.0)	3.16 (1.34–7.48) **	10.90 (2.74–43.38)**
BMI for the mother				
Normal weight	46 (41.4)	9 (22.5)	1.0	1.0
Underweight	4 (3.6)	3 (7.5)	3.83 (0.73–20.13)	13.39 (1.52–118.12) *
Overweight/Obese	61 (55.0)	28 (70.0)	2.35 (1.01–5.45) *	14.68 (3.22–66.96) **
Consumption of coffee and tea (<i>n</i> = 375)	<i>n</i> = 294	<i>n</i> = 81	OR (95% CI) ^b	aOR (95% CI) ^c
Drinks coffee/tea between meals ^l				
No	140 (47.6)	35 (43.2)	1.0	1.0
Yes	154 (52.4)	46 (56.8)	0.82 (0.48–1.39)	0.87 (0.44–1.73)
Drinks coffee/tea during a meal ^m				
No	140 (47.6)	35 (43.2)	1.0	1.0
Yes	154 (52.4)	46 (56.8)	1.20 (0.73–1.96)	1.38 (0.73–2.62)

NPNLM: Non-pregnant non-lactating mothers; * $p < 0.05$, ** $p < 0.01$, ^α $p < 0.001$; ^a Categorical variables are expressed as *n*(%) and continuous variables are expressed as mean ± SD. Lack of corresponding sum of frequencies with total sample size is due to missing data.

^b Odds Ratio (OR) of the dependent variable (Anemic vs. Not Anemic (reference group)) are presented with 95% CI using simple logistic regression. ^c Adjusted OR (aOR) are presented with 95% CI using multiple logistic regression analysis. Model 2: adjusted for age of the mother and child, sex of the child, reproductive status of the mother (pregnant, lactating, or non-pregnant non-lactating), marital status, education and employment status of the parents, household monthly income, crowding index, UNHCR registration status, perception of safety, receipt of cash or food assistance, reliance on savings, household type, head of household, total number of under-five children, health insurance coverage, healthcare type, and sources of health messages. ^d Model 3: Model 2 without receipt of cash or food assistance.

^e Healthcare professionals included physicians, nurses, dietitians, and pharmacists. ^f Multiple sources include family, friends, media, other, and healthcare professionals. ^g Total anemia was defined as hemoglobin (Hb) < 12.0 g/dL for LM and NPNLM, <11.0 g/dL for PM and children (6–59 months), and <10.5 g/dL for infants (0–5 months). ^h Anemia was classified as mild and moderate for LM and NPNLM (Hb 11.0–11.9 g/dL and 8.0–10.9 g/dL, respectively) and for PM and children aged 6 to 59 months (Hb 10.0–10.9 g/dL and 7.0–9.9 g/dL, respectively). ⁱ Non-pregnant mothers include lactating mothers and non-pregnant non-lactating mothers. ^j Model 4: Model 2 without reproductive status of the mother (pregnant, lactating, or non-pregnant non-lactating). ^k Model 5: Model 2 without the marital status, employment status of the father, UNHCR registration status, reliance on savings, and reproductive status of the mother (pregnant, lactating, or non-pregnant non-lactating). ^l Between meals is defined as two hours before or after a meal. ^m During the course of a meal is defined as during or one hour before or after a meal.

Table 7. Dietary intake and nutritional inadequacy (<2/3rd of DRIs) of energy and macro- and micronutrients by the reproductive status of Syrian mothers.

Variables	Intake/Day (Mean $\pm$ SD)				<2/3rd DRIs (n, %)			
Energy and Macronutrients (%EI)	PM n = 77	LM n = 204	NPNLM n = 152	Total n = 433	PM n = 77	LM n = 204	NPNLM n = 152	Total n = 433
Energy (kcal/d)	1622.6 $\pm$ 872.9 ^a	1555.5 $\pm$ 729.4 ^b	1341.5 $\pm$ 685.2 ^c	1492.3 $\pm$ 749.0	-	-	-	-
Carbohydrates (%EI/d)	51.8 $\pm$ 10.6	51.9 $\pm$ 11.2	53.1 $\pm$ 11.7	52.3 $\pm$ 11.3	-	-	-	-
Protein (%EI/d)	12.2 $\pm$ 5.1	12.3 $\pm$ 3.9	12.8 $\pm$ 4.6	12.4 $\pm$ 4.4	-	-	-	-
Total fat (%EI/d)	37.2 $\pm$ 11.0	36.8 $\pm$ 11.3	35.5 $\pm$ 11.3	36.4 $\pm$ 11.2	-	-	-	-
MUFA (%EI/d)	13.5 $\pm$ 8.4	12.8 $\pm$ 8.0	12.6 $\pm$ 9.4	12.9 $\pm$ 8.6	-	-	-	-
Linoleic acid (%EI/d)	8.9 $\pm$ 4.3	9.0 $\pm$ 5.1	8.7 $\pm$ 4.7	8.9 $\pm$ 4.8	-	-	-	-
Linolenic acid (%EI/d)	1.6 $\pm$ 3.8	1.4 $\pm$ 2.7	1.4 $\pm$ 2.8	1.4 $\pm$ 3.0	-	-	-	-
PUFA (%EI/d)	12.2 $\pm$ 13.0	12.1 $\pm$ 14.3	12.7 $\pm$ 21.3	12.3 $\pm$ 16.9	-	-	-	-
SFA (%EI/d)	9.4 $\pm$ 10.7	9.2 $\pm$ 7.0	8.2 $\pm$ 4.2	8.9 $\pm$ 7.0	-	-	-	-
TFA (%EI/d)	0.1 $\pm$ 0.22	0.2 $\pm$ 0.4	0.2 $\pm$ 0.4	0.2 $\pm$ 0.3	-	-	-	-
Cholesterol (mg/d)	146.4 $\pm$ 158.0 ^a	162.5 $\pm$ 186.5 ^b	116.9 $\pm$ 130.7 ^c	143.6 $\pm$ 164.7	-	-	-	-
Total sugar (%EI/d)	12.8 $\pm$ 8.5	13.8 $\pm$ 7.79	15.0 $\pm$ 7.8	14.0 $\pm$ 8.0	-	-	-	-
Macronutrient intake								
Carbohydrates (g/d)	205.9 $\pm$ 104.8 ^a	197.0 $\pm$ 90.6 ^b	171.4 $\pm$ 81.4 ^c	189.6 $\pm$ 91.1	16 (20.8) ^d	60 (29.4) ^e	21 (13.8) ^f	97 (22.4)
Protein (g/d)	45.3 $\pm$ 21.7	46.7 $\pm$ 26.3	41.4 $\pm$ 24.5	44.6 $\pm$ 25.0	46 (59.7) ^d	121 (59.3) ^e	58 (38.2) ^f	225 (52.0)
Linoleic acid (g/d)	17.1 $\pm$ 12.5	16.2 $\pm$ 12.7	13.9 $\pm$ 11.2	15.6 $\pm$ 12.2	24 (31.2)	65 (31.9)	55 (36.4)	144 (33.3)
Linolenic acid (g/d)	4.3 $\pm$ 13.2	2.3 $\pm$ 4.4	2.2 $\pm$ 4.8	2.6 $\pm$ 6.9	43 (55.8)	110 (53.9)	90 (59.2)	243 (56.1)
Fibers (g/d)	16.8 $\pm$ 12.0	15.5 $\pm$ 11.0	14.5 $\pm$ 10.7	15.3 $\pm$ 11.1	51 (66.2) ^d	148 (72.5) ^e	107 (70.9) ^f	306 (70.8)
Micronutrient intake								
Iron (mg/d)	10.2 $\pm$ 9.8	8.2 $\pm$ 6.2	8.0 $\pm$ 6.1	8.5 $\pm$ 7.0	63 (81.8) ^d	92 (45.1) ^e	121 (80.1) ^f	276 (63.9)
Folate (μ g/d)	238.8 $\pm$ 222.0	221.3 $\pm$ 204.5	203.8 $\pm$ 178.3	218.2 $\pm$ 199.0	65 (84.4)	161 (78.9)	116 (76.3)	342 (79.0)
Vitamin B12 (μ g/d)	1.4 $\pm$ 3.3	1.4 $\pm$ 2.4	1.2 $\pm$ 1.8	1.4 $\pm$ 2.4	59 (76.6)	160 (78.4)	117 (77.0)	336 (77.6)
Vitamin C (mg/d)	62.9 $\pm$ 65.1	64.4 $\pm$ 58.6	52.9 $\pm$ 43.0	60.1 $\pm$ 55.1	46 (59.7)	140 (68.6)	86 (57.0)	272 (63.0)
Vitamin A (μ g/d)	418.6 $\pm$ 668.8	425.6 $\pm$ 530.7	329.8 $\pm$ 397.3	390.7 $\pm$ 517.9	57 (74.0) ^d	182 (89.2) ^e	126 (82.9) ^f	365 (84.3)
Vitamin D (μ g/d)	0.7 $\pm$ 0.8 ^a	0.8 $\pm$ 1.1 ^b	0.4 $\pm$ 0.6 ^c	0.6 $\pm$ 0.9	77 (100.0)	204 (100.0)	152 (100.0)	433 (100.0)
Vitamin E (mg/d)	9.1 $\pm$ 9.2	7.7 $\pm$ 5.9	7.1 $\pm$ 6.5	7.8 $\pm$ 6.8	53 (68.8) ^d	175 (85.8) ^e	120 (78.9) ^f	348 (80.4)
Vitamin K (μ g/d)	132.1 $\pm$ 194.5	133.6 $\pm$ 276.9	111.0 $\pm$ 174.7	125.4 $\pm$ 231.2	35 (45.5)	90 (44.1)	84 (55.6)	209 (48.4)
Thiamin (mg/d)	1.3 $\pm$ 0.8 ^a	1.3 $\pm$ 0.7 ^b	1.1 $\pm$ 0.6 ^c	1.2 $\pm$ 0.7	24 (31.2)	65 (31.9)	40 (26.5)	129 (29.9)
Riboflavin (mg/d)	1.1 $\pm$ 0.7 ^a	1.1 $\pm$ 0.6 ^b	0.9 $\pm$ 0.5 ^c	1.0 $\pm$ 0.6	37 (48.1)	111 (54.4)	70 (46.4)	218 (50.5)
Niacin (mg/d)	13.7 $\pm$ 7.1	13.8 $\pm$ 8.3	11.9 $\pm$ 6.9	13.1 $\pm$ 7.6	35 (45.5)	86 (42.2)	63 (41.4)	184 (42.5)

Table 7. Cont.

Variables	Intake/Day (Mean $\pm$ SD)				<2/3rd DRIs (<i>n</i> , %)			
Energy and Macronutrients (%EI)	PM <i>n</i> = 77	LM <i>n</i> = 204	NPNLM <i>n</i> = 152	Total <i>n</i> = 433	PM <i>n</i> = 77	LM <i>n</i> = 204	NPNLM <i>n</i> = 152	Total <i>n</i> = 433
Pantothenic acid (mg/d)	3.4 $\pm$ 2.4	3.3 $\pm$ 2.1	2.9 $\pm$ 1.9	3.2 $\pm$ 2.1	55 (71.4) ^d	171 (83.8) ^e	111 (73.0) ^f	337 (77.8)
Vitamin B6 (mg/d)	1.0 $\pm$ 0.6 ^a	0.9 $\pm$ 0.6 ^b	0.8 $\pm$ 0.5 ^c	0.9 $\pm$ 0.6	52 (67.5) ^d	173 (84.8) ^e	99 (65.6) ^f	324 (75.0)
Zinc (mg/d)	6.4 $\pm$ 4.3	6.0 $\pm$ 3.7	5.5 $\pm$ 3.5	5.9 $\pm$ 3.8	55 (71.4) ^d	161 (78.9) ^e	94 (62.3) ^f	310 (71.8)
Copper (mg/d)	1.3 $\pm$ 1.1 ^a	1.0 $\pm$ 0.6 ^b	0.9 $\pm$ 0.6 ^c	1.0 $\pm$ 0.7	20 (26.0) ^d	98 (48.0) ^e	58 (38.2) ^f	176 (40.6)
Calcium (mg/d)	475.1 $\pm$ 386.1	449.6 $\pm$ 341.2	414.1 $\pm$ 325.9	441.7 $\pm$ 344.3	62 (80.5)	166 (81.4)	125 (82.8)	353 (81.7)
Magnesium (mg/d)	216.2 $\pm$ 140.9 ^a	183.1 $\pm$ 99.6 ^b	174.2 $\pm$ 105.4 ^c	186.8 $\pm$ 110.7	52 (67.5)	139 (68.1)	108 (71.5)	299 (69.2)
Sodium (mg/d)	2088.9 $\pm$ 1235.6	2217.8 $\pm$ 1335.6	1948.2 $\pm$ 1170.1	2100.2 $\pm$ 1265.0	13 (16.9)	33 (16.2)	32 (21.1)	78 (18.0)
Potassium (mg/d)	744.6 $\pm$ 459.1 ^a	1798.2 $\pm$ 956.4 ^b	1600.4 $\pm$ 879.9 ^c	1752.9 $\pm$ 972.2	66 (85.7) ^d	195 (95.6) ^e	144 (94.7) ^f	405 (93.5)
Phosphorus (mg/d)	744.6 $\pm$ 459.1	696.4 $\pm$ 437.9	621.4 $\pm$ 391.6	678.6 $\pm$ 427.6	20 (26.0)	66 (32.4)	61 (40.4)	147 (34.0)
Manganese (mg/d)	2.8 $\pm$ 1.6	2.5 $\pm$ 1.6	2.4 $\pm$ 1.5	2.5 $\pm$ 1.6	14 (18.2) ^d	71 (34.8) ^e	33 (21.9) ^f	118 (27.3)
Selenium (μ g/d)	69.9 $\pm$ 39.0 ^a	72.0 $\pm$ 37.9 ^b	59.2 $\pm$ 34.0 ^c	67.2 $\pm$ 37.2	18 (23.4)	55 (27.0)	40 (26.3)	113 (26.1)

DRIs: Dietary Reference Intakes; PM: Pregnant mothers; LM: Lactating mothers; NPNLM: Non-pregnant non-lactating mothers; d: day; %EI: percent energy intake; MUFA: monounsaturated fatty acids; PUFA: polyunsaturated fatty acids; SFA: saturated fatty acids; TFA: trans-fatty acids; Categorical variables are expressed as *n* (%) and continuous variables are expressed as mean $\pm$ SD. The nutritional inadequacy (<2/3rd DRIs) represents the proportion of mothers not meeting 2/3rd of the RDA or AI for micronutrients key macronutrient according to their age group and reproductive status (displayed in Annex A—Table A1). ^{a,b,c} Mean values in a row with unlike superscript letters were significantly different ($p < 0.05$) using ANOVA test for the comparison of mean intakes/day. ^{d,e,f} Mean values in a row with unlike superscript letters were significantly different ($p < 0.05$) using chi-square analysis for <2/3rd DRI.

4. Discussion

To our knowledge, this is the first study to examine the prevalence and key determinants of anemia and the nutritional status of Syrian refugee mothers and their children under five years according to the mother's reproductive status. Overall, the prevalence of anemia was 21.7% among mothers and 30.5% among children under five years, this being categorized as a moderate public health significance according to the WHO classification [55]. Our findings remained below the global prevalence of anemia estimated at 29.9% for women of reproductive age and 39.8% for children under five years in 2019. Nevertheless, an increasing trend of anemia has been recorded by the WHO between 2012 and 2019 among women of reproductive age and children under five years in Lebanon and Syria [3]. Anemia levels reported in the present study were higher than those in previous reports among Syrian refugees in Lebanon, but lower than Iraqi refugees in Lebanon and Syrian refugees in the Za'atari refugee camp in Jordan [24,25,56]. According to a survey conducted in Syria in 2015 and 2016, almost a quarter of women of reproductive age (24.5%) and children under five years (25.9%) had anemia [57]. Our findings are more consistent with anemia levels of the Lebanese host population for women of reproductive age and children under five years about two decades ago [58–61].

The highest prevalence of total and mild anemia among mothers was noted among non-pregnant non-lactating mothers (NPNLM), followed by lactating mothers (LM) and last by pregnant mothers (PM). Concomitantly, NPNLM were also found to be significantly older than LM and PM. An interpretation of these findings suggests that the occurrence of anemia may increase as women are getting older and move forward in the stages of the life cycle [62], even though maternal age and the number of children under five years were not significantly associated with maternal anemia in our survey. Similar findings were reported among pregnant women in rural Jordan [63]. In contrast, other studies in the literature indicated that the anemia prevalence among pregnant women increased with age and the number of children under five years in the household [62,64]. This is due to increased nutrient requirements during pregnancy and lactation and gradual depletion of the iron stores with repeated pregnancies, although lactation amenorrhea compensates for the loss of iron [10,65,66]. Low maternal iron stores at conception are a strong predictor of the risk of iron deficiency and anemia during pregnancy, but also mirror the infant's iron endowment after birth [67,68]. In fact, our findings showed that child anemia was strongly associated with maternal anemia. Particularly, children of LM suffered the most from total, mild, and moderate anemia and had 3-times higher odds of mild anemia than those of NPNLM. Possible explanations for the increased risk of child anemia include: (1) an inadequate iron intake of women during pregnancy resulting in a minimized accumulation of iron in the fetus during the last trimester [67,68] and (2) a suboptimal maternal and child nutrition due to increased nutrient requirements leading to greater risks of malnutrition and micronutrient deficiencies [9,10]. Birth spacing and family planning play an important role in replenishing depleted maternal iron stores following a pregnancy [66,69].

The prevalence of anemia among PM in our survey was much lower than the WHO Global and Eastern Mediterranean Region estimates as well as other reported anemia rates from neighboring countries [3,62,63]. Indeed, a significantly lower risk of mild anemia was found among PM in our study (aOR = 0.26, 95%CI: 0.08–0.82). This may be explained by the fact that PM and LM had 12-folds and 2-folds higher odds of using micronutrient supplements than NPNLM in our study, despite an overall low usage of micronutrient supplements by mothers in the study sample. The benefits of multiple ANC visits and micronutrient supplementation, including iron and iron-folic acid, on anemia levels during pregnancy and birth outcomes have been well documented [64,65,68,69]. The access to free or subsidized healthcare assistance in place for UNHCR-registered and unregistered refugees in Lebanon could have played a role in reducing the mild anemia prevalence among PM. As a matter of fact, the majority of Syrian refugees across the nation and in our survey reported having access to primary healthcare services, despite main barriers such as economic vulnerability, area of residence, and household composition [70]. Albeit

the high proportion of mothers who attended at least four ANC visits (62.1%), slightly less than a quarter of PM had zero visits in our survey. One explanation can be related to their UNHCR registration status as refugees. It was observed that nearly a quarter of PM were not registered as refugees and had a shorter length of stay in Lebanon as compared to LM and NPNLM, suggesting these women arrived in Lebanon after the suspension of UNHCR registrations by the government in 2015 [70,71]. As a consequence, unregistered PM, with higher nutritional needs and requirements, may not have had access to any cash or food assistance and may have faced additional barriers to access and utilize the free or subsidized healthcare assistance in place for registered and unregistered refugees in Lebanon, such as the lack of awareness of service availability [72]. Multiple sources of health messages, including family, friends, and social media, had a protective impact on maternal anemia. These findings shed light on the crucial role of counselling approaches and awareness-raising sensitive to cultural norms which need to target mothers and older members of the household to improve the health and nutritional status of women of reproductive age. For instance, women's groups at a community level can be developed to promote the engagement of women in discussions and provide maternal social support [73–75].

Medium levels of wasting and low levels of stunting were identified among children under five years as per the WHO classification for malnutrition [76]. These levels were also within observed ranges in the Eastern Mediterranean Region. In contrast, the prevalence of overweight and obesity among children in our study was far below those of countries of the region [77]. Stunting rates have dropped by nearly 40% in the Eastern Mediterranean Region from 1990, despite the milder reduction rate observed since 2012 [78]. This trend is also reflected among the Syrian refugee pediatric population in Lebanon. When comparing our findings to the nutritional assessment conducted by UNICEF in 2013, stunting levels dropped by half, yet wasting and underweight increased sharply [25]. A significantly higher risk of wasting was also found among children of PM in our survey. As stunting indicates chronic malnutrition [79], it suggests that poor dietary habits and food-related coping strategies have been in place for a longer period of time [80].

On the other hand, overnutrition was predominant among non-pregnant mothers with more than 60% being overweight or obese. Our findings are in accordance with the 2016 age-standardized estimates of overweight and obesity in Lebanon and Syria [81] and with previous studies conducted among Lebanese women [82,83]. Even though two-thirds of the mothers appeared to have moderate or high activity levels, no association was found with the nutritional status of mothers in the context of our study. According to Lee et al., the IPAQ-SF typically overestimated physical activity levels by 84% [84]. Moderate to high activity was shown to have a protective role against the risk of obesity among Lebanese women, however, this was in the setting of a better socio-economic status and higher education enabling them to buy food with available resources and the knowledge to make better food and lifestyle choices [85]. With two-thirds of the participants reporting a monthly household income below the legal minimum wage in Lebanon, we project that excess overweight and obesity may be due not only to the shift in dietary patterns, but also to increased food-coping strategies due to food insecurity, thus leading to inadequate diet quality that may be energy-dense yet poor in micronutrients [5,86]. Lebanon has been undergoing the nutrition transition with increasing rates of obesity and non-communicable diseases with a shift in dietary patterns characterized by an elevated intake of foods with high energy density and rich in fat and added sugar [87,88]. The prices of food influence to a great extent the choices of food, and lower socio-economic groups tend to resort to cheaper lower-quality diets [89]. In addition, the interrelationship between economic vulnerabilities, food insecurity, and psychological distress has been well documented and can negatively impact health status [28,90].

Findings from this study demonstrated a significant association between total anemia and overweight or obesity ($\text{BMI} \geq 25.0 \text{ kg/m}^2$) and an at-risk waist circumference among mothers, suggesting the existence of a double burden of malnutrition at the individual level [91]. Controversial findings regarding the relationship of anemia with overweight

and obesity, central obesity, and obesity-associated inflammation were found in the literature [92,93]. For instance, Wirth et al. found associations between obesity and inflammation, but showed that the risk of anemia was lower among overweight and obese women [92]. However, obesity is generally linked to micronutrient deficiencies interceded by poor nutrition and chronic inflammation [5,66,94]. Another explanation comes into play linking poverty, food insecurity, and malnutrition including anemia [95] and obesity [82,96]. These findings point towards a poor diet leading to the gradual accumulation of malnutrition, nutrient deficiencies, and anemia in the long term [94]. Maternal obesity, associated with poor micronutrient status, may also impair offspring development and early growth as a consequence of the intergenerational effects of malnutrition [5].

Looking at the dietary intake of mothers, overall low energy intakes were reported by our study population. The latter may be explained by the commonly identified underreporting among women [97]. Misreporting may be biased towards reporting lower intakes of fat, carbohydrates, and alcohol [98] and may be influenced by several psychosocial factors such as being overweight, body image concerns, demographics, depression, anxiety, and social desirability [99]. Nevertheless, the diet of women of reproductive age in our study was characterized by a percent energy intake of total fat and total sugar exceeding their respective recommendations, in addition to inadequate intakes of protein and fibers. Protein-rich foods include meat, poultry, seafood, eggs, milk, and dairy products from animal sources and beans, peas, nuts, and seeds from plant sources. These sources also contribute to the dietary intake of B vitamins, vitamins D and E, iron, zinc, calcium, and magnesium among others. In addition, dietary fibers naturally occur in fruits, vegetables, beans, and nuts as well as whole-grain products. These foods are also known to be the primary contributors to a wide range of vitamins and minerals, namely vitamins A and C, folate, and potassium [100]. As a result, it is not surprising that a widespread inadequate dietary intake of the abovementioned vitamins and minerals was simultaneously observed in the diet of the mothers in our survey. Our findings corroborate with those of Nasreddine et al. showing that Lebanese women had a high intake of total fat and higher consumption of sweets, while a lower micronutrient intake was observed [18]. We suggest that similar dietary patterns, that mimic those of the local population, were a sign of “dietary acculturation”. The latter refers to the adoption and integration of new eating patterns and food choices of the host country after migration [101]. Studies among asylum seekers in Germany, including Syrian refugees, established similar conclusions [102]. Multidimensional factors led to dietary adaptations and a remarkable shift towards Western/urban eating habits among asylum seekers in Germany [103].

Poor nutritional adequacies were also found among mothers according to their reproductive status. Of particular interest are the essential hemopoietic nutrients recognized for their role in erythropoiesis, including protein, iron, vitamins A, B12, B6, C, D, E, folate, riboflavin, copper, and zinc [65,94,104]. Higher proportions of PM and LM did not meet 2/3rd RDA for protein than NPNLM. This is mainly due to their higher requirements, even though no significant differences were found in their daily intake of protein. Concomitantly, the majority of PM and NPNLM fell short of 2/3rd RDA for iron as compared to LM. Since no significant differences were observed in the dietary intake of iron among mothers, the advantage was rather the result of lower needs of iron for LM justified by the lactation amenorrhea [66]. Additionally, LM were the least to reach 2/3rd of the RDA for dietary fibers due to higher requirements compared to PM and NPNLM, even though LM consumed a significantly higher number of meals on average per day. In fact, significantly higher proportions of nutritional inadequacies were found among LM, followed by NPNLM and PM, particularly for vitamin A, vitamin B6, zinc, copper, potassium, and manganese. A suboptimal maternal diet during lactation compromises the human milk quality as the content of certain micronutrients are affected, namely the water-soluble vitamins and fat content [105,106]. Breastfeeding has a vital role in the prevention of all forms of malnutrition and micronutrient deficiencies, indicating the need to improve maternal nutrition and women’s nutritional status as early as possible [107]. Similar to our findings,

studies in Lebanon found that women were at risk of micronutrient inadequacies especially for hematinic nutrients including iron, folate, zinc, vitamin B12, and calcium [18,58]. Our findings are also in line with the literature showing low intakes of micronutrients among pregnant women and women of reproductive age in low- and middle-income countries [108,109] and in developed countries [110].

Healthier lifestyle patterns were present significantly more among PM and LM with higher odds of consuming daily breakfast and lower odds of smoking. Our findings are less pronounced compared to a previous assessment conducted among Lebanese pregnant women. These women were more likely to have low birth weight babies and reported a lower duration of breastfeeding [111]. The consumption of coffee and tea during a meal was found to be common among mothers in our survey, especially among LM. However, no association with anemia was found in our study despite that they are potent inhibitors of iron absorption. It can be explained by the multifactorial nature of the causes of and contributors to anemia, such as poor dietary practices, infections and inflammation, and socio-economic factors [65]. In addition, no associations between anemia and socio-economic characteristics were found in our study. This is in accordance with previous studies among women in Lebanon and rural Jordan [58,61,63] and the NHANES study among pregnant women [112].

Shifts towards unhealthy foods and lifestyle, with an escalating burden of overweight and obesity, coexisting with undernutrition and anemia, reflect the nutrition situation of most low- and middle-income countries and countries in the Eastern Mediterranean Region [16]. Despite the extensive humanitarian assistance provided to Syrian refugees in Lebanon since the beginning of the conflict in 2011 [23], Beirut and Mount Lebanon governorates have the fewest number of beneficiaries as compared to other regions in Lebanon [70]. The aforementioned was also reflected in our survey as 82.1% of the Syrian households in Greater Beirut were registered as refugees with the UNHCR, of which only 8.9% were receiving food assistance from the World Food Programme. The nutritional status of vulnerable population groups can be further exposed to acute and chronic malnutrition due to the severe financial crisis in Lebanon since October 2019, resulting in hyperinflation of food prices, soaring unemployment rates, and reduced incomes, combined with containment measures for COVID-19 pandemic and the aftermath of the Beirut port explosion in August 2020 [78,113,114].

The findings of this study should be considered in light of a few limitations. The cross-sectional design allows for the investigation of associations rather than causal relationships. Furthermore, dietary data were explored using one 24-h dietary recall which may face potential limitations due to reliance on memory and day-to-day variations; however, every attempt was exerted to minimize misreporting. The five-step multiple pass recall method may reduce bias and provide accurate estimates of food intake at the population level; however, underreporting under field conditions and its accuracy in overweight and obese persons remain underexplored [43,115]. Nevertheless, the 24-h dietary recall presents several strengths such as capturing all eating patterns and preparation methods, not relying on the literacy of the respondent, not affecting food choices, and having a low burden on the memory [116]. The IPAQ-SF was shown to overestimate levels of physical activity by 84% on average and its use as an indicator of relative or absolute physical activity is weak [84]. Lastly, our study sample consists of Syrian mothers and children under five years attending primary healthcare centers in the most vulnerable areas of Greater Beirut and thus the results cannot be generalized to all Syrian refugees in Lebanon. In the context of this study, a randomized recruitment strategy through the UNCHR could have been more representative of Greater Beirut, yet a convenience sample was selected in order to avoid coercion due to offered benefits to registered refugees and fear related to their legal residency status. One of the strengths of this study is the inclusion of unregistered Syrian refugees and displaced persons in the study population. The number of unregistered Syrian refugees may have increased in Lebanon due to the governmental decision in 2015 to suspend registration of Syrian refugees by the UHNCR or to other associated barriers to

obtain legal residency [70,71]. Recruitment took place in primary healthcare centers where patients come freely, without expectations, to participate in vaccination campaigns and/or benefit from other health services. Therefore, our sample population is representative of Syrian refugee mothers attending primary healthcare centers in Greater Beirut. Our population group, mothers with children under five years in a highly vulnerable setting, represents a group of interest for international humanitarian assistance and policy makers at national and regional levels, especially as the number of refugees and displaced people might increase rapidly with current economic crises.

5. Conclusions

This study highlights the co-existence of overweight, obesity, and anemia among women of reproductive age as well as undernutrition among children under five years within the same households. Evidence on poor dietary intake and nutritional inadequacies of Syrian refugee mothers during pregnancy and lactation is also presented. Findings from this study can serve as a basis for culture-specific interventions, long-term strategies, and policies to protect and promote maternal and child nutrition for refugees in Lebanon and neighboring countries. The burden of malnutrition and nutritional inadequacies calls for immediate double-duty actions and reforms in order to alleviate poverty and food insecurity and promote more decent and sustainable livelihoods for Syrian refugees [117]. Culture-specific interventions to improve the nutritional status of women of reproductive age and children are crucial, in addition to efforts to protect and promote breastfeeding [16,17]. Family planning services should be intensified to allow the replenishment of nutrient stores by the promotion of birth spacing, reduction of unplanned pregnancies, and receiving adequate nutrition during pregnancy that is essential for the mothers and their offspring's health and wellbeing [69,109]. Further research is still needed to explore the determinants of the double burden of malnutrition and anemia among refugee women and children in countries affected by protracted conflicts and displacement.

Author Contributions: J.A.-R., T.J., and V.S. conceptualized the research design and led the parent study. L.N., L.J., and N.H. provided support in designing the parent study. J.A.-R., T.J., V.S., and L.N. sought after ethics approval. J.A.-R. and T.J. organized, implemented, and supervised the study during data collection and entry. H.T. provided support in biostatistics and assistance through the MRVP program during data collection. J.A.-R. conducted data analysis, conceptualized, and wrote the original draft of the manuscript. T.J., V.S., L.N., L.J., and N.H., and J.F. critically reviewed the manuscript. All authors have read and agreed to the published version of the manuscript.

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Institutional Review Board Statement: The study was conducted according to the guidelines of the Declaration of Helsinki, and approved by the Institutional Review Board (IRB) of the Freiburger Independent Ethics Committee (FEKI) in Germany (FEKI code: 017/1434) and the IRB for Social and Behavioral studies at the American University of Beirut (AUB) in Lebanon (IRB ID: SBS-2017-0294) prior to the onset of the study. The Primary Health Care Department of the MoPH in Lebanon granted a letter of approval to access to the PHCC which are part of the National PHC Network overseen by the MoPH in Greater Beirut. Approval letters were also obtained from the directors of PHCC selected for the survey prior accessing their premises.

Informed Consent Statement: Written informed consent was obtained from all participants' prior enrollment in the study. When mothers below 18 years were identified, a parental consent and an informed assent were sought. In case the mother was illiterate, a witness or the nurse signed on her behalf after reading and explaining the consent form to the participant. Confidentiality was

assured to the participants by assigning random identifiers and allowing access to the data only to the investigators.

Data Availability Statement: Dataset analyzed during this study are available from the corresponding author on reasonable request.

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Appendix A

Table A1. Dietary Reference Intakes (DRIs) for macro- and micronutrients women of reproductive age according to their reproductive status.

	Pregnant Mothers	Lactating Mothers	Non-Pregnant Non-Lactating Mothers
Energy and macronutrients			
Energy (kcal/d)	2200–2652	2600–2700	2200
Carbohydrates (%EI/d)	45–65	45–65	45–65
Protein (%EI/d)	10–35	10–35	10–35
Total fat (%EI/d)	20–35	20–35	20–35
MUFA (%EI/d)	15–20	15–20	15–20
Linoleic acid (%EI/d)	5–10	5–10	5–10
Linolenic acid (%EI/d)	0.6–1.2	0.6–1.2	0.6–1.2
PUFA (%EI/d)	6–11	6–11	6–11
SFA (%EI/d)	8–10	8–10	8–10
TFA (%EI/d)	<1	<1	<1
Cholesterol (mg/d)	<200	<200	<200
Total sugar (%EI/d)	<10	<10	<10
Macronutrients			
Carbohydrates (g/d)	175	210	130
Protein (g/d)	71	71	46
Linoleic acid (g/d)	13 *	13 *	11–12 *
Linolenic acid (g/d)	1.4 *	1.3 *	1.1 *
Fibers (g/d)	28 *	29 *	25–26 *

Table A1. Cont.

	Pregnant Mothers	Lactating Mothers	Non-Pregnant Non-Lactating Mothers
Micronutrients			
Iron (mg/d)	27	9–10	15–18
Folate (µg/d)	600	500	400
Vitamin B12 (µg/d)	2.6	2.8	2.4
Vitamin C (mg/d)	80–85	115–120	65–75
Vitamin A (µg/d)	750–770	1200–1300	700
Vitamin D (µg/d)	15	15	15
Vitamin E (mg/d)	15	19	15
Vitamin K (µg/d)	75–90 *	75–90 *	75–90 *
Thiamin (mg/d)	1.4	1.4	1–1.1
Riboflavin (mg/d)	1.4	1.6	1–1.1
Niacin (mg/d)	18	17	14
Pantothenic acid (mg/d)	6 *	7 *	5 *
Vitamin B6 (mg/d)	1.9	2	1.2–1.3
Zinc (mg/d)	11–12	12–13	8–9
Copper (mg/d)	1	1.3	0.9
Calcium (mg/d)	1000–1300	1000–1300	1000–1300
Magnesium (mg/d)	350–400	310–360	310–360
Sodium (mg/d)	1500 *	1500 *	1500 *
Potassium (mg/d)	4700 *	5100 *	4700 *
Phosphorus (mg/d)	700–1250	700–1250	700–1250
Manganese (mg/d)	2.0 *	2.6 *	1.6–1.8 *
Selenium (µg/d)	60	55	70

d: day; %EI: percent energy intake; MUFA: monounsaturated fatty acids; PUFA: polyunsaturated fatty acids; SFA: saturated fatty acids; TFA: trans-fatty acids. Dietary Reference Intakes (DRIs) refers to the Recommended Dietary Allowances (RDAs), Adequate Intakes (AIs), and Acceptable Macronutrient Distribution Ranges (AMDRs) for energy and macro- and micronutrients as recommended by the Institute of Medicine [47,48]. RDAs are presented in **bold type** and AIs in ordinary types followed by an asterisk (*). Intakes of MUFA, PUFA, SFA, and TFA were analyzed based on the FAO recommendations [49]. Cholesterol intake was assessed based on the criteria of the National Institute of Health [50]. The reference intake of total sugar was based on the WHO recommendation [51].

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4

Chapter 4

Food Insecurity, Low Dietary Diversity, and Poor Mental Health Among Syrian Refugee Mothers Living in Vulnerable Areas of Greater Beirut, Lebanon

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Food insecurity, low dietary diversity and poor mental health among Syrian refugee mothers living in vulnerable areas of Greater Beirut, Lebanon

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Abstract

Syrian refugees in Lebanon are facing vulnerabilities that are affecting their food insecurity (FI) levels. The objectives of this study were to measure dietary diversity, FI and mental health status of Syrian refugee mothers in Lebanon and to explore its associations with their anaemia and nutritional status. A cross-sectional study was conducted among mothers with children under 5 years (n 433) in Greater Beirut, Lebanon. Dietary diversity was measured using the Minimum Dietary Diversity for Women (MDD-W) of reproductive age and FI using the global Food Insecurity Experience Scale at the individual level. Depression and post-traumatic stress disorder (PTSD) were measured to assess the maternal mental health status. Data on socio-economic characteristics, anthropometric measurements and Hb concentrations were collected. Overall, 63.3 % of the mothers had a low dietary diversity (LDD) and 34.4 % were moderately to severely food insecure, with 12.5 % being severely food insecure. The prevalence of PTSD, moderate depression and severe depression was 13.2, 11.1 and 9.9 %, respectively. A significant correlation was found between LDD and FI ($P < 0.001$). Low income was significantly associated with LDD and FI. Poor mental health was significantly associated with FI. LDD and FI were not associated with anaemia and nutritional status of mothers. Low-income households had significantly higher intakes of grains and refined starchy staples, whereas high-income households consumed more nutritious foods and sweets. Evidence of inadequate diet quality, FI and poor mental health among Syrian refugee mothers in Lebanon is presented. Multifaceted actions are needed to reduce FI and improve dietary diversity.

Key words: Dietary diversity: Food insecurity: Food consumption: Mental health: Syrian refugees: Lebanon

The eradication of hunger, achieving food security and promoting adequate nutrition, is the ultimate aim of the Sustainable Development Goal 2, yet it remains a major challenge worldwide⁽¹⁾. Since 1996, food security is declared a human right and ‘exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life’⁽²⁾. Food insecurity (FI) and malnutrition continue to affect hundreds of million people and may be both a cause and a consequence of conflicts and protracted crises^(3–5). While hunger may be associated with severe FI, moderate FI reflects uncertainties about the ability to obtain food and may compromise diet quality and diversity^(6,7).

Food-coping strategies may be employed to decrease food consumption in the face of emerging shortfalls⁽⁸⁾. Households may resort to rationing strategies such as reducing the number of meals, limiting portion sizes, restricting consumption by adults

in favour of children or even skipping entire days without eating. Other strategies involve dietary changes such as eating fewer kinds of food groups and relying on less preferred or inexpensive foods⁽⁹⁾. As households and individuals may attempt to cope with household FI, women may be particularly consuming a more monotonous diet and be exposed to a higher risk of malnutrition due to the maternal buffering to feed children first, their roles within households and sex inequalities within societies. Intra-household differences in food allocation and choices may be masked by the measure of FI at the household level, indicating a need to assess at the individual level⁽⁷⁾. In fact, the perception of the concept of ‘being out of food’ is different between men and women. While men tend to interpret it as not being able to feed the family, women associate it more with a monotonous diet⁽¹⁰⁾.

Poor dietary diversity has an exacerbating effect on the nutritional status of children and women of reproductive

Abbreviations: EAR, estimated average requirement; % EI, percentage energy intake; FI, food insecurity; FIES, Food Insecurity Experience Scale; LDD, low dietary diversity; LM, lactating mother; MDD-W, Minimum Dietary Diversity for Women; NPNLM, non-pregnant non-lactating mother; PHCC, primary healthcare centre; PM, pregnant mother; PTSD, post-traumatic stress disorder; WFP, World Food Programme.

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age, particularly pregnant mother (PM) and lactating mother (LM)^(6,11). Proper nutrition during the first 1000 d, since conception to the child's second birthday, lays the foundations for optimal growth and healthy life for more than just a generation^(12–14). Paradoxically, undernutrition and overweight can both emerge from FI and poverty⁽⁷⁾. This paradox exists due to the compromise in the diet quality by consuming foods with higher energy density, often less expensive, rather than foods with higher nutrient density, which contributes to nutrient inadequacies and excessive energy intake^(15,16). Furthermore, FI and depression have been previously linked in many contexts⁽¹⁷⁾. Feelings of deprivation, anxiety and poor mental health may emerge due to the struggle to provide food regularly in the context of poverty^(7,18). Poor maternal mental health may ultimately have a negative effect on caregiving and the child's development, especially in low socio-economic contexts^(19–21).

More than a decade ago, the *Arab Spring* surged in the Middle East and North Africa region with poverty and FI being the main drivers and outcomes of the protests and wars that followed^(22,23). The Syrian war, a protracted conflict that is currently in its eleventh year, remains one of the major challenges of the twenty-first century, with more than 5.5 million refugees still residing in neighbouring countries, including Lebanon, Turkey, Jordan, Egypt and Iraq^(23,24). Lebanon hosts more than 1.5 million Syrians and remains the country with the highest refugee per capita concentration worldwide⁽²⁵⁾. Despite large-scale assistance programmes, about half of the Syrian refugee households in Lebanon were living in extreme poverty in 2018 and 2019. They continue to face tremendous challenges that affect their FI status and increase vulnerabilities associated with their legal status, restricted mobility, access to services and limited employment opportunities⁽²⁶⁾. With few informal settlements in Greater Beirut, the vast majority of Syrian refugees are living in rented accommodation⁽²⁷⁾ and are suffering from high costs of living, household debts and dependency on food assistance (e-vouchers). Recent findings among Syrian refugee mothers in Greater Beirut showed that high levels of overweight and obesity coexist with anaemia, in addition to poor maternal diet and nutritional inadequacies⁽²⁸⁾.

Despite numerous surveys conducted annually by the UN High Commission on Refugees (UNHCR) and the World Food Programme (WFP) on the household level of FI and food consumption among Syrian refugees in Lebanon⁽²⁵⁾, limited data explore FI at the individual level and dietary diversity among female refugees in urban settings of a humanitarian crisis. The present study aims to: (1) assess the prevalence of FI, maternal low dietary diversity (LDD) and poor mental health of Syrian refugee mothers of children under 5 years, (2) explore the associations between dietary diversity, FI, mental health, anaemia and nutritional status of mothers and (3) examine the consumption food groups according to household monthly income among Syrian refugee mothers in Greater Beirut following years into the crisis.

Methods

Study design and sampling method

A cross-sectional survey was carried out in July–September 2018 among Syrian refugee mothers with at least one child below

5 years living in vulnerable areas of Greater Beirut, Lebanon. A two-step purposeful sampling was used to select primary healthcare centres (PHCC) in localities in Greater Beirut with the highest vulnerability level⁽²⁹⁾, which included Baouchriyeh, Bourj Barajneh, Bourj Hammoud, Chiyah, Mazraa and Mousaytbeh. Greater Beirut is considered to be the melting pot of the country; therefore, the catchment area of PHCC in Greater Beirut covers the capital city Beirut and adjacent urban surroundings of Mount Lebanon Governorate⁽³⁰⁾. Inclusion criteria included women of reproductive age (15–49 years) from Syrian households with at least one child (0–59 months) that is not suffering from any inborn errors of metabolism or physical malformations. Mother–child dyads were identified through three approaches, via: (1) the nurses at PHCC, (2) direct contact by the research assistant in the waiting rooms and (3) flyers with a brief description of the study made available in PHCC locations. A detailed methodology of this survey has been described elsewhere⁽²⁸⁾.

The present study is part of a larger cross-sectional survey among Syrian refugee mothers and their children under 5 years in Greater Beirut that explored anaemia as one of the key outcomes. Sample size calculations were based on previous estimates of anaemia of 26.1 % among Syrian refugee women in Lebanon⁽³¹⁾. A minimum of 296 participants were needed to provide a power of 80 % and a margin of error of 5 % at 95 % CI. Accounting for a study design effect of 1.5, non-response rate of 15 % and dropout rate of 10 %, we aimed for a sample size of 555 mothers. Out of the 665 women approached, 590 mothers with at least one child under the age of 5 years from Syrian households were eligible and 489 mothers (82.9 %) consented to participate in the survey. A total of 433 mothers (88.6 %) completed the interview and were included in the present study.

Ethical approval and consent to participate

The original study was approved by the Institutional Review Board for Social and Behavioral studies at the American University of Beirut in Lebanon (IRB ID: SBS-2017-0294) and the Freiburg Ethics Commission International in Germany (FEKI code: 017/1434). The Primary Health Care (PHC) Department at the Ministry of Public Health (MoPH) granted with an approval letter access to PHCC in Greater Beirut, which is part of the National PHC Network overseen by the MoPH. Directors of PHCC selected for the survey also granted approval letters prior accessing their premises. Consent forms and questionnaires written in North Levantine Arabic dialect were used. Written informed consent was obtained prior enrolment in the study, and a copy of the consent form was given to each participant. A parental consent and an informed assent were sought from mothers aged below 18 years. In case of illiteracy, a witness or the nurse on duty signed on the behalf of the participant after reading and explaining the consent form. Confidentiality and voluntary participation were assured by the data collectors by assigning random identifiers and allowing access to the data only to the investigators.

Data collection

A culture-specific multi-component questionnaire was carried out during face-to-face interviews by Collaborative Institutional

Training Initiative certified and well-trained enumerators. Data quality control was performed on a regular basis to ensure an increased accuracy of data and to limit risks of reporting bias. Data on socio-economic and household characteristics such as parents' education level and employment status, household monthly income, size of the household, registration with the UNHCR as refugees, receiving food assistance (e-vouchers) from the WFP and healthcare services utilisation were collected. Mental health status of mothers was assessed using the Patient Health Questionnaire-9 to measure depression⁽³²⁾, validated among Lebanese adults⁽³³⁾ and the Arabic version of the Mini International Neuropsychiatric Interview (MINI) to measure post-traumatic stress disorder (PTSD)⁽³⁴⁾. Crowding index was defined as the total number of co-residents per household divided by the number of rooms, excluding kitchens, bathrooms, hallways, balconies and garage⁽³⁵⁾. The income group classification was based on the legal minimum wage in Lebanon, approximately equal to 675 000 LBP (450 USD in 2018)⁽³⁶⁾. Therefore, low-income household was defined as $\leq 750\,000$ LBP and high-income household as $> 750\,000$ LBP (500 USD in 2018).

FI was measured at the individual level for the mother using the global Food Insecurity Experience Scale. The prevalence of moderate and severe FI in the total study population represents the Sustainable Development Goal indicator 2.1.2. The Food Insecurity Experience Scale generates two indicators, the FI prevalence rates at the moderate and severe level and at the severe level only, by computing the probability of being food insecure for each individual⁽³⁷⁾. The probability of belonging to a food security class was extracted to be used in the analysis as such: probability of being moderately and severely food insecure and probability of being severely food insecure. Food Insecurity Experience Scale was internally validated using statistical methods based on the Rasch measurement model. The development of the score and validation process is published elsewhere^(38,39).

Anthropometric and biochemical assessment

Mid-upper arm, waist and hip circumference were measured among mothers with light clothing using a non-elastic measuring tape (SECA 201). An average of two measurements was recorded to the nearest decimal using standardised protocols⁽⁴⁰⁾. The classification of malnutrition using the mid-upper arm circumference was applied for all mothers as follows: < 23.0 cm for undernourished, $23.0\text{--}27.9$ cm for normal weight and ≥ 28.0 cm for overweight and obese mothers^(41–44). For non-PM, the BMI was computed as the weight (kg) divided by the height squared (m^2). BMI classification was categorised into two groups 'Underweight' ($\text{BMI} < 18.5 \text{ kg/m}^2$), 'Normal weight' ($\text{BMI} 18.5\text{--}24.9 \text{ kg/m}^2$) and 'Overweight/Obese' ($\text{BMI} \geq 25.0 \text{ kg/m}^2$)⁽⁴⁵⁾. Hb concentrations were measured using the 'HemoCue Hb301 System' by certified phlebotomists. The accuracy of the measurement was routinely ensured with the use of control solutions. A small drop of blood was collected by conducting a finger prick on mothers. Anaemia cut-offs were defined using the WHO criteria. Total anaemia was set at $\text{Hb} < 12.0 \text{ g/dl}$ for non-pregnant non-lactating and LM and at $\text{Hb} < 11.0 \text{ g/dl}$ for PM at sea level⁽⁴⁶⁾.

Dietary assessment

Data were collected on the characteristics of daily meal patterns and the dietary intake of the mother using two dietary assessment methods: (1) a 24-h dietary recall during the previous day and (2) a FFQ during the past 12 months. The 24-h dietary recall was used for the assessment of maternal dietary diversity and nutrient inadequacies, whereas the FFQ method was used to assess the percentage contribution of food groups to total energy consumption. Both dietary assessment methods were conducted by trained nutritionists using the 2D food portion visual⁽⁴⁷⁾ and standardised reference portions to facilitate the collection of dietary data and ensure standardisation. The five-step multiple-pass 24-h dietary recall method was used to assess the dietary intake during the previous day, which included the following steps: (1) start with a quick uninterrupted listing of foods by the interviewee, (2) probe for forgotten foods list, (3) collect the time and occasion, (4) gather a comprehensive description of foods and amounts eaten in the detailed cycle and (5) end with a final probe review^(48,49). Furthermore, a ninety-four-item semi-quantitative context-specific FFQ, validated among adults in Lebanon⁽⁵⁰⁾, was used to assess the dietary intake of mothers over the past 12 months. Dietary data stemming from the FFQ were combined into numerous food groups and subgroups in order to examine their contribution to the percentage energy intake (% EI). Dietary data were analysed using the United States Department of Agriculture (USDA) database (SR 28, version: May 2016) which was complemented with single food items from local food composition tables available for specific Lebanese foods, given the similarities between Eastern Mediterranean cuisines^(51,52). Standardised recipes were added to analyse composite and traditional Lebanese and Syrian dishes. NutriSurvey 2007 software was used for the analysis of macro- and micronutrients' intake from the 24-h recalls⁽⁵³⁾.

Minimum Dietary Diversity for Women of reproductive age

Based on the 24-h dietary recalls, maternal dietary diversity was assessed using the Minimum Dietary Diversity for Women (MDD-W) of reproductive age. Food items were aggregated into sixteen food groups as follows: (1) grains, white roots and tubers, (2) pulses (beans, peas and lentils), (3) nuts and seeds, (4) dairy products, (5) meat, poultry and fish, (6) eggs, (7) dark green leafy vegetables, (8) other vitamin A-rich fruits and vegetables, (9) other vegetables, (10) other fruits, (11) other oils and fats, (12) fried and salty foods, (13) sweet foods, (14) sugar-sweetened beverages, (15) condiments and seasonings and (16) other beverages and foods. Food items consumed in very small quantities ($< 15 \text{ g}$) were placed in the 'Condiments and seasonings' category. Sweetened coffees, teas and milk were placed in the 'Sweetened beverages' category. Mixed and traditional dishes (e.g. stews, soups, vegetable dishes, sandwiches) were carefully evaluated to classify main ingredients consumed in large quantities in their respective food groups and minor ingredients to other groups such as groups 11 and/or 15. Composite dishes and food items (e.g. bread, pizza, porridge, fried savoury, sweets and pastries, sweet drinks) were assigned to a single food group based on the major ingredient. Food group diversity score was

computed by summing up the first ten MDD-W food groups consumed yesterday into a score ranging from 0 to 10. The MDD-W indicator defined achieving MDD-W as a food group diversity score ranging from 5 to 10 and LDD as not achieving MDD (< 5 food groups yesterday)⁽¹¹⁾.

Nutrient inadequacies

Nutrient intakes stemming from the 24-h dietary recalls were used to assess the prevalence of inadequate intakes by comparing the intakes of a nutrient to the estimated average requirements (EAR) according to the Institute of Medicine. The EAR is the average daily nutrient intake level estimated to meet the requirements of half of the mothers according to their age and reproductive status groups (pregnant, lactating or non-pregnant non-lactating). The adequate intake was used in the absence of an EAR, as for dietary fibres⁽⁵⁴⁾. The analysed micronutrients represent those for which the MDD-W indicator was validated against⁽¹¹⁾. Further analysis was conducted using the criterion of two-thirds of the Dietary Reference Intakes which has been commonly used by researchers as a target⁽⁵⁵⁾ and in previous national studies in Lebanon^(56–58). Dietary Reference Intakes refer to the RDA and adequate intakes for selected macro- and micronutrients⁽⁵⁴⁾. This criterion represents the proportion of mothers failing to meet two-thirds of the RDA or adequate intake for key macro- and micronutrients taking into account their age and reproductive status.

Statistical analysis

Data entry was completed with the support of Kobo Technology provided by Harvard Humanitarian Institute⁽⁵⁹⁾. Data analysis was carried out using the Statistical Package for Social Sciences, version 27.0 (SPSS Inc.). Descriptive statistics were expressed as mean and standard deviation for continuous variables or as number of subjects and percentages (n , %) for nominal variables. Reproductive status of the mother was categorised as PM, non-pregnant LM and non-pregnant non-lactating mothers (NPNLM). Associations were investigated between the reproductive status of the mother and the MDD-W indicator and food group diversity score using χ^2 test for categorical variables and one-way ANOVA test to compare means. Simple and multiple binary logistic regressions were used to examine the association between maternal LDD (dependent variable) and socio-economic and household characteristics, healthcare service utilisation, anaemia, nutritional and mental health status of the mothers, daily meal patterns of mothers and nutrient inadequacies. Regression models were assessed for significance by evaluating the R^2 , overall percentage and Hosmer and Lemeshow test. Crude odds were expressed as OR and adjusted OR as aOR with 95 % CI. Point biserial and Pearson's correlation tests were used to examine the association between the probability of being food insecure and key variables in the study. Independent-samples t test was used to examine the associations between the main food groups and subgroups from the FFQ and the low- and high-income group. Statistical significance was defined as P -value < 0.05 . Correlation coefficients, tolerance, variance inflation factors and the condition index were used to measure multicollinearity on all the independent variables.

Results

A total of 433 subjects were included in the final analysis of the study, of which 17.8 % were PM, 35.1 % NPNLM and 47.1 % LM. The prevalence of moderate and severe FI in the total study population was 34.4 % (SD 0.1), whereby the prevalence of severe FI reached 12.5 % (SD 0.1). No significant differences were found between the prevalence of FI and the reproductive status groups of mothers (data not shown in table). Nearly two out of three Syrian refugee mothers had a LDD (63.3 %) in the present study, while only 36.7 % of the mothers achieved MDD-W. On average, mothers with LDD consumed 3.2 (SD 0.8) food groups per day, while mothers with MDD-W consumed 5.6 (SD 0.8) food groups, with scores ranging from 1 to 9 food groups (Table 1).

As shown in Table 1, the MDD-W indicator and food groups consumed yesterday by mothers were presented according to their reproductive status and based on the 24-h dietary recalls. Overall, no significant differences in the MDD-W indicator were observed among PM, LM and NPNLM. Nearly two-thirds of the mothers consumed less than five food groups over the previous day (PM: 62.3 %, LM: 62.7 %, NPNLM: 64.5 %), with an average consumption of 4.1 (SD 1.4) food groups. Almost all mothers in the study sample consumed grains, white roots and tubers (99.5 %). Sugar-sweetened beverages (82.0 %) and oils and fats (79.7 %) were consumed by a majority and nearly half of the mothers had eaten sweets (42.7 %) during the previous day. The consumption of fruits and vegetables was reportedly high (86.8 %); however, dark green leafy vegetables and vitamin A-rich fruits and vegetables were rarely included in their diet (11.8 and 13.4 %). Mothers consumed largely other vegetables (74.8 %) and moderately other fruits (39.0 %). Similarly, animal-source foods were widely consumed (86.6 %), yet less than 50 % ate meat, poultry and fish (44.6 %) or eggs (29.8 %) while dairy products were more prevalent in their diet (68.4 %). The lowest consumption was observed for pulses, nuts and seeds (27.3 %) among all mothers. LM consumed more dairy products and other beverages and foods than PM and NPNLM, while PM had a higher intake of eggs as compared with LM and NPNLM ($P < 0.05$). Furthermore, even though it did not reach a statistical difference, a higher proportion of LM consumed sweets, sugar-sweetened beverages, other fats and oils, as compared with PM and NPNLM.

Nutrient inadequacies of key macro- and micronutrients according to maternal LDD, based on 24-h dietary recalls, are shown in Table 2. High prevalence of inadequate intakes was found among mothers for proteins, fibres, folate, vitamins B₁₂, B₆, C and A, Zn and Ca ranging from 70.8 to 89.6 %. Moreover, more than half of the mothers did not meet the EAR for riboflavin (64.7 %), Fe (59.5 %) and niacin (55.7 %). Simple regressions showed that maternal LDD was significantly associated with nutrient inadequacies ($< \text{EAR}$) for key vitamins, minerals and macronutrients studied. After adjusting for the energy intake of mothers, significant associations between LDD and nutritional inadequacies persisted for vitamins B₁₂, C and A and riboflavin. The odds of nutrient inadequacies increased by two to three times among mothers with LDD as compared with mothers who achieved MDD-W. Further analysis displaying the proportion of mothers failing to meet two-thirds of



**Table 1.** MDD-W indicator among Syrian mothers according to their reproductive status based on 24-h dietary recalls (Mean values and standard deviations)

Variables*	Pregnant mothers <i>n</i> 77		Lactating mothers <i>n</i> 204		NPNLM <i>n</i> 152		Total <i>n</i> 433		<i>P</i> †
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	
MDD-W indicator									
Food group diversity score‡									
Mean		4.17		4.19		4.04		4.13	0.591
SD		1.5		1.4		1.3		1.4	
MDD-W indicator§									
LDD (< 5 out of 10 food groups)	48	62.3	128	62.7	98	64.5	274	63.3	
MDD-W (≥ 5 out of 10 food groups)	29	37.7	76	37.3	54	35.5	159	36.7	0.929
Consumption of nutrient-rich food groups									
Pulses, nuts and seeds	22	28.6	52	25.5	44	28.9	118	27.3	0.738
Animal-source foods¶	65	84.4	185	90.7	125	82.2	375	86.6	0.056
Fruits and vegetables**	68	88.3	171	83.8	137	90.1	376	86.8	0.201
MDD-W food groups consumed on the day before the interview									
1. Grain, white roots and tubers	77	100.0	204	100.0	150	98.7	431	99.5	0.156
2. Pulses (beans, peas and lentils)	15	19.5	41	20.1	30	19.7	86	19.9	0.992
3. Nuts and seeds	11	14.3	20	9.8	22	14.5	53	12.2	0.344
4. Dairy	51	66.2	152	74.5	93	61.2	296	68.4	0.025
5. Meat, poultry and fish	27	35.1	97	47.5	69	45.4	193	44.6	0.166
6. Eggs	29	37.7	66	32.4	34	22.4	129	29.8	0.031
7. Dark green leafy vegetables	7	9.1	24	11.8	20	13.2	51	11.8	0.666
8. Other vitamin A-rich fruits and vegetables	9	11.7	27	13.2	22	14.5	58	13.4	0.839
9. Other vegetables	58	75.3	154	75.5	112	73.7	324	74.8	0.922
10. Other fruits	37	48.1	70	34.3	62	40.8	169	39.0	0.094
11. Other oils and fats	58	75.3	170	83.3	117	77.0	345	79.7	0.195
12. Fried and salty foods	8	10.4	14	6.9	12	7.9	34	7.9	0.618
13. Sweet foods	28	36.4	95	46.6	62	40.8	185	42.7	0.254
14. Sugar-sweetened beverages	61	79.2	171	83.8	123	80.9	355	82.0	0.612
15. Condiments and seasonings	67	87.0	170	83.3	131	86.2	368	85.0	0.652
16. Other beverages and foods	22	28.6	98	48.0	67	44.1	187	43.2	0.013

MDD-W, Minimum Dietary Diversity for Women; NPNLM, non-pregnant non-lactating mothers; LDD, low dietary diversity.

* Categorical variables are expressed as *n* (%) and continuous variables are expressed as mean values and standard deviations.

** The variable 'fruits and vegetables' is the sum of food groups 7, 8, 9 and 10.

† Significantly different at *P*-value <0.05; *P*-value was derived using one-way ANOVA test for continuous variables and χ^2 analysis for categorical variables.

‡ Food group diversity score is the sum of the first ten MDD-W food groups consumed yesterday.

§ The MDD-W indicator defined LDD as a food group diversity score <5 and MDD-W as ≥5 out of ten food groups.

|| The variable 'pulses, nuts and seeds' is the sum of food groups 2 and 3.

¶ The variable 'animal-source foods' is the sum of food groups 4, 5 and 6.

the RDA or adequate intake for key macro- and micronutrients is shown in online Supplementary Table S1. Findings showed a high prevalence of nutrient intake below two-thirds of Dietary Reference Intake for the majority of the studied macro- and micronutrients. After adjusting for energy, significant associations remained between LDD and intake below two-thirds of Dietary Reference Intake for a wide array of vitamins and minerals as well as protein and dietary fibres.

Key determinants of LDD among Syrian mothers of children under 5, including socio-economic and household characteristics, healthcare service utilisation, maternal daily meal pattern, anaemia and nutritional status, are presented in Table 3. Simple logistic regression analysis showed that LDD among mothers was significantly associated with mother's education, father's employment status, household monthly income, UNHCR registration status as a refugee, being a beneficiary of WFP food assistance, crowding index score, mother's use of micronutrient supplements, number of antenatal care visits during the previous pregnancy and sources of health and nutrition messages from healthcare professionals ($P < 0.05$). Using the multiple logistic regression model, mothers in households with

a monthly income ≤ 750 000 LBP had a two times higher odds of having LDD (aOR = 2.09; 95 % CI 1.19, 3.67) than those in households with a higher income. In addition, LDD was significantly associated with higher odds of being registered as a refugee with the UNHCR (aOR = 2.13; 95 % CI 1.07, 4.24), receiving WFP food assistance (e-vouchers) (aOR = 3.70; 95 % CI 1.09, 12.53) and a higher crowding index score (aOR = 1.32; 95 % CI 1.07, 1.64). On the other hand, mothers with LDD were less likely to use micronutrient supplements (aOR = 0.49; 95 % CI 0.27, 0.88). LDD was also inversely associated with receiving health and nutrition messages from a community healthcare worker and from multiple healthcare professionals (aOR = 0.27; 95 % CI 0.08, 0.84 and aOR = 0.04; 95 % CI 0.00, 0.43, respectively) as compared with mothers who did not receive any messages. Mother's education, father's employment and number of antenatal care visits were no longer statistically significantly associated with LDD after adjusting for socio-economic variables. Mothers consuming a daily breakfast and a higher number of snacks per day were significantly less likely to have LDD ($P < 0.05$). No significant associations were found between maternal dietary diversity, anaemia and nutritional status of the mother.



Table 2. Nutrient inadequacy of key macro- and micronutrients according to maternal low dietary diversity based on 24-hour dietary recalls

Variables**	EAR†	MDD-W n=159	LDD n=274	Total (N=433)	Maternal Low Dietary Diversity			
					OR‡ (95% CI)	P	aOR§ (95% CI)	P
Macronutrient intake								
Protein (g/kg/d)	0.66–1.05							
≥ EAR		58 (36.7)	49 (17.9)	107 (24.8)	1.0		1.0	
< EAR		100 (63.3)	225 (82.1)	325 (75.2)	2.66 (1.70-4.17)	0.000	1.38 (0.82-2.32)	0.229
Carbohydrates (g/d)	100–160							
≥ EAR		132 (83.0)	169 (61.7)	301 (69.5)	1.0		1.0	
< EAR		27 (17.0)	105 (38.3)	132 (30.5)	3.04 (1.88-4.91)	0.000	1.40 (0.78-2.51)	0.260
Fibers (g/d)	25–29*							
≥ AI		24 (15.2)	21 (7.7)	45 (10.4)	1.0		1.0	
< AI		134 (84.8)	253 (92.3)	387 (89.6)	2.16 (1.16-4.02)	0.015	0.74 (0.35-1.56)	0.430
Micronutrient intake								
Iron (mg/d)	6.5–23							
≥ EAR		86 (54.4)	89 (32.5)	175 (40.5)	1.0		1.0	
< EAR		72 (45.6)	185 (67.5)	257 (59.5)	2.48 (1.66-3.71)	0.000	1.30 (0.80-2.10)	0.290
Folate (µg/d)	320–520							
≥ EAR		28 (17.7)	18 (6.6)	46 (10.6)	1.0		1.0	
< EAR		130 (82.3)	256 (93.4)	386 (89.4)	3.06 (1.63-5.74)	0.000	1.57 (0.79-3.13)	0.200
Vitamin B12 (µg/d)	2.0–2.4							
≥ EAR		42 (26.4)	22 (8.0)	64 (14.8)	1.0		1.0	
< EAR		117 (73.6)	252 (92.0)	369 (85.2)	4.11 (2.35-7.20)	0.000	3.08 (1.70-5.56)	0.000
Vitamin C (mg/d)	56–100							
≥ EAR		68 (43.0)	58 (21.2)	126 (29.2)	1.0		1.0	
< EAR		90 (57.0)	216 (78.8)	306 (70.8)	2.81 (1.83-4.32)	0.000	1.96 (1.24-3.11)	0.004
Vitamin A (µg/d)	485–900							
≥ EAR		34 (21.5)	23 (8.4)	57 (13.2)	1.0		1.0	
< EAR		124 (78.5)	251 (91.6)	375 (86.8)	2.99 (1.69-5.30)	0.000	2.33 (1.27-4.26)	0.006
Thiamin (mg/d)	0.9–1.2							
≥ EAR		102 (64.2)	135 (49.3)	237 (54.7)	1.0		1.0	
< EAR		57 (35.8)	139 (50.7)	196 (45.3)	1.84 (1.23-2.75)	0.003	0.83 (0.51-1.37)	0.471
Riboflavin (mg/d)	0.9–1.3							
≥ EAR		91 (57.2)	62 (22.6)	153 (35.3)	1.0		1.0	
< EAR		68 (42.8)	212 (77.4)	280 (64.7)	4.58 (3.00-6.98)	0.000	2.97 (1.83-4.81)	0.000
Niacin (mg/d)	11–14							
≥ EAR		96 (60.4)	96 (35.0)	192 (44.3)	1.0		1.0	
< EAR		63 (39.6)	178 (65.0)	241 (55.7)	2.82 (1.89-4.23)	0.000	1.44 (0.87-2.38)	0.157
Vitamin B6 (mg/d)	1.0–1.7							
≥ EAR		40 (25.3)	23 (8.4)	63 (14.6)	1.0		1.0	
< EAR		118 (74.7)	251 (91.6)	369 (85.4)	3.70 (2.12-6.46)	0.000	1.75 (0.92-3.32)	0.086
Zinc (mg/d)	8.5–10.9							
≥ EAR		23 (27.2)	27 (9.9)	70 (16.2)	1.0		1.0	
< EAR		115 (72.8)	247 (90.1)	362 (83.8)	3.42 (2.01-5.81)	0.000	1.66 (0.90-3.05)	0.105
Calcium (mg/d)	800–1100							
≥ EAR		27 (17.1)	23 (8.4)	50 (11.6)	1.0		1.0	
< EAR		131 (82.9)	251 (91.6)	382 (88.4)	2.25 (1.24-4.08)	0.008	1.06 (0.54-2.08)	0.861

LDD, low Dietary Diversity; EAR, estimated average requirements; MDD-W, Minimum Dietary Diversity for Women; aOR, adjusted OR; AI, adequate intake.

AI is presented in ordinary types followed by an asterisk (*)⁽⁵⁴⁾.

** Categorical variables are expressed as n(%).

† EAR is the average daily nutrient intake level estimated to meet the requirements of half of the mothers according to their age and reproductive status groups.

‡ OR of the dependent variable (MDD-W vs. LDD) are presented with 95% CI using simple logistic regression. aOR are presented with 95% CI using multiple logistic regression analysis.

§ Model 1: adjusted for total energy intake.

Statistical significance was defined as *P*-value < 0.05.

The mental health status of mothers according to maternal LDD and its associations are displayed in Table 4. The prevalence of PTSD was 13.2%, 16.2% for mild depression, 11.1% for moderate depression and 9.9% for severe depression. In total, 27.1% of the mothers suffered from PTSD and/or moderate/severe depression. Simple logistic regressions showed that mothers with PTSD, mild depression or severe depression had significantly higher odds of LDD (*P* < 0.05). Similarly, mothers with PTSD and/or moderate/severe depression combined had

1.6 times higher odds of LDD as compared with those not suffering from PTSD or depression. However, these associations did not remain significant after adjusting for socio-economic characteristics and maternal anaemia. Additional analysis showed that mothers with a higher crowding index had 1.2 times higher odds of suffering from PTSD and/or moderate/severe depression (aOR = 1.24, 95% CI 1.01, 1.52). Furthermore, a higher proportion of mothers suffering from the flu were found to have a crowding index higher than 2 as compared with those

**Table 3.** Key determinants of maternal low dietary diversity among Syrian mothers

Variables*	MDD-W	LDD	Maternal Low Dietary Diversity			
	n=159	n=274	OR** (95% CI)	P	aOR† (95% CI)	P
<i>Socio-economic characteristics</i>						
Mother's education level						
No schooling/Illiterate	20 (12.7)	50 (18.5)	1.0		1.0	
Primary, Intermediate school	84 (53.2)	165 (60.9)	0.78 (0.44–1.40)	0.416	0.87 (0.39–1.94)	0.727
Secondary school and higher	54 (34.2)	56 (20.7)	0.42 (0.22–0.79)	0.007	0.97 (0.38–2.45)	0.943
Father's employment status						
Full-time job/Self-employed	92 (58.6)	122 (46.9)	1.0		1.0	
No job/Part-time job	65 (41.4)	138 (53.1)	1.60 (1.07–2.39)	0.021	1.50 (0.89–2.55)	0.132
Monthly household income						
≤ 750,000 LBP	79 (53.4)	190 (72.2)	2.27 (1.49–3.46)	0.000	2.09 (1.19–3.67)	0.010
> 750,000 LBP	69 (46.6)	73 (27.8)	1.0		1.0	
UNHCR refugee registration status						
No	39 (25.3)	37 (13.7)	1.0		1.0	
Yes	115 (74.7)	234 (86.3)	2.14 (1.30–3.54)	0.003	2.13 (1.07–4.24)	0.031
Receiving WFP food assistance (e-vouchers)						
No	148 (96.7)	244 (90.4)	1.0		1.0	
Yes	5 (3.3)	26 (9.6)	3.15 (1.18–8.39)	0.021	3.70 (1.09–12.53)‡	0.035
Crowding index score (mean ± sd)	3.27 (1.2)	3.95 (1.8)	1.34 (1.17–1.55)	0.000	1.32 (1.07–1.64)	0.031
<i>Healthcare service utilization</i>						
Mother's use of micronutrients supplements						
No	99 (63.1)	200 (73.8)	1.0		1.0	
Yes	58 (36.9)	71 (26.2)	0.61 (0.39–0.93)	0.020	0.49 (0.27–0.88)	0.018
Number of antenatal care visits						
0 times	26 (16.7)	45 (16.6)	1.21 (0.70–2.08)	0.491	0.85 (0.42–1.73)	0.666
1 to 3 times	21 (13.5)	70 (25.8)	2.33 (1.35–4.02)	0.002	2.01 (1.00–4.02)	0.050
≥ 4 times	109 (69.9)	156 (57.6)	1.0		1.0	
Sources of health and nutrition messages from healthcare professionals only						
No healthcare professionals	105 (66.0)	203 (74.4)	1.0		1.0	
One healthcare professional§	36 (22.6)	57 (20.9)	0.82 (0.51–1.32)	0.414	0.72 (0.38–1.35)	0.309
Community healthcare worker	9 (5.7)	9 (3.3)	0.52 (0.20–1.34)	0.175	0.27 (0.08–0.84)	0.024
Multiple healthcare professionals	9 (5.7)	4 (1.5)	0.23 (0.07–0.76)	0.016	0.04 (0.00–0.43)	0.008
<i>Maternal daily meal pattern</i>						
Have breakfast every day						
No	37 (23.9)	91 (33.3)	1.0		1.0	
Yes	118 (76.1)	182 (66.7)	0.63 (0.40–0.98)	0.041	0.55 (0.31–0.99)	0.045
Number of main meals per day (mean ± sd)	2.19 (0.6)	2.08 (0.6)	0.73 (0.53–1.02)	0.067	0.54 (0.35–0.85)	0.008
Number of snacks per day (mean ± sd)	1.54 (1.0)	1.19 (1.0)	0.72 (0.59–0.88)	0.001	0.76 (0.59–0.99)	0.038
<i>Anemia and nutritional status of all mothers</i>						
Maternal anemia status						
Not anemic	122 (77.7)	214 (78.7)	1.0		1.0	
Anemic	35 (22.3)	58 (21.3)	0.94 (0.59–1.52)	0.814	1.17 (0.61–2.23)	0.643
Classification of malnutrition using MUAC						
Normal weight (23.0–27.9 cm)	47 (29.6)	99 (36.4)	1.0		1.0	
Undernourished (< 23.0 cm)	9 (5.7)	11 (4.0)	0.58 (0.22–1.50)	0.260	0.32 (0.10–1.03)	0.056
Overweight/Obese (≥ 28.0 cm)	103 (64.8)	162 (59.6)	0.75 (0.49–1.14)	0.179	0.82 (0.46–1.46)	0.503
<i>Nutritional status of non-pregnant mothers </i>						
	n=130	n=226	OR** (95% CI)		aOR¶ (95% CI)	
BMI for the mother (kg/m ²)						
Normal weight (18.5–24.9)	39 (30.0)	92 (40.7)	1.0		1.0	
Underweight (< 18.5)	4 (3.1)	5 (2.2)	0.53 (0.14–2.08)	0.363	0.58 (0.12–2.76)	0.492
Overweight/Obese (≥ 25.0)	87 (66.9)	129 (57.1)	0.63 (0.40–0.99)	0.049	0.69 (0.37–1.26)	0.226

LDD, low dietary diversity (< 5 out of 10 food groups); MDD-W, Minimum Dietary Diversity for Women (≥ 5 out of 10 food groups); WFP, World Food Programme; aOR, adjusted OR; PM, pregnant mothers.

* Categorical variables are expressed as n (%) and continuous variables are expressed as mean ± sd. Lack of corresponding sum of frequencies with total sample size is due to missing data.

** OR of the dependent variable (MDD-W vs. LDD) are presented with 95% CI using simple logistic regression.

† aOR are presented with 95% CI using multiple logistic regression analysis. Model 2: adjusted for age of the mother and child, sex of the child, reproductive status of the mother, marital status, education and employment status of the parents, household monthly income, crowding index, UNHCR registration status, perception of safety, receiving cash or food assistance, reliance on savings, household type, head of household, total number of under-five children, health insurance coverage, healthcare type, sources of health messages, the probability of being moderately and severely food insecure, and maternal anemia.

‡ Model 3: Model 2 without receiving cash or food assistance.

§ Healthcare professionals included physicians, nurses, dietitians, and pharmacists.

|| Non-PM include lactating mothers and non-pregnant non-lactating mothers.

¶ Model 4: Model 2 without the age/marital status/physiological status of the mother.

Statistical significance was defined as *P*-value < 0.05.



Table 4. Mental health status of Syrian mothers by maternal low dietary diversity and its associations

Variables*	MDD-W	LDD	Total**	Maternal Low Dietary Diversity			
<i>Mental health status of the mother</i>	<i>n=159</i>	<i>n=274</i>	<i>N=433</i>	OR† (95% CI)	<i>P</i>	aOR‡ (95% CI)	<i>P</i>
Current state of PTSD							
No	146 (91.8)	229 (83.9)	375 (86.8)	1.0		1.0	
Yes	13 (8.3)	44 (16.1)	57 (13.2)	2.16 (1.12–4.14)	0.021	1.47 (0.60–3.62)	0.405
Depression screening (PHQ-9)							
Minimal symptoms (< 5)	108 (71.1)	151 (57.9)	259 (62.7)	1.0		1.0	
Mild depression (5 to 9)	17 (11.2)	50 (19.2)	67 (16.2)	2.10 (1.15–3.84)	0.016	1.26 (0.57–2.81)	0.570
Moderate depression (10 to 14)	17 (11.2)	29 (11.1)	46 (11.1)	1.22 (0.64–2.33)	0.547	0.89 (0.35–2.29)	0.814
Severe depression (≥ 15)	10 (6.6)	31 (11.9)	41 (9.9)	2.22 (1.04–4.71)	0.039	1.62 (0.61–4.35)	0.334
Mental health status§							
No PTSD or mod./sev. depression	125 (78.6)	190 (69.6)	315 (72.9)	1.0		1.0	
PTSD and/or mod./sev. depression	34 (21.4)	803 (30.4)	117 (27.1)	1.61 (1.02–2.54)	0.043	1.31 (0.70–2.47)	0.404

MDD-W, Minimum Dietary Diversity for Women; LDD, low dietary diversity; aOR, adjusted OR; PTSD, post-traumatic stress disorder; PHQ-9, Patient Health Questionnaire-9.

* Categorical variables are expressed as n(%).

** Lack of corresponding sum of frequencies with total sample size is due to missing data.

† OR of the dependent variable (MDD-W vs. LDD) are presented with 95% CI using simple logistic regression.

‡ aOR are presented with 95% CI using multiple logistic regression analysis. Model 2: adjusted for age of the mother and child, sex of the child, reproductive status of the mother, marital status, education and employment status of the parents, household monthly income, crowding index, UNHCR registration status, perception of safety, receiving cash or food assistance, reliance on savings, household type, head of household, total number of under-five children, health insurance coverage, healthcare type, sources of health messages, the probability of being moderately and severely food insecure, and maternal anaemia.

§ Moderate/severe (mod./sev.) depression was defined as PHQ-9 score ≥ 10⁽³²⁾.

Statistical significance was defined as *P*-value < 0.05.

without the flu (97.4% *v.* 81.3%, *P* < 0.05) (data not included in table).

Table 5 displays correlations analyses between FI and dietary indicators, mental health, anaemia, nutritional status and socio-economic characteristics. A moderately strong significant negative correlation was found between the food group diversity score and the probability of being moderately and severely food insecure (*r* = -0.283; *P* < 0.000) as well as severely food insecure (*r* = -0.251; *P* < 0.000). Furthermore, the number of meals and snacks consumed per day was also negatively correlated with FI. As for the mental health indicators, suffering from PTSD, depression and PTSD and/or moderate/severe depression were significantly correlated with the probabilities of being food insecure (*P* < 0.000). The strongest correlation was found between the depression screening and the probability of being moderately and severely food insecure (*r* = -0.353; *P* < 0.000). Noticeable significant correlations were also found between the probability of being food insecure and the household monthly income level, employment status of the father and the crowding index. Very weak correlations were found with the education level and employment status of the mother, number of children under the age of 5 years, the reliance on savings and subsidies, registration status as refugee, head of the household and receiving health messages from healthcare professionals only. No associations were found between the probability of being food insecure and anaemia, nutritional status of the mother and the mother's use of micronutrient supplements. Further analysis showed that receiving WFP food assistance was significantly associated with a higher mean crowding index and a higher number of children aged under 5 in the household compared with not receiving WFP food assistance (4.7 (SD 1.8) *v.* 3.6 (SD 1.6) and 4.5 (SD 1.6) *v.* 2.5 (SD 1.4), respectively; *P* < 0.000) (data not shown in table).

Food groups consumption of mothers based on dietary data from the FFQ according to the household monthly income is

shown in Table 6. Overall, grains and starchy staples constituted the highest share of the total energy intake reaching 45.2% EI (SD 16.3) followed by 15.7% EI (SD 0.6) from fats and oils and 7.8% EI (SD 6.3) from sweets and sugar derivatives. On average, dairy products, pulses, nuts, seeds and fruits contributed from 3.2 to 5.8% to energy consumption, while very low contributions were observed from eggs and flesh foods (2.0% EI (SD 2.2) and 2.3% EI (SD 2.3), respectively). The lowest contribution to energy consumption was noted from the vegetables group. Other food groups such as mixed dishes, pizzas and pies, salty snacks, beverages and condiments and pickles also had a limited share in the total energy intake of about 1.7% EI to 2.7% EI.

Mothers from the low-income households had a significantly higher contribution to energy consumption from grains and starchy staples when compared with those from the high-income households, such as bread (26.5 (SD 14.7)% EI *v.* 22.2 (SD 11.7)% EI, *P* < 0.05) and rice (6.2 (SD 5.4)% EI *v.* 5.1 (SD 3.8)% EI, *P* < 0.05). In contrast, the contribution to energy consumption from highly nutritious food groups was significantly lower among mothers from low-income households than those from high-income households, including fruits and fresh fruits, cheese, olive oil and flesh foods, in particular beef, lamb, organ meat and poultry (*P* < 0.05). On the other hand, it was observed that the high-income households had a significantly higher contribution to energy consumption from sweets and sugar derivatives, especially chocolate and candies, as compared with the low-income households (*P* < 0.05). Tea consumption contributed significantly more to the dietary intake of the low-income households, as compared with high-income households (*P* < 0.05). No significant differences between the income groups were observed for vegetables, processed meat, fish, eggs, pulses, nuts, seeds, milk, yogurt, pizzas and pies, other vegetables oils and fats, salty snacks, condiments, pickles, sugar-sweetened beverages and other drinks (Table 6).

**Table 5.** Correlations between food insecurity and dietary, health and socio-economic characteristics of Syrian mothers

	Probability of being moderately and severely food insecure		Probability of being severely food insecure	
	Correlation coefficient (<i>r</i>)†	<i>P</i>	Correlation coefficient (<i>r</i>)†	<i>P</i>
Dietary diversity and meal patterns				
Food group diversity score* (<i>n</i> 427)	−0.283	0.000	−0.251	0.000
Number of main meals per day* (<i>n</i> 425)	−0.105	0.042	−0.104	0.032
Number of snacks per day* (<i>n</i> 411)	−0.143	0.004	−0.103	0.038
Mental health indicators‡				
Current state of PTSD (<i>n</i> 426)	0.214	0.000	0.197	0.000
Depression screening (PHQ-9 ≥ 10) (<i>n</i> 407)	0.353	0.000	0.175	0.000
Mental health status (<i>n</i> 426)	0.247	0.000	0.190	0.000
Anaemia and nutritional status§				
Anaemia status (<i>n</i> 423)	0.035	0.473	−0.010	0.837
Malnutrition using MUAC (<i>n</i> 425)	0.062	0.201	0.006	0.902
BMI (<i>n</i> 351)	−0.005	0.920	−0.015	0.776
Socio-economic and household characteristics				
Crowding index score* (<i>n</i> 423)	0.263	0.000	0.167	0.001
Monthly household income (<i>n</i> 406)	−0.242	0.000	−0.165	0.001
Father's employment status (<i>n</i> 411)	−0.208	0.000	−0.138	0.005
Mother's education level (<i>n</i> 423)	−0.179	0.000	−0.063	0.196
Number of children < 5 years* (<i>n</i> 427)	0.175	0.000	0.085	0.078
Reliance on savings or subsidies (<i>n</i> 426)	0.144	0.003	0.158	0.001
UNHCR refugee registration status (<i>n</i> 419)	0.141	0.004	0.067	0.170
Head of the household (<i>n</i> 420)	0.119	0.015	0.133	0.006
Mother's employment status (<i>n</i> 420)	0.085	0.083	0.113	0.021
Healthcare service utilisation¶				
Sources of health messages from healthcare professionals only (<i>n</i> 426)	−0.105	0.031	−0.111	0.022
Mother's use of micronutrient supplements (<i>n</i> 422)	−0.073	0.133	−0.030	0.534

PTSD, post-traumatic stress disorder; PHQ-9, Patient Health Questionnaire-9; MUAC, mid-upper arm circumference.

* Indicate continuous variables.

† Point biserial correlation test was used for continuous and dichotomous variables. Pearson's correlation test was used for continuous variable. The strength of correlation is interpreted as follows: up to 0.2 (very weak), up to 0.5 (weak), up to 0.7 (moderate) and up to 0.9 (high). Significantly different at *P*-values < 0.05.

‡ Current state of PTSD (no *v.* yes), depression screening (minimal or mild depression (PHQ-9 < 10) *v.* moderate or severe depression (PHQ-9 ≥ 10)⁽³²⁾), mental health status (no PTSD and/or moderate/severe depression *v.* PTSD and/or moderate/severe depression).

§ Anaemia status (no *v.* yes), classification of malnutrition using MUAC (undernourished/normal weight *v.* overweight/obese), BMI (underweight/normal weight *v.* overweight/obese).

|| Monthly household income (≤ 750 000 LBP *v.* > 750 000 LBP), father's employment status (full-time job *v.* no job/part-time job), mother's education level (intermediate school or lower *v.* secondary school or higher), reliance on savings or subsidies (no *v.* yes), UNHCR refugee registration status (no *v.* yes), head of the household (father/family-in-law *v.* mother/both parents), mother's employment status (no paid job/housewife *v.* paid job).

¶ Sources of health messages from healthcare professionals only (no *v.* yes), mother's use of micronutrient supplements (no *v.* yes).

Discussion

The present study aimed to assess and examine the associations between maternal FI and dietary diversity, and mental health, anaemia and nutritional status of Syrian refugee mothers living in Greater Beirut, Lebanon. The study's main findings showed that one out of three mothers was moderately to severely food insecure (34.4%), with 12.5% being severely food insecure, and almost two-thirds of the mothers had a LDD (63.3%). A large body of literature recorded a wide range of FI and LDD prevalence among women^(60–67) and refugees^(68,69) in low- and middle-income countries. Rates of FI in our study were close to those among registered Syrian refugee households in 2018–2019 across Lebanon, with one of the highest recorded in Mount Lebanon, as reported by the WFP and UNHCR^(26,70). However, higher rates of moderate to severe FI were previously found among urban Lebanese households in Greater Beirut as well as households of Palestinian and Iraqi refugees in Lebanon (42, 61 and 80%, respectively)^(56,71,72). Lower FI rates reported in the present study may be attributed to the extensive humanitarian assistance targeting primarily Syrian refugees across Lebanon since the start of the war in 2011 and the large displacement of refugees from Syria⁽⁷⁰⁾.

The prevalence of LDD in our study was found to be comparable to those from low- and middle-income countries such as mothers in Lebanon (61.8%)⁽⁷³⁾ and women refugees in Algeria (69%)⁽⁶⁸⁾. Yet, it remained much higher compared with women asylum seekers in Norway, a high-income country (49%)⁽⁶⁹⁾. Hanley-Cook *et al.* showed evidence of overreporting of food groups by 10–16% for assessing the prevalence of MDD-W of reproductive age using the list-based or open recall methods⁽⁷⁴⁾. This suggests that the prevalence of LDD can be even higher in our study. Our findings are alarming and indicate that a significant proportion of women of reproductive age have a poor diet quality and are far from reaching the recommendations for nutrient requirements and dietary diversity.

FI and poor dietary diversity among mothers were significantly correlated in our study. This link has been well documented in the literature^(63,64,75). Our findings showed that a household monthly income below or approximately equal to the legal minimum wage and a higher crowding index were significantly associated with FI and LDD. It is no surprise that both indicators share common underlying determinants as a result of their leading denominator: a low socio-economic status. Similar findings were also reported by a national study among Lebanese



Table 6. Percentage contribution of food groups to total energy intake (% EI) by income groups based on dietary data from the FFO (Mean values and standard deviations)

Food groups and subgroups*	Percentage energy intake (% EI)						P†
	Low-income group (n 267)		High-income group (n 142)		Total (n 409)		
	Mean	SD	Mean	SD	Mean	SD	
Grains and starchy staples	47.6	16.5	40.6	14.8	45.2	16.3	0.000
Bread	26.5	14.7	22.2	11.7	25.0	13.9	0.005
Rice	6.2	5.5	5.1	3.8	5.8	5.0	0.005
Bulgur/pasta	3.1	3.3	2.6	2.2	2.9	3.0	0.005
Potato/French fries	11.7	10.7	10.5	8.8	11.3	10.1	0.005
Dry breadsticks	0.1	0.2	0.2	0.8	0.1	0.5	0.005
Crackers/toast/cereals	0.01	1.0	0.04	0.3	0.02	0.2	0.176
Vegetables	0.9	0.9	0.9	0.8	0.9	0.9	0.574
Fresh vegetables	0.8	0.6	0.9	0.7	0.8	0.7	0.197
Canned vegetables	0.1	0.6	0.0	0.2	0.1	0.5	0.446
Fruits	2.9	3.3	3.6	3.4	3.2	3.3	0.034
Fresh fruits	2.8	3.2	3.6	3.3	3.1	3.2	0.031
Dried/canned/cocktails	0.1	0.8	0.1	0.5	0.1	0.7	0.905
Flesh foods	2.1	2.0	2.6	2.8	2.3	2.3	0.021
Beef/lamb/organ meat	0.4	0.8	0.6	0.9	0.5	0.9	0.041
Processed meat	0.3	0.6	0.2	0.5	0.3	0.6	0.446
Poultry	1.1	1.3	1.4	2.3	1.2	1.7	0.038
Fish	0.3	0.7	0.3	0.6	0.3	0.7	0.593
Eggs	2.0	2.2	2.0	2.0	2.0	2.2	0.780
Pulses, nuts and seeds	5.1	6.1	5.8	5.6	5.3	5.9	0.250
Legumes	2.7	2.6	2.8	2.7	2.7	2.6	0.623
Nuts and seeds	2.4	5.4	3.0	5.0	2.6	5.2	0.293
Dairy products	5.6	5.6	6.3	4.9	5.8	5.4	0.182
Cheese	1.6	2.3	2.3	2.4	1.8	2.4	0.004
Milk	0.7	2.9	0.6	1.5	0.7	2.5	0.710
Yogurt and derivatives	3.3	3.7	3.4	3.6	3.3	3.7	0.721
Mixed dishes	2.4	2.2	2.2	2.3	2.3	2.2	0.443
Pizzas and pies	2.1	3.4	2.4	3.0	2.2	3.3	0.406
Fats and oils	15.0	11.8	16.9	11.4	15.7	0.6	0.116
Olive oil	3.3	4.2	4.8	5.3	3.8	4.7	0.002
Other vegetable oils	9.5	9.5	9.3	8.9	9.4	9.3	0.852
Other fats	2.2	6.2	2.8	4.6	2.4	5.7	0.338
Sweets and sugar derivatives	7.3	6.3	8.8	6.1	7.8	6.3	0.020
Sugar/jam/honey/molasses	2.8	2.9	2.8	2.7	2.8	2.8	0.869
Desserts/pastries/ice cream/puddings	2.8	4.3	3.4	3.8	3.1	4.1	0.135
Chocolate/candies	1.7	3.5	2.6	3.8	2.0	3.6	0.014
Salty snacks/potato chips	2.4	4.9	2.7	3.8	2.5	4.6	0.552
All beverages	2.6	2.9	2.9	2.6	2.7	2.8	0.370
Tea	0.09	0.1	0.07	0.1	0.08	0.1	0.015
Coffee	0.1	0.2	0.1	0.1	0.1	0.1	0.228
Sugar-sweetened beverages	2.4	2.9	2.7	2.6	2.5	2.8	0.392
Other: alcoholic/diet soda	0.0	0.1	0.0	0.2	0.0	0.2	0.259
Condiments and pickles	1.8	2.4	1.5	1.8	1.7	2.2	0.185

% EI, percentage energy intake.

* Continuous variables are expressed as mean values and standard deviations.

† Significantly different at *P*-value < 0.05; *P*-value was derived using one-way ANOVA test.

mothers⁽⁷³⁾. Furthermore, receiving WFP food assistance was significantly associated with LDD among Syrian refugee mothers in Greater Beirut in our study. This suggests that WFP food assistance may not necessarily ensure a diverse diet. Staple foods accounted for 42 % of total food expenditure among Syrian refugees in Lebanon, while only 13 % was spent on fruits and vegetables and 8 % on fresh meat⁽⁷⁰⁾. This indicates that a more monotonous diet was consumed by the refugees. In fact, Beirut witnessed a drawback in food consumption scores and Mount Lebanon continued to have the poorest food consumption scores, despite a nationwide improvement in poor and borderline food consumption levels among Syrian refugees in

Lebanon in 2018–2019⁽²⁶⁾. Moreover, poor dietary diversity and low meal frequency emerged as potential coping mechanisms against FI among mothers in our study. Syrian refugees, notably in Mount Lebanon, were increasingly reducing the number of meals eaten per day and portion sizes but also restricting food consumption by adults for the sake of children⁽²⁶⁾.

Our previous study showed evidence of higher proportions of nutritional inadequacies among PM and LM as well as an overall maternal diet rich in sugar and fat and poor in protein, fibres and micronutrients⁽²⁸⁾. Further analysis showed that the consumption of food groups was also consistent with the 'Western diet' in the present study, characterising the nutrition



transition in low- and middle-income countries⁽⁷⁶⁾. Overall, high contributions to energy intake from grains, starchy staples, and oils and fats were recorded over the past year with poor incorporation of nutrient-rich foods. Contribution of legumes, nuts, seeds, fruits and vegetables was low, particularly of vitamin A-rich fruits and green leafy vegetables. Similar nutritional habits and monotonous diets were found among asylum seekers living in Germany^(77,78) and Norway⁽⁶⁹⁾. Nasreddine *et al.*⁽⁷⁹⁾ also highlighted a shift in consumption towards refined grains, highly processed foods and added fats and oils and deviating from nutritious foods in Lebanon. Food systems and environments are well-known to influence food choices, customs and diets as well as to a great extent food security and nutrition. Key aspects include the physical, economic, political and socio-cultural context. Food customs are also shaped by religions and beliefs, traditions, cultures and social norms⁽⁸⁰⁾. According to a recent study, food played a central role in the social integration among Syrian refugees in Germany and was considered essential to their cultural value and psychological well-being despite challenges associated with food-related autonomy and environment. However, the authors also highlighted that, while Syrian refugees in the Middle East might benefit from a similar food environment to the one in Syria, refugees in Lebanon might be confronted with higher economic hardships hindering their purchasing power and access to food⁽⁸¹⁾.

Socio-economic disparities, such as the income, shape the diet structure to a great extent among vulnerable populations. Higher contributions to energy intake from grains and refined starchy staples such as bread and rice were found among low-income households in our findings. Lower income groups usually spend a higher share of money on food, influencing their food choices. The higher cost of a healthy diet may be a significant barrier, especially that lean meats, fish and fresh produce are more expensive energy sources compared with grains, fats and sweets⁽⁸²⁾. Syrian refugee households in Mount Lebanon recorded the highest percentage of food expenditures on bread and pasta (47 %) compared with other governorates in Lebanon⁽⁷⁰⁾. Inversely, high-income households in our study had a more diverse diet with significantly higher contributions of fruits, cheese, olive oil and flesh foods but also of sweets and sugar derivatives to total energy consumption. Lopez *et al.*⁽⁸³⁾ also found that other vegetable oils were consumed more than olive oil to lower the total costs of the diet. A Mediterranean dietary pattern was found to be more expensive than a Western dietary pattern, as it is mostly based on the consumption of local fruits and vegetables, beans, nuts and seeds, dairy products and olive oil⁽⁸⁴⁾. With increasing economic vulnerabilities and FI, poor diet quality and diversity are often the result of an increased consumption of cheap and high energy-dense foods rather than nutrient-dense foods as a strategy to stretch the energy cost and reduce food expenditures⁽⁸²⁾. An inadequate intake of vitamins and minerals and distorted contribution of fats and sugars to energy can lead to under- and overnutrition alongside persisting micronutrient deficiencies^(15,85,86). The co-occurrence of overnutrition and anaemia among mothers and undernutrition among children was reported in our previous study among Syrian refugees from the same household in Greater Beirut⁽²⁸⁾.

Regarding the mental health status of the mothers, nearly one-third were suffering from PTSD and/or moderate to severe depression in our study. Comparable and higher prevalence rates were reported among Palestinian and Syrian refugees in Lebanon^(72,87–90). A strong relationship was observed between poor maternal mental health, FI and a high crowding index in our findings. Poverty and FI are well documented as factors associated with psychological distress and depression symptoms. The struggle to provide food on a day-to-day basis and worrying about living expenses can exacerbate effects on mental health^(18,91). Certainly, overcrowding, poor living conditions and lack of resources can accumulate the risk of deterioration of the health status⁽³⁵⁾. Furthermore, evidence on the association between depression, FI and poor dietary diversity is found in the literature, suggesting a relationship between micronutrient deficiencies and mental health disorders^(17,92,93). However, the lack of association between the mental health status and LDD in our study could be due to the fact that the MDD-W indicator does not assess the intake of certain nutrients or food groups related to mental health outcomes.

As for the nutritional status of the mothers, the lack of association with LDD and FI observed in our survey was in line with the literature^(73,94–96), even though a relationship between FI and obesity was documented among Lebanese mothers⁽⁵⁶⁾. One explanation could be that the food group diversity score does not account for the amounts of food consumed, physical activity levels and total energy expenditure⁽⁹⁴⁾. We also suggest it could be explained by the exclusion of the nutrient-dense food groups from the score, such as oils and fats, sweets, snacks and sugar-sweetened beverages. Furthermore, anaemia was not associated with maternal LDD and FI in our survey, similar to findings from pregnant women in Ghana⁽⁹⁷⁾ and Pakistan⁽⁹⁸⁾. Other studies were able to demonstrate a relationship between anaemia and LDD as well as FI^(99,100). The multifactorial nature of anaemia can provide an explanation to these controversial findings as several factors may act as causes or contributors. These may be related not only to poor dietary practices, low bioavailability of nutrients, high intake of inhibitors, genetic disorders, infections and inflammation but also to environmental and socio-economic factors including women's empowerment, poverty, education and access to healthcare⁽¹⁰¹⁾. In fact, a very plausible explanation regarding the lack of association in our study could be related to the role of health and nutrition awareness programmes. While our previous study showed that receiving health and nutrition messages and access to the free or subsidised healthcare in place for refugees in Lebanon could have played a role in reducing anaemia⁽²⁸⁾, our present findings also shed light on the role of healthcare professionals. Once more, an indication on the beneficial impact of health services offered to refugees is found and emphasises the crucial role of counselling on improving dietary diversity and anaemia.

New threats to food security and nutrition were rising in Lebanon since October 2019 due to the strong socio-political unrest and severe financial crisis involving spiralling food inflation rates and strong currency depreciation. With the combination of containment measures for the COVID-19 pandemic, unemployment rates and reduced income soared across Lebanon for the population and refugees⁽¹⁰²⁾. In addition,

Lebanon relies heavily on imported commodities and food to cover domestic needs; for instance, 80 % of cereals consumption is met through imports. Long-term effects of the Beirut port explosion on 4 August 2020 will reflect on the economy and supply chain, particularly in Beirut and Mount Lebanon⁽¹⁰³⁾. As the ability to access and purchase food is compromised even further, food security and nutrition are expected to worsen and the risk of deterioration of the health and nutritional status of vulnerable groups is higher among both the host population and refugees in Lebanon⁽²⁵⁾.

Double-duty actions and multicomponent strategies targeting multiple forms of malnutrition simultaneously are a priority and need to tackle social determinants of health and nutrition disparities⁽⁸⁶⁾. Economic interventions, subsidies and fiscal incentives should be considered to encourage changes in dietary behaviours towards a healthier and sustainable diet. For instance, financial and food assistance programmes should be strengthened and provide additional support to the most vulnerable groups among refugees and the host population. Our findings also shed light on the crucial role of a multidisciplinary approach with a diverse team of healthcare professionals to improve nutrition knowledge, family planning and mental health of women of reproductive age through counselling and awareness-raising sensitive to cultural norms. In light of increasing vulnerabilities, Syrian refugees lack resources to cover essential needs⁽²⁵⁾. Admittedly, recent studies showed that Syrian women are willing to overcome sex barriers and cultural norms to accessing economic participation when working conditions are decent and safe⁽¹⁰⁴⁾. Policy efforts should target to improve women's access to economic resources. Strategies need to consider the role of women as both a caregiver and a provider to combat FI and LDD among mothers in poor and vulnerable settings⁽¹⁰⁵⁾.

Limitations

Few limitations should be considered when interpreting the study findings. First, the design of the study is cross-sectional; hence, it cannot infer causality but rather associational relationships. The study was narrowed to the most vulnerable areas of Greater Beirut and to mothers attending PHCC. This may limit the findings to be representative of Syrian refugees in rural settings and at a national level. Recruitment took place in Greater Beirut, covering Beirut and adjacent districts of Mount Lebanon. It is considered to be the melting pot of the country with more than half of the Lebanese population and over 305 000 refugees^(30,106). Second, our measure of FI at the individual level could limit the comparison with other findings measuring household FI using different scales. However, the Food Insecurity Experience Scale has demonstrated its robustness and provides the opportunity to generate internationally comparable measures of FI⁽¹⁰⁷⁾. Third, the Patient Health Questionnaire-9 was shown to have a good sensitivity but poor specificity in capturing depressive symptoms among adults in Lebanon. The tool was found to be useful in screening for depression in settings lacking sufficient psychiatric care to determine the need for psychiatry referral⁽³³⁾. Lastly, dietary data may be subjected to possible recall bias. Enumerators underwent extensive trainings and used standardised

protocols to limit the social desirability bias and overcome the memory bias. The 24-h dietary call was collected using the five-step multiple pass recall method, which may improve the accuracy of dietary estimates among adults; however, underreporting under field conditions and among overweight and obese adults remains a constraint^(48,108,109). The 24-h dietary recall may not take into account seasonal variations; however, the latter is compensated for by the use of FFQ over the past 12 months⁽¹¹⁰⁾. The FFQ used in our study encompassed a wide range of food groups, including ultra-processed foods. This is an advantage in measuring changing dietary patterns in the context of the nutrition transition⁽¹¹¹⁾. Another limitation worth mentioning is the absence of an extensive food composition database in Lebanon. So, the USDA database was used, and specific food items were added from the local food composition tables available for a limited number of local foods. Although the absolute estimates of dietary intake could have been affected, its effects on the observed inadequate intakes among mothers would have been limited.

Conclusion

The present study shows evidence of poor dietary diversity and mental health as well as FI among Syrian refugee mothers in an urban setting of a humanitarian crisis. Findings demonstrate poor nutritional practices and low diet quality among women of reproductive age. With increasing economic vulnerabilities and FI, inadequate dietary habits often take place and compromise the quality of the diet. Multifaceted interventions are needed to address the situation holistically, including nutrition-specific interventions and assistance programmes, which can be developed or strengthened at the local and national level, in addition to psychosocial support and family planning. Both, the women's roles as a caregiver and as provider need to be considered in order to reduce FI and improve dietary diversity among vulnerable groups. Further research is needed to examine the impact of suboptimal maternal nutrition during the first 1000 d on the diet quality and health of children in a humanitarian context. The relationship between poor maternal mental health, breast-feeding practices and maternal nutrition needs to be further explored among Syrian refugee mothers in Lebanon.

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Supplementary material

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Supplementary Table 1: Criterion of two-thirds DRI of key macro- and micronutrients according to maternal low dietary diversity based on 24-hour dietary recalls.

Variables ^a	DRI ^b	MDD-W <i>n</i> =159	LDD <i>n</i> =274	Total (<i>N</i> =433)	Maternal Low Dietary Diversity	
					OR ^c (95% CI)	aOR ^d (95% CI)
<i>Macronutrient intake</i>						
Protein (g/d)	46-71					
≥ 2/3 rd DRI		114 (71.7)	94 (34.3)	208 (48.0)	1.0	1.0
< 2/3 rd DRI		45 (28.3)	180 (65.7)	225 (52.0)	4.85 (3.17-7.43)	3.27 (2.02-5.29)
Fibers (g/d)	25-29*					
≥ 2/3 rd DRI		73 (46.2)	53 (19.3)	126 (29.2)	1.0	1.0
< 2/3 rd DRI		85 (53.8)	221 (80.7)	306 (70.8)	3.58 (2.32-5.52)	1.91 (1.12-3.24)
<i>Micronutrient intake</i>						
Iron (mg/d)	9-27					
≥ 2/3 rd DRI		85 (53.8)	71 (25.9)	156 (36.1)	1.0	1.0
< 2/3 rd DRI		73 (46.2)	203 (74.1)	276 (63.9)	3.33 (2.20-5.03)	1.90 (1.17-3.11)
Folate (μg/d)	400-600					
≥ 2/3 rd DRI		52 (32.7)	39 (14.2)	91 (21.0)	1.0	1.0
< 2/3 rd DRI		107 (67.3)	235 (85.8)	342 (79.0)	2.93 (1.82-4.70)	1.60 (0.94-2.72)
Vitamin B12 (μg/d)	2.4-2.8					
≥ 2/3 rd DRI		62 (39.0)	35 (12.8)	97 (22.4)	1.0	1.0
< 2/3 rd DRI		97 (61.0)	239 (87.2)	336 (77.6)	4.36 (2.71-7.03)	3.60 (2.19-5.94)
Vitamin C (mg/d)	65-120					
≥ 2/3 rd DRI		86 (54.4)	74 (27.0)	160 (37.0)	1.0	1.0
< 2/3 rd DRI		72 (45.6)	200 (73.0)	272 (63.0)	3.23 (2.14-4.87)	2.26 (1.45-3.51)
Vitamin A (μg/d)	700-1300					
≥ 2/3 rd DRI		39 (24.5)	29 (10.6)	68 (15.7)	1.0	1.0
< 2/3 rd DRI		120 (75.5)	245 (89.4)	365 (84.3)	2.75 (1.62-4.66)	1.98 (1.12-3.48)
Thiamin (mg/d)	1-1.4					
≥ 2/3 rd DRI		129 (81.6)	174 (63.5)	303 (70.1)	1.0	1.0
< 2/3 rd DRI		29 (18.4)	100 (36.5)	129 (29.9)	2.56 (1.60-4.10)	1.23 (0.71-2.14)
Riboflavin (mg/d)	1-1.6					
≥ 2/3 rd DRI		118 (74.7)	96 (35.0)	214 (49.5)	1.0	1.0
< 2/3 rd DRI		40 (25.3)	178 (65.0)	218 (50.5)	5.47 (3.54-8.46)	3.83 (2.36-6.21)
Niacin (mg/d)	14-18					
≥ 2/3 rd DRI		121 (76.1)	146 (53.3)	249 (57.5)	1.0	1.0
< 2/3 rd DRI		38 (23.9)	128 (46.7)	184 (42.5)	3.63 (2.35-5.61)	2.11 (1.27-3.52)
Vitamin B6 (mg/d)	1.2-2					
≥ 2/3 rd DRI		66 (41.8)	42 (15.3)	108 (25.0)	1.0	1.0
< 2/3 rd DRI		92 (58.2)	232 (84.7)	324 (75.0)	3.96 (2.51-6.25)	2.27 (1.34-3.84)
Zinc (mg/d)	8-13					
≥ 2/3 rd DRI		77 (48.7)	45 (16.4)	122 (28.2)	1.0	1.0
< 2/3 rd DRI		81 (51.3)	229 (83.6)	310 (71.8)	4.84 (3.10-7.56)	3.07 (1.85-5.10)
Calcium (mg/d)	1000-1300					
≥ 2/3 rd DRI		39 (24.7)	40 (14.6)	108 (25.0)	1.0	1.0
< 2/3 rd DRI		119 (75.3)	234 (85.4)	324 (75.0)	1.92 (1.17-3.14)	1.00 (0.58-1.76)

MDD-W, Minimum Dietary Diversity for Women; LDD, Low Dietary Diversity; d, day; ^a Categorical variables are expressed as n(%). ^b Dietary Reference Intakes (DRI) refers to the Recommended Dietary Allowances (RDA) and Adequate Intakes (AI) ⁽⁵⁴⁾. RDA are presented in **bold type** and AI in ordinary types followed by an asterisk (*). The criterion of two-thirds DRI represents the proportion of mothers not meeting 2/3rd of the RDA or AI for micronutrients key macro- and micronutrient according to their age group and reproductive status. ^c Odds Ratio (OR) of the dependent variable (Minimum Dietary Diversity for Women vs. Low Dietary Diversity) are presented with 95% CI using simple logistic regression; *P*-values of <0.05 are formatted in bold. Adjusted OR (aOR) are presented with 95% CI using multiple logistic regression analysis. ^d Model 1: adjusted for total energy intake; *P*-values of <0.05 are formatted in bold.

5

Chapter 5

Infant Feeding Practices, Nutrition, and Associated Health Factors During the First Six Months of Life among Syrian Refugees in Greater Beirut, Lebanon: A Mixed Methods Study

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Article

Infant Feeding Practices, Nutrition, and Associated Health Factors during the First Six Months of Life among Syrian Refugees in Greater Beirut, Lebanon: A Mixed Methods Study

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Abstract: The objective was to describe infant feeding practices, nutrition and related health aspects of infants under six months among Syrian refugees in Greater Beirut, Lebanon. A cross-sectional study was conducted among Syrian refugee mothers with infants under six months in July–October 2018 (N = 114). Additionally, eleven focus group discussions were conducted to explore supportive factors and barriers associated with early breastfeeding practices. The prevalence of pre-lacteal feeding was high (62.5%), whereas early initiation of breastfeeding was low (31%), and exclusive breastfeeding very low (24.6%). One-fifth of the infants were anemic (20.5%) and 9.6% were wasted. A significantly higher proportion of non-exclusively breastfed infants had a fever and took medicines than those who were exclusively breastfed. Supporting factors of adequate infant feeding practices comprised knowledge on maternal nutrition and exclusive breastfeeding, along with receiving support from healthcare professionals and family members. Identified barriers included preterm delivery, pre-lacteal feeding, an at-risk waist circumference and moderate to severe depression among mothers, bottle feeding, early introduction of food, maternal health reasons, breastmilk substitutes' distribution, and misinformation offered by mothers-in-law. To address sub-optimal feeding practices documented among Syrian refugees, awareness on proper breastfeeding practices, maternal nutrition, and psychosocial support should be provided to mothers and family members alike.

Keywords: early initiation of breastfeeding; exclusive breastfeeding; bottle feeding; anemia; nutrition and health aspects; infants under six months; Syrian refugees; Lebanon



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1. Introduction

The benefits of breastfeeding have been well-documented in the long- and short-term for both the mother and child [1]. Human breast milk is renowned to be the safest and healthiest food for infants, offering invaluable protection against infections and their consequences [2,3]. As such, the World Health Organization (WHO) and United Nations International Children's Emergency Fund (UNICEF) strongly recommend early initiation of breastfeeding within the first hour of birth and exclusive breastfeeding (EBF) for the first six months of life for optimal growth and development [4,5]. This is most critical during emergencies, as infants and children quickly fall among the most vulnerable victims. Malnutrition and infections emerged as the leading cause of childhood mortality and were often associated with crowded and unsanitary spaces subsequent to large-scale migration [6,7].

The global nutrition target was set to increase the rate of EBF in the first six months up to at least 50% by 2025 and 70% by 2030 [8,9]. Despite the improvement in the global prevalence of EBF from 36.5% in 2000–2009 to 45.7% in 2010–2018 in Low- and Middle-Income Countries, the Eastern Mediterranean region was among those that were the most away from global targets. Yet, it was the only region to experience a downward trend in the EBF prevalence by 5.3% and recorded the lowest EBF prevalence (34.5%) in 2010–2018 [10]. By the end of 2010, the Middle East and North Africa region had witnessed a wave of revolutions followed by many conflicts and wars in countries such as Tunisia, Egypt, Libya, Yemen, and Syria, with poverty and food insecurity being the main drivers and outcomes simultaneously [11].

The Syrian refugee crisis has become the largest worldwide with more than 6.7 million being forced to flee by the end of 2018. Lebanon hosted more than 1.5 million Syrian refugees, making it the country with the highest per capita concentration of refugees worldwide [12,13]. Syrian refugees in Lebanon have been subjected to harsh living conditions affecting their food security, nutritional status, and mental health, particularly among mothers and children [14–16]. Exposure to wars and conflicts could negatively impact maternal mental health and nutrition, resulting in long-lasting intergenerational effects on the health of the child. Evidence have shown that war times could decline breastfeeding rates and contribute to increased acute and chronic malnutrition among children [17,18].

Very few studies and reports have examined breastfeeding practices among Syrian refugees in Lebanon [19,20]. Up to date, no existing studies have examined early breastfeeding practices, the prevalence of anemia, and the nutritional status of infants under six months and their associated health factors among Syrian refugees in Lebanon. The objectives of this study were to (1) characterize infant feeding practices as well as anemia, nutritional status and related health aspects of infants under six months among Syrian refugees in Greater Beirut, Lebanon, (2) identify factors related to early initiation of breastfeeding, exclusive breastfeeding, and nutritional status of infants under six months, and (3) investigate barriers to the initiation of breastfeeding and exclusive breastfeeding among Syrian refugees with children under five years.

2. Materials and Methods

2.1. Study Design and Sampling Strategy

The mixed-methods survey was part of a larger project conducted among Syrian refugees living in the Greater Beirut area in Lebanon (July–October 2018). This area represented the urban agglomeration of the capital city of Beirut and its adjacent districts of Mount Lebanon Governorate, constituting the melting pot of the country. Primary health care centers were identified in localities with the highest level of vulnerability according to the United Nations Office for the Coordination of Humanitarian Affairs (UNOCHA) [21]. Mothers with at least one child aged less than five years were enrolled through primary health care centers using a two-step purposeful sampling strategy. The original sample size was calculated based on previous prevalence of anemia among Syrian refugee women in Lebanon to provide a power of 80%, a margin of error of 5% at 95% CI, and a design effect of 1.5 ($N = 444$). Mother-child pairs were eligible to participate if the inclusion criteria were met: (1) mother and child were Syrian, (2) the mother was between 15 and 49 years old, and (3) the child was aged 0–59 months and did not suffer from any inborn errors of metabolism or physical malformations. Out of the 590 eligible mother-child pairs to participate in this research project, 489 were recruited (17.1% non-response rate) and 433 completed the interview (11.4% dropout rate). Further details on the research project were presented elsewhere [15]. For this current study, mothers with children less than six months were included ($N = 114$).

2.2. Recruiting Strategy and Data Collection

In the original research project, mothers with children under five years were identified in primary health care centers via three approaches, including (1) the nurses at the centers,

(2) direct contact by trained research assistants in the waiting rooms of the centers, and (3) posting flyers with a brief description of the project in the centers. An oral script was used by the research assistant to introduce the project to the potential participant, check the eligibility criteria, and seek the informed written consent of the mother.

One-on-one interviews were conducted by well-trained enumerators (Collaborative Institutional Training Initiative certified) to collect data using a multi-component questionnaire (July–September 2018). Data quality control and random checks were conducted during data collection and entry to increase the accuracy of the data and reduce the risk of reporting bias. Data were collected on socio-economic, household, maternal characteristics, nutritional status of mothers and their children, infant health and birth characteristics, infant feeding practices, maternal dietary diversity, and maternal mental health. The minimum dietary diversity for women (MDD-W) of reproductive age was measured using the open recall method. Achieving MDD-W was defined as consuming five or more out of ten food groups [22]. The Patient Health Questionnaire-9 (PHQ-9) was used to measure depression among mothers [23]. Self-reported gestational age, weight, and length at birth were recorded. Birth weight was classified as low birth weight (<2500 g) [24], normal birth weight (2500–3999 g), and macrosomia ($\geq$ 4000 g) [25]. Gestational age of infants was collected in months instead of weeks for cultural adaption and was classified as: pre-term for infants born before 37 weeks (<nine months) and full-term from 37 weeks ($\geq$ nine months) [26]. The household monthly income was classified according to the legal minimum wage in Lebanon, approximately equal to 750,000 Lebanese Pounds (LBP) (equivalent of USD 500 at the time of data collection) [27]. Crowding index was based on the American Crowding Index definition (total number of co-residents by number of rooms without kitchens, bathrooms, hallways, balconies, and garages) [28].

2.3. Definitions of Infant Feeding Practices

Data on infant feeding practices were collected using a culturally adapted questionnaire based on the 2008 Infant and Young Child Feeding (IYCF) indicators [29,30]. Definitions of infant feeding indicators used in this study were described as follows:

1. Ever breastfed (EvBF): percentage of infants who ever breastfed successfully after birth (Indicator 1) [31].
2. Ever received pre-lacteal feeding before any breast milk: percentage of infants who were offered pre-lacteal food or liquid before receiving any breast milk after birth.
3. Early initiation of breastfeeding: percentage of infants who were put to the breast within one hour of birth (Indicator 2) [31].
4. Child breastfed yesterday: percentage of infants who received breast milk yesterday, including drops or syrups and anything else (any food or liquid, non-human milk, and formula) [29].
5. Bottle feeding yesterday (BoF): percentage of children who were fed from a bottle with a nipple during the previous day (Indicator 16) [31].
6. Ever received infant formula and/or other types of milk: percentage of infants who ever received infant formula and/or other types of milk.
7. Introduction of solid, semi-solid, or soft foods before six months: percentage of infants who ever received solid, semi-solid, or soft foods before six months.

In addition, a detailed breakdown and description of infant feeding practices among infants under six months during the previous day (adding up to 100%) was defined as follows:

8. Exclusive breastfeeding: percentage of infants who received exclusively breastmilk yesterday, including drops or syrups, but without anything else (Indicator 3) [31].
9. Breastfeeding, mixed with infant formula, without other liquids and/or solid foods: percentage of infants who received breast milk and infant formula (excluding animal milk, other liquids and foods) (adapted from Indicator 5) [31].

10. Breastfeeding, with other liquids and/or solid food: percentage of infants who received liquids (animal milk, tea, yogurt, sugary water, etc.) and solid foods in addition to breast milk, but without infant formula.
11. Mixed milk feeding, with other liquids and/or solid foods: percentage of infants who received infant formula, any food, and other liquids yesterday, in addition to breast milk (adapted from Gao et al., 2016) [32].
12. Exclusive infant formula feedings, with other liquids and/or solid foods: percentage of infants who received infant formula yesterday, animal milk, other liquids, and solid foods, but without any breast milk (adapted from Gao et al., 2016) [32].

2.4. Anthropometric and Biochemical Assessment

Standardized techniques and calibrated equipment were used to measure anthropometrics among mothers and infants. The average of two measurements was recorded to the nearest decimal. The waist circumference of non-pregnant mothers was measured with light clothing using a non-elastic measuring tape (SECA 201) and was classified as normal (≤ 79 cm) and at-risk (> 80 cm) [33]. As for infants under six months, weight and length were measured using a measuring mat (SECA 417) and an electronic 2-in-1 weighing scale (SECA 876). Their nutritional status was defined using the WHO child growth standards and the WHO Anthro Survey Analyzer to derive the z-scores [34]. Stunting was defined using the length/height-for-age Z-scores ($L/HAZ < -2$), underweight using the weight-for-age Z-scores ($WAZ < -2$), wasting using the weight-for-length/height Z-scores ($WHZ < -2$), and overweight/obese using the body mass index-for-age (BMI-for-age) Z-scores ($BAZ > +2$) [35]. Microcephaly was assessed using the head circumference Z-scores ($HCZ < -2$) [36]. Mid-upper arm circumference (MUAC) was measured using the UNICEF MUAC measuring tapes and was classified as acute malnutrition (< 115 mm) and at-risk malnutrition (115–129 mm) [37]. Anemia status was assessed among infants under six months by certified phlebotomists using the “HemoCue Hb301 System” to measure hemoglobin (Hb) concentrations. Given the lack of WHO criteria for classifying the severity of anemia for this age group [38], total anemia was defined as $Hb < 10.5$ g/dL, according to Marques et al. (2014) [39].

2.5. Statistical Analysis

Descriptive analyses were presented as frequencies with percentages for categorical variables and as means with standard deviations (SD) for continuous variables. Characteristics between non-exclusively and exclusively breastfed infants were conducted using chi-square analysis for categorical variables and independent sample t-test to compare means across groups. Factors associated with early initiation of breastfeeding, time of breastfeeding initiation, and exclusive breastfeeding (as dichotomous dependent variables) were identified using multiple logistic regressions. Factors associated with the weight-for-length/height Z-score (as continuous dependent variables) was evaluated using a multiple linear regression. Different models were used for each of the dependent variables. All variables that have shown a p -value < 0.05 in the univariate logistic or linear regressions were checked for multicollinearity using the tolerance, variance inflation factors (VIF), and the condition index prior being included in the models. Independent variables that were entered in the models were reported. The significance of regression models was evaluated using R-squared, the overall percentage, and Hosmer and Lemeshow test for logistic regression models and using R-square and the normal probability plot of residuals for linear regression models. Results from the logistic regressions were expressed as aOR for adjusted odds ratios with a 95% confidence interval (CI) and from the linear regressions as $a\beta$ for adjusted β with a 95% CI. A p -value < 0.05 was considered statistically significant. KoBo ToolBox (version March 1, 2018, Harvard Humanitarian Initiative, Cambridge, MA, USA) was used for data entry and Statistical Package for Social Sciences (version 27.0, SPSS Inc., Chicago, IL, USA) was used to conduct the statistical analysis [40].

2.6. Qualitative Study and Analysis

A qualitative research approach was adopted to explore perceived barriers to, and facilitators of, infant feeding practices in relationship with maternal mental health and nutritional status, infant formula use, and traditional practices among Syrian refugee mothers living in Greater Beirut, Lebanon. A topic guide was developed and approved by the ethical board prior the onset of the study.

A pool of participants was drawn from the parent study by contacting mothers who had provided permission to be contacted for future research ($n = 201$). Overall, 183 mothers were invited to participate in focus group discussions (FGDs), of which 30 mothers partook together with 13 Syrian female relatives (sister, mother, or mother-in-law). In total, 43 Syrian women took part in 11 FGDs between September and October 2018. An additional informed consent was obtained from participants prior to the start of FGDs. Participants were randomly assigned to the FGDs, depending on their availabilities. Discussions were conducted in colloquial Arabic and lasted between 20 and 75 min, with two to nine participants per group, and were recorded using a digital voice recorder. Data collection was completed when data saturation was achieved for the studied themes.

FGDs were first transcribed to Latin Arabic and then translated to English. Transcripts were analyzed using MAXQDA software (version 2022.2, VERBI, Berlin, Germany) [41]. Qualitative content analysis was conducted using a combined technique of deductive and inductive thematic analysis. A coding guideline was developed with anchor quotes defining main and sub-themes. To meet the criteria of validity and reliability, a countercheck was conducted by trained members of the research team. Inter-code reliability checks were carried out to reduce inter-subjectivity by checking the coding guidelines and their corresponding quotes [42,43].

3. Results

Household and maternal characteristics are described in Table 1. Nearly half of the mothers were less than 25 years old (44.7%), had one to two children aged less than five years (53.1%), and lived with their extended family (51.8%) with a mean crowding index of 3.8 (± 1.6). The majority were registered as refugees with the United Nations High Commissioner for Refugees (UNHCR) (82.3%) and had a household monthly income below the minimum wage (63.3%). Two-thirds of the mothers did not achieve MDD-W (64.0%), and three-quarters of non-pregnant mothers had an at-risk waist circumference (75.5%).

Table 1. Socio-economic, maternal characteristics, and child growth indicators of infants under six months among Syrian refugees in Greater Beirut, Lebanon.

Variables ^a	Total (N = 114)	Variables ^a	Total (N = 114)
Socio-Economic and Household Characteristics		Maternal Characteristics	
Sex of the child		Age of the mother (years)	26.40 $\pm$ 5.7
Male	62 (54.4)	<25 years	51 (44.7)
Female	52 (45.6)	25 to 29 years	33 (28.9)
		≥ 30 years	30 (26.3)
Mother's education level		MDD-W for mothers	
No schooling/Illiterate	19 (16.7)	Not achieved (<5 food groups)	73 (64.0)
Primary, Intermediate school	68 (59.6)	Achieved (≥ 5 food groups)	41 (36.0)
Secondary school and higher	27 (23.7)		
Father's education level		Waist circumference of non-pregnant mothers ($n = 110$) ^b	
No schooling/Illiterate	17 (15.2)	Normal (≤ 79 cm)	27 (24.5)
Primary, Intermediate school	76 (67.9)	At-risk (> 80 cm)	83 (75.5)
Secondary school and higher	19 (17.0)		
Mother's employment status		Child growth indicators (Z-scores)	
No paid job/Housewife	109 (98.2)		
Paid job (daily/part-/full-time)	2 (1.8)		

Table 1. Cont.

Variables ^a	Total (N = 114)	Variables ^a	Total (N = 114)
Socio-Economic and Household Characteristics		Maternal Characteristics	
Father's employment status			
No job	5 (4.5)	Length/Height-for-age	0.60 ± 2.3
Part-time job	50 (45.5)		
Full-time job/ Self-employed	55 (50.0)		
Monthly household income		Weight-for-age	0.09 ± 1.8
≤750,000 LBP	69 (63.3)		
>750,000 LBP	40 (36.7)	Weight-for-length/height	−0.46 ± 1.4
Crowding index score	3.77 ± 1.6	Body Mass Index-for-age	−0.33 ± 1.4
Length of stay in Lebanon (years)	3.90 ± 4.5		
UNHCR refugee registration status		Head-circumference-for-age	0.19 ± 1.9
No	20 (17.7)		
Yes	93 (82.3)		
Household type		Mid-upper arm circumference-for-age	0.34 ± 1.3
Nuclear family	55 (48.2)		
Extended family	59 (51.8)		
Number of children < 5 years per household	2.53 ± 1.4		
1 to 2	60 (53.1)		
3 to 4	43 (38.1)		
≥5	10 (8.8)		

LBP: Lebanese Pounds; UNHCR: United Nations High Commissioner for Refugees; MDD-W: Minimum Dietary Diversity for Women; ^a Categorical variables are expressed as n (%) and continuous variables are expressed as mean ± SD. Lack of corresponding sum of frequencies with total sample size is due to missing data. ^b Non-pregnant mothers include lactating and non-pregnant non-lactating mothers.

Table 2 presents feeding practices of infants under six months. The vast majority were ever breastfed (98.2%). Among those, only 31.0% were breastfed within the first hour of birth and 30.1% during the first day (1–23 h), while more than a third received late breastfeeding initiation (≥24 h; 38.9%). In addition, nearly two-thirds received pre-lacteal feedings before the onset of lactation (62.5%). The most common type of pre-lacteal feeding was infant formula milk (70.0%), followed by sugary water (31.4%) and herbal infusions (15.7%). Current feeding practices showed that most of the infants breastfed the previous day (90.4%) and almost half were bottle fed the day before (44.7%). Only 24.6% were exclusively breastfed during the previous day. Most of the infants received breast milk with other liquids or foods, but without infant formula milk (37.7%), followed by those who received breast milk and infant formula milk, with other liquids or foods (15.8%) or without other liquids or foods (12.3%). The most common types of liquids consumed the previous day included plain water (51.8%), infant formula milk (36.8%), and herbal infusions (10.5%). Furthermore, only 39.3% of the infants never received infant formula or other types of milk, and 25.9% received them since the first day of birth. In addition, 83.9% had never received solid, semi-solid, or soft foods before six months.

Table 3 displays maternal, birth, and health characteristics of infants according to their exclusive breastfeeding status. Overall, 79.1% of infants were born full-term (≥37 weeks), the prevalence of low birth weight (<2500 g) was 10.9%, and the rate of caesarean section reached 33.3%. The prevalence of anemia among infants was 20.5% and of wasting 9.6%. Mild and moderate to severe depression rates among mothers reached 17.6% and 15.7%, respectively. Among non-exclusively breastfed infants as compared to exclusively breastfed infants, a significantly higher proportion of Caesarean section (38.4% vs. 17.9%, $p = 0.045$), late breastfeeding initiation (≥24 h; 44.7% vs. 21.4%, $p = 0.019$), and maternal depression rates (mild: 21.7% vs. 4.0%, $p = 0.032$; moderate to severe: 18.1% vs. 8.0%, $p = 0.032$) were found.

Table 2. Feeding practices of infants under six months among Syrian refugees in Greater Beirut, Lebanon (questionnaire-based).

Infant Feeding Practices during the Previous Day	Total (N = 114)	Ever Applied Infant Feeding Practices	Total (N = 114)
Child breastfed the previous day			
Yes	103 (90.4)	Ever breastfed	112 (98.2)
No	11 (9.6)		
Bottle feeding yesterday		Ever received pre-lacteal feeding before any breast milk	70 (62.5)
Yes	51 (44.7)		
No	63 (55.3)	Types of pre-lacteal feeding received (n = 70) *	
Detailed description of feeding practices		Infant formula milk	49 (70.0)
Exclusive breastfeeding	28 (24.6)	Sugary water	22 (31.4)
Breastfeeding, mixed with infant formula, without other liquids and/or solid foods	14 (12.3)	Herbal infusions	11 (15.7)
Breastfeeding, with other liquids and/or solid food	43 (37.7)	Bottled/boiled water	3 (4.3)
Mixed milk feeding, with other liquids and/or solid foods	18 (15.8)	Other liquids/solid foods (e.g., yogurt and electrolytes)	2 (2.9)
Exclusive infant formula feeding, with other liquids and/or solid foods	11 (9.6)	Initiation of breastfeeding	
Types of liquids consumed the previous day *		≤1 h	35 (31.0)
Plain water	59 (51.8)	1–23 h	34 (30.1)
Infant formula milk	42 (36.8)	≥24 h	44 (38.9)
Herbal infusions (e.g., anis, chamomile, caraway)	12 (10.5)	Ever received infant formula and/or other types of milk	70 (61.4)
Other milk (tinned, powdered, or fresh)	7 (6.1)	Age of introduction	
Yogurt	7 (6.1)	Never	44 (39.3)
Juice	6 (5.3)	≤1 day	29 (25.9)
Clear broth	1 (0.9)	2–29 days	14 (12.5)
Other liquids (e.g., sodas, chocolate drinks)	1 (0.9)	1–3 months	19 (17.0)
		4–5 months	6 (5.4)
		Milk types introduced (n = 68) *	
		Infant formula milk	62 (91.2)
		Powdered cow's milk	5 (7.4)
		Fresh cow's milk	1 (1.5)
		Introduction of solid, semi-solid, or soft foods before six months	18 (15.8)
		Age of introduction	
		Never	94 (83.9)
		<3 months	3 (2.7)
		4 months	5 (4.5)
		5 months	10 (8.9)

Categorical variables are expressed as n (%). Lack of corresponding sum of frequencies with total sample size is due to missing data. * Multiple answers were allowed.

In addition, a higher proportion of mothers attended one or less antenatal care visits (26.2% vs. 18.5%, $p = 0.014$) among non-exclusively breastfed infants compared to those who were exclusively breastfed. While nearly one third of the infants suffered from various symptoms in the past two weeks, a higher proportion of non-exclusively breastfed infants had a fever compared to exclusively breastfed infants (25.0% vs. 7.1%, $p = 0.043$). Likewise, significantly more non-exclusively breastfed infants were taking medicines in the past two weeks (46.8% vs. 23.1%, $p = 0.033$), particularly pain killers and anti-inflammatory tablets (67.6% vs. 16.7%, $p = 0.018$), than exclusively breastfed infants.

Factors associated with early initiation of breastfeeding, time of breastfeeding initiation, exclusive breastfeeding, and wasting using regression models are shown in Table 4. Mothers who initiated breastfeeding within the first hour of birth had significantly higher odds of not achieving MDD-W (aOR = 5.52, 95% CI: 1.28–20.75) and having a higher WHZ score among their infants (aOR = 1.58, 95% CI: 1.03–2.43), compared to mothers who did not. On the other hand, early initiation of breastfeeding was significantly associated with lower odds of having a preterm birth (aOR = 0.18, 95% CI: 0.03–0.98), receiving pre-lacteal feeding

among infants (aOR = 0.06, 95% CI: 0.02–0.20), and having an at-risk waist circumference (aOR = 0.19, 95% CI: 0.05–0.82), compared to those with late initiation of breastfeeding (>1 h after birth). Further analysis showed that late initiation of breastfeeding (≥ 24 h) was nearly 4-times more likely to occur among mothers with moderate to severe depression (aOR = 3.46, 95% CI: 1.09–10.97) as compared to those who initiated breastfeeding within the first day of birth. Exclusive breastfeeding was negatively associated with the age of the infant (aOR = 0.56, 95% CI: 0.39–0.81) and bottle feeding (aOR = 0.04, 95% CI: 0.00–0.38), compared to those who were not exclusively breastfed. As for wasting, the WHZ score was positively associated with receiving infant formula milk ($a\beta = 1.41$, 95% CI: 0.34–2.48) and negatively with bottle feeding ($a\beta = -0.83$, 95% CI: -1.52 ; -0.14).

Table 3. Maternal, birth, health characteristics, anemia, and nutritional status of infants under six months by exclusive breastfeeding status among Syrian refugees in Greater Beirut, Lebanon.

Variables ^a	Exclusive Breastfeeding		Total	p-Value ^b
	Yes	No		
Birth Characteristics	n = 28	n = 86	N = 114	
Type of delivery				
Vaginal birth	23 (82.1)	53 (61.6)	76 (66.7)	0.045
Caesarean section	5 (17.9)	33 (38.4)	38 (33.3)	
Self-reported gestational age (months)	8.85 ± 0.6	8.95 ± 0.3	8.92 ± 0.4	0.468
Preterm (<37 weeks)	4 (15.4)	19 (22.6)	23 (20.9)	0.428
Full-term (≥37 weeks)	22 (84.6)	65 (77.4)	87 (79.1)	
Self-reported weight of child at birth (kg)	3.13 ± 0.5	3.09 ± 0.6	3.10 ± 0.6	
Low birth weight (<2500 g)	3 (10.7)	9 (11.0)	12 (10.9)	0.750
Normal birth weight (2500–3999 g)	23 (82.1)	70 (85.4)	93 (84.5)	0.747
Macrosomia (≥4000 g)	2 (7.1)	3 (3.7)	5 (4.5)	
Self-reported length of child at birth (cm)	48.00 ± 6.9	50.37 ± 2.7	49.6 ± 4.5	0.201
Maternal and child characteristics				
Age of the infant on the day of the survey	2.24 ± 1.0	3.31 ± 1.6	3.05 ± 1.6	
<4 months	26 (92.9)	44 (51.2)	70 (61.4)	0.000
≥4 months	2 (7.1)	42 (48.8)	44 (38.6)	0.000
Number of antenatal care visits				
0 to 1 time	5 (18.5)	22 (26.2)	27 (24.3)	0.014
2 to 3 times	7 (25.9)	5 (6.0)	12 (10.8)	
≥4 times	15 (55.6)	57 (67.9)	72 (64.9)	
Time of breastfeeding initiation				
≤1 h	8 (28.6)	27 (31.8)	35 (31.0)	0.019
1–23 h	14 (50.0)	20 (23.5)	34 (30.1)	
≥24 h	6 (21.4)	38 (44.7)	44 (38.9)	
Depression screening among mothers				
Minimal symptoms (PHQ-9 < 5)	22 (88.0)	50 (60.2)	72 (66.7)	0.032
Mild depression (PHQ-9 5–9)	1 (4.0)	18 (21.7)	19 (17.6)	
Moderate to severe depression (PHQ-9 ≥ 10)	2 (8.0)	15 (18.1)	17 (15.7)	
Infant health characteristics				
Suffered from symptoms in the past two weeks				
None	9 (32.1)	29 (34.5)	38 (33.9)	0.818
Vomiting	7 (25.0)	21 (25.0)	28 (25.0)	1.000
Irritability	5 (17.9)	22 (26.2)	27 (24.1)	0.372
Diarrhea	5 (17.9)	19 (22.6)	24 (21.4)	0.595
Fever	2 (7.1)	21 (25.0)	23 (20.5)	0.043
Cough/Wheeze	4 (14.3)	18 (21.4)	22 (19.6)	0.410
Runny nose/cold	2 (7.1)	14 (16.7)	16 (14.3)	0.212
Insomnia	3 (10.7)	7 (8.3)	10 (8.9)	0.702
Fatigue	0 (0.0)	8 (9.5)	8 (7.1)	0.090
Ear infection	1 (3.6)	4 (4.8)	5 (4.5)	0.792

Table 3. Cont.

Variables ^a	Exclusive Breastfeeding		Total	p-Value ^b
	Yes	No		
Received medicines in the past two weeks				
No	20 (76.9)	42 (53.2)	62 (59.0)	0.033
Yes	6 (23.1)	37 (46.8)	43 (41.0)	
If yes, type of medicine				
Pain killers/Anti-inflammatory tablets	1 (16.7)	25 (67.6)	26 (60.5)	0.018
Antibiotics	0 (0.0)	5 (13.5)	5 (11.6)	
Received any supplements in the past six months				
No	7 (25.9)	36 (42.4)	43 (38.4)	0.126
Yes	20 (74.1)	49 (57.6)	69 (61.6)	
If yes, type of supplements received				
Vitamin D	10 (55.6)	25 (52.1)	35 (53.0)	0.801
Multivitamins	1 (5.6)	8 (16.7)	9 (13.6)	0.241
Iron	1 (5.6)	5 (10.4)	6 (9.1)	0.541
Anemia and nutritional status of infants				
Hemoglobin concentration (g/dL)				
Mean ($\pm$ SD)	11.70 $\pm$ 1.8	11.35 $\pm$ 1.1	11.43 $\pm$ 1.3	0.239
25th percentile	10.67	10.50	10.50	
50th percentile (median)	11.80	11.40	11.40	
Anemia (Hb < 10.5 g/dL)	6 (23.1)	17 (19.8)	23 (20.5)	0.714
Stunting (L/HAZ < -2)	2 (7.1)	0 (0.0)	2 (1.8)	0.012
Underweight (WAZ < -2)	1 (3.6)	5 (5.8)	6 (5.3)	0.644
Wasting (WHZ < -2)	0 (0.0)	11 (12.8)	11 (9.6)	0.046
Overweight/obese (BAZ > +2)	1 (3.6)	5 (5.8)	6 (5.3)	0.539
Microcephaly (HCZ < -2)	2 (7.1)	3 (3.5)	5 (4.4)	0.412
Mid-upper arm circumference				
Z-score mean ($\pm$ SD)	1.62 $\pm$ 1.0	0.23 $\pm$ 1.2	0.34 $\pm$ 1.3	0.034
Acute malnutrition (<115 mm)	2 (7.1)	8 (9.3)	10 (8.8)	
At-risk malnutrition (115–129 mm)	6 (21.4)	17 (19.8)	23 (20.2)	

PHQ-9: Patient Health Questionnaire-9; SD: Standard Deviations; Hb: Hemoglobin Concentrations; L/HAZ: Length/Height-for-Age Z-score; WAZ: Weight-for-Age Z-score; WHZ: Weight-for-Length/Height Z-scores; BAZ: Body Mass Index-for-Age Z-score; HCZ: Head Circumference Z-score; ^a Categorical variables are expressed as n (%) and continuous variables are expressed as mean $\pm$ SD. Lack of corresponding sum of frequencies with total sample size is due to missing data. ^b Significantly different at *p*-value < 0.05 (in bold).

Table 4. Key determinants of selected breastfeeding and child growth indicators among infants under six months.

Independent Variables	Early Initiation of Breastfeeding (WHO Indicator 2) ^a Reference Group: No (>1 h) ^b	
	Unadjusted OR (95% CI)	Adjusted OR (95% CI)
Type of delivery		
Vaginal birth	1.0 (Reference)	1.0 (Reference)
Caesarean section	0.39 (0.15; 0.99) *	0.85 (0.10; 1.43)
Self-reported gestational age (months)		
Full-term	1.0 (Reference)	1.0 (Reference)
Preterm	0.27 (0.08; 0.98) *	0.18 (0.03; 0.98) *
Received pre-lacteal feeding		
No	1.0 (Reference)	1.0 (Reference)
Yes	0.06 (0.02; 0.15) α	0.06 (0.02; 0.20) α
Weight-for-length/height Z-score	1.43 (1.04; 1.97) *	1.58 (1.03; 2.43) *
MDD-W of mothers		
Achieved (≥ 5)	1.0 (Reference)	1.0 (Reference)
Not achieved (<5)	6.83 (2.20; 21.16) α	5.52 (1.28; 20.75) *
Waist circumference of non-pregnant mothers ^c		
Normal	1.0 (Reference)	1.0 (Reference)
At-risk	0.36 (0.15; 0.90) *	0.19 (0.05; 0.82) *

Table 4. Cont.

Independent Variables	Time of Breastfeeding Initiation ^a Reference Group: No (<24 h) ^d	
	Unadjusted OR (95% CI)	Adjusted OR (95% CI)
WHO Indicator 3: Exclusive breastfeeding		
No	1.0 (Reference)	1.0 (Reference)
Yes	0.34 (0.12; 0.92) *	0.60 (0.17; 2.05)
WHO Indicator 16: Bottle feeding		
No	1.0 (Reference)	1.0 (Reference)
Yes	3.18 (1.45; 6.98) *	2.31 (0.92; 5.77)
Depression screening		
Minimal symptoms	1.0 (Reference)	1.0 (Reference)
Mild depression	2.65 (0.94; 7.45)	2.19 (0.74; 6.48)
Moderate to severe depression	4.36 (1.43; 13.35) *	3.46 (1.09; 10.97) *
Independent Variables	Exclusive Breastfeeding (WHO Indicator 3) ^a Reference Group: No ^e	
	Unadjusted OR (95% CI)	Adjusted OR (95% CI)
Age of the infant (months)	0.62 (0.46; 0.85) *	0.56 (0.39; 0.81) *
WHO Indicator 16: Bottle feeding		
No	1.0 (Reference)	1.0 (Reference)
Yes	0.03 (0.00; 0.20) **	0.04 (0.00; 0.38) *
Received breast milk substitutes instead or in addition to breast milk		
No	1.0 (Reference)	1.0 (Reference)
Yes	0.12 (0.05; 0.32) ^α	0.38 (0.11; 1.34)
Independent Variables	Weight—for—Length/Height Z—Score ^f	
	Unadjusted β (95% CI)	Adjusted β (95% CI)
Age of the mother (years)		
<25 years	0.0 (Reference)	0.0 (Reference)
≥25 years	0.58 (0.07; 1.09) *	0.50 (−0.12; 1.12)
Received breastmilk substitutes: infant formula		
No	0.0 (Reference)	0.0 (Reference)
Yes	1.32 (0.20; 2.44) *	1.41 (0.34; 2.48) *
WHO Indicator 3: Exclusive breastfeeding		
No	0.0 (Reference)	0.0 (Reference)
Yes	0.63 (0.08; 1.18) *	0.64 (−0.08; 1.36)
WHO Indicator 16: Bottle feeding		
No	0.0 (Reference)	0.0 (Reference)
Yes	−0.73 (−1.23; −0.22) *	−0.83 (−1.52; −0.14) *

WHO: World Health Organization; OR: Odds Ratio; MDD-W: Minimum Dietary Diversity for Women; * $p < 0.05$, ** $p < 0.001$, ^α $p < 0.001$; ^a All variables that have shown a p -value < 0.05 in the univariate logistic regression were included in the multiple logistic regression models. Adjusted Odds Ratio of the dependent variable are presented with 95% CI using multiple logistic regression. ^b The reference group for the dependent variable Early Initiation of Breastfeeding is No (>1 h) vs. Yes (≤ 1 h). ^c Non-pregnant mothers include lactating and non-pregnant non-lactating mothers. ^d The reference group for the dependent variable Time of Breastfeeding Initiation among infants is No (<24 h) vs. Yes (≥ 24 h). ^e The reference group for the dependent variable Exclusive Breastfeeding is No vs. Yes. ^f All variables that have shown a p -value < 0.05 in the univariate linear regression were included in the multiple linear regression models. Adjusted βs of the dependent variable for the Weight-for-length/height Z-score (as continuous dependent variable) are presented with 95% CI using multiple linear regression.

Findings from FGDs related to infant feeding practices are found in Table 5 with major themes, codes, and representative quotes. Two major thematic axes emerged as follows: (1) Enablers and (2) Barriers for early initiation of breastfeeding and exclusive breastfeeding.

Table 5. Enablers and barriers for the initiation of breastfeeding and exclusive breastfeeding among Syrian refugee mothers of children under five years in vulnerable areas of Greater Beirut, Lebanon –qualitative analysis of focus group discussion (N = 11).

Themes	Codes	Representative Quotes
A- Enablers for early initiation of breastfeeding and exclusive breastfeeding		
Knowledge on infant feeding practices and maternal nutrition	Cultural beliefs	“I wished I was able to breastfeed. They say that a child who has taken his mother’s milk develops a better immunity and becomes gentle and caring.” (Mother 1) “I gave him what he deserves.” (Mother 2) “I don’t want to stop breastfeeding, I want to give him his right to breastfeed, even if it’s from my heart, I want to give him his rights.” (Mother 3)
	Maternal nutrition	“Some people have certain convictions, that when the child breastfeeds from his mother, everything the mother eats comes with the milk, so him, he eats everything.” (Mother 4) “Now I eat everything, I’m breastfeeding the girl, I’m eating everything (...) I didn’t stop anything honestly.” (Mother 5) “We should not eat until we’re very full, so that the child doesn’t feel full. But we should eat and not hold back on anything.” (Mother 6)
	Exclusive breastfeeding	“[I gave my children] only breast milk, until six months (...), not even water.” (Mother 4) “[Just] my breast milk [since the beginning] (...), [with] nothing [else at all].” (Mother 7) “I started [feeding my child] at seven months (...), [in the beginning it was] only [breast] milk.” (Mother 8) “I breastfeed her only, I don’t give the bottle at all to my children.” (Mother 9)
Support from healthcare providers and family	Healthcare professional support	“My mother used to tell me to stop this and that, I didn’t listen to her, I know the doctor says we can eat everything, I listen to the doctor. (...) She would tell me, don’t eat hummus, don’t eat lentil, those bloats. But whatever the doctor tells me I listen to him. (...) and the doctor, when she gave me the C-section she told me to eat everything so that the child can get used to them [family food] later.” (Mother 5)
	Family support	“[When I am worried or tired], I can’t breastfeed (...), I wait till I calm down. (...) My husband’s sister [gave me this advice]. My mother isn’t here, but she has a telephone, so I also take information from her. (...) Yes true [that we ask relatives], if the condition progresses, we go to the doctor, but we ask relatives more.” (Mother 10) “[I take advice from] my mother-in-law, (...) [she doesn’t live with me], but she has experience, she’s tried it, if you look at the internet, everyone says something ... and some of which are not true either, but the mother law has tried them before.” (Mother 11) “We all breastfeed.” (Mothers 12 and 13)
B- Barriers for early initiation breastfeeding of and exclusive breastfeeding		
Pre-lacteal feeding	Oral rehydration solutions	“When they are in the hospital, when they bring them to breastfeed, [they would have given him a] water that is called “mayit el ghalib” [referring to oral rehydration solutions].” (Mother 13) “I, it’s different from what the doctor gives ... I personally didn’t give the child any cumin [or water and sugar] when he was small. After the first day, the doctor gave me a small box [referring to a type of feed] and said to give it to him the first few days, and after that the milk came in and I was breastfeeding.” (Mother 14)
Infant feeding practices	Early introduction of solid, semi-solid, or soft foods (before the age of six months)	“My children starting three to four months to taste whatever I cook so they won’t be disgusted by it when they grow up. Now, they eat anything I put in front of them. (...) Everything, whatever I cook. I put a small quantity on my finger and in his mouth.” (Mother 1) “Of course, I started; I fed him the first month. (...) [For example], Yogurt, fig jam, herbal tea.” (Mother 3) “Around five months, (...) [I started to introduce] fruits, like apples, I remove the skin, I squeeze it for juice, a quarter of a cup I mean.” (Mother 15) “At around four months, I mashed rice [with breast milk] and fed it to him. [I also gave him] banana for example ... apple. (...) when he was four months old, I gave him those meals ... ” (Mother 16) “He’s eating since he was four months, I feed them yogurt, mashed rice ... ” (Mother 17)

Table 5. Cont.

Themes	Codes	Representative Quotes
Infant feeding practices	Infant formula milk use	“During the first period, I start using the baby bottle. As you know, milk is present abundantly in the village.” (Mother 1) “[I was breastfeeding him for six months] but with help, from the first month, I got help with the [infant formula] milk. (...) First three months, or four months, [it was] only breast milk ... then I started helping them with the [infant formula] milk.” (Mother 4) “[I started giving her infant formula milk] around two months and a half, because she never got very full, so I got her formula milk.” (Mother 17) “In ten days, she will be four months old. (...) [She’s receiving] my milk and I got her [infant formula milk]. (...) I’ve been doing it for a month and ten days.” (Mother 18)
	Water and/or herbal tea consumption	“[He was only breastfed until four months but received] water, yes.” (Mother 17) “[He was only breastfeeding until five months, but] with water of course, I gave him [bottled] water.” (Mother 19) “I gave him just drops [of water] (...) from day 40 [after birth].” (Mother 18) “I gave him so much herbal tea, he suffered from dehydration, so I took him to the hospital. (...) [I gave him the chamomile tea] because I didn’t have any milk left to breastfeed.” (Mother 3)
Maternal health reasons	Perceived lack of breast milk	“I had five kids, and I didn’t breastfeed anyone of them. The reason is that I don’t have [any breast] milk.” (Mother 1) “He is the only one I had to buy milk for. And the rest I breastfed them, but him, he is the only one whom I couldn’t breastfeed because it was dry. (...) After I gave birth, I didn’t produce a lot of milk.” (Mother 3) “[I didn’t try to breastfeed after the delivery, because] I didn’t have any breast milk left.” (Mother 19) “The youngest girl I have, I didn’t get [breast] milk to give her ... I didn’t get milk ... (...) only 2–3 months ... and the milk stopped.” (Mother 20) “There wasn’t any milk for him to breastfeed on ... three days I would put him, I would breastfeed [him], he would start crying and crying.” (Mother 13) “[The oral rehydration solution is given to the infant at the hospital] when, for instance, the breast of the mother doesn’t produce milk, it remains for two days, and three days, until it starts producing milk.” (Mother 12)
	Insufficient maternal dietary intake	“I had no milk; it was dry from lack of nutrition.” (Mother 3) “I stopped because I lost a lot of weight, and I couldn’t breastfeed anymore. My nutrition ... I didn’t have any vitamins to strengthen my milk ... (...) it didn’t have vitamins, I wasn’t taking any vitamins to strengthen my milk, it was just regular food. And I lost a lot of weight ... ” (Mother 21)
	Poor mental health	“[When I am worried or tired], I can’t breastfeed (...).” (Mother 10) “My mother-in-law has diabetes and hypertension, and thyroid problems, and my husband’s sister is pregnant, and the owner kicked her out. Now one week she sleeps with us, one week at my husband’s brother’s house. And how am I supposed to handle all that, and I have five kids, and I’m ill, I’m take relaxants [anti-anxiety drugs].” (Mother 20)
	Maternal illness	“But if you have a problem, your milk won’t help him if you’re sick, the breast milk will be only like water.” (Mother 2) “Yes, the doctor told me it was from my milk. I got a fever, and I got worked up, then I got this bacterium. (...) Honestly, I always get bothered [and angry] and develop fever, but this is the first time my son gets this bacterium, he almost died.” (Mother 19)
	Feeling tired	“I’m getting tired when I’m breastfeeding, I’m very tired, my bones, they hurt. (...) I can’t stand up, when I finish breastfeeding, I feel beaten and dizzy ... ” (Mother 3) “When I was breastfeeding. I used to get very tired, so bit by bit I introduced them [my children] to food. It affected my body. (...) I stopped breastfeeding her [one of her children], she needs to suite her needs, so she can forget what she used to take. She’s giving her what she wants so she would forget the milk. Because the mother is getting tired, she is getting tired ... ” (Mother 20)

Table 5. Cont.

Themes	Codes	Representative Quotes
Maternal health reasons	Complications during pregnancy and delivery	“[I breastfed my son only] one month. (...) I gave birth by caesarian surgery, and the wound got infected. So, the doctor prescribed medication. So, due to the odor of the medication, he started vomiting.” (Mother 22) “In breastfeeding I’m not harsh on the child. As much as I eat and nurture myself, I tried with this child. (...) but this child is an exception, I gave birth to him through C-section (...) and I bled through the surgery ... ” (Mother 4) “My son, this one, didn’t breastfeed. (...) I didn’t have [any breast milk], I had during pregnancy ... (...) complications, yes and bleeding, and I didn’t get any [breast] milk ... ” (Mother 23)
	Premature delivery	“I have never breastfed them, (...) they were born early, (...) they were born in the end of the 7th month.” (Mother 24) “[The child] was [receiving] both [breast milk and infant formula milk] ... Ever since I got him, he was very small, he was tired and that was the situation.” (Mother 25)
	Distribution of breastmilk substitutes	“No, even in Syria I didn’t breastfeed. (...) Neither here [in Lebanon] nor there [in Syria]. On the contrary, here they gave me [samples of infant formula] milk. In Syria, we had cows nearby, so I used to feed her that.” (Mother 1) “They helped me a lot with the [infant formula] milk, I didn’t consider getting the milk but Dar-El-Fatwa [local non-governmental organization] got them for me. (...) I used to visit the doctor there she’s very good, and she would automatically take out the milk and hand it to me, every time I went to see her. (...) Yes, thank God, it was not bad, now when he grew up a little, the doctor told me, now sometimes ... Every time they have some left, she tells me to take a pack [of infant formula milk]. If there aren’t any, I get Nido [brand of powdered cow’s milk] and they cause a lot of constipation ... Well, the Nido, because it isn’t for his age, they told me that it’s not good ... yes but I still give it to him (...)” (Mother 25) “[I started to give her a bottle of milk at four months] because in the hospital they taught her that. She stayed in the hospital for four days, they taught her on the milk bottle, so I started giving her ... ” (Mother 26)
Social factors	Recommendations to use infant formula milk by healthcare professionals	“I went to the pharmacist and explained the situation, that you can’t tell hand from foot, and she’s always lying down, the pharmacist said, “she died, does she still have her soul?” I said yes. So, she gave me infant formula milks (NAN and Nido) from the pharmacy, and the girl got better from the first week. Because of my situation, when I came to Lebanon, financially we weren’t good. Until he [my husband] worked, and thankfully things got better.” (Mother 20) “There wasn’t any milk for him to breastfeed on. For three days I would put him, I would breastfeed, he would start crying and crying. (...) They took him to the doctor; I told him this child hasn’t taken milk in three days. (...) He [the doctor] gave me the sugary water, they told me to give it to him, and then he gave me [infant formula] milk. [The child received] formula milk from the start.” (Mother 13)
	Misinformation from mothers-in-law	“My mother-in-law used to nag on me not to eat, I started eating in secret. Yes, it’s true. They say it affects my stomach and they tell me not to eat except potato and rice only. (...) Yes, my mother-in-law used to tell me. After that in 20 days, I didn’t have milk left. (...) I didn’t eat what I wanted to, so I lost my milk.” (Mother 20) “I also started eating potato and rice, potato, and rice, [it was my mother-in-law’s advice]. (...) It was wrong. I lost my milk, what can I do.” (Mother 6) “Her [the mother-in-law] advice is right, she’s an old woman and she’s given birth and she knows ... but with my last child I didn’t get milk. I didn’t get milk but it’s not her fault, but she also told me to get her [the infant] starch, so I fed her starch until she [almost] died [and looked very sick], you wouldn’t know the girl’s hand from foot. I don’t know, she [my mother-in-law] told me [to get infant formula milk], so I got.” (Mother 20)

Under the Enablers axis, two major themes were generated representing (1.a) knowledge on infant feeding practices and maternal nutrition and (1.b) support from healthcare providers and family. Breastfeeding emerged as a core practice according to their cultural beliefs as mothers referred to it as a “right” (Mother 3) and crucial for the development of the child. Mothers highlighted the importance of proper maternal nutrition and to be able to “eat everything [...] and not stop anything” (Mother 5). Many mothers also demonstrated positive attitude towards exclusive breastfeeding and eagerly confirmed to have given their infants “only breast milk, until six months (...), not even water” (Mother 4). Receiving support from healthcare professional or family was discussed by participants. A couple of mothers mentioned that they follow the recommendations of doctors, yet they still valued

their family members' advice. As a result, several women preferred to talk to their mothers or mothers-in-law first and turn to a doctor when *"the condition progresses"*. When feeling overwhelmed, one mother stated that she took the advice of her sister-in-law to *"calm down"* because she *"can't breastfeed"* and other times she would call her mother *"to take information from her"* (Mother 10). Other mothers stated that *"we all breastfeed"* (Mothers 12 and 13), indicating that it was a common practice adopted well and supported by their families and communities.

As for the Barriers axis, four major themes emerged, including (2.a) pre-lacteal feeding, (2.b) infant feeding practices, (2.c) maternal health reasons, and (2.d) social factors. According to the discussions with the mothers, pre-lacteal feedings and early introduction of solid, semi-solid, or soft foods may have not been seen as the main barrier to early initiation of breastfeeding and exclusive breastfeeding. Pre-lacteal feeding consisted of oral rehydration solutions and possibly infant formula milk, as mothers referred to it as *"a small box [referring to a type of feed or solutions]"*, and mothers seemed to be content with using it until *"the milk came in"* (Mother 14). Similarly, early introduction of foods appeared to be common and was perceived as a practice that encouraged infants to taste a variety of food *"so they won't be disgusted by it when they grow up"* (Mother 1). Mothers appeared to be satisfied with introducing a *"small quantity"* of foods such as family dishes, *"yogurt, fig jam, herbal tea"*, *"fruits"*, and *"mashed rice"* at *"five months"* or even earlier starting *"three to four months"* (Mothers 1, 4, 15, 16, and 17).

When asked about the use of infant formula milk, many mothers confirmed having used a mixed milk feeding to *"help"* the child for various reasons *"from the first month"* or between the second and fourth months (Mothers 4, 17, and 18). Water consumption was also widely discussed. It appears that this practice was known among mothers *"from day 40 [after birth]"* (Mother 18). As for herbal tea consumption, one mother explained to have used it as an alternative to breast milk because she *"didn't have any milk left to breastfeed"*, which caused her child to be hospitalized because of *"so much herbal tea"* (Mother 3).

On the other hand, discussions suggested that maternal health reasons were perceived as a major barrier to adequate breastfeeding practices. Perceived lack of breast milk was widely mentioned as a reason for not breastfeeding. Commonly used statements included *"I didn't have any breast milk"*, *"it was dry"*, and *"the milk stopped"* (Mothers 1, 3, 19, and 20). Some mothers even highlighted that they *"had no milk; it was dry from lack of nutrition"* (Mother 10), indicating insufficient maternal dietary intake was a known barrier to breastfeeding. Furthermore, mothers were able to express that having poor mental health, an illness, or feeling tired were known obstacles to proper breastfeeding practices. One mother readily stated that *"[when I am worried or tired], I can't breastfeed (...)"* (Mother 10) and *"I'm getting tired when I'm breastfeeding, I'm very tired, my bones, they hurt. (...) I can't stand up, when I finish breastfeeding, I feel beaten and dizzy ..."* (Mother 3). Complications during pregnancy or delivery and premature delivery were also viewed by mothers as barriers to breastfeeding. Mothers openly shared their struggles to initiate breastfeeding because of experiencing *"complications"* and *"bleeding"* during delivery (Mother 23) or having a *"very small"* newborn (Mother 25).

As for social factors, discussions indicated that the use of breastmilk substitutes seemed to influence the mother's choice to initiate or continue breastfeeding. Several mothers readily acknowledged receiving free samples of infant formula milk from healthcare professionals or local non-governmental organizations. Mothers also stated receiving strong recommendations to use infant formula milk from healthcare professionals when their infants were very ill or when *"there wasn't any milk"* (Mother 13). In addition, discussions revealed that mothers were aware of some misinformation being passed down by earlier generations, particularly from mothers-in-law. For instance, mothers shared that they received specific nutritional advice to avoid or consume a certain food group such as *"potato and rice only"* (Mothers 20 and 6) and for infants to consume *"starch"* (Mother 20), resulting in malnutrition among both the mother and her infant.

4. Discussion

This is the first study to investigate infant feeding practices as well as the prevalence of anemia and the nutritional status of infants under six months among Syrian refugees in Greater Beirut, Lebanon—representing an urban setting of a humanitarian crisis. Despite the very high rate of ever breastfed infants (98.2%), less than a third were breastfed within the first hour of birth (31.0%) and a quarter were exclusively breastfed (24.6%) in our study. Our prevalence was comparable to those reported in Syria in 2019 [44,45] and among Syrian refugees in Lebanon in 2013 [19], but lower than those recorded in Syria before the start of the war in 2009–2010 [44,45] and among Syrian refugees in Southern Turkey, Northern Lebanon, and Jordan in 2016–2020 [20,46,47]. Similarly, low exclusive breastfeeding (EBF) rates were documented among internally displaced persons in eastern Ukraine [48] and Sahrawi refugees in Algeria [49]. Our findings were also in line with recent national and regional studies in Lebanon reporting a prevalence of EBF varying from 30% to 59% among children under six months conducted in 2019–2021 [50–52]. However, our rates remained below the global and Middle East and North Africa regional rates of early initiation of breastfeeding and EBF in 2014–2020 [44,45].

Ever breastfeeding was most widespread among Syrian refugees in Greater Beirut, Lebanon. Similar findings were registered among Syrian refugees in Northern Lebanon and Turkey [20,46,53]. In our study, mothers explained that breastfeeding is a core practice in their culture as they “*all breastfed*” and believed that breastfeeding is a “*right*” for their children. Breastfeeding intention was found to have a crucial role in the initiation and sustainability of effective breastfeeding among refugees [54,55]. According to the World Health Organization (WHO), ever breastfeeding is a reflection of the acceptance of breastfeeding in the culture [31]. In fact, the prevalence of ever breastfeeding, early initiation, and EBF were even higher in Syria in 2009–2010 before the start of the war [44,45], indicating that this practice has been well integrated in their culture. Nevertheless, evidence have shown that breastfeeding practices deteriorate during humanitarian crises and conflicts, increasing the risk of infant malnutrition [48,56].

The prevalence of anemia (20.5%) and wasting (9.6%) among children under six months were classified as a medium public health significance in our study [57,58]. Very few studies examined anemia levels of infants under six months in the literature, especially among refugees. The anemia level in our study were not too far from findings recorded in Argentina (28.9%) [59] and South Africa (33%) [60]. As for wasting, recent surveys conducted among Syrian refugees and Lebanese children aged 6 to 59 months in Lebanon showed that childhood wasting was maintained to about 5% in 2018–2021 [15,52]. However, a similar prevalence of wasting was found among infants of Sahrawi refugees [49]. This suggests that infants among the refugee population may be at an increased risk of acute malnutrition from an early age.

Pre-lacteal feedings were given to 62.5% of the infants in our study, with the majority receiving infant formula milk, followed by sugary water and herbal infusions, before lactation was started. It appears that mothers in our study did not view pre-lacteal feedings, consumption of water or herbal tea, and early introduction of foods as a barrier to exclusive breastfeeding. Syrian refugees in Turkey and Jordan as well as Sahrawi refugees in Algeria practiced similar customs [47,49,61]. For instance, sugary water was believed to cleanse the intestines and prevent jaundice by most parents and family members in Syria [61]. Other common beliefs were observed among internally displaced persons in eastern Ukraine, such as giving infants water when the mother felt thirsty while it was warm outside [48]. Some mothers also introduced foods before the age of six months, despite the WHO recommendations. In our study, mothers justified this common practice as an approach to get their children to eat “*everything*” and “*anything*” at home. Others believed that introducing food early would lead to a chubby baby, as a sign of good health [62]. Similar traditions were also documented among Syrian refugees in Turkey [61], Lebanon [20], and Germany [62] as well as refugees in Algeria [49] and displaced persons in eastern Ukraine [48].

Early initiation of breastfeeding was shown to be protective against receiving pre-lacteal feeding and wasting (WHZ) among infants. Timely onset of breastfeeding was also significantly associated with EBF, despite the lack of association in the regression models. Breastfeeding within the first hour of birth is known for its decisive role in securing that newborns receive colostrum feedings, limiting the possibilities of feeding newborns anything other than breast milk, and establishing EBF successfully [5]. This is confirmed by the robust literature supporting the advantages of breastfeeding for the baby by reducing gastrointestinal and respiratory infections and non-communicable diseases as well as increasing intelligence in the long-term [63–65]. Our findings also showed that a significantly higher proportion of non-exclusively breastfed infants suffered from a fever and received medicines compared to those who were exclusively breastfed. Moreover, early introduction of complementary food has been known to shorten the duration of breastfeeding and stop it prematurely [66]. Therefore, adequate infant feeding practices can set the child on the right path to prevent malnutrition from early infancy [67].

Bottle feeding was also identified as a main barrier to exclusive breastfeeding in our study. In addition, the use of bottles had a significant negative association with the weight-for-length/height Z-score, while the use of infant formula milk had a positive association. According to the WHO, feeding bottles and teats were discouraged as they are often difficult to keep clean and could lead to the transmission of pathogens. Their uses increased the risk of diarrhea, dehydration, and malnutrition [6]. Bottle feeding was also known to increase unfavorable behaviors during breastfeeding, such as suckling behavior, affectivity, baby's response, and the mother/baby position, which might interfere with the infant's weight gain and increase the risk of early weaning [68]. Hence, it is recommended to use a feeding cup when needed and to secure a suitable breastmilk substitute, prepared according to instructions for safe preparation and use, to be given only to infants who do not have access to breast milk [7]. The prevalence of bottle feeding documented in our study (44.7%) was similar to those observed among the Lebanese population and Syrian refugees in Lebanon [19,51], but lower compared to Syrian refugees in Jordan [47]. Our discussions with the mothers indicated that the use of breastmilk substitutes seemed to influence the mother's choice to breastfeed due to free samples of infant formula milk distributed or strong recommendations for their use by healthcare professionals. These findings were a direct reflection of the violations to the Code of Marketing of Breastmilk Substitutes previously documented in Lebanon [69,70].

Moreover, having a pre-term delivery was found to be negatively associated with early initiation of breastfeeding. Studies have shown that preterm delivery might delay the initiation of lactation among mothers [71]. Nevertheless, it would still be possible to establish exclusive breastfeeding among preterm infants [72]. A high prevalence of caesarian delivery was recorded in our study (33.3%), exceeding the global rate of 21.1% [73]. Caesarian delivery, labor complications, and premature birth also emerged as barriers to breastfeeding during focus group discussions in our study. Caesarian deliveries are known to hamper the initiation of breastfeeding and exclusive breastfeeding rates. This might be mediated by various reasons, including the delayed onset of breastfeeding and disrupted mother-infant interaction due to postoperative care routines [74]. The lack of association of caesarian delivery and breastfeeding in our study might be explained by the large number of caesarian sections performed that could have been elective and not medically recommended. As a result, mothers who underwent elective caesarian sections might have better outcomes and be able to start breastfeeding earlier compared to those who had a medical reason [75]. Mixed findings on the role of caesarian sections as a predictor of delayed initiation of breastfeeding were also documented in Lebanon [75,76].

Low dietary diversity among mothers was also associated with higher odds of early initiation of breastfeeding. Poor dietary diversity was also linked to low income and food insecurity among Syrian refugee mothers in Greater Beirut, Lebanon [16]. This suggests that mothers facing increased economic vulnerabilities would be more inclined to initiate breastfeeding early as breast milk is known to be more cost-effective. In addition, Syrian

refugees in Turkey and Lebanon stated that breast milk is “free”, “less costly and more natural” [53,61]. However, it was also mentioned by the mothers that insufficient maternal nutrition and poor health were major reasons to halt breastfeeding prematurely. Among Syrian refugees in Greater Beirut, Lebanon, lactating mothers were found to have higher proportions of nutritional inadequacies and 19.4% of them suffered from anemia [15]. In addition, Syrian refugees in Turkey reported that malnutrition and fatigue of mothers were often the biggest obstacles to breastfeeding [61]. These findings shed the light on the role of adequate maternal nutrition during pregnancy and lactation as it impacts the development and health of the offspring [77,78], which was particularly difficult to achieve among Syrian refugee mothers in Greater Beirut, Lebanon [15,16].

Maternal-related adverse factors also included maternal obesity and maternal depression. Having an at-risk waist circumference was associated with lower odds of early initiation of breastfeeding. This is concerning as more than 60% of the mothers in our study were found to be overweight or obese [15]. According to the literature, maternal obesity is associated with lower rates of early initiation of breastfeeding and EBF not only due to mechanical factors, hormonal imbalances, and a delayed onset of lactogenesis II, but also to psychosocial factors associated with body image dissatisfaction or concerns [79,80]. Maternal depression was also identified as a predictor to delayed initiation of breastfeeding. Possible explanations are that maternal psychological distress, such as depression or anxiety, may impair the release of oxytocin and delay the onset of lactogenesis, thus reducing breastfeeding outcomes [81]. Crowded spaces were also reported to negatively impact breastfeeding practices among Syrian refugees in Lebanon [53]. This could be explained by the strong association between poor maternal mental health, food insecurity, and a high crowding index found among Syrian refugee mothers in Lebanon [16]. Particularly, stress related to conflicts was recognized as a major contributor to the discontinuation of breastfeeding among refugees and displaced persons, as it might interfere with the mother’s let down reflex and lactation [6,46,48,53]. These cues could be easily perceived as a sign of insufficient milk production by mothers [6], as stated during focus group discussions. Providing reassurance and support to these mothers is beneficial and would enhance the lactation outcome [6], particularly among mothers that were experiencing loss of social support due to migration [61]. Mothers in our study described that they were able to breastfeed following the advice of a family member to “calm down” when worried or tired. These findings emphasize the significance of the role of psychosocial support for effective breastfeeding practices.

Receiving support from healthcare providers and family members were mentioned as enablers for breastfeeding by mothers in our study. Spousal support was found to be a strong influencer for breastfeeding attitudes [54], along with female relatives which were viewed as key sources of support for breastfeeding among Syrian refugee mothers in Turkey, Germany, and Lebanon [53,61,62]. However, some nurses and midwives reported that the support provided by grandmothers was sometimes seen as excessive since it reduced the mother’s contact with the newborn and affected the mother–infant bonding [61]. In addition, some mothers also discussed receiving misinformation from their mothers-in-law that lead to malnutrition and an early cessation of breastfeeding in our study. This indicates the importance of engaging family members such as grandmother and mothers-in-law in counselling, programs, or interventions targeted to promote optimal infant and young child feeding practices as well as maternal nutrition [82]. Although nutrition knowledge is known to be a key modulator in breastfeeding practices [82,83], a strong intention to breastfeed prenatally and a positive attitude towards breastfeeding are also significant predictors [84]. Furthermore, the number of antenatal care visits was positively associated with exclusive breastfeeding, even though this relationship was not significant in the multivariate models. The positive impact of antenatal care visits on breastfeeding practices has been well documented in the literature [6,85,86]. However, the lack of or difficulty to access antenatal care might act as a barrier for Syrian refugee mothers, especially among

those not registered as refugees with the UNHCR in Lebanon or those facing a language barrier such as in Turkey and Germany [15,46,61,62].

Findings of this study should be interpreted considering some limitations and strengths. This is a cross-sectional study, hence limiting the ability to infer causality. Data collection was focused on the most vulnerable areas of Greater Beirut using a purposeful sampling approach; thus, findings cannot be generalized to rural areas or the whole country. However, one strength of our study is the inclusion of unregistered refugees living in the catchment area of these primary health care centers, which would have not been possible if a randomized approach using the UNHCR list of refugees was used. Another limitation is the use of the previous day's feeding to measure the proportion of exclusively breastfed infants. The proportion of EBF can be overestimated as some infants may have not received other liquids or foods on the day before the interview [87]. It is also worth noting that data on birth characteristics may be subjected to recall bias as the gestational age, weight, and length at birth were self-reported. In addition, the definition of gestational age was adapted to the culture and was interpreted in months instead of weeks as understood by the mothers. Therefore, the proportion of full-term births could be overestimated. Lastly, the Patient Health Questionnaire-9 (PHQ-9) was validated among Lebanese adults instead of Syrian refugees. It also had a poor specificity in capturing depressive symptoms, yet a good sensitivity. Thus, it was regarded as a useful screening tool for depression in settings lacking sufficient psychiatric care [88].

5. Conclusions

In conclusion, this study demonstrated poor infant feeding practices among infants under six months of Syrian refugees in Greater Beirut, Lebanon. Our findings showed that 20.5% and 9.6% of infants under six months were anemic and wasted, respectively. Despite a nearly universal onset of breastfeeding, early initiation and exclusive breastfeeding were considerably low. While the early initiation of breastfeeding was associated with lower odds of receiving pre-lacteal feeding and wasting among infants, bottle feeding was identified as a significant obstacle to exclusive breastfeeding. Key maternal-related factors were found to be adversely related to the early initiation of breastfeeding, which included low dietary diversity, obesity, and depression. The role of family members' support, antenatal and post-natal care, and nutrition education for effective breastfeeding practices were underlined in our study.

Our findings could help strengthen existing campaigns and interventions to address the identified gaps and barriers. Raising awareness on proper breastfeeding practices would be essential for mothers and their family members alike. Psychosocial support would be particularly important for refugee mothers, considering the role of maternal mental health status in the successful establishment of breastfeeding. As maternal nutrition and infant nutrition are tightly linked, nutrition specific interventions should focus their efforts on improving the nutritional status of mothers at the community and individual levels to reduce infant malnutrition. Furthermore, the implementation of the Code of Marketing of Breastmilk Substitutes and the Baby Friendly Hospital Initiative would need to be reinforced in Lebanon. Future research should investigate the determinants of anemia and the nutritional status among infants under six months in prospective cohort studies.

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Informed Consent Statement: Written consents were obtained from all mothers prior to enrollment in the study. A parental consent and an informed assent were sought when mothers were aged less than 18 years. In case of illiteracy, a witness or the nurse signed on the mother's behalf after reading and explaining the consent form to the participant. Confidentiality was assured to the participants by assigning random identifiers and allowing access to the data only to the investigators.

Data Availability Statement: The dataset analyzed during this study is available from the corresponding author on reasonable request.

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6

Chapter 6

General Discussion

6. General Discussion

The original work of this dissertation contributes to the existing literature with the following key messages as stated below:

First, the nutritional status and anemia levels were described among mothers and children under five years, revealing moderate public health significance among Syrian refugees in Greater Beirut, Lebanon. Mothers and children were affected by under- and over-nutrition as well as anemia in the same household, portraying the double burden of malnutrition.

Second, most of the mothers were consuming a diet low in diversity and mothers from low-income households had a more monotonous diet. A higher proportion of pregnant and lactating mothers did not meet their nutrient requirements. Status of food security and mental health were found to be inadequate among mothers. A significant relationship between food insecurity, poor dietary diversity, and poor mental health was documented among Syrian refugee mothers.

Third, poor infant feeding practices were found among Syrian refugee infants under six months in Greater Beirut, characterized by a high prevalence of pre-lacteal feeding and low levels of early initiation of breastfeeding and exclusive breastfeeding. Factors associated with infant feeding practices and nutritional status were documented. Supporting factors included proper knowledge and healthcare services, while the main barriers comprised the nutritional and mental health status of the mother, inadequate feeding practices, misinformation, and violations to the Code of Marketing of Breastmilk Substitutes.

In the following chapter, the key findings of this thesis are discussed in the light of the conceptual framework developed and explained in Chapter 1. The pathways between the studied outcomes and immediate, underlying, and enabling determinants were identified. The strengths and limitations of this dissertation are also presented in this chapter.

6.1. Anemia and nutritional status among Syrian refugee mothers and their children in Greater

Beirut, Lebanon

The first and third paper focused on assessing anemia levels and the nutritional status of Syrian refugee mothers and their children below five years, with a particular interest on infants under six months, as one of their primary objectives.

Our findings contribute to the second-level outcomes as per the conceptual framework. Anemia levels were described among mother and child pairs, showing that the prevalence of total anemia reached

21.7% among mothers (15-49 years) and 30.5% among children under five years (0-59 months) from the same household. The prevalence of anemia among infants under six months (0-6 months) reached 20.5%. Their nutritional status (under- and over-nutrition) was also described, revealing a high prevalence of overweight and obesity among mothers (60.7%), low level of stunting among children under five years (9.0%), and medium levels of wasting among infants under six months (9.6%). These findings documented that mothers and children were affected by under- and over-nutrition as well as anemia in the same household, portraying the double burden of malnutrition [1,2]. Similarly, a systematic review by Khuri *et al.*, (2022) observed the existence of the double burden of malnutrition across different studies conducted among refugees worldwide [3].

6.1.1. Anemia among Syrian refugee mothers and their children

As discussed in Chapters 3 and 5, the prevalence of anemia among mothers and children under five years presents a moderate public health significance according to the World Health Organization (WHO) classification among Syrian refugees living in an urban setting of a humanitarian crisis in Lebanon [4]. The prevalence of anemia among women of reproductive age in our study were in line with the findings of a national study conducted in Lebanon in 2004 [5]. Our findings remained lower than the global estimates of anemia among women of reproductive age reported by the WHO in Lebanon (28.3%) and Syria (32.8%) in 2019 [6]. The prevalence of anemia among children (0-59 months) in our study was similar to those reported by the WHO Global Health Observatory in Syria at onset of the conflict among children aged (6-69 months) in 2011 (30.5%) [7]. Despite the overall decrease in anemia rates among children (45.6% to 42.7%) and the observed steady rate among women (34.8% to 34.9%) in the Eastern Mediterranean region from 2011 until 2019, a gradual increase in the prevalence of anemia was observed in Syria (children: 30.5% to 32.9%; mothers: 31.8% to 32.8%) and in Lebanon (Children: 21.2% to 22.8%; mothers: 25.2% to 28.3%) [6,7]. In addition, our prevalence of anemia were lower than those reported of Syrian refugees living in refugee camps in Jordan or Iraqi refugees in Lebanon, but higher than previous reports among Syrian refugees in Lebanon and more recently in Germany [8–10].

Furthermore, this is the first study to report the prevalence of anemia among infants below six months in the context of a humanitarian crisis. Very few studies are available on anemia among infants under six months due to the lack of cut-off values for hemoglobin for this age group [11,12]. Data from low- and middle-income countries (LMICs) documented a prevalence of anemia ranging from 28.9% to 37% with a lower cut-off (Hb < 10.0-10.5 g/dL), only to reached 60.9% when a higher cut-off was used (Hb < 11 g/dL) [13–16]. Despite recording a lower anemia prevalence among infants in our study using the lower cut-off, it remains to be classified as a medium public health significance [4].

6.1.2. Under- and over-nutrition among Syrian refugee mothers and their children

Nearly two-thirds of Syrian refugee mothers were found to be overweight or obese (60.7%), while only 2.5% were found to be underweight. These findings were in line with the 2016 age-standardized estimates of overweight and obesity in Lebanon and Syria [17] and with previous studies conducted among Lebanese women [18,19]. High rates of overweight or obesity were also found among Syrian refugees in Germany and other refugees worldwide, with the highest being recorded among Somalian and Cambodian refugees in the United States [3,10]. Overall, an increasing trend of overweight and obesity has been observed in LMICs, particularly in the Eastern Mediterranean region in the last decades [17,20,21].

The prevalence of overweight among children (0-59 months) was low (4.4%), while medium levels of wasting (5.1%) and low levels of stunting (9.0%) were identified among children under five years as per the WHO classification for malnutrition. In contrast, infants under six months displayed a higher prevalence of wasting reaching 9.6%, presenting a medium public health significance in our study [22]. Hossain *et al.*, (2016) found that Syrian refugee children in Lebanon, Jordan, and Iraq had a tendency to be slightly overweight on average and documented higher rates of stunting in 2014, indicating a problem of chronic malnutrition [8]. A study conducted among Sahrawi refugees also documented a similar prevalence of wasting among infants (8.2%) [23]. Whereas, a high prevalence of stunting reaching 17% was found among children aged zero to 59 months of Syrian and Yazidi refugees in Greece and refugees along the Thailand-Myanmar border [24,25].

The level of overweight and obesity among children was far below those observed in neighboring countries [26]. As for stunting, a decreasing trend was observed in the Eastern Mediterranean region with different income levels from 40% in 1990 to 24.2% in 2019 [21,27]. While a reduction in stunting rates was also documented among Syrian refugee children across Lebanon, wasting and underweight have increased sharply since the nutritional assessment conducted by United Nations International Children's Emergency Fund (UNICEF) in 2013 [28]. Our findings suggested that infants were more subject to acute weight loss, while older children (up to 59 months) were more prone to stunting. Similarly, analysis from 19 LMICs showed that the prevalence of severe wasting were higher at younger ages and declined by 24 months, whereas stunting rates were progressively increasing and stabilizing around 24 months [29]. As wasting is an indicator of acute malnutrition and stunting of chronic malnutrition [29], these findings indicate that infants among the refugee population may be at an increased risk of malnutrition from an early age, while older children may have been exposed to poor dietary habits and food-related coping strategies may have been in place for a longer period of time [30].

6.2. Food consumption and feeding practices of Syrian refugee in Greater Beirut, Lebanon

The first and second paper assessed the nutrient intake and adequacy of mothers according to their reproductive status as well as their minimum dietary diversity score and dietary patterns. As highlighted in Chapters 3 and 4, Syrian refugee mothers in our study consumed mostly a monotonous diet with poor dietary diversity and did not meet the dietary requirements for key nutrients. In addition, evidence of poor maternal nutrition and higher nutritional inadequacies during pregnancy and lactation was documented.

6.2.1. Minimum dietary diversity and nutrient intake of Syrian refugee mothers

According to the Minimum Dietary Diversity Score for Women (MDD-W), only 37% of Syrian refugee mothers in our study achieved the MDD-W by consuming five or more out of ten food groups. In other words, nearly two-thirds of these mothers (63%) had a low dietary diversity (LDD). Our findings are consistent with those from LMICs, such as Lebanese mothers (62%) and women refugees in Algeria (69%), whereas only 49% of women asylum seekers in Norway had a LDD [31–33]. It has also been reported that the prevalence of LDD can be 10% to 16% higher when using the open recall method to assess the MDD-W [34]. Accordingly, the prevalence of LDD is significant in our study and indicate that Syrian refugee mothers are far from reaching their nutritional requirements and consuming a diverse diet.

Our findings described the consumption of a predominantly monotonous diet. Starchy staples, including grains, white roots, and tubers, were the most consumed food group. Maternal diet was also characterized by high consumptions of oils and fats and sugar-sweetened beverages, exceeding their recommended requirements for total fat and total sugar. On the other hand, it was revealed that the consumption of nutrient-rich foods was inadequate, such as flesh foods, eggs, legumes, nuts, seeds, green leafy vegetables, and vitamin A-rich fruits. In fact, mothers in our study did not meet the nutrient requirements for protein, fiber, and most of the key micronutrients, including folate, vitamins B12, B6, C and A, zinc, and calcium. Comparable to our findings, national studies in Lebanon revealed poor micronutrient intake and a shift towards the high consumptions of fats and sugars among Lebanese women [35,36]. This is consistent with the adoption of the “Western diet” and is fitting the description of the nutrition transition in LMICs [37]. Recent studies among refugees and asylum seekers also documented similar nutritional habits and the consumption of a monotonous diet in Germany and Norway [10,33,38,39]. A recent systematic review by Khuri *et al.*, (2022) also observed poor dietary diversity and low consumption of nutritious food groups among refugees worldwide [3].

6.2.2. Nutritional inadequacy of micronutrients during pregnancy and lactation

Evidence of poor maternal nutrition during pregnancy and lactation was presented in our findings. Higher proportions of pregnant and lactating mothers failed to meet two-thirds of the recommended dietary allowance (2/3rd RDA) for key micronutrients according to the Institute of Medicine [40]. Deficiencies in hemopoietic nutrients may lead to nutritional anemia as they are recognized for their role in erythropoiesis [41,42]. Maternal diet during pregnancy and lactation was not meeting 2/3rd RDA for protein, vitamins A, B12, B6, C, D, E, folate, and zinc. As for iron, even though it appeared that more than half of lactating mothers met at least 2/3rd of the RDA, it was observed that their dietary intake of iron was in fact lower than the intake of pregnant mothers. The advantage may be justified by the lactation amenorrhea and the lower needs for iron during the lactation period [43].

Studies in Lebanon also documented nutritional inadequacies for hemopoietic nutrients among women of reproductive age [35,44]. Our findings are in line with those of pregnant women and women of reproductive age in LMICs showing low intakes of micronutrients [45,46]. Similarly, recent studies found inadequate intake of micronutrients among Syrian refugees in Germany, but also among refugees in Canada, South Korea, Ecuador, and Israel [3,10,39]. Inadequate maternal nutrition during pregnancy and lactation may imprint the intrauterine growth and impact negatively the short- and long-term health outcomes of the offspring [47]. Diets poor in diversity and quality during lactation may alter the content of certain micronutrients of breastmilk, particularly the water-soluble vitamins and fat content [48–50].

6.3. Infant feeding practices during the first six months of life of Syrian refugee in Greater Beirut, Lebanon

The third paper assessed infant feeding practices during the first six months of life among Syrian refugees in Greater Beirut, Lebanon. As emphasized in Chapter 5, sub-optimal infant feeding practices were documented, describing a common practice of pre-lacteal feeding (62.5%) and low rates initiation of breastfeeding within the first hour (31.0%) and exclusive breastfeeding (24.6%), despite a high ever breastfeeding practice (90.4%). A recent meta-analysis by the *Lancet* showed that less than half of newborns were breastfed within the first hour of birth (47.2%) and a third received pre-lacteal feeding (34.3%) in LMICs. Practices were worse in the Middle East and North Africa region with early initiation of breastfeeding reaching only 34.2% of newborns and pre-lacteal feedings being given to 57.6% [51]. A varied range of prevalence of early initiation and exclusive breastfeeding are found in the Eastern Mediterranean region; however, rates remained relatively low and inadequate overall [21].

Our findings provide evidence that breastfeeding practices deteriorate following large migrations or exposure to conflicts. Recent studies documented similar findings among refugees or displaced people in other countries. A qualitative study among Syrian refugees in Turkey in 2020 found that breastfeeding duration was related to migration and to inadequate feeding practices, such as giving pre-lacteal feedings to the newborn and early introduction of complementary feeding [52]. Pre-lacteal feeding was also practiced by Syrian refugee in Germany as mothers reported to believe that colostrum was not suitable for their child and gave water, tea, or honey in return [39]. A cross-sectional study among internally displaced people in Ukraine in 2015 recorded low exclusive breastfeeding rates and liquids like water, tea, and infant formula were commonly given to infants [53]. Introduction of solid foods was also a common practice among Sahrawi refugees in Algeria where rates of exclusive or predominant breastfeeding were low [23]. A recent systematic review by Ozkaya *et al.*, (2020) found that the main factors affecting breastfeeding practices and attitudes among Syrian refugees were socio-economic and household factors, cultural beliefs, and previous breastfeeding experiences. It was also found that the breastfeeding duration was below six months despite an overall positive attitude, especially among mothers who did not receive support from their spouse or social circles [54]. While breastfeeding practices may deteriorate during conflicts and forced displacements due to stress and violence, malnutrition and infections, loss of social fabric, destruction of infrastructures, loss or reduced access to healthcare facilities, and inadequate distributions of breastmilk substitutes, breastfeeding remains the safest mode of infant feeding [55–57].

6.4. Status of food security and mental health of Syrian refugee mothers in Greater Beirut, Lebanon

The second paper assessed the prevalence of food insecurity at the individual level of the mother as well as the prevalence of depression and post-traumatic stress disorder among mothers, which were also described in Chapter 4.

6.4.1. Food security status

Our findings showed that 34.4% of the mothers were moderately to severely food insecure and 12.5% were severely food insecure. Our prevalence were similar to those of Syrian refugee households in Lebanon in 2018-2019 [58,59]. However, our findings were lower than those of Palestinian and Iraqi refugees in Lebanon and those of urban Lebanese households in Greater Beirut [9,18,60]. The extensive humanitarian assistance provided to Syrian refugees in Lebanon by international and local organizations has very likely contributed to decreasing the burden of food insecurity [58]. According to Khuri *et al.*, (2022), a wide range of food insecurity (39% to 100%) were observed among refugees worldwide,

suggesting that food insecurity was a major contributor to poor dietary intake [3]. A study conducted among Sahrawi refugees in Algeria in 2014 mentioned that reducing food consumption by adults for the sake of children was a common food-related coping mechanism [32]. It is possible that household food insecurity may mask by the intra-household differences in food allocation and choices as a result of gender inequalities and the role of women within households, hence not reflecting the mother's food security status [61,62].

6.4.2. Maternal mental health status

Our findings showed that 13.2% suffered from post-traumatic stress disorder (PTSD), 11.1% from moderate depression, and 9.9% from severe depression. Overall, more than a quarter (27.1%) of the mothers suffered from poor mental health, including PTSD and / or moderate or severe depression in our study. Numerous recent studies assessed the status of mental health among Syrian refugee adolescents and adults in Lebanon and neighboring countries. Higher prevalence of PTSD were found, ranging from 25% to 36% among Syrian refugees in Lebanon and from 31% to 42% in Turkey, Jordan, and Iraq [63–68]. In addition, according to Stevenson *et al.*, (2019), up to 78% of Syrian refugee mothers were possibly or probably depressed [69]. Comparable to our findings, 22% of Syrian refugees in Lebanon were found to suffer from moderate or severe depression, while higher rates, reaching 41%, were found among Syrian refugees in Turkey [68,70]. Furthermore, a recent systematic review and meta-analysis by Stevenson *et al.*, (2023) analyzed data from 135 studies and found that the pooled prevalence of perinatal depressive disorders and PTSD were 33% and 17% among forced migrants. Key risk factors included exposure to trauma, life stressors, lack of social support and support from partner, a short length of stay in the host country, and being from a minority group [71].

6.5. Pathways linking enabling, underlying, immediate determinants and outcomes among Syrian refugee mothers and infants in Greater Beirut, Lebanon

The second and third research questions of this dissertation were investigating the associations between different determinants of nutritional and health outcomes as well as investigating the barriers associated to caring and feeding practices. Findings are presented from the angle of the conceptual framework developed for this dissertation in Chapter 1 to explore the different pathways linking the enabling, underlying, immediate determinants, to the outcomes in our study. In the next section, the association between anemia and nutritional status is discussed, followed by the pathway from enabling determinants to nutritional and health outcomes among mothers and infants and two pathways related to enabling determinants: (1) from socio-economic status and host country resources and (2) from pre-

settlement experiences and dietary acculturation to food consumption and diets, including breastfeeding and infant feeding practices. In addition, the roles of maternal mental health status and healthcare services across different pathways are presented in the following sections.

6.5.1. Associations between anemia and nutritional status

A strong association between maternal and child anemia was demonstrated in our study. A recent study also recorded a strong correlation between the prevalence of total anemia among mothers and children (six to 59 months) among refugees worldwide [72]. A study from Indonesia showed that infants aged three to five months were at higher risk of anemia if their mothers were anemic or they were born with low birth weight. The authors mentioned that the hemoglobin and iron stores of many infants were low before reaching six months and that the risk was higher for infants of anemic mothers [13]. Maternal iron stores at conception may result in a minimized accumulation of iron during the last trimester of pregnancy, influencing the infant's iron endowment after birth [73,74]. Infants depend greatly on the iron stores at birth despite the minimal requirement of dietary iron during the first six months of life. Many factors may lead to low iron stores during infancy, such as preterm birth, low birth weight, discharge of colostrum, maternal iron deficiency anemia, and early cord clamping [75]. A recent systematic review and meta-analysis concluded that maternal iron store during pregnancy and those of infants after birth are likely linked; however, limited evidence supported beneficial effects of a higher maternal iron stores on child health outcomes due to a multitude of factors [76]. Our findings also showed that the risk of anemia is especially higher for children of lactating mothers. Another explanation may be related to inadequate infant and young child feeding practices, such as not being exclusively breastfed during the first six months, delayed introduction of complementary feeding, and insufficient consumption of iron-rich foods when solid foods are introduced [41,73,75]. The pathway from enabling determinants to anemia and nutritional outcomes among infants is discussed in the next section.

In addition, an association was found between anemia and overweight / obesity among mothers in our study, pointing towards the co-existence of the double burden of malnutrition at the individual and household level. A recent meta-analysis from 33 LMICs showed that the intra-individual double burden of overweight / obesity and anemia among women of reproductive is rising, in parallel of observed reductions in anemia and yet increasing trends of overweight and obesity [77]. It is well-known that obesity can result in micronutrient deficiencies via the two primary pathways: the overweight/obesity- mediated inflammation and the consumption of diets poor in quality and quantity [43,47,77,78]. The relationship between obesity and anemia remains unclear according to the literature [79,80], this association may be also explained by the pathway linking food insecurity, overweight and obesity, and micronutrient deficiencies as described in

Chapter 1 [81]. The associations from the enabling determinants to anemia and nutritional status found in our study are discussed in the following section. Irache *et al.*, (2023) also suggested a third plausible pathway that the main global public health initiatives addressing anemia may have been successful among underweight and normal weight women [77]. The detrimental effects of obesity and anemia are known for both women and their offspring through the intergenerational cycle of malnutrition, indicating the need for double duty actions targeting overnutrition and micronutrient deficiencies among women [47,77].

6.5.2. Pathway from enabling determinants to nutritional and health outcomes

Starting with the enabling determinants, our findings did not find any direct associations between socio-economic characteristics and anemia among mothers and children. This could be explained by the relative homogeneity of the study population displaying similar socio-economic traits. This is also in accordance with previous national studies on anemia among women of reproductive age in Lebanon and rural Jordan [58,61,63]. As discussed earlier, it is interesting that the prevalence of anemia among women in our study conducted in 2018 is closer to the prevalence recorded among women in Lebanon in 2004 rather than in Syria in 2011 [5,6]. One explanation could be tied to the phenomenon of dietary acculturation following migrations and exposure to new food environments, which is further discussed in the section below on the pathway from acculturation to food consumption and diets. The multifactorial aspect of the causes of anemia could explain the various findings in the literature regarding the existence or lack of association between anemia and socio-economic characteristics (enabling determinant) and food insecurity (underlying determinant) as well as food consumption and diets (immediate determinant) [41]. This interpretation may be behind the lack of association between low dietary diversity and food insecurity with anemia and nutritional status among mothers in our findings. In addition, another plausible explanation for the lack of association between the different levels of determinants and anemia is the role of healthcare services on the prevention of anemia via the use of supplementations and antenatal care services. This is further discussed in the following sections of this chapter.

Controversial findings on the relationship between the nutritional status, food security, and dietary diversity are found in the literature [18,31,82–84]. For instance, studies conducted among pregnant women in Ghana and Pakistan did not find an association between anemia, dietary diversity, and food insecurity, contrary to studies conducted in rural Ethiopia and Bangladesh [85–88]. A gradual accumulation of nutrient deficiencies due to poor diets may contribute to the development of anemia in the long-term [78]. A recent study from South Africa did not find an association between the nutritional status of non-pregnant women and anemia or food security. The authors noted that underweight and obesity can co-occur with micronutrient deficiencies under similar conditions of poverty and poor diets [84]. A systematic review

conducted among refugees showed that a limited number of studies analyzed the association between dietary intake and nutritional status. The results indicated that a healthy diet was associated with better health outcomes, while poor diet quality increased the risk of overweight and obesity, reinforcing the need for nutrition interventions and policies to address malnutrition among refugees [3]. The pathway from socio-economic status to food consumption and diets is discussed in more detail in the following section.

Looking at the household characteristics, our findings suggested that the risk of developing anemia among mothers may increase with the maternal age and number of children under five in the household, despite the lack of associations in our study. A study conducted among pregnant Palestinian refugee women showed that the risk of anemia increased with age, parity, and trimester of gestation [89]. Similarly, an association was found between the prevalence of anemia and number of under five children in the household [85]. The increased nutrient requirements during pregnancy and the gradual depletion of the iron stores with repeated pregnancies can explain these observations [43]. As a result, the risk of anemia among women during pregnancy is increased as a result of low maternal iron stores at conception, affecting the endowment of iron among infants, as discussed earlier [73,74].

As for the link between nutritional status and infant feeding practices, an inverse relationship between maternal obesity and early initiation of breastfeeding was found. This is worrying as two-thirds of the mothers in our study were found to be overweight or obese. It has been well-documented in the literature that maternal obesity was related to poor breastfeeding practices due to many factors, mostly associated to a delayed onset of lactogenesis, but also to psychological factors [90,91]. The influence of psychological factors on breastfeeding practices is further discussed in the following sections of this chapter. In addition, insufficient maternal nutrition and poor health among lactating mothers circled back to affect breastfeeding and reduce its duration in our study. Similar reports were made by Syrian refugees in Turkey [52].

Associations between the nutritional status of infants and infant feeding practices were also documented in our findings. Weight-for-length/height Z-score was positively associated with early initiation of breastfeeding and negatively associated with bottle feeding. Our findings also found a strong association between pre-lacteal feeding and delayed initiation of breastfeeding. These findings indicate that early initiation of breastfeeding has a protective role against wasting and pre-lacteal feeding, while the risk of wasting among infants increased with bottle feeding. The newly published *Lancet* series on Breastfeeding (2023) also found pre-lacteal feeding to be strongly associated with delayed initiation of breastfeeding [51]. A study conducted among infants of Sahrawi refugees in Algeria found a positive relationship between early initiation of breastfeeding and exclusive breastfeeding and that exclusive or predominant breastfeeding had a protective effect against wasting and underweight [23]. Initiation of breastfeeding within the first hour from birth limits the newborn's exposure to pre-lacteal feedings and ensures that

colostrum feedings are received, in return giving an immunity boost and facilitating exclusive breastfeeding successfully [92]. In addition, the WHO condemn the use of bottles and teats due to their associated increased risk of diarrhea and malnutrition and strongly recommends the protection and promotion of exclusive breastfeeding until six months especially also during emergencies and large migrations [57,93]. In fact, our findings showed that non-exclusively breastfed infants displayed poor health outcomes, as a higher proportion of these infants had a fever and were receiving medications compared to exclusively breastfed infants. More about other enabler and barriers to adequate infant feeding practices are presented as part of each of the pathways in the sections below.

6.5.3. Pathway from socio-economic status and host country resources to food consumption and diets

The first and second paper assessed the socio-economic status, food insecurity at the individual level of the mothers, and their relationship to food consumption and dietary diversity. Overall, our findings have demonstrated that these key factors were interrelated and allowed for the pathway from socio-economic status and host country resources to food consumption and diets to emerge as a key justification for poor dietary diversity and quality. The associations between available resources in the host country, such as food assistance, and their impact on food consumption and diets among mothers were also noted.

A strong correlation between food insecurity and low dietary diversity among mothers was found in our study. Both indicators shared a significant association with a high crowding index, household monthly income below the minimum wage, refugee status, and reliance on food assistance or savings and subsidies. Female-headed household and the employment of the mother were strongly correlated with severe food insecurity. The link between food insecurity and low dietary diversity has also been well-documented among mothers in other LMICs [31,94–96]. In addition, our findings identified different dietary patterns according to the household monthly income. Low-income households were stretching their bill to reduce the cost on food expenditures. Consequently, their diets were primarily composed of grains and starchy staples such as bread and rice and were poor in highly nutritious foods such as fruits, cheese, olive oil, and flesh foods. Drewnowski (2022) has well documented the economic root causes of food insecurity, relating it to low socio-economic status and low wages [97]. The consequences of food insecurity in terms of poor diets have been well elicited and were tied to food-related coping mechanisms. Altered food choices were greatly driven by food prices and income and shaped by socio-economic disparities. Food insecurity was linked to poverty and the consumption of diets poor in diversity and quality, compromising the dietary intake of micronutrients [97–99]. A recent systematic review showed that food insecurity and low socio-economic status among refugees were associated with diets low in diversity and

nutritious food, especially fruits, vegetables, and meats. For the case of refugees in Lebanon, it was highlighted that national residency policy limited refugees' potential and opportunities for education and legal economic activities [3].

Low maternal dietary diversity was also strongly associated with the reliance on food assistance among Syrian refugee mothers in our study. In addition, skipping breakfast and the consumption of fewer meals per day emerged as coping mechanisms to low dietary diversity and food insecurity in our findings. These findings corroborate those of Syrian refugees in Lebanon, particularly in Mount Lebanon. Syrian refugees in Lebanon were found to spend 42% of their total food expenditure on staple foods, indicating that a monotonous diet was consumed [58]. Syrian refugees in Beirut and Mount Lebanon governorates continued to record the lowest food consumption scores as well [59]. These findings suggest that, despite receiving food assistance, Syrian refugees had the need to resort to food-related coping strategies, such as low dietary diversity and low meal frequency. Coping mechanisms to food insecurity included the reduction in the number of meals and portion sizes and restriction of food consumption of adults for the benefit of the child [59]. Consequently, intra-household food allocation may not be in favor of the mothers. Gender disparities are still predominant in the countries of the region with a patriarchal culture, influencing social and household roles as well as eating behaviors [35,100].

As for breastfeeding practices, despite no direct association recorded in our study, low maternal dietary diversity was found to be associated with early initiation of breastfeeding. Given that low dietary diversity was linked to food insecurity and low socio-economic status, it is suggested that economic hardships encouraged mothers to breastfeed as a coping strategy since it is a more cost-effective solution to feed the infant. Studies conducted among Syrian refugees in Turkey and Lebanon revealed similar practices as breastmilk is cost-effective and sustainable [52,101]. Other studies conducted in Canada and the United States showed that food insecurity negatively affected the duration of exclusive breastfeeding during infancy, despite an almost universal initiation of breastfeeding [102,103].

6.5.4. Pathway from pre-resettlement experiences and dietary acculturation to food consumption and diets

The dietary acculturation pathway to food consumption and diets was implied by our findings as signs of dietary acculturation and were shown among the refugee population in Lebanon. As mentioned earlier, the food consumption and dietary intake / patterns of Syrian refugee mothers were mirroring those of women of reproductive age in Lebanon, marking a shift towards a higher intake of fats and sugars as well as comparable micronutrient deficiencies [35,36,44]. Findings are in line with the Koçtürk's model of

dietary changes. This model was developed to understand the dietary acculturation after migration that usually starts with the incorporation of the sweetest and fattest foods of the hosting environment [104,105]. It states that the first substitutions in the adaptation process are made to accessory foods, including nuts and fruits, while basic and staple food patterns are more resilient [104]. The adoption and integration of new dietary patterns could also be attributed to changes in pre- and post-settlement experiences. Khuri *et al.*, (2022) suggested that refugees may increase their consumption of high-fat and high-sugar foods after resettlement, especially when these food items are abundantly present in the host country [3].

Studies conducted among asylum seekers in Germany, including Syrian refugees, made similar observations regarding the fast adaptation of Western / urban eating habits into their traditional nutritional habits [38,39]. Al-Sayed and Bieling (2021) showed that Syrian refugees in Germany experienced low autonomy and environmental obstacles related to their food choices due to language barriers and lack of information. Food-related well-being was compromised during forced migrations, impacting the psychological well-being of refugees and in return their social acceptance and integration. Authors also explained that Syrian refugees living neighboring countries to Syria (Lebanon, Jordan, Iraq, and Turkey) may not benefit from the similarities in food environments due to obstacles related to economic difficulties [106]. Food environments are known to influence food choices and food customs – which are also shaped by economic, political, and cultural contexts – and to affect to a great extent food security and nutrition [107]. Porreca *et al.*, (2020) investigated the levels of dietary acculturations among Syrian refugees in Brazil and found that children were more likely to accept changes in new foods compared to adults. Most of the adults tried to conserve their original eating habits and traditional food preparation methods; nevertheless, changes were observed as part of the integration. The conservation of their original culture allowed refugees to cope with their displacement, as food is a symbol of collective solidarity and identity [108].

As for infant feeding practices, pre-settlement feeding practices were safeguarded by Syrian refugee mothers to a certain extent; however, changes can ripple when exposed to new food environments, even in neighboring countries. Our findings found that despite a high prevalence of ever breastfeeding, which is a reflection of the acceptance of breastfeeding in the culture according to the WHO [109], the rates of ever breastfeeding, early initiation, and exclusive breastfeeding among Syrian refugees in Lebanon were lower compared to those in Syria before the start of the war in 2009–2010 [110,111] and among Syrian refugees in Southern Turkey, Northern Lebanon, and Jordan in 2016–2020 [112–114]. In fact, rates from our study were similar to those reported by national and regional studies conducted among Lebanese women [115–117]. These findings indicate that despite the strong intention to breastfeed, to carry on with pre-settlement infant feeding practices, and the wide acceptance of breastfeeding in the Syrian culture, current practices among Syrian refugee mothers were mirroring those of Lebanon because of acculturation and

exposure to new food environments. Furthermore, our findings revealed that lactating mothers faced barriers to breastfeeding that were already existing in the host country's environment. For instance, the use of breastmilk substitutes was promoted and recommended by some organizations and healthcare professionals. Violations to the Code of Marketing of Breastmilk Substitutes were previously documented in Lebanon [118,119]. Our findings also identified perceived lack of sufficient breastmilk as a major barrier to breastfeeding. The newly published *Lancet* series on Breastfeeding (2023) also highlighted that self-reported insufficient breastmilk was the primary reason for introducing commercial milk formulas during the first six months of life and for a shorter duration of breastfeeding [51]. The influence of healthcare professionals on breastfeeding practices is further discussed in the following sections of this chapter.

6.6. Role of maternal mental health across different pathways

The prevalence of poor maternal mental health (depression and post-traumatic stress disorder) and its associations with different determinants and practices were assessed in Chapters 4 and 5. Our findings showed that a third of the mothers suffered from moderate or severe depression and / or post-traumatic stress disorder. The role of maternal mental health was linked to underlying determinants and caring and feeding practices in our study. Poor mental health was significantly associated with moderate and severe food insecurity and delayed initiation of breastfeeding. A recent study conducted among Syrian refugees in Norway also found that an association between poor mental health and moderate food insecurity, but not severe food insecurity [120]. Mental health can be immensely impacted by the struggle to provide food on a daily basis and worrying about living expenses [121,122]. In addition, as highlighted in Chapter 1, the relationship between food insecurity and poor mental and its negative impact on breastfeeding has been established [123–125]. Among refugees and displaced persons, the weaning process may be accelerated due to interference with the breastmilk flow when mothers are exposed to stress during conflicts and experiencing depression [53,93,101,112,126]. In fact, our findings also showed that some mothers may have observed the lower flow of breastmilk as insufficient milk production, whereas others were aware of the negative impact of stress on lactation and were advised by family members to relax to able to have more favorable outcomes when lactating. Summers *et al.*, (2018) found that the primary reported reason to early discontinuation of breastfeeding before the infant reaches six months was stress related to conflict among internally displaced people in Ukraine [53]. As for Syrian refugee mothers in Turkey, depression, economic difficulties, and language barriers stood out as obstacles to successful breastfeeding practices [52].

6.7. Role of health services across different pathways

The role of healthcare services across different pathways and its impact on nutritional and health outcomes were highlighted in our three papers available in Chapters 3 to 5. First, our findings showed that pregnant mothers were at lower risk of being affected by mild anemia and had higher odds of using micronutrient supplements compared to non-pregnant non-lactating mothers. The use of iron and folic acid supplementation among pregnant women was prevalent in our study, despite the low routine supplementation among women of reproductive age. The WHO recommends the use of multiple micronutrients supplements containing 13 to 15 micronutrients, including iron and folic acid, during pregnancy for improved maternal and fetal/neonatal outcomes and supports pregnant women to receive adequate nutrition through a healthy and balanced diet [127]. Studies among pregnant women showed that the risk of developing anemia was lower among mothers who attended multiple or at least four antenatal care visits [85,128]. Secondly, despite the lack of association between the number of antenatal care visits and anemia in our study, our results also showed that the risk of maternal anemia was reduced among mothers that received health and nutrition messages from multiple sources, including healthcare professionals as well as family, friend, and social media. In addition, our findings showed that the risk of poor dietary diversity was significantly lower among mothers who received health and nutrition messages from multiple healthcare professionals. Similarly, the risk of poor dietary diversity was higher among those who attended less than four antenatal care visits, despite being statistically not significant after adjusting for confounding factors. These outcomes may be a reflection of the free or subsidized healthcare assistance in place by the United Nations High Commissioner for Refugees (UNHCR) for registered and unregistered refugees in Lebanon [59]. However, some Syrian refugee mothers may face barriers to antenatal care services such as cost of treatment or lack of or difficulty to access in Lebanon and a language barrier in Turkey and Germany [38,52,59,112].

As for infant feeding practices, there was a positive association between the number of antenatal care visits and exclusive breastfeeding in our study. Antenatal care visits were found to be a predictor of exclusive breastfeeding in numerous studies, particularly antenatal breastfeeding education [129,130]. In addition, healthcare professionals appeared to have a positive and negative influencing role on feeding practices among mothers in our study. The positive influence of health professionals was cited as an important source of information about infant feeding practices among mothers. However, violations to the Code of Marketing of Breastmilk Substitutes emerged and were in line with those previously documented in Lebanon [118,119]. The newly published *Lancet* series on Breastfeeding (2023) showed that health professionals and scientific institutes are often targeted by the commercial milk formula industry, threatening

their integrity and impartiality and influencing infant and young child feeding practices [131]. In addition, our findings revealed that mothers relied on their families and social circles for support, which could have been either beneficial or detrimental as the provided opinions were predominantly based on personal experiences and knowledge. Similarly, other studies conducted in Turkey, Germany, and Lebanon also showed that Syrian refugees mothers relied on female relatives for support, despite some reports from the nurses and midwives suggest that relatives may in fact become a barrier to adequate infant feeding practices due to common misinformation or misconduct [38,52,101].

6.8. Strength and limitations

The strengths and limitations of this study were discussed thoroughly in Chapters 3 to 5. In this section, an overview of the strengths and limitations will be provided for this dissertation altogether.

One of the main strength of this study was the extensive training invested in the research staff and volunteers to assure high quality of scientific research. A thorough description of the quality assurance and control is available in Chapter 2. In addition, the strengths also included the research design and selection of tools or analysis techniques. First, the larger research project was a mixed-method design as a qualitative approach would complement the quantitative nature of the survey. Face-to-face interviews took place in a private setting at the premises of primary healthcare centers by the certified research assistants and enumerators to increase the quality of the survey and reduce the reliance on the literacy of the participants. The selected tools to assess the mental health status of mothers were validated among Lebanese adults for the Patient Health Questionnaire (PHQ-9) [132] and in the Arabic language for the Mini International Neuropsychiatric Interview (M.I.N.I.) to measure PTSD [133]. The global Food Insecurity Experience Scale (FIES) had the advantage of being internally validated using statistical methods based on the Rasch measurement model [134,135]. The FIES is a robust tool and allows for our findings to be comparable at the international level [136]. Finally, one key strength is the inclusion of unregistered Syrian refugees and displaced persons in the study population, instead of only using the list of registered refugees with the UNHCR. This approach was deemed crucial as many displaced persons were not able to obtain a legal status as a refugee in Lebanon due to the suspension in the registrations in 2015 [59,137].

On the other hand, the study findings should be interpreted taking into consideration the following limitations. This design of this research project was a cross-sectional study; hence, it has a limited ability to infer causality, but it can investigate associational relationships. In addition, the study population was narrowed to Syrian mothers and children under five years attending primary healthcare centers in the most vulnerable areas of Greater Beirut. This could limit the external validity of the study and its generalization

to Syrian refugees at sub-national (e.g., rural areas) or national levels. However, the location of the primary healthcare centers included in the study cover the areas of the Beirut governorate and the adjacent districts of the Mount Lebanon governorate. This region is known as the Greater Beirut area and is considered to be the melting pot of the country with more than half of the Lebanese population and over 305,000 refugees [138,139]. A purposeful sampling approach and a convenience sample were selected to avoid coercion related to the use of a randomized recruitment strategy based on the UNHCR list of registered refugees as those refugees were also receiving free and subsidized benefits and assistance from the UNHCR. In addition, this approach allowed to recruit unregistered refugees and to minimize fear related to the legal residency status. Primary healthcare centers were the selected recruitment site for the study as refugees were able to visit freely to participate in vaccination campaigns and benefit from other health services. Our population study included vulnerable groups, women of reproductive age and children under five years, and represented a group of interest for health professionals, scientists, policy makers, and advocates working towards ending all forms of malnutrition and building an improved human capital.

In addition, other limitations should be taken into consideration related to the tools used in data collection; however, every attempt was made to reduce their impact on the collected data. Some of the limitations of the 24-h dietary recall include the reliance on the memory, day-to-day variations, underreporting under field conditions, and its limited accuracy among overweight and obese persons [140,141]. The absence of an extensive food composition database in Lebanon is also considered as a limitation. The United States Department of Agriculture (USDA) database was used and was complemented with data from the local food composition tables available for a limited number of local foods. The latter may affect the absolute estimates of dietary intake; however, its effects on the observed inadequate intakes among mothers would be negligible. In addition, the use of the MDD-W with an open recall method may have contributed to an overreporting of food groups by 10% to 16%, suggesting that the prevalence of low dietary diversity may be underestimated in our study [34]. The MDD-W was also not designed to assess the intake of certain nutrients or food groups related to mental health outcomes and does not take into account the amounts of food consumed, physical activity levels, and total energy expenditure, explaining the lack of association of the MDD-W with the mental health and nutritional status [82].

Furthermore, the limitations of the International Physical Activity Questionnaire Short Form included overestimating the physical activity levels by 84% on average and being a weak indicator of relative or absolute physical activity [142]. The use of the global Food Insecurity Experience Scale (FIES) at the individual level may limit the comparability of our findings to other studies using different scales and measuring food security at the household level. As for breastfeeding practices, the use of the previous day's feeding to measure the proportion of exclusively breastfed infants may be overestimated as other liquids or

foods may have not been given to some infants on the day of the interview [143]. For birth characteristics, as the data were self-reported, the recall bias cannot be ruled out for the gestational age, weight, and length at birth. Also, the proportion of full-term births could be overestimated as the definition of gestational age calculated in months rather than in weeks to be culturally acceptable. Finally, the Patient Health Questionnaire-9 (PHQ-9) was shown to have a good sensitivity and poor specificity and was validated among Lebanese adults instead of Syrian refugees. Nevertheless, it is a useful tool in screening for depression in primary healthcare setting with insufficient psychiatric care [132].

6.9. References

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7

Chapter 7

Conclusion and Implications

7. Conclusion and Implications

7.1. Conclusion

The findings of this dissertation contribute to the literature on the food and nutrition security status of refugees living in an urban setting of a protracted humanitarian crisis. Our findings demonstrated poor nutritional status and health outcomes, including anemia and mental health status, among Syrian refugee mothers and their offspring. Poor maternal nutrition and inadequate infant feeding practices were documented. This dissertation has contributed to the literature on pathways to malnutrition in women and children among refugees. Linkages between different levels of determinants (enabling, underlying, and immediate) and nutrition and health outcomes were established. Predominantly, the association between poor nutritional status and increased risk of anemia was evidenced. In addition, three principal pathways emerged showing, first, the linkages starting from the enabling determinants to the nutritional and health outcomes, second, from socio-economic status and host country resources to food consumption and diets, and third, from pre-resettlement experiences and dietary acculturation to food consumption and diets. The crucial role of healthcare services in reducing the risk of anemia and improving maternal nutrition and infant feeding practices was exhibited. Poor mental health and food insecurity were strongly correlated and the impact of poor mental health on infant feeding practices in a refugee setting was documented.

7.2. Implications

Our findings can serve as evidence to key stakeholders, including ministries, local and international non-governmental organizations, policy-makers, healthcare professionals, and researchers, involved in the nutrition programming and planning targeting malnutrition among the most vulnerable groups, including refugee women and children, in Lebanon and neighboring countries. Implications for practice and future research can be drawn from this dissertation.

7.2.1. Implications for practice

The *Lancet* series on Maternal and Child Nutrition (2013) proposed a framework for nutrition actions that include nutrition-specific and nutrition-sensitive interventions to enhance the growth and development of offspring on the long-term [1]. A revised framework was proposed by the *Lancet* series on Maternal and Child Undernutrition Progress (2021), which categorizes nutrition actions into direct and indirect health and non-health-care nutritional interventions alongside cross-cutting strategies for nutrition support and integration, as shown in **Figure 9** [2].

Nutrition-specific, also referred to as direct, interventions address the immediate determinants of malnutrition and include interventions such as the promotion and support of adequate breastfeeding practices and a healthy diet and the use of micronutrient supplementations. On the other hand, nutrition-sensitive, or indirect, interventions address the underlying determinants of malnutrition and target food insecurity, mental health, family planning, women's empowerment, and social safety nets among others. Nutrition-sensitive interventions can scale up and enhance the effectiveness of nutrition-specific interventions [1–3]. Nutrition actions are needed to address enabling, underlying, and immediate determinants of maternal and child malnutrition. However, to tackle the triple burden of malnutrition, doubly duty actions must also be considered to tackle the common root causes of multiple forms for malnutrition [4].

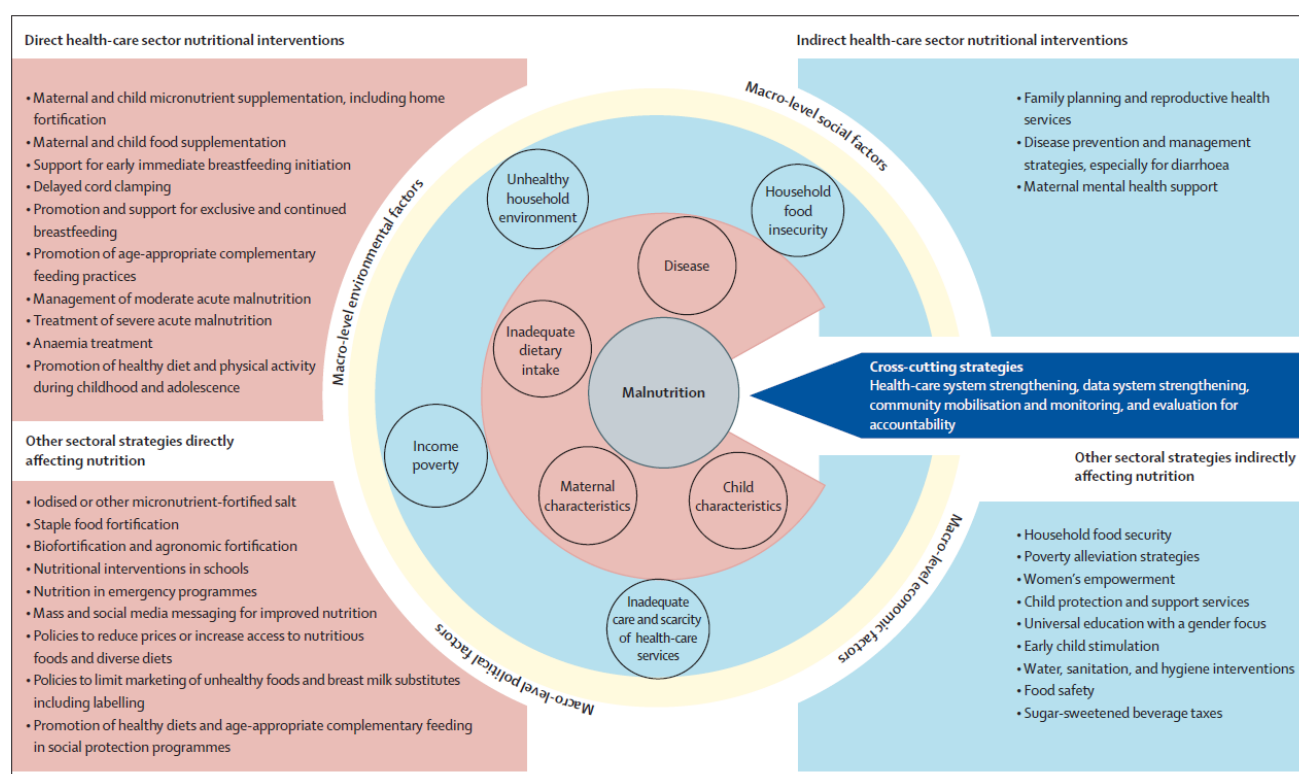


Figure 9: Revised framework for the classification of nutrition actions by the 2021 Lancet series on Maternal and Child Undernutrition Progress (Source: Keats et al., 2021)

In the context of emergencies, nutrition interventions and their delivery strategies may be subjected to challenges and call for an enhanced approach. The focus has widened towards prevention and health promotion strategies, in addition to the management of acute malnutrition, micronutrient deficiencies, and

inadequate food consumption [5]. A recent systematic review by Shah *et al.*, (2021) on the delivery of nutrition interventions to women and children in conflict settings found that the most common interventions provided were general food distribution (such as meal provisions and cash or vouchers for food) and disease prevention and management. Other interventions frequently focused on severe and moderate acute malnutrition treatment, micronutrient supplementation, nutrition assessment, and nutrition education. Fewer interventions were reported on appropriate infant and young child feeding practices, with some focusing on breastfeeding promotion, but also on inappropriate infant formula distribution [6].

Nevertheless, in the context of protracted crises, such as the situation of Syrian refugees in Lebanon, interventions and programs designed for acute emergencies with short-term objectives may not be suitable for long-term nutrition and health outcomes, such as chronic diseases and stunting. Therefore, interventions with short-term objectives should be considered as entry points and lay the grounds for longer-term actions addressing the underlying causes of malnutrition [5]. However, despite the availability of free or subsidized healthcare assistance for refugees and displaced people in Lebanon that was set out by the United Nations High Commissioner for Refugees, additional out-of-pocket expenditures and lack of awareness were amongst the identified barriers to the utilization of antenatal care (ANC) and other health services [7–9].

Therefore, context-specific interventions and strategies are needed to target the nutrition situation holistically in refugee settings. Various delivery platforms ought to be considered for direct and indirect nutritional interventions to improve reach and effectiveness, such as community-based platforms and mass media, in addition to cash transfers [2]. It has been acknowledged that it may be difficult to seek political commitment and to work within the governance systems to advocate for and implement nutrition and health actions in a conflict setting [10]. Key barriers that seriously impacted the delivery of interventions, including destruction of healthcare facilities and infrastructure, disruption of supply chains, insufficient resources (human capital, funds, commodities, and logistics), insufficient coordination between sectors and cross-borders, ongoing conflict situation, limited population adherence due to lack of cooperation or frequent movement, and poor outcome reporting [6].

Nevertheless, multi-sectoral collaboration and community engagement were deemed necessary for successful nutrition interventions. It was suggested that certain key facilitators may improve and enable the implementation of nutrition actions, such as effective monitoring system, multi-sector programming, use of guidelines and evidence-based approaches, advocacy of social mobilization, capacity building of workforce, and innovative technology [6]. In addition, knowledge and evidence, politics and governance, and capacity and resources were listed as primary factors that shape the enabling determinants and support nutrition governance and policy [11]. It was also highlighted that early child development and mental health failed to be integrated in the nutrition programming targeting women and children in conflict settings and

require attention [6]. Based on our findings, the below direct and indirect nutrition interventions could be developed or strengthened to address the food and nutrition security among Syrian refugees living in the urban setting of a humanitarian crisis in Lebanon and in neighboring countries.

7.2.1.1. Direct interventions

Based on the evidence emerging from this dissertation, the following direct nutritional interventions were recognized as a need for Syrian refugees living in Greater Beirut, Lebanon: maternal and child micronutrient supplementation during the preconception and perinatal periods, including home fortification, anemia treatment, delayed cord clamping, kangaroo mother care for neonates, support for early breastfeeding initiation and exclusive breastfeeding, the promotion of healthy maternal diets and age-appropriate feeding practices, policies to avoid / limit the distribution of breastmilk substitutes, and strategies to promote adequate infant and young child feeding practices and a healthy diet [1,2].

According to the World Health Organization, at least four ANC visits are recommended for pregnant women to optimize the benefits and learnings, leading to positive pregnancy outcomes. ANC incorporates nutritional interventions, maternal and fetal assessment, preventive measures, interventions for common physiological problems, and health systems interventions to improve the utilization and quality of ANC. Examples include context-specific interventions and counselling targeting dietary intake and healthy diets, micronutrient supplementations, anemia, and exclusive breastfeeding promotion [12].

There is strong evidence on the benefits of multiple micronutrient supplementation for women in the preconception and antenatal period as well as for infants and children below five years. A Cochrane review by Keats *et al.* (2019) showed that multiple micronutrient supplementation among pregnant women led to fewer preterm births, less infants with a low birthweight, and infants with a small-for-gestational age in low- and middle-income countries (LMICs) [13]. The use of multiple micronutrient supplements, including iron and folic acid, was shown to be beneficial for mothers and their offspring as it improved maternal and fetal/neonatal outcomes, along with the consumption of an adequate nutrition through a healthy and balanced diet [14]. Evidence have also shown that weekly iron-folic acid supplements during the perinatal period decreased the risk of anemia among women of reproductive age in LMICs [15]. Likewise, multiple micronutrient supplements among children below five years in LMICs were found to reduce the risk of anemia and diarrhea and to result in an increase in height [16]. Furthermore, delayed cord clamping was shown to decrease the risk of anemia, iron deficiency, and iron-deficiency anemia among infants born at full term, despite the limited evidence [17]. Some studies found that delayed cord clamping resulted in higher ferritin concentrations and lower risk of hemorrhage among newborns [18,19].

Educational strategies for breastfeeding, dietary diversity, and healthy diets are also recommended and identified as double-duty actions [2,4]. The effectiveness of educational interventions regarding breastfeeding and appropriate complementary feeding was found to be increased when interventions are context-specific and administered by healthcare professionals in relatively all settings, including facilities, communities, and households [2,20,21]. In addition, the positive impact of nutrition education and promotion has been well documented among pregnant women and women of reproductive age in LMICs. Higher nutrition knowledge and dietary diversity scores were achieved through the promotion of locally available nutrient-dense foods among pregnant women in low-resource settings [22–24]. It is recommended to integrate these initiatives and interventions into primary healthcare centers and health services that are frequently accessed by refugees and displaced persons [25].

Scaling up programs to protect, promote, and support breastfeeding has been identified as one of the top ten priority areas for double-duty actions [4]. Supportive strategies and programs are recommended to promote early initiation of breastfeeding and exclusive breastfeeding, such as the kangaroo mother care, the baby friendly hospital initiative, individual and group counselling, and educational strategies, in addition to adequate maternity leave provision and the reinforcement of the International Code of Marketing of Breastmilk Substitutes [2,5,26,27]. By promoting early skin-to-skin contact soon after birth, the kangaroo mother care was shown to improve early initiation, exclusive breastfeeding, and continued breastfeeding among preterm and term infants. This method was shown to be most beneficial to improve care of low birthweight infants and reduce neonatal and infant mortality [28,29]. Furthermore, the implementation of the baby friendly hospital initiative is known to improve breastfeeding outcomes at the hospital and community levels [27,30,31]. For instance, the Ministry of Public Health in Lebanon have launched the National Policy on Infant and Young Child Feeding in 2018 and published the National Nutrition Strategy and Action Plan in 2021 to pave the way towards optimal nutritional outcomes among all residents in Lebanon across the lifecycle [32,33].

7.2.1.2. Indirect interventions

As for non-healthcare nutritional interventions and other sectoral strategies, the following nutrition-sensitive and double-duty actions were deemed necessary to address and support family planning and reproductive health services, maternal mental health and psychosocial support, household food security, women's empowerment, and social safety nets for Syrian refugees living in Greater Beirut, Lebanon based on the evidence from our findings [1,2,4].

Strong evidence has shown that family planning services and birth spacing are effective indirect nutritional interventions [2]. Contraceptive use had a significant negative effect on anemia among women of reproductive age, child stunting, and child underweight [34]. Family planning can lead to better nutritional outcomes, reduce the risk of malnutrition among women and children, and allow the replenishment of depleted maternal iron stores following a pregnancy [35,36]. According to Demirhan *et al.*, (2022), refugee women may not be accessing family planning services due to various barriers such as the lack of spousal support and cultural beliefs, resulting in poor outcomes related to pregnancy, postpartum, and lactation [37]. Another study conducted among Syrian refugees in Turkey showed that the lack of use of family planning techniques and wanting to have as many children as possible were associated with poor breastfeeding practices, in addition to social factors such as teenage marriages and pregnancies as well as excessive involvement of grandmothers in the mother-child relationship after birth [38].

In addition, there is a strong need for psychosocial support and mental health services for Syrian refugees in Lebanon, considering the effects of maternal distress and depression on the success of breastfeeding and their associations with food insecurity [39–41]. Multiple strategies could be considered, such as capacity building initiatives to allow health workers the capability to deliver basic mental health services and the integration of mental health services into primary healthcare centers or community-based organizations. Culturally-sensitive approaches and efforts are recommended to reduce stigma and improve literacy on the importance of mental health [39,42]. Moving in this direction, the Lebanese Ministry of Public Health has launched a National Mental Health Programme in 2015 to address the dire need [43]. It is also important to consider the inclusion of family members in awareness campaigns, counselling, and interventions promoting adequate maternal nutrition and infant and young child feeding practices [44–46]. Studies among Syrian refugees in various host countries have shown the positive influence of a support system, including spouses and female relatives, on breastfeeding outcomes [38,47–49].

Nutrition-sensitive strategies and double-duty actions targeting social safety nets, food insecurity, women's empowerment, and gender equality need to be considered to improve income, access to healthy foods, and alleviate malnutrition among women and children [3,4]. A recent scoping review on food security interventions among refugees worldwide by Nisbet *et al.*, (2022) found that cash, vouchers, and food transfers were the most common types of interventions implemented in refugee crisis areas, such as among Palestinian and Syrian refugees in Lebanon and Jordan [50]. However, more sustainable approaches have recently taken place in Lebanon, such as school-based nutrition, community kitchens, and urban agriculture [51–54]. Khuri *et al.*, (2022) recommended the implementation of interventions assisting with initial stages of a resettlement that take into consideration the legal status, long-term residency, external environmental factors, acculturation, and family environment in host countries [55].

In addition, the role of women and equitable gender considerations need to be considered in the design and implementation of interventions to support the most vulnerable among refugees [50,56]. Women's empowerment through income generating activities has been linked with improved nutrition for women and children by granting them the ability to manage their time and resources, increase their decision-making power regarding household food allocations, health, and care [3,57]. In fact, it was found that Syrian refugee women would join the working force and overcome gender and cultural barriers if the presented working conditions were safe; thus policies should support women's access to economic resources considering their role as both a caregiver and a provider to alleviate food insecurity and improve dietary diversity in low-resources settings [56,57]. As Lebanon has been facing multiple and overlapping crises since 2019, including the COVID-19 pandemic, an unprecedented financial meltdown, and the colossal effects of the tragic Beirut port explosion, the prevalence of food insecurity is expected to increase nationwide [58]. Therefore, a national food security strategy was recommended for Lebanon to build resilience among the most vulnerable, strengthen the social and safety nets, and develop sustainable food and cash transfer programs [58,59]. For instance, a redesign to cash and food transfers, subsidies, and vouchers is recommended to promote the consumption of fresh food such as fruits and vegetables and enhance dietary diversity among vulnerable groups [4,59].

7.2.2. Implications for future research

It is recommended that future studies to be guided by the conceptual framework developed in Chapter 1 to further investigate the different pathways to malnutrition and the linkages between determinants that were not examined by this study, such as the governance and host country resources. The role of health services and environmental health and its linkages to other determinants and nutritional and health outcomes among refugees should be further investigated. Given the high prevalence of overweight and obesity among Syrian refugee mothers in our study, future research is also needed to explore the determinants of overweight and obesity among mothers and the double burden of malnutrition among women and children in refugee settings. In addition, future analysis from this study can investigate infant and young child feeding practices as well as the determinants of poor mental health and their associated dietary patterns and nutrient intake among Syrian refugees living in Greater Beirut, Lebanon. Further research is needed to re-evaluate the diagnostic criteria for anemia and iron deficiency during infancy [60]. Future studies also need to investigate the coverage and effectiveness of nutrition interventions as well as the different delivery approaches in conflict settings [6]. Lastly, prospective cohort studies and appropriate sampling strategies are needed to increase the representativeness of hard-to-reach populations and investigate the long-term changes in health and dietary behavior post-migration [55].

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Chapter 8

General References

8. General References

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Curriculum Vitae

Personal information

Name: Joana Abou-Rizk
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Education

2016 – Present (Expected 2023)	Ph.D. in Nutritional Sciences (Dr. rer. nat.) University of Hohenheim, Institute of Nutritional Sciences (140b), Stuttgart, Germany <i>Ph.D. Thesis: Food and nutrition security and associated health aspects of Syrian refugee mothers and their offspring: A mixed-method study in Greater Beirut, Lebanon</i>
2015	Graduate Diploma in Food Security American University of Beirut, Food Security Program, Beirut, Lebanon
2010 – 2013	Master of Science in Nutrition American University of Beirut, Department of Nutrition and Food Sciences, Beirut, Lebanon <i>M.Sc. Thesis: Determinants of Complementary and Alternative Medicine Use, Dietary Practices and Food Security among People living with HIV and AIDS (PLWHA) in Lebanon</i>
2012	50th United Nations Graduate Study Programme (GSP) United Nations, Geneva, Switzerland <i>GSP Theme: "Opportunities and challenges in a world of seven billion"</i>
2006 – 2009	Bachelor of Science in Human Nutrition and Dietetics – French Université Saint Esprit de Kaslik, Department of Human Nutrition and Dietetics, Kaslik, Lebanon
2006	French Baccalaureate (Scientific: Physics-Chemistry) MLF Grand Lycée Franco-Libanais de Beyrouth, Beirut, Lebanon

Work Experience

02/2023 – Present	Technical Advisor – Nutrition Systems Integration (full-time) Nutrition International Ottawa, Canada
08/2022 – 02/2023	Project Coordinator (part-time) The Ottawa Hospital Research Institute, The Clinical Epidemiology Program Ottawa, Canada
03/2022 – 02/2023	Clinical Research Assistant II (part-time) The Ottawa Hospital Research Institute, The Clinical Epidemiology Program Ottawa, Canada
06/2013 – 08/2016	Research Assistant (full-time) American University of Beirut, Department of Nutrition and Food Sciences Beirut, Lebanon

02/2011 – 08/2012	Graduate / Teaching Assistant (part-time) American University of Beirut, Department of Nutrition and Food Sciences Beirut, Lebanon
10/2009 – 09/2010	Dietetic Intern (full-time) Saint George Hospital University Medical Center Beirut, Lebanon

Scholarships

08/2021 – 12/2021	STIBET Doktoranden Scholarship (Dissertation Completion Grants for Foreign Doctoral Candidates Scholarship) University of Hohenheim, Graduate Academy, Stuttgart, Germany <i>Supported by the DAAD Funding Program</i>
09/2016 – 11/2020	Excellence Scholarship for Ph.D. Students University of Hohenheim, Food Security Center, Stuttgart, Germany <i>Supported by the German Academic Exchange Service (DAAD) with funds of the Federal Ministry of Economic Cooperation and Development (BMZ) of Germany</i>
06/2015 – 07/2015	Staff Educational Scholarship American University of Beirut, Department of Nutrition and Food Sciences, Beirut, Lebanon
02/2011 – 08/2012	Graduate / Teaching Assistant Scholarship American University of Beirut, Department of Nutrition and Food Sciences, Beirut, Lebanon

Awards

2017	“BCFN YES! 2017 Award” Research Grant (First Winner) Barilla Center for Food & Nutrition (BCFN) Foundation, Milan, Italy
2013	“Graduate Travel Award” Research Travel Fund American University of Beirut, Department of Nutrition and Food Sciences, Beirut, Lebanon

Publications

- Jeremias, T., **Abou-Rizk, J.**, Burgard, L., Entenmann, I., Nasreddine, L., Jomaa, L., Hwalla, N., Frank, J., & Scherbaum, V. (2023). Anemia among Syrian Refugee Children Aged 6 to 23 Months Living in Greater Beirut, Lebanon, including the Voices of Mothers' and Local Healthcare Staff: A Mixed-Methods Study. *Nutrients*, 15(3), 700. <https://doi.org/10.3390/nu15030700>
- Abou-Rizk, J.**, Jeremias, T., Nasreddine, L., Jomaa, L., Hwalla, N., Frank, J., & Scherbaum, V. (2022). Infant Feeding Practices, Nutrition, and Associated Health Factors during the First Six Months of Life among Syrian Refugees in Greater Beirut, Lebanon: A Mixed Methods Study. *Nutrients*, 14(21), 4459. <https://doi.org/10.3390/nu14214459>
- Abou-Rizk, J.**, Jeremias, T., Cocuz, G., Nasreddine, L., Jomaa, L., Hwalla, N., Frank, J., & Scherbaum, V. (2022). Food insecurity, low dietary diversity, and poor mental health among Syrian refugee mothers living in vulnerable areas of Greater Beirut, Lebanon. *British Journal of Nutrition*, 1-47. doi:10.1017/S0007114521004724
- Abou-Rizk, J.**, Jeremias, T., Nasreddine, L., Jomaa, L., Hwalla, N., Tamim, H., Frank, J., & Scherbaum, V. (2021). Anemia and Nutritional Status of Syrian Refugee Mothers and Their Children under Five Years in Greater Beirut, Lebanon. *International Journal of Environmental Research and Public Health*, 18(13), 6894. doi.org/10.3390/ijerph18136894

5. Schmitt, R., Fülle, J., **Abou-Rizk, J.**, Al-Sayed, L., Masserat, N., Schüle, E., Scherbaum, V. (2019). Nutritional habits of female asylum seekers—from tradition to adaptation [Ernährungsgewohnheiten asylsuchender Frauen—von Tradition zur Adaption]. *Ernahrungs Umschau*, 66(3): M145-M151. English version doi: 10.4455/eu.2019.010
6. Nasreddine, L., Tamim, H., Itani, L., Nasrallah, M. P., Isma'eel, H., Nakhoul, N. F., **Abou-Rizk, J.**, Naja, F. (2018). A minimally processed dietary pattern is associated with lower odds of metabolic syndrome among Lebanese adults. *Public Health Nutrition*, 21(1), 160–171. doi.org/10.1017/S1368980017002130
7. **Abou-Rizk, J.**, Alameddine, M., Naja, F. (2016) Prevalence and Characteristics of CAM Use among People Living with HIV and AIDS in Lebanon: Implications for Patient Care. *Evidence-Based Complementary and Alternative Medicine*, vol. 2016, Article ID 5013132, 11 pages. doi:10.1155/2016/5013132.

Thesis & Reports

1. **Abou-Rizk J.** Determinants of Complementary and Alternative Medicine Use, Dietary Practices and Food Security among People living with HIV and AIDS (PLWHA) in Lebanon (*M.Sc. thesis*). 2013, American University of Beirut, Lebanon (<https://scholarworks.aub.edu.lb/handle/10938/9983>).
2. 50th United Nations Graduate Study Programme (GSP) "Opportunities and challenges in a world of seven billion", Report of the Working Groups. Information Service, United Nations Office at Geneva (2012) (<http://tinyurl.com/bo3vsjp>).

Conference Proceedings

1. Lisa Pross, **Abou-Rizk J.** The Nutritional Aspects of Refugee Women and Children Living in Low-, Middle- and High-Income Countries: A Systematic Review. *10th Studentische Humboldt reloaded - Jahrestagung 2021, University of Hohenheim*.
2. **Abou-Rizk J.**, Jeremias T., Nasreddine L., Hwalla H., Jomaa L, Frank J., Scherbaum V. Fighting anemia among vulnerable mother and child pairs of refugees and host communities living in Greater Beirut, Lebanon. Volume 27 (2021). *Proceedings of the German Nutrition Society (DGE)*;32:P1-5.
3. Jeremias T., **Abou-Rizk J.**, Nasreddine L., Hwalla H., Jomaa L, Frank J., Scherbaum V. Fighting anemia among vulnerable mother and child pairs of refugees and host communities living in Greater Beirut, Lebanon. Volume 27 (2021). *Proceedings of the German Nutrition Society (DGE)*;49:P7-4.
4. **Abou-Rizk, J.**, Jeremias, T., Nasreddine, L., Jomaa, L., Hwalla, N., Frank, J., & Scherbaum, V. (2020). Anemia, nutritional status, and breastfeeding practices among mother-child pairs in vulnerable areas of Greater Beirut, Lebanon. *Proceedings of the Nutrition Society*, 79(OCE2), E473. doi:10.1017/S0029665120004218
5. Meisberger, M., Stiller, C., Jeremias, T., **Abou-Rizk, J.**, Entwurf von partizipativen Schulungs-Bild-Material für anämische Frauen im Libanon. *8th Studentische Humboldt reloaded - Jahrestagung 2018, University of Hohenheim*.
6. Jeremias T.*, **Abou-Rizk J.***, Nasreddine L., Hwalla H., Jomaa L, Frank J., Scherbaum V. Fighting anemia among vulnerable mother and child pairs of refugees and host communities living in Greater Beirut, Lebanon. Volume 24 (2018). *Proceedings of the German Nutrition Society (DGE)*;24:P8-4 (Jeremias and Abou-Rizk are considered joint co-first authors)
7. Nasreddine, L., Tamim, H., Itani, L., Nasrallah, M. P., Isma'eel, H., Nakhoul, N. F., **Abou-Rizk, J.**, Naja, F. (2018). A minimally processed dietary pattern is associated with lower odds of metabolic syndrome among Lebanese adults. *The Faseb Journal*;31(suppl 1), April 2017

8. **Abou-Rizk J.**, Alameddine M., Nasreddine L., Naja F. Complementary and alternative medicine use among people living with HIV and AIDS (PLWHA) in Lebanon. IUNS 20th International Congress of Nutrition: Granada, Spain, September 15–20, 2013. *Ann Nutr Metab* 2013;63(suppl 1):1055 PO1660 (DOI:10.1159/000354245).

Poster Presentations

1. **Abou-Rizk J.**, Jeremias T., Nasreddine L., Jomaa L., Hwalla N., Frank J., Scherbaum V. Early breastfeeding practices and food habits among Syrian refugees living in Greater Beirut, Lebanon. 8th European Regional Conference of the Academy of Breastfeeding Medicine and the European Association of Breastfeeding Medicine (ABM/EABM), May 11-13, 2023, Split, Croatia.
2. Jeremias T., **Abou-Rizk J.**, Nasreddine L., Jomaa L., Hwalla N., Frank J., Scherbaum V. Infant and young child feeding practices among Syrian refugee children aged 6 to 23 months living in Greater Beirut, Lebanon. 8th European Regional Conference of the Academy of Breastfeeding Medicine and the European Association of Breastfeeding Medicine (ABM/EABM), May 11-13, 2023, Split, Croatia.
3. **Abou-Rizk J.**, Jeremias T., Cocuz G., Nasreddine L., Jomaa L., Hwalla N., Frank J., Scherbaum V. Is there an association between poor mental health and the nutritional status of Syrian refugee mothers and their children under five? A cross-sectional study in Greater Beirut, Lebanon. 22nd IUNS-ICN International Congress of Nutrition, December 6-11, 2022, Tokyo, Japan (Online).
4. Jeremias T., **Abou-Rizk J.**, Nasreddine L., Jomaa L., Hwalla N., Frank J., Scherbaum V. Determinants of low minimum dietary diversity among Syrian refugee children aged 6 to 23 months living in Greater Beirut, Lebanon including the perspectives of mothers and health staff. 22nd IUNS-ICN International Congress of Nutrition, December 6-11, 2022, Tokyo, Japan (Online).
5. Jeremias T., **Abou-Rizk J.**, Nasreddine L., Jomaa L., Hwalla N., Frank J., Scherbaum V. Costs of nutrient adequate complementary feeding diets of Syrian refugee children aged 6 to 23 months living in Greater Beirut, Lebanon. 7th Annual Agriculture, Nutrition and Health (ANH) Academy Week Research, June 20-30, 2022, South Africa (Online).
6. Pross L., **Abou-Rizk J.**, Jeremias T. The Nutritional Aspects of Refugee Women and Children Living in Low-, Middle- and High-Income Countries: A Systematic Review. Humboldt reloaded Day, University of Hohenheim, October 28, 2021, Stuttgart, Germany (Online).
7. **Abou-Rizk J.**, Jeremias T., Cocuz G., Nasreddine L., Jomaa L., Hwalla N., Frank J., Scherbaum V. Low dietary diversity, food insecurity, and poor mental health among Syrian refugee mothers in vulnerable areas of Greater Beirut, Lebanon. 6th Annual Agriculture, Nutrition and Health (ANH) Academy Week Research, June 29 – July 1, 2021, Pakistan (Online).
8. **Abou-Rizk J.**, Jeremias T., Nasreddine L., Jomaa L., Hwalla N., Frank J., Scherbaum V., The double burden of malnutrition among Syrian refugee mothers in vulnerable areas of Greater Beirut, Lebanon. 58th Wissenschaftlicher Kongress der Deutschen Gesellschaft für Ernährung e.V., February 17-19, 2021, Online.
9. Jeremias T., **Abou-Rizk J.**, Nasreddine L., Jomaa L., Hwalla N., Frank J., Scherbaum V., Snack consumption of Syrian refugee children aged 6 to 23 months living in Greater Beirut, Lebanon. 58th Wissenschaftlicher Kongress der Deutschen Gesellschaft für Ernährung e.V., February 17-19, 2021, Online. (*Winner of DGE 2021 Poster Prize*)
10. Cocuz G., **Abou-Rizk J.**, Jeremias T. Assessment of dietary intake and food groups consumption among Syrian women of reproductive age and identification of nutritional gaps based

- on income levels. Scientific Student Conference of the Euroleague for Life Sciences - Online, University for Natural Resources and Life Sciences, November 20-21, 2020, Vienna, Austria.
11. Jeremias T., **Abou-Rizk J.**, Nasreddine L., Jomaa L., Hwalla N., Frank J., Scherbaum V., Anemia and dietary diversity of Syrian refugee children aged 6-23 months living in Greater Beirut, Lebanon. The Sustainable Food Systems - going beyond Food Security Workshop, 7-8 February, 2020, Giessen, Germany.
 12. **Abou-Rizk J.**, Jeremias T., Nasreddine L., Jomaa L., Hwalla N., Frank J., Scherbaum V., Anemia, nutritional status, and breastfeeding practices among mother-child pairs in vulnerable areas of Greater Beirut, Lebanon. 13th European Nutrition Conference, October 15-18, 2019, Dublin, Ireland.
 13. **Abou-Rizk J.***, Jeremias T.*, Nasreddine L., Hwalla H., Jomaa L., Frank J., Scherbaum V. Anemia prevalence of mothers and children under five among Syrian refugees and Lebanese host communities in Greater Beirut, Lebanon. 4th International Congress on Hidden Hunger, February 27 – March 1, 2019, Stuttgart, Germany. (Jeremias and Abou-Rizk are considered joint co-first authors)
 14. Jeremias T.*, **Abou-Rizk J.***, Nasreddine L., Hwalla H., Jomaa L., Frank J., Scherbaum V., Fighting anemia among vulnerable mother and child pairs of refugees and host communities living in Greater Beirut, Lebanon. 55th Wissenschaftlicher Kongress der Deutschen Gesellschaft für Ernährung e.V., March 7-9, 2018, Stuttgart, Germany. (Jeremias and Abou-Rizk are considered joint co-first authors)
 15. Meisberger, M., Stiller, C., Jeremias, T., **Abou-Rizk, J.**, Entwurf von partizipativen Schulungs-Bild-Material für anämische Frauen im Libanon. Humboldt reloaded Day, University of Hohenheim, October 23, 2018, Stuttgart, Germany.
 16. **Abou-Rizk J.**, Alameddine M., Nasreddine L., Naja F., Complementary and alternative medicine use among people living with HIV and AIDS (PLWHA) in Lebanon, IUNS 20th International Congress of Nutrition, September 15-20, 2013, Granada, Spain.

Oral Presentations

1. *Anemia and Nutritional Status of Syrian Refugee Mothers and Their Children under Five Years in Greater Beirut, Lebanon.* “Lebanon Nutrition Sector – Fortnightly meetings”, Lebanon Nutrition Sector, August 12, 2021, Online (Invited speaker).
2. *Youth Investigators Panel Discussion.* “World Food Day Colloquium 2020”, University of Hohenheim, October 16, 2020, Online (Invited speaker).
3. *Maternal and child nutrition among refugees and host communities in Greater Beirut, Lebanon: A focus on hidden hunger and food security.* “Nutrition and food security in the context of climate change. Block Seminar 5, 2019 – CLIFOOD German-Ethiopian SDG Graduate School”, University of Hohenheim, March 5, 2019, Stuttgart, Germany (Invited speaker).
4. *Food and Youth: Successful Stories.* “9th International Forum and Food and Nutrition”, Barilla Center for Food and Nutrition, November 27-28, 2018, Milan, Italy. (Invited speaker)
5. *Maternal and child nutrition among refugees and host communities in Greater Beirut, Lebanon: A focus on anemia.* “Humboldt reloaded Interdisciplinary Summer School 2018”, University of Hohenheim, September 19, 2018, Stuttgart, Germany (Invited lecturer).
6. *Maternal and child nutrition in the first 1000 days: a focus on anemia.* “Spring Lebanese Congress of Surgery”, The Lebanese Society for General Surgery and The Syndicate of Dietitians in Lebanon, Lebanese Order of Physicians, June 29, 2018, Beirut, Lebanon (Invited speaker).

7. *Maternal and child nutrition among refugees and host communities in Greater Beirut, Lebanon: A focus on anemia*. “8th International Forum and Food and Nutrition”, Barilla Center for Food and Nutrition, December 5, 2017, Milan, Italy (Invited finalist).
8. *Proposal presentation - Maternal and child nutrition among refugees and host communities in Greater Beirut, Lebanon: A focus on anemia*. “(1401-530) Global Nutrition Summer Block Module 2017”, University of Hohenheim, July 14, 2017, Stuttgart, Germany (Invited lecturer).
9. *Humanitarian crisis in modern day: Syrian humanitarian crisis in Lebanon*. Continuing Lecture Session (Ringvorlesung) on the theme of “Sustainable Development, Food Security and Humanitarian Assistance”. November 2, 2016, University of Kassel, Witzenhausen, Germany (Invited guest lecturer).
10. *Training Course on the Use of Dietary, Lifestyle, Biochemical, and Anthropometric Assessment Tools for Mother and Infant Cohort Studies*. Mother and Child Nutrition Assessment (MINA) Cohort Study: Towards Curbing the Epidemic of Non-Communicable Diseases in Qatar and Lebanon, American University of Beirut, May 28 - June 2, 2016, Ministry of Public Health, Doha, Qatar (Invited trainer).

Co-Supervision of Master and Bachelor Students

Lisa Pross (2022)

“The nutritional status of refugee women and children – a systematic review”

Bachelor Thesis, University of Hohenheim, Stuttgart, Germany

Supervisors: Scherbaum, **Abou-Rizk**, Jeremias

Malte Meisberger (2021)

“Costing of Improved Diets of Syrian Children of 6 to 23 Months Living in Greater Beirut, Lebanon: A Focus on Anemia Prevention”

Master Thesis, Justus Liebig University Giessen, Giessen, Germany

Supervisors: Petrick, Scherbaum, Jeremias, **Abou-Rizk**

Alexandra Maurer (2021)

“Knowledge, attitudes, and practices on infant and young child feeding of Syrian refugee mothers and primary health care staff in Greater Beirut, Lebanon”

Bachelor Thesis, University of Hohenheim, Stuttgart, Germany

Supervisors: Scherbaum, Jeremias, **Abou-Rizk**

Isa Entenmann (2020)

“A comparison of knowledge, attitudes, and perceptions on child anemia of Syrian refugee mothers of children aged under five living in refugee communities and primary health care staff in Greater Beirut, Lebanon”

Bachelor Thesis, University of Hohenheim, Stuttgart, Germany

Supervisors: Scherbaum, Jeremias, **Abou-Rizk**

Leonie Burgard (2020)

“Food intake analysis for designing improved diet quality among Syrian refugee children aged 6 to 23 months living in Greater Beirut, Lebanon with particular emphasis on anemia”

Master Thesis, University of Hohenheim, Stuttgart, Germany

Supervisors: Scherbaum, Jeremias, **Abou-Rizk**

Dima Charara (2020)

“Anemia and its association with dietary intakes and infant and young child feeding practices: a cross-sectional study amongst 0-2-year-old Syrian refugee children in Lebanon”

Master Thesis, American University of Beirut, Beirut, Lebanon

Supervisors: Nasreddine, Jomaa, Tamim, **Abou-Rizk**, Jeremias

Georgiana Cocuz (2020)

“Assessment of dietary intake of Syrian refugee women living in Greater Beirut, Lebanon, and identification of nutritional gaps based on income groups”

Master Thesis, University of Hohenheim, Stuttgart, Germany

Supervisors: Scherbaum, **Abou-Rizk**, Jeremias

Lena Paul (2019)

“Fighting anemia among vulnerable children of refugees and host communities living in Greater Beirut, Lebanon: Development of improved recipes and meal plans for children aged 9 to 35 months”

Bachelor Thesis, University of Hohenheim, Stuttgart, Germany

Supervisors: Scherbaum, Jeremias, **Abou-Rizk**

Melanie Köger (2019)

“Fighting anemia among vulnerable mother and child pairs of refugees and host communities living in Greater Beirut, Lebanon: Development of improved recipes and meal plans for mothers”

Bachelor Thesis, University of Hohenheim, Stuttgart, Germany

Supervisors: Scherbaum, **Abou-Rizk**, Jeremias

Supervision of Humboldt Reloaded Projects

Lisa Pross (2019)

“A literature review on the nutritional aspects of refugee women and children living in developing countries, middle income countries and the industrialized world”

Humboldt Reloaded, University of Hohenheim, Stuttgart, Germany

Supervisor: **Abou-Rizk**, Scherbaum, Jeremias

Malte Meisberger (2018)

“Design of counselling cards and material for anemic women in Lebanon”

Humboldt Reloaded, University of Hohenheim, Stuttgart, Germany

Supervisors: Jeremias, **Abou-Rizk**, Stiller

Peer Review Activities

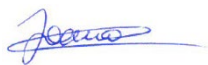
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|-------------|---|
| 2023 | Annals of Human Biology / Taylor & Francis Online (1)
BMJ open / BMJ (2)
International Breastfeeding Journal / BMC Part of Springer Nature (1)
Life / MDPI (1)
Social Science & Medicine / ScienceDirect (1) |
| 2022 | Annals of Human Biology / Taylor & Francis Online (1)
British Journal of Nutrition / Cambridge University Press (1)
Children / MDPI (1)
IJERPH / MDPI (1)
International Journal of Women's Health / Dove Medical Press (1)
Journal of Nutritional Science / Cambridge University Press (1)
NFS Journal / Elsevier (2)
Nutrients / MDPI (3)
Public Health Nutrition / Cambridge University Press (2) |
| 2021 | Heliyon / Elsevier (4)
Journal of Human Nutrition and Dietetics / Wiley (1)
NFS Journal / Elsevier (3)
Public Health Nutrition / Cambridge University Press (5)
Sustainability / MDPI (2) |

Additional Skills and Qualifications

Software	Nutritional analysis: NutriSurvey [®] , Nutritionist Pro [™] , WHO Anthro Survey Analyzer [®] Statistical analysis: IBM [®] SPSS [®] Statistics, R software Qualitative analysis: MAXQDA [®] , NVIVO [®] Databases: EPIC systems, RedCap, KoBoToolBox [®] Reference manager: Endnote [™] , Zotero
Evidence of training	Social & Behavioral Research - Basic/Refresher (CITI); Biomedical Research - Basic/Refresher (CITI); Good Clinical Practice (ICH-GCP); Tri-Council Policy Statement-2 (TCPS-2); Research Ethics Certificate (TRREE)
Languages	Fluent in English, French, and Arabic (Native) Intermediate in German Beginner in Spanish
License	Licensed Dietitian and Nutritionist (LDN) by the Ministry of Public Health in Lebanon (since 2010)

Ottawa, Canada, April 28, 2023

Place, Date



Joana Abou-Rizk

Feature of Poster Presentations

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Anemia prevalence of mothers and children under five years among Syrian refugees and Lebanese host communities in Greater Beirut, Lebanon

Abou-Rizk* J.^{1,2}, Jeremias* T.¹, Nasreddine L.³, Jomaa L.³, Hwalla N.³, Frank J.^{1,2}, Scherbaum V.^{1,2}

¹University of Hohenheim / Institute for Biological Chemistry and Nutrition (140), Stuttgart, Germany, ²University of Hohenheim / Food Security Center (791), Stuttgart, Germany, ³American University of Beirut, Department of Nutrition and Food Sciences, Beirut, Lebanon

* Abou-Rizk and Jeremias are considered joint co-first authors

Objective

- Lebanon is host of the world's highest per capita concentration of refugees, exposing the nutritional status of vulnerable groups.
- Children under five and women of reproductive age are at increased risk of malnutrition coupled with micronutrient deficiencies.
- Up-to-date, there is a lack of recent studies assessing hidden hunger in Lebanon, such as anemia and its determinants.
- Objective:** To assess the prevalence of anemia and its determinants among refugees and host communities in the urban setting of a humanitarian crisis in Lebanon.

Measuring hemoglobin concentrations among mother/child pairs (Abou-Rizk & Jeremias, 2018)

Methods

- A cross-sectional study was conducted among mothers with children < 5 years of Syrian refugees and Lebanese host communities (n=538) attending primary health care centers in vulnerable areas of Greater Beirut, Lebanon during July and September 2018.
- Face-to-face interviews were carried using a semi-structured questionnaire. Data on socio-economic characteristics, and nutritional status were gathered (n=478) and hemoglobin concentrations were measured using the HemoCue Hb301+ analyzer.
- Anemia was defined using the WHO cut-offs^a. Data analysis used descriptive statistics, t-test, and chi-square test.

Results

- Overall, 91.2% of the mothers were Syrian and 8.8% Lebanese, with average ages of 27.9±6.0 years for women and 17.4±14.7 months for children.
- Anemia in children:** Anemia rates of children were found to be significantly higher among those aged 6-23m and among young mothers (<25 years) as compared to the other age groups (p<0.05).
- Anemia in women:** Maternal anemia was significantly higher among mothers of children aged 0-23 months as compared to mothers of children aged 24-59 months (66.3% vs 33.7%; p<0.05).

Figure 1: Prevalence of anemia^a among children <5y and women of reproductive age in Greater Beirut

Anemia Type	Children (n=473)	Mothers (n=393)
Total anemia	34.9%	22.4%
Mild anemia	25.6%	16.0%
Moderate anemia	9.1%	6.4%
Severe anemia	0.2%	0.0%

^a WHO. Hemoglobin concentrations for the diagnosis of anemia and assessment of severity. Vitamin and Mineral Nutrition Information System. Geneva, World Health Organization, 2011 (WHO/NMH/NHD/MN.V11.1)

Figure 2: Anemia rates of children according to the age of the children and mothers in Greater Beirut

Age Group	Anemia Rate
Children <6m	26.1%
Children 6-23m	61.5%
Children 24-59m	12.4%
Mothers <25y	43.4%
Mothers 25-29y	29.6%
Mothers ≥30y	27.0%

Conclusion

- Anemia rates were found to be prevalent among women of reproductive age and children < 5 years in vulnerable areas of Greater Beirut, Lebanon.
- Further analysis will be conducted to examine the determinants of anemia, level of food security, and nutritional status in order to design an effective nutrition education intervention.

Acknowledgement

This study is supported by the DAAD and Fiat Panis Foundation through the Food Security Center of the University of Hohenheim, BCFN! YES 2017 Research Award by the BCFN Foundation, and the American University of Beirut.

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Anemia, nutritional status, and breastfeeding practices among mother-child pairs in vulnerable areas of Greater Beirut, Lebanon

Abou-Rizk J.^{1,2}, Jeremias T.¹, Nasreddine L.³, Jomaa L.³, Hwalla N.³, Frank J.^{1,2}, Scherbaum V.^{1,2}

¹University of Hohenheim, Institute of Nutritional Science (140), Stuttgart, Germany, ²University of Hohenheim, Food Security Center (791), Stuttgart, Germany, ³American University of Beirut, Department of Nutrition and Food Sciences, Beirut, Lebanon

Background

- Micronutrient deficiencies and malnutrition during the first 1000 days of life can have lifelong effects on the physical and cognitive development of the child.
- Host of the world's highest per capita number of refugees, the nutritional status of mothers and children under five in Lebanon is increasingly compromised due the protracted crisis.

Objective

- To examine the prevalence of anemia, breastfeeding practices, and their characteristics among Syrian refugees and Lebanese host communities in an urban setting of a humanitarian crisis.



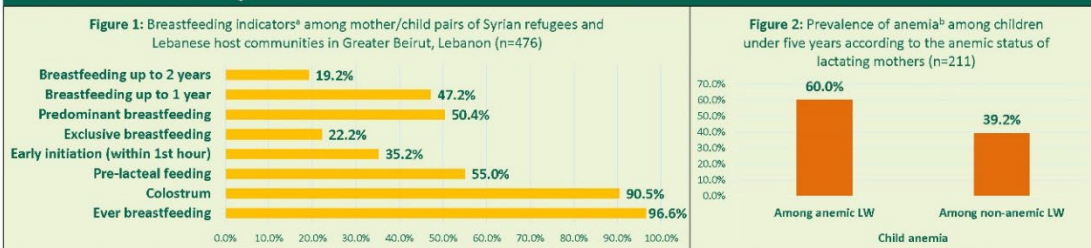
Face-to-face interview with a mother and her child in a primary healthcare setting (Abou-Rizk, 2018)

Methods

- A cross-sectional study was conducted among mothers with children under 5 years of Syrian refugees (n=444) and Lebanese host communities (n=32) attending primary health care centers in vulnerable areas of Greater Beirut, Lebanon from July until September 2018.
- Data on socio-economic characteristics, infant and young child feeding practices, nutritional status, and hemoglobin concentrations were gathered.
- Anemia was defined using the WHO cut-offs^b. Data analysis used descriptive statistics, t-test, and chi-square test.

Results

- Overall, 16.6% of the women were pregnant (PW), 45.4% lactating (LW), and 38.0% non-pregnant non-lactating (NP/NL).
- Ever breastfeeding, offering colostrum, and long term breastfeeding were in line with WHO recommendations.
- The initiation of breastfeeding was delayed and half of the infants were offered pre-lacteal feeding, consequently the prevalence of exclusive breastfeeding was low.



^a WHO (2008). Indicators for assessing infant and young child feeding practices: part 1: definitions: conclusions of a consensus meeting held 6-8 November 2007 in Washington DC, USA.

^b WHO (2011). Haemoglobin concentrations for the diagnosis of anaemia and assessment of severity. Vitamin and Mineral Nutrition Information System. Geneva, Switzerland.

- Prevalence of anemia among mothers was found to be 17.7% among PW, 18.8% among LW, and 26.1% among NP/NL.
- Prevalence of anemia among children was significantly higher in LW compared to PW and NP/NL (43.0%, 21.5%, 30.0%, respectively, $p < 0.01$).
- Prevalence of anemia among children under 5 years of lactating mothers was significantly higher among anemic mothers as compared to non-anemic mothers (60.0% vs 39.2%, $p < 0.05$).
- Prevalence of mild anemia among infants under 6 months of lactating mothers was significantly higher among overweight and obese mothers as compared to mothers with a healthy BMI (66.7% vs 33.3%, $p < 0.05$).

Conclusion

- Despite an almost universal initiation of breastfeeding, early onset and exclusive breastfeeding of infants under six months were low.
- Higher prevalence of anemia was found among children of lactating women and this was significantly associated to the anemia and overnutrition of their mothers.

Acknowledgement

This study is supported by the DAAD and Fiat Panis Foundation through the Food Security Center of the University of Hohenheim, BCFN! YES 2017 Research Award by the BCFN Foundation, and the American University of Beirut.

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Low dietary diversity, food insecurity, and poor mental health among Syrian refugee mothers in vulnerable areas of Greater Beirut, Lebanon

Abou-Rizk J.¹, Jeremias T.¹, Cocuz G.¹, Nasreddine L.², Jomaa L.², Hwalla N.², Frank J.¹, Scherbaum V.¹

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INTRODUCTION

- Syrian refugees in Lebanon are facing vulnerabilities that are limiting their economic resources. Food-coping strategies may be increasingly used against food insecurity, compromising the quality and quantity of their diet (UNHCR *et al.*, 2018).

OBJECTIVES

- This study aimed **(1)** to assess the prevalence of low dietary diversity, food insecurity, and poor mental health of Syrian refugee mothers in Lebanon and their correlates, **(2)** to explore associations with anemia and nutritional status, and **(3)** to examine food groups consumption according to the household income.

Abou-Rizk, 2018

METHODS

- A cross-sectional study was conducted in June-September 2018. Mothers with children under 5 years (n=433) were recruited from primary health care centers in vulnerable areas of Greater Beirut, Lebanon. Data were collected during face-to-face interviews and analyzed, as follows:

Low dietary diversity	Food insecurity	Dietary intake of mothers	Mental health status of mothers
(1) Minimum Dietary Diversity for Women of Reproductive Age (MDD-W) (FAO, 2021)	(2) The global Food Insecurity Experience Scale (FIES) at the individual level (FAO, 2018)	(3) 24-hour dietary recall (Conway <i>et al.</i> , 2004) (4) Food frequency questionnaire (past 12-months) (El Sayed Ahmad <i>et al.</i> , 2020)	(5) Depression: Patient Health Questionnaire (PHQ-9) (Sawaya <i>et al.</i> , 2016) (6) Post-traumatic stress disorder (PTSD): Mini International Neuropsychiatric Interview (Kadri <i>et al.</i> , 2005)

- The monthly household income was categorized into low-income (defined as ≤ 750.000 LBP) and high-income (> 750.000 LBP; equivalent to US\$500 in 2018). Crowding index was defined as the total number of residents per household divided by the number of rooms excluding kitchens, bathrooms, hallways, balconies, and garage (WHO, 2018).
- Anthropometric measurements and hemoglobin concentrations were measured using standardized protocols (NIH, 1998; WHO, 2000).

FINDINGS

- Prevalence among mothers of:

Low dietary diversity (LDD): 63.3%	PTSD: 13.2%
Moderate to severe food insecurity: 34.4%	Moderate depression: 11.1%
Severe food insecurity: 12.5%	Severe depression: 9.9%

Results showed a significant correlation between LDD and individual-level food insecurity ($P < 0.001$). A high crowding index and low-income were significantly associated with LDD and food insecurity. Poor mental health (defined as PTSD and/or moderate or severe depression) was significantly associated with food insecurity and a high crowding index.

Food insecurity was correlated with a lower consumption of main meals and snacks per day, while LDD was associated with the lack of a daily breakfast and a lower number of snacks per day ($P < 0.05$). No association between anemia and nutritional status of the mother and LDD or food insecurity.

High consumptions of grains, fats, oils, sweets, and sugar derivatives were observed. Flesh foods, legumes, fruits, and vegetables were consumed minimally. Low-income households had significantly higher intakes of grains and refined starchy staples, whereas high-income households had higher intakes of highly nutritious food groups (fruits, cheese, olive oil, and flesh foods), sweets, and sugar derivatives ($P < 0.05$).

CONCLUSIONS

- This study presents evidence of poor dietary diversity and food insecurity among Syrian refugee mothers in an urban setting of a humanitarian crisis and poor nutritional practices and a low diet quality.
- Findings highlight that food insecurity and overcrowding affect the mental health status of mothers.
- Counselling and awareness-raising sensitive to cultural norms need to target mothers and provide psychosocial support.
- Socio-economic disparities, such as the income, shapes the diet structure to a great extent among vulnerable populations.
- A multifaceted action is needed to reduce food insecurity and improve dietary diversity among vulnerable groups, especially women of reproductive age.

ACKNOWLEDGEMENT This study is supported by the DAAD and Fiat Panis Foundation through the Food Security Center of the University of Hohenheim, BCFNI YES 2017 Research Award by the BCFNI Foundation, and the American University of Beirut.

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Poster No. PAB(T6)-186

Is there an association between poor mental health and the nutritional status of Syrian refugee mothers and their children under five? A cross-sectional study in Greater Beirut, Lebanon

Authors | Abou-Rizk J¹, Jeremias T¹, Cocuz G¹, Nasreddine L², Jomaa L^{2,3}, Hwalla N², Frank J¹, Scherbaum V¹

Affiliation | ¹ Institute of Nutritional Sciences (140b), University of Hohenheim, Germany
² Department of Nutrition and Food Sciences, American University of Beirut, Lebanon
³ Department of Human Sciences, North Carolina Central University, USA

Background and Objectives

More than **one out of four** mothers were found to suffer from a form of depression and/or post-traumatic stress disorder (PTSD) among Syrian refugees in Greater Beirut, Lebanon. [1]

The objective of this study was:

- To examine the associations between maternal mental health and socio-economic characteristics, nutritional inadequacies, nutritional status, and anemia of mothers and their children aged under five years.

Methods

A cross-sectional study was conducted among Syrian refugee mothers of children under five years from June-October 2018 in Greater Beirut, Lebanon (n=433). [2]

Data was gathered on socio-economic, maternal health, dietary intake (24-hour recalls), and anthropometric characteristics.

Hemoglobin concentrations were measured using the HemoCue Hb301+ analyzer.

Mental health was assessed using the Patient Health Questionnaire-9 (PHQ-9) for depression and the Mini International Neuropsychiatric Interview (MINI) for PTSD. [3,4]

Descriptive statistics, chi-square test and ANOVA were applied.

Results

PTSD:
6.9%

Moderate or severe depression:
13.9%

Depression & PTSD:
6.2%



Abou-Rizk, 2018

Conclusions

Poor mental health is associated with socio-economic and health characteristics

Plays a crucial role in caregiving and impact the nutrition of offspring's

Need to examine its associations with maternal dietary patterns among refugees

Keywords & Conflict of Interest

Women of reproductive age; Nutrition; Refugees; Mental Health; Dietary Intake; Diet

There is no conflict of interest.

References

[1] Abou-Rizk, J., Jeremias, T., Cocuz, G., Nasreddine, L., Jomaa, L., Hwalla, N., Frank, J., & Scherbaum, V. (2022). Food insecurity, low dietary diversity, and poor mental health among Syrian refugee mothers living in vulnerable areas of Greater Beirut, Lebanon. *British Journal of Nutrition*, 126(1), 1-11.

[2] Abou-Rizk, J., Jeremias, T., Nasreddine, L., Jomaa, L., Hwalla, N., Tamm, H., Frank, J., & Scherbaum, V. (2021). Anemia and Nutritional Status of Syrian Refugee Mothers and Their Children under Five Years in Greater Beirut, Lebanon. *International Journal of Environmental Research and Public Health*, 18(13), 6894.

[3] Smeets, H., Abou, M., Hamadeh, A., et al. (2016). Adaptation and initial validation of the Patient Health Questionnaire - 9 (PHQ-9) and the generalized anxiety disorder - 7 questionnaire (GAD-7) in Arabic speaking Lebanese psychiatric outpatient sample. *Psychiatry Res*, 239, 246-252.

[4] Kazi, N., Agoub, M., El Ghazou, S., et al. (2005). Moroccan colloquial Arabic version of the mini international neuropsychiatric interview (MINI): qualitative and quantitative validation. *Eur Psychiatry*, 20, 105-105.

Further Collaborators






Feature of the BCFN YES! 2017 Research Award



JOANA ABOU RIZK
AWARDED PROJECT

“Maternal and child nutrition among refugees
and host communities in Greater Beirut, Lebanon: A focus on anemia”

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Article by the BCFN Foundation



BCFN YES! 2017

The 2017 edition of BCFN YES! (Young Earth Solutions) once again lays down a challenge for young PhD students and post-doc researchers from around the world, inviting them to come up with innovative projects in the field of food sustainability.

The new feature of this edition is the prize on offer: a research grant of €20,000 for one year which this time will be awarded to a maximum of three winning projects.

Like every year, the finalists will be presented at the International Forum on Food and Nutrition, and it is at this event, in front of a collection of experts, that the winner will be announced.

WINNING PROJECTS



Joana Abou Rizk



University of Hohenheim - Germany
Lebanon



Theresa Jeremias



University of Hohenheim - Germany
Germany

A great path to sustainably rebuild post-crisis Syria and improve the nutrition situation in Lebanon is by raising healthy generations from early life.

Maternal and child nutrition among refugees and host communities in Greater Beirut, Lebanon: A focus on anemia

Malnutrition during the first 1000 days of life can have lifelong effects on a child's development and constitute a window of opportunity to address nutritional deficiencies. In Lebanon, having the highest per capita concentration of refugees in the world, the nutritional status of children under-five and women of reproductive age is increasingly compromised by the protracted crisis. Up to date, there is a lack of studies assessing anemia and its associations with nutritional status, child feeding practices, mental health and household food insecurity in this context. This project is

composed of two phases, a cross-sectional and an intervention study among mother/child pairs of Syrian refugees and their Lebanese host communities attending primary healthcare centers in Greater Beirut. The aim is to examine the underlying causes of anemia and to improve maternal and child nutrition using sustainable nutrition education approaches to fight hidden hunger in Lebanon and post-conflict Syria.

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BCFN YES! 2017 FINALISTS



Joana Abou Rizk

Lebanon

University of Hohenheim - Germany



Theresa Jeremias

Germany

University of Hohenheim - Germany



A great path to sustainably rebuild post-crisis Syria and improve the nutrition situation in Lebanon is by raising healthy generations from early life.

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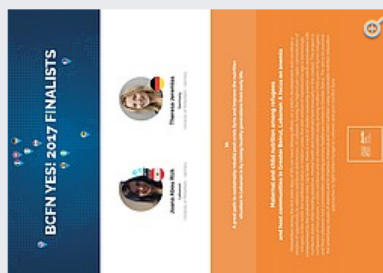


Available at: <https://www.barillacfn.com/en/bcfnyes/2017/>

Article by the Food Security Center at the University of Hohenheim

FSC Scholar winner of the BCFN YES! 2017

FSC Scholar Joana Abou-Rizk is the first winner of the BCFN YES! 2017 Research Grant for young PhD students and post-doc researchers from around the world with innovative projects in the field of food sustainability



FSC is very proud and excited for this opportunity and looks forward to the implementation of the scholars work with the title: "Maternal and child nutrition among refugees and host communities in Greater Beirut, Lebanon: A focus on anemia".

The award winners were announced at the 8th **International Forum on Food and Nutrition** held from December 4 to 5, 2017 in Milan. For materials and videos of this event including the award ceremony with the presentation of **Joana Abou-Rizk**, please refer to the Barilla Center for Food and Nutrition - website.

Available at: <https://fsc.uni-hohenheim.de/en/bcfn2017>

Article by the American University of Beirut

FAFS alumna Joana Abou-Rizk won the "BCFN YES!" 2017 Research Grant Competition

1/18/2018

We are proud to announce that Ms. Joana Abou-Rizk and Ms. Theresa Jeremias, Ph.D. candidates and nutritionists, won the "BCFN YES! 2017" Research Grant Competition of the Barilla Center for Food & Nutrition (BCFN) Foundation for their project entitled "Maternal and Child Nutrition among Refugees and Host Communities in Greater Beirut, Lebanon: A Focus on Anemia". This research project is jointly supervised by the Department of Nutrition and Food Sciences at the American University of Beirut (AUB) and the Institute for Biological Chemistry and Nutrition at the University of Hohenheim in Germany.

The BCFN YES! Research Grant Competition, active since 2012, invites 10 selected finalists (Ph.D. students and post-doc researchers under 35) each year from around the world to present their innovative projects focusing on food sustainability in front of a panel of experts. At the 2017 edition of BCFN YES! (Young Earth Solutions), the 10 finalists were selected after a rigorous review of 135 proposals of doctoral students and post-doc researchers from 43 countries on all continents.

Ms. Abou-Rizk and Ms. Jeremias received the award, along another winner from Italy, during a live ceremony as part of the 8th International Forum and Food and Nutrition in Milan, Italy on December 5, 2017. The award is comprised of a one year research grant, allowing the young researchers to find effective and sustainable solutions to food and nutrition security.

The research project aims at a first stage to assess the prevalence and determinants of anemia among Syrian refugees and Lebanese host communities in Greater Beirut, and in particular among children under five and women of reproductive age, using a cross-sectional design. The second phase of the project has the objective to develop a sustainable nutrition education intervention promoting locally affordable and culturally appropriate foods and to test its effectiveness in raising hemoglobin levels of mildly anemic women and children under five.

The Lebanese Ph.D. candidate Abou-Rizk is a FAFS alumna with a M.Sc. in Nutrition (2013), holds a Graduate Diploma in Food Security (2015) and is a recipient of the Excellence Ph.D. Scholarship (DAAD supported) by the Food Security Center at the University of Hohenheim in Germany.

The German Ph.D. candidate Jeremias holds a M.Sc. in Nutritional Sciences from the University of Hohenheim and a M.Sc. in Epidemiology from the London School of Hygiene and Tropical Medicine, University of London. She currently works for the NGO, CARE Germany-Luxemburg, as a Coordinator for Food and Nutrition Security and serves as CARE International Global Policy Lead in Nutrition.

The BCFN Foundation, founded in 2009, focuses on reducing hunger, fighting food waste, and promoting healthy lifestyles and sustainable agriculture. As a private, nonprofit, and, nonpolitical foundation, BCFN is an institution that evokes the causal relationships of the economy, science, society and the environment have on food. It acts as a knowledge and scientific database that others can use to make daily conscious choices about food and nutrition, health, and sustainability.

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Declaration in lieu of an oath on independent work

according to Sec. 18(3) sentence 5 of the University of Hohenheim's Doctoral Regulations for the Faculties of Agricultural Sciences, Natural Sciences, and Business, Economics and Social Sciences

1. The dissertation submitted on the topic

Food and nutrition security and associated health aspects of Syrian refugee mothers and their offspring: A mixed-method study in Greater Beirut, Lebanon

is work done independently by me.

2. I only used the sources and aids listed and did not make use of any impermissible assistance from third parties. In particular, I marked all content taken word-for-word or paraphrased from other works.

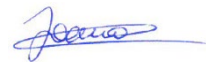
3. I did not use the assistance of a commercial doctoral placement or advising agency.

4. I am aware of the importance of the declaration in lieu of oath and the criminal consequences of false or incomplete declarations in lieu of oath.

I confirm that the declaration above is correct. I declare in lieu of oath that I have declared only the truth to the best of my knowledge and have not omitted anything.

Ottawa, Canada, April 28, 2023

Place, Date



Signature