REVIEW

Dietary Intake and Nutritional Status among Refugees in Host Countries: A Systematic Review

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ABSTRACT

Refugees remain vulnerable to acute food insecurity, malnutrition, and critically inadequate food and nutrient intake after migration, regardless of the economic level of the host country. We conducted this systematic review to summarize and evaluate the dietary intake and nutritional status among refugees resettled in non-camp settings worldwide. We searched PubMed and Web of Science databases to review relevant studies published between 2009 and 2020 using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. We also conducted an additional manual search through PubMed and Google Scholar. Studies that evaluated both dietary intake and nutritional status of refugees in host countries were included. A total of 15 articles from 10 countries were included and assessed for study quality and outcomes. Poor dietary diversity and insufficient intake of specific food groups were reported. In addition to these dietary patterns, a high prevalence of stunting, underweight, and anemia was reported, particularly among children. A double burden of malnutrition was also observed across and within studies. Post-resettlement dietary intake and nutritional status of refugees are both influenced by factors at the pre- and post-resettlement stages as refugees transition to their host countries. Those factors, including pre-resettlement experiences, host country resources, socioeconomic status, acculturation, and food security, were summarized and presented in a conceptual model. There is a need for comprehensive dietary and health screening as well as culturally appropriate and sustainable nutrition education resources and interventions for refugees to improve their diet and nutrition. Longitudinal studies and novel methodological approaches are also suggested to measure changes in refugees' food intake and nutritional status as well as to further investigate factors associated with these 2 components. *Adv Nutr* 2022;13:1846–1865.

Statement of Significance: This is the first systematic review summarizing the evidence on both dietary intake and nutritional status among refugees who have resettled in non-camp settings within host countries worldwide.

Keywords: refugee, asylum seeker, diet, food intake, nutritional status, malnutrition, systematic review

Introduction

Globally, there are at least 26 million refugees who have been forcibly displaced due to war, violence, conflict, or persecution (1, 2). The vast majority of refugees (~78%) live in cities and urban communities, rather than refugee camps, within host countries around the world (3). Before resettlement, most refugees reside in countries or territories affected by acute food insecurity and malnutrition (4, 5). After resettlement, refugees often remain vulnerable to critically inadequate food intake and numerous nutrition-related challenges that lead to malnutrition; each stage of the migration process may have an impact on their dietary patterns and nutritional health outcomes (6–10).

A large proportion of refugees are hosted in low- or middle-income countries, which are most at risk for nutritional problems—in particular, the double burden of malnutrition (11–13). As a result of the change to

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Abbreviations used: BAZ, BMI-for-age *z* score; GNI, gross national income; NOS, Newcastle-Ottawa Scale; NCD, noncommunicable disease; NKR, North Korean refugee; OB, obesity; OW, overweight; SES, socioeconomic status; SKC, South Korean control.

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vastly different food systems, the increased availability of inexpensive low-nutrient-dense foods and low-quality diets has led to increased malnutrition. These nutritional challenges are exacerbated further among refugee population groups as they often face unique economic-, culture-, and linguistic-related obstacles to healthy eating in host countries (6, 14). Additionally, poor nutrition is a global health problem and a leading risk factor for several noncommunicable diseases (NCDs), including cardiovascular disease, diabetes, cancer, and anemia, regardless of the economic level of the country (15–17). In fact, refugees resettled in high-income countries also experience obstacles to healthy eating that result in nutrition-derived health problems similar to refugees resettled in low- and middle-income countries (6, 9, 18).

Despite the array of published primary studies on the topic, there is currently no systematic review summarizing the knowledge on both dietary intake and nutritional status among refugees resettled in non-camp settings within host countries worldwide. The existing systematic and scoping reviews assessing refugee nutrition are limited to a specific country, region, country economic level, or age range, and these reviews do not elicit a comprehensive profile of food intake and nutritional status of refugee populations (6–10, 18–21). Some reviews do not differentiate refugees from immigrants and other migrant groups. Previous reviews also do not generally differentiate between refugees residing in camps and refugees in non-camp settings, although food resources and accessibility are quite different between these 2 environments. For instance, the availability of food may be more abundant in cities versus in camps where refugees are often dependent entirely on humanitarian aid; consequently, food shortages are more prevalent in refugee camps (6, 10, 22). Moreover, an insufficient quantity of food is not the only problem in camps; the lack of nutrient-dense foods comprising variety and diversity is also common (10).

To fill the gap in the literature, we systematically reviewed the evidence from primary studies focusing on dietary intake and nutritional status of refugees living in non-camp settings on a global scale, without limitations to a specific country, region, country economic/development level, age, etc. Our objectives were as follows: *1*) to describe and summarize the dietary intake and nutritional status in this population, *2*) to critically evaluate the potential association between refugee dietary intake and nutritional status, and *3*) to specify and highlight the associated factors influencing refugee dietary patterns and nutritional health outcomes. Further, we provide a conceptual model that captures these relevant nuanced factors, and we identify insights that could inform the design and development of nutrition intervention programs and research for this population.

Methods

The systematic review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (23). The review methods, which included the review questions, search strategy, inclusion/exclusion criteria, and assessments of risk of bias, were established prior to conducting the review.

Definition of nutritional status

Nutritional status describes the status of an individual's health in terms of the intake of food and nutrients. Based on the WHO (11) and the US CDC (24) definitions, we disaggregated nutritional status into 3 broad groups of conditions: undernutrition, overnutrition, and micronutrient malnutrition (**Text Box 1**). We defined the double burden of malnutrition as the coexistence of undernutrition along with overnutrition, or diet-related NCDs (13, 25).

Text Box 1
Variables of nutritional status

Undernutrition: wasting (low weight-for-height), stunting (low height-for-age), and/or underweight (low weight-for-age)

Overnutrition: overweight, obesity, and/or diet-related NCDs, such as diabetes and heart disease

Micronutrient malnutrition: prevalence of deficiencies in vitamins or minerals, such as iodine, vitamin A, and iron, among others

Classification of a country's economic level

Refugees' country of origin and host country were classified into 4 categories based on the country's economic level as measured by gross national income (GNI) per capita, calculated using the World Bank Atlas method for the 2021 fiscal year (26). (Low-income countries are those with a GNI per capita of ≤$1035; lower-middle-income countries are those with a GNI per capita between $1036 and $4045; upper-middle-income countries are those with a GNI per capita between $4046 and $12,535; and high-income countries are those with a GNI per capita of ≥$12,536.)

Eligibility criteria

The eligibility criteria were based on the Population, Intervention, Comparison, Outcomes, and Study (PICOS) framework (27) (**Table 1**), and a preliminary search was conducted to finalize the review objectives and study criteria. With consideration for the statistical power needed for data analysis, studies with a sample size of at least 100 participants were included in the review (28, 29). Studies that evaluated both dietary intake and nutritional status of refugees were included, while those that evaluated only dietary intake or only nutritional status were excluded. We included both refugees and asylum seekers in our study population criteria as they have a similar legal status. For the purpose of this review, we excluded migrants as they often have a different legal status and thus different resources compared with refugees and asylum seekers. Studies that included both refugees and migrants in their sample but did not differentiate their data between both groups were

TABLE 1 PICOS inclusion and exclusion criteria for screening studies on the food intake and nutritional status among refugees in host countries[1]

Parameter	Inclusion criteria	Exclusion criteria
Population	Refugees or asylum seekers[2] (any age or sex)	Migrants, immigrants, internally displaced persons, ethnic minorities
Intervention/ Exposure	Living in non-camp settings in host countries	Living in refugee camps
Comparison	N/A	N/A
Outcomes	Dietary intake, nutritional status	Dietary intake exclusively or nutritional status exclusively, or neither
Study design	Observational, intervention, and/or mixed-methods studies	Systematic reviews/meta-analyses, reports, theses, guidelines, etc.; studies published in languages other than English
Number of participants	More than or equal to 100 participants	Less than 100 participants

[1] N/A, not applicable; PICOS, Population, Intervention, Comparison, Outcomes, and Study.
[2] A refugee is someone who has fled war, violence, conflict, or persecution and has crossed an international border to find safety in another country (68). An asylum seeker is someone who has also fled their home country and calls on the protection of another country but whose request for sanctuary has yet to be processed (69). Refugee status is granted when an asylum seeker has been acknowledged as a refugee (70).

excluded, while studies that did differentiate their data between refugees and migrants were included, and only data on refugees were analyzed in this review. Similarly, due to the aforementioned differences in food environments, studies that included refugees both in camp and non-camp settings were included only if they differentiated their data between the 2 refugee groups. Studies that only recruited refugees in camp settings were excluded.

Information sources and search strategies

We searched PubMed and Web of Science databases for relevant literature published in English between 1 January 2009 and 30 November 2020. Specific terms and search strategies used are listed in **Table 2**. Using the PubMed and Google Scholar databases, we also conducted an extensive manual search wherein we screened some of the articles similar to and articles that cited the relevant full-text articles as well as the previously published similar systematic reviews. Further, we also searched the reference lists of all the final studies included in our review in addition to the references cited in similar systematic reviews. The overall manual search yielded hundreds of articles that were reviewed for eligibility, and a number of these articles were selected to move forward in the screening process.

Selection process

The title and abstract of each article identified were screened and selected for eligibility by 2 reviewers independently according to the inclusion and exclusion criteria. In this process, each reviewer was responsible for half of the studies. An additional manual search was conducted by one of the reviewers. Full texts of relevant articles were then screened separately for eligibility by the 2 reviewers. Here, both reviewers read all of the selected articles. Discrepancies between the reviewers over the eligibility of articles in both the text/abstract and full-text screenings were resolved through discussions with a third reviewer. Studies that met our selection criteria were included in the review.

Data collection process and data items

For each selected study, 1 reviewer extracted the relevant data and another reviewer confirmed the extracted data and reached a consensus with the research team. The standardized data extraction form using Microsoft Excel (Microsoft Corporation) included information on author, publication year, study design, intervention if applicable, sampling method, time of data collection, target population, country/region of origin, host country, sample size, sex, age, food security, acculturation, socioeconomic status (SES), dietary intake (food consumption by specific food group, dietary diversity, meal frequency, and intake by specific macronutrient and micronutrient), nutritional status [the prevalence of undernutrition (wasting, stunting, underweight), overnutrition (overweight [OW], obesity [OB], diet-related NCDs, and micronutrient malnutrition), implications, and insights for future interventions and research. Any data on reported associations between refugee dietary patterns and nutritional outcomes as well as factors associated with diet or nutritional status were also extracted.

Assessment of risk of bias

Two reviewers independently assessed the included studies for risk of bias prior to data analysis. The reviewers compared both assessments, and discrepancies were resolved by discussion and consensus with the research team. A modified version of the Newcastle-Ottawa Scale (NOS) quality-assessment tool was used for observational and cross-sectional studies (30, 31), while the Evidence Project risk-of-bias tool was used for both randomized and nonrandomized intervention studies as well as the cohort study (32). The modified NOS tool uses a star system, with a maximum of 10 stars, to evaluate a study in 3 domains: selection of participants, comparability of study groups, and ascertainment

TABLE 2 Database terms and search strategies for searching articles related to food intake and nutritional status among refugees in host countries[1]

Database	Search strategy
PubMed	(("Refugees"[MeSH]) OR (refuge*)) AND (("Nutritional Status"[MeSH]) OR (nutrition*)) AND (("Diet"[MeSH]) OR ("Food"[MeSH]) OR ("Food Supply"[MeSH]) OR (food*) OR (diet*))
Web of Science	Refugee AND (food OR diet OR nutrition)

[1] MeSH, medical subject heading.

of outcomes and exposures of interest. Studies that receive a score of 9 or 10 stars are judged to be at low risk of bias; a score of 7 or 8 indicates medium risk; and a score of 6 or less indicates a high risk of bias (**Supplemental Tables 1** and **2**).

The Evidence Project tool includes 3 domains (study design, participant representativeness, equivalence of comparison groups) composed of 8 items, each of which is rated as being present (yes) or not present (no) and, for some items, not applicable (NA) or not reported (NR). We also assessed whether each study adjusted for confounding variables.

Results

Study selection

The initial search yielded 535 articles (**Figure 1**). Out of the hundreds of articles reviewed from our manual search process, we identified 78 potentially relevant articles that were included in the initial search. In the title/abstract screening, 502 articles were excluded, and the full texts of 48 articles were screened. From these full-text articles, 33 articles were excluded. A total of 15 articles met the inclusion criteria and were included in this review.

Main characteristics of the studies

Distribution of refugee countries of origin and host countries.

The included studies that comprised refugees were originating mostly from low-income and lower-middle-income countries. Five studies had refugee participants from low-income countries [Somalia (33), Syria (34), North Korea (35, 36), Eritrea and Sudan (37)], 4 studies were from lower-middle-income countries [Bhutan (38), Cambodia (39), Palestine (40, 41)], and 2 studies were from upper-middle-income countries [Colombia (42), Iraq (43)] (**Table 3**). The remaining 4 studies described refugees' origin by region rather than specific countries (44–47). These studies had refugees originating from the Middle East, Asia, Africa, and Latin America.

The included studies were conducted in a total of 10 host countries. Refugee study participants migrated to and resided mostly in high-income (66.7%) and upper-middle-income (33.3%) host countries. Ten studies targeted refugees residing in high-income countries [United States (33, 38, 39), Australia (44), Canada (45–47), South Korea (35, 36), Israel (37)] and 4 studies in upper-middle-income countries [Lebanon (34, 41, 43), Ecuador (42)]. One study had refugee participants residing in multiple countries (40): Syria (low-income), Gaza and the West Bank (lower-middle-income), and Jordan and Lebanon (upper-middle-income).

Study design and research methods.

All of the included studies utilized a quantitative design, while 4 studies applied a mixed-methods design wherein they administered both quantitative surveys and qualitative interviews. The included studies consisted of 11 cross-sectional studies, 3 intervention studies, and 1 cohort study (Table 3). Of the 3 intervention studies, 2 applied a quasi-experimental design (34, 41) and one was a microsimulation-based intervention (40). Four studies applied probability sampling strategy (34, 39, 41, 42); 8 studies applied a non-probability sampling strategy (33, 35, 37, 38, 44–47); 2 studies used a mix of probability and non-probability sampling methods (36, 43); and 1 study used simulated participants (40). Eleven studies had a sample size of several hundred (range of 104 to 556); 3 studies had a sample size over 1000 (range of 1131 to 2795); and 1 study had a sample size that was in the millions. The earliest study publication year was 2010, and most studies (66.7%) were published within the last 3 y (2018–2020).

Participant characteristics.

Most of the studies included both males and females, except for 3 studies that only included women (Table 3). Among the studies with both males and females, 7 studies only included children, 3 studies included adults and children, and 2 studies only included adults. Three studies included both immigrants and refugees and 1 study only included asylum seekers. With regard to the 3 studies that included immigrants, we only evaluated data from their refugee sample, and these studies passed our criteria as they differentiated their data between immigrant and refugee participants. Ten studies reported the SES of study participants and 9 studies reported participants' acculturation levels. The specific SES measures that were reported varied across the studies, but they mostly consisted of educational level, financial/nutrition assistance, employment, and income measures (Table 3). Even with the variation in how SES was reported across studies, it was clear that the majority of study participants were highly disadvantaged and resource-limited. Acculturation measures also varied across the studies but were reported through either host country language proficiency, length of residency in the host country, and/or standardized acculturation scores (Table 3). The acculturation to the host country among most study participants was notably low.

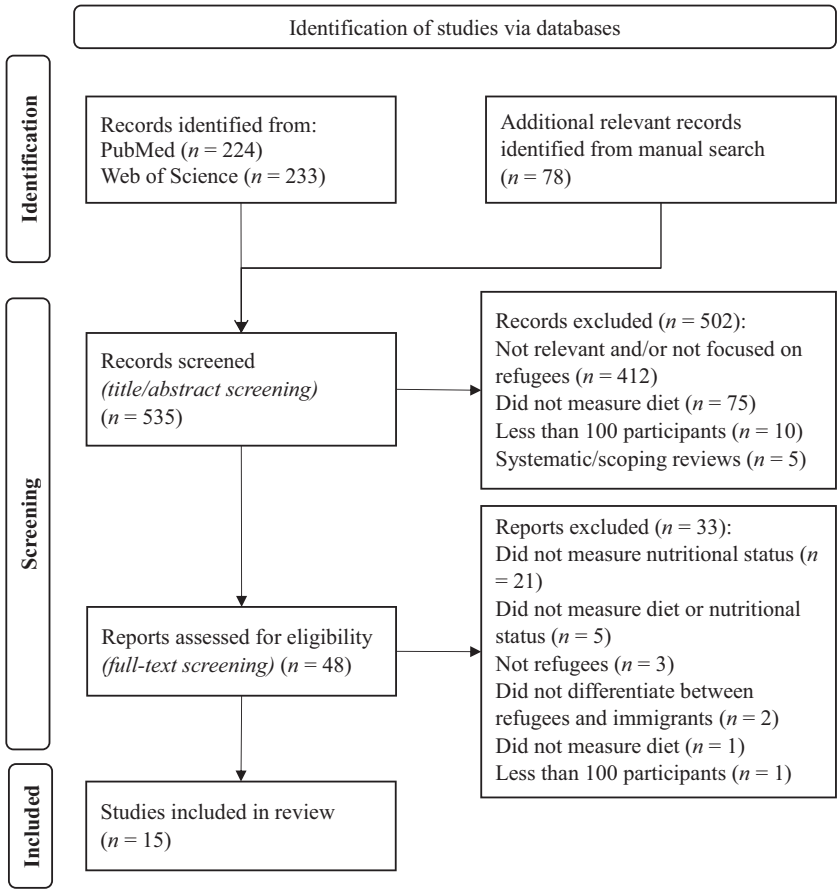

FIGURE 1 PRISMA flowchart of study screening and selection process. PRISMA, Preferred Reporting Items for Systematic Reviews and Meta-Analyses.

Main study measures and variables.

All studies measured dietary intake and nutritional status with a combination of different specific variables reported, and seven studies (46.7%) reported the association between dietary intake and nutritional status (**Table 4**). Nine studies (60%) reported food security status of the study participants.

Risk of bias in studies.

Of the 15 studies, 13 studies (86.7%) were rated as low or medium risk of bias and 2 studies (13.3%) were rated as high risk of bias (37, 46) (Supplemental Tables 1 and 2). The study that applied microsimulation methodology did not fit the evaluation criteria of the Evidence Project risk-of-bias tool; however, based on the robust study design and novel approach, we assessed this study as having a low risk of bias.

Main findings of refugee dietary intake and nutritional status

Dietary intake—food consumption by specific food group, dietary diversity, and meal frequency.

Table 5 summarizes the main findings of the selected studies. Overall, dietary intake by specific food groups varied across studies and between children and adults; nevertheless, insufficient food intake and poor dietary diversity were common among refugees (Table 5). Compared with a South Korean control (SKC) sample, North Korean refugees (NKRs) residing in South Korea reported a higher prevalence of deficient dietary intake (36). In a study of Iraqi refugees in Lebanon, the average household dietary diversity score (HDDS) was relatively low (6.2 vs. a target of 8.9 on a 12-item scale), indicating low fruit and meat consumption with a high reliance on cereals and fats, all of which had implications for micronutrient and protein intakes (43). In another study of refugee children living in Australia, one-third of children older than 6 mo (33%) did not consume any meat and the overall prevalence of inadequate dairy intake was 41%. In addition, the prevalence of inadequate dairy intake in refugee children 12 y and older in Australia was more than 2-fold of the overall dairy inadequacy (85%) (44). Similarly, refugee children in a Canadian study had lower intakes of meat and alternatives, milk and alternatives, and whole grains compared with immigrant children ($P < 0.05$) (46). Refugee children in Canada also reported not often having had access to milk before resettlement, and this influenced their milk consumption habits after resettlement (47).

TABLE 3 Main characteristics of refugees in host countries from the selected studies[1]

Study, year (ref)	Study design	Sampling method	Time of data collection	Target population	Origin	Host country	Sample size	Age, y	SES	Time lived in or acculturation to host country
Dharod et al., 2013 (33)	Cross-sectional	Snowball	2006–2007	Refugee women	Somalia	United States	195	33.6 ± 8.26[2]	No formal schooling: 49%; monthly household income: $947.39 ± $480.4; SNAP: 92%; WIC: 75%	Fair/poor/very poor English proficiency: 72%; only Somali (and/or Arabic) language spoken at home: 58%
El Harake et al., 2018 (34)	Intervention	Random	2015–2016; 2016–2017	Refugee children (M, F)	Syria	Lebanon	183	11.04 ± 0.23	Intermediate-level education: 1/3 mothers, <50% fathers; unemployment: 94.4% mothers, 43.1% fathers; <$200 mo income: 62.7% households	N/A
Newman et al., 2019 (44)	Cross-sectional	Purposive	2010-2015	Refugee children	Southeast Asia, Africa, South Asia, Middle East	Australia	1131	2 mo–17.8 y	Decile 1–5[3]: 77.4%; 44.7% lived in decile 2	Poor/minimal/no English literacy of carers: 86.7%
Lane et al., 2018 (45)	Mixed-methods	Purposive	2011	Immigrant and refugee children (M, F)	Middle East, Asia, Africa, Latin America	Canada	166	3–13 y	Neither parent has high school diploma: 80%; lowest income category: 41.4%; income below low-income cutoff: 77.1%	Length of residence (y): 2.6 ± 1.5
Peterman et al., 2010 (39)	Mixed-methods	Random	2010	Refugee women	Cambodia	United States	133	35–60 y (48.2 ± 7.2)	Less than high school education: 82%; 1 y of school or less: 27%	Length of residence (y): 18.8 ± 7.5; acculturation score[3]: 2.0 ± 0.6
Villena-Esponera et al., 2019 (42)	Cross-sectional	Stratified random sampling	2014	Refugee adults and children (M, F)	Colombia	Ecuador	104	19.58 ± 17.68; child age: 8.0 ± 4.0	Unemployment: 50% of people > 14 y; poverty: 56%; extreme poverty: 40%; households do	N/A

(*Continued*)

TABLE 3 (*Continued*)

Study, year (ref)	Study design	Sampling method	Time of data collection	Target population	Origin	Host country	Sample size	Age, y	SES	Time lived in or acculturation to host country
									not have toilets and refrigerators: 75%	
Ghattas et al., 2014 (43)	Cross-sectional	Multistage cluster random sampling, snowball sampling	2012	Refugee households (M, F)	Iraq	Lebanon	630 households; 2321 household members	27.6 (95% CI: 26.8, 28.3)	N/A	N/A
Jeong et al., 2017 (35)	Cohort	Snowball, convenience	2008, 2012, 2013, 2015	Refugee adults (M, F)	North Korea	South Korea	149	37.8 ± 13.0	Secondary-level education or less: 51.0%; 76.4% earned ≤ 1,990,000 South Korean won per month	Length of residence in the third nation (mo): 49.1 ± 42.5; length of residence in South Korea (mo): 84.6 ± 51.0
Basu et al., 2018 (40)	Individual-level microsimulation	Simulation	2011–2017	Refugee households (M, F)	Palestine	Syria, Jordan, Lebanon, Gaza, and the West Bank	Demographic data: 5,340,443; food-consumption data: 2554 households[4]; health data: 516,386	32.5 (IQR: 15.6–43.2)	N/A	N/A
Lane et al., 2019 (46)	Mixed-methods	Purposive	2010–2015	Immigrant and refugee children (M, F)	Middle East	Canada	166	7.8 ± 2.7; range: 3–13 y	N/A	Length of residence <5 y: 2.6 ± 1.5
Koren et al., 2019 (37)	Cross-sectional	Purposive	2018	Asylum-seeking children (M, F)	Eritrea and Sudan	Israel	386	9 mo–12 y (2.96 ± 2.77)	N/A	N/A
Kim et al., 2020 (36)	Cross-sectional	Snowball (NKR), random (SKR)	2012–2015	Refugee adults (M, F)	North Korea	South Korea	NKR: 139; SKR: 417	NKR: M: 52.4 ± 12.2, F: 47.7 ± 11.9; SKR: M: 52.4 ± 12.1, F: 47.7 ± 11.9	NKR household monthly incomes of <$1000/mo: 39.1% (M), 41.7% (F); NKR middle/high school education or less: 48% (M), 62.2% (F)	NKR length of residence: 7.8 ± 2.8 y (M) and 6.9 ± 4.6 y (F)

(*Continued*)

TABLE 3 (*Continued*)

Study, year (ref)	Study design	Sampling method	Time of data collection	Target population	Origin	Host country	Sample size	Age, y	SES	Time lived in or acculturation to host country
Lane et al., 2019 (46, 47)	Mixed-methods	Purposive	N/A	Immigrant and refugee children (M, F)	Middle East	Canada	166	3–13 y (7.8 ± 2.7)	N/A	Length of residence: 2.6 ± 1.5 y
Jamaluddine et al., 2020 (41)	Intervention	Random	2014–2015	Refugee children (M, F)	Palestine	Lebanon	Baseline: 1433; post-intervention: 1362	5– 15 y (8.92 ± 0.08)	54.1% children had mothers/ caretakers illiterate/completed primary education; monthly expenditure per capita: $191.8 ± 4.36; 15.7% receive financial assistance	N/A
Bhatta et al., 2014 (38)	Cross-sectional	Convenience	2011	Refugee women	Bhutan	United States	108	36.5 ± 12.2 y; range: 18–65 y	No formal education: 54%; employed: 21%	Length of residence (mo): 19.4 ± 11.9; 55.6% not able to read English

[1] N/A, not applicable; NKR, North Korean refugees; ref, reference; SES, socioeconomic status; SKR, South Korean refugees; SNAP, Supplemental Nutrition Assistance Program; WIC, Special Supplemental Nutrition Program for Women, Infants, and Children.
[2] Mean ± SD (all such values).
[3] Acculturation score on 1- to 5-point Psychological Acculturation Scale; score of 2 indicates high identification with Cambodian culture and low identification with American culture.
[4] World Food Program food-consumption data include 1507 households receiving traditional food parcel delivery of food aid and 1047 households receiving electronic debit card delivery of food aid (2011–2017).

TABLE 4 Main dietary intake and nutrition-related measures among refugees in host countries from the selected studies[1]

Measure	Specific variable	Association with related factors
Dietary intake	Food consumption by specific food group (e.g., grains, cereals, meat, dairy, fruits, vegetables, beverages, sweets, etc.), dietary diversity, and meal frequency (33, 35, 36, 38–41, 43, 44, 46, 47)	Association with food security (33, 39, 43)
	Intake by specific macronutrient (e.g., energy, fiber, fat, protein, saturated fat, lipid, carbohydrate) and/or micronutrient (e.g., zinc, calcium, magnesium, phosphorus, iron, potassium, sodium, niacin, folate, riboflavin, and vitamins A, B-12, C, D, E, and K) (34–37, 40–42, 46, 47)	N/A
	Dietary knowledge/attitude (34)	N/A
Nutritional status	Undernutrition (34, 38, 39, 41, 42, 44, 45)	N/A
	Overnutrition (33, 35, 38–45)	Association with food security (33, 35, 39, 43)
		Association with SES (38, 44, 45) and acculturation (38)
	Micronutrient-related malnutrition (36, 37, 41–44, 46, 47)	N/A
Association between dietary intake and nutritional status	Food intake and overnutrition (33, 38, 40)	
	Nutrient intake and overnutrition (35, 45)	
	Diet quality and overnutrition (45)	
	Diet diversity and micronutrient-related malnutrition (41)	
	Breastfeeding and micronutrient-related malnutrition (44)	

[1] N/A, not applicable; NKR, North Korean refugees; SES, socioeconomic status.

On the other hand, the intake of dairy, meat, and sweetened beverages was common among some refugees. Among Somalian refugee women in the United States, 89% consumed dairy and 87% consumed meat at least once a day (33). Among Cambodian refugee women in the United States, 43% consumed meat with fat, and almost 94% did not consume whole grains (39). Furthermore, among Bhutanese refugee women in the United States, only 20% reported being a vegetarian, while 90%, 80%, and 67% reported consuming dairy, meat, and sweetened beverages, respectively (38). Among NKRs residing in South Korea, the consumption frequency of milk and dairy products was 2.3 times/d compared with local Koreans, and that of cereals and vegetables each was 3 times/d (35).

Dietary intake—intake by specific macronutrients and micronutrients.

Certain macronutrient and micronutrient intakes were mostly insufficient and paralleled the intake of specific food groups. In terms of intake of energy, fiber, fat, protein, saturated fat, lipid, and carbohydrate, 4 studies reported low consumption of these categories, with a few exceptions and variations by gender and age across studies (35, 36, 42, 46). Refugee children consumed less in total energy, energy from fat and saturated fat, fiber, and protein compared with immigrant children in Canada ($P < 0.05$) (46). In South Korea, NKRs reported lower energy intake than SKCs ($P < 0.05$), with the exception of fat intake (36). Eighty-five percent of NKRs reported consuming less energy than required, and 40% reported consuming less protein than recommended (35). Among Colombian refugees in Ecuador, the percentage of DRIs for energy, lipid, carbohydrates, and fiber were higher in women than in men ($P < 0.001$) (42). Most age groups in this sample reached or exceeded the DRI for protein and carbohydrates, while no age group met the DRI for fiber. The intake of lipid varied based on gender and age; excess intake was reported in 40–50-y and >60-y age groups as well as in women aged 14–19 y and 50–70 y, while children and men had low or sufficient intake (42).

All 6 studies that investigated intake of micronutrients (e.g., zinc, calcium, magnesium, phosphorus, iron, potassium, sodium, riboflavin, niacin, folate, and vitamins A, B-12, C, D, E, and K) reported insufficient micronutrient consumption among refugees, with the exception of sodium intake, which was in excess (35–37, 42, 46, 47). As an example, more than half of the refugees in the cohort study consumed less riboflavin (54.4%), niacin (54.4%), and vitamin C (59.7%) than recommended (35). In particular, both refugee adults and children consumed less iron (35–37, 42, 46) and calcium (35, 36, 42, 46), with calcium intake predicting the total body bone mineral content levels of refugee children in 1 study (47). Compared with immigrant children, refugee children consumed significantly less vitamin B-12, folate, vitamin D, iron, calcium, and zinc ($P < 0.05$) (46). Additionally, some studies reported a very high intake of sodium among refugee adults, children, and men older than 50 y (35, 42, 46).

Nutritional status—double burden of malnutrition.

Across and within the selected studies, a double burden of malnutrition, both under- and overnutrition, was reported; in 1 study, this double burden was observed among mothers with OW and OB while children exhibited stunting within the same households among Colombian refugees in Ecuador

TABLE 5 Main findings of the selected observational studies regarding dietary intake and nutritional status among refugees in host countries[1]

Study, year (ref)	Food security	Dietary intake	Nutritional status
Dharod et al., 2013 (33)	Food insecure: 67%	Intake of grains, meat, and dairy very common; 89% eat dairy and 87% eat meat at least once a day	Normal BMI score (kg/m^2; 18–24.9): 35%; OW BMI score (25–29.9): 41%; OB BMI score ≥30: 24%
Newman et al., 2019 (44)	N/A	Inadequate dairy intake: 41.0%, 293/714; inadequate dairy intake in children ≥12 y: 85.2%; 1/3 of children did not consume meat; infant breastfeeding sustained in infants <12 mo: 77.8%	Iron deficiency: 12.3%; anemia: 7.3%; vitamin D deficiency: 50.3%; stunting in <24-mo-old cohort: 22.1%; underweight children (=24 mo): 11.8%; OW: 9.1%; OB: 5.8%
Lane et al., 2018 (45)	N/A	Refugee children and those with higher saturated-fat intakes at risk of unhealthy cholesterol concentrations	Stunted growth: 23%, ≤5th percentile and were shorter than immigrants: 4.6% ($P < 0.05$); high blood cholesterol: 60%; borderline high cholesterol (≥4.4 mmol/L): 32%; high (≥5.2 mmol/L): 28%; percentile BMI: 58.5 ± 29.3; OW: 11.5%; OB: 8.5% (WHO criteria); weight categories of 5–13 y in American anthropometric standards: OB ≥95th centile: 21.9%; overfat; ≥85th centile: 29.2%; waist circumference of 11–13 y in Canadian standards <90th percentile: 80% compared to 45.5% among immigrants ($P < 0.05$)
Peterman et al., 2010 (39)	Participants experienced severe past food deprivation and insecurity; the food deprivation measure had a high correlation with number of strategies employed to avoid starvation ($P < 0.01$)	93.6% did not consume whole grains; 43.2% consumed meat with fat; 77.5% ate inferior foods; 44.2% ate nonfoods as food-coping strategies	At least 1 sign of malnutrition: 26.9%; had weight loss as a sign of malnutrition: 21.6%; BMI: 25.9 ± 4.0; OW or OB (WHO standards), BMI ≥23: 72.1%; OW or OB (CDC standards), OB (WHO standards), BMI ≥25: 56.9%
Villena-Esponera et al., 2019 (42)	Food insecure: 100%; severely food insecure: 81%	Differences by gender for intake of energy, lipid, carbohydrate, fiber, and iron ($P < 0.001$); in all cases, except iron, the % DRI higher in women than in men; most age groups reach/exceed the DRI in protein and carbohydrates; older groups tend to increase carbohydrate intake and reduce protein intake; lipid intake exceeds DRI in 40–60-y and >60-y groups; excess lipid intake above DRI in 14–19-y and 50–70-y women; low or sufficient lipid intake in children and men; no age group met the DRI for intake of fiber, calcium, potassium, and iron; high sodium intake in all age groups	Children and adolescents: were underweight (z ←−2 SDs): 15.7%, stunted: 45.1%, 35.3% stunting [−2 SDs <z score < −3 SDs, 9.8% severely stunted (z score < −3 SDs)]; women had higher rates of OW/OB (60% in women vs. 26% in men) Entire sample: underweight: 41.3%; overweight: 19.2%; obese: 4.8%; deficiencies in vitamins A, D, folate, and thiamin, with global intakes of 30%, 38%, 58%, and 66%, respectively; vitamin C and B-12 deficiencies in adults >60 y; iron deficiency in all age groups except for 30–39-y-old males
Ghattas et al., 2014 (43)	Food insecurity: 80%; moderate food insecurity: 35.5% (95% CI: 32.0, 39.2%); severe food insecurity: 44.4% (95% CI: 40.8, 48.1%)	Low household dietary diversity: low (6.2% vs. a target of 8.9%), translating into low fruit and meat consumption and high reliance on cereals and fats	Anemic: 41% of children <5 y, 59.3% of 6–24 mo old, 30.8% of children >2 y of age ($P = 0.0146$); diabetes: 6.7% of adult refugees (>18 y of age), hypercholesterolemia: 2.5%, hypertension: 9.8%, chronic IHD: 2%

(*Continued*)

TABLE 5 (*Continued*)

Study, year (ref)	Food security	Dietary intake	Nutritional status
Jeong et al., 2017 (35)	Food insecure: 76.9%; severely food insecure: 59.2%; food security status improved from 12.1% in North Korea to 61.7% in South Korea	In the 3 groups of participants (body-weight loss, body-weight maintenance, body-weight gain), breakfast was most often skipped meal (35.8%); body-weight-loss group showed most irregular meal consumption pattern ($P < 0.05$), and eating out was infrequent in all 3 groups; good quality with values >1, with the exception of calcium; consumed functional foods: 41.9%; consumed vitamin and mineral supplements: 39.5%; body-weight-loss group (75.8%) consumed less than recommended amount of riboflavin ($P < 0.05$); highest consumption of fish in body-weight-gain group ($p < 0.05$); cereals and vegetables were only food groups consumed >3 times daily; consumption frequency of hamburgers, pizza, and fried foods was the lowest; consumption frequency of milk and dairy; 85.2% had less energy intake than required; 40.3% had less protein intake; 75.8% consumed less calcium; 54.4% consumed less riboflavin and niacin; 59.7% consumed less vitamin C; 71.8% consumed more sodium; 16.8% had insufficient consumption of energy, calcium, iron, vitamin A, vitamin C, and riboflavin; 12.8% had excess consumption of energy and fat than recommended	39.6% maintained their body weight between first and second examinations, whereas 38.3% gained and 22.1% lost at least 3% of their body weight; body weight increased during relocation by an average of 4 kg; subjects' body weights consistently increased after leaving North Korea (52.1 ± 8.0 kg) until entering South Korea (54.3 ± 9.0 kg); by the first examination, body weight increased up to 55.7 ± 8.9 kg by the second examination; 59.7% had weight gain since relocating to South Korea, whereas 20.8% had weight loss; OB increased from first examination (20.1%) to second examination (26.2%)
Lane et al., 2019 (46)	N/A	Refugees had lower intakes of meat and alternatives, milk and alternatives, and whole grains; less likely to consume sufficient servings from meat and alternatives and whole grains ($P < 0.05$); 16% consumed sufficient servings of milk and alternatives. Refugees consumed less in macro- and micro-nutrients all categories, including total energy, energy from fat and saturated fat, and protein ($P < 0.05$); refugees consumed less vitamin B-12, folate, calcium, vitamin D, iron, and zinc ($P < 0.05$); consumed too much sodium, above the upper limit	Higher levels of micronutrient inadequacies, which included a higher risk of having an inadequacy of folate (37%) and iron (18%) compared with immigrant children; refugee children at high risk of inadequacy in vitamin D (93%), calcium (80%), and zinc (31%); fiber and vitamin B-12 inadequacy: 99% and 12% of 153 refugee children, respectively
Koren et al., 2019 (37)	N/A	42.3% of children did not receive the recommended daily iron intake for their age; daily nutritional iron intake: 8.4 ± 0.47 mg	131 children (34%) were anemic and had hemoglobin concentrations <11 g/dL, 4-fold more prevalent than among Jewish Israeli children of the same age group (OR: 4.15; 95% CI: 2.67, 6.43; $P < 0.0001$); hemoglobin concentrations: 10.88 ± 1.47 g/dL

(*Continued*)

TABLE 5 (*Continued*)

Study, year (ref)	Food security	Dietary intake	Nutritional status
Kim et al., 2020 (36)	Food security of NKR improved on moving to transient countries and to South Korea for men and women, but remained significantly poorer for NKR women than SKC women ($P < 0.001$)	Meal skipping was 3 times more frequent than for SKC; breakfast skipping was more frequent among NKR men (44.0%) and women (33.6%) than among SKC men (8.0%) and women (11.4%) ($P < 0.001$); dinner skipping was more frequent among NKR women (12.3%) than SKC women (5.3%) ($P = 0.011$); eating-out was less frequent among NKR than among SKC ($P < 0.001$); NKR reported less intake of energy and most nutrients than SKC ($P < 0.05$), except for fat and vitamin A intake for both men and women and vitamin C and thiamin intake for women; average energy intake was 1509 kcal/d for NKR men and 1344 kcal/d for NKR women, which was lower than SKC; deficient dietary intake more prevalent among NKR men ($P = 0.003$) and women ($P = 0.005$)	More NKR showed simultaneous deficiencies in energy, calcium, iron, vitamin A, and riboflavin than SKC [men: 2.7% ($P = 0.003$); women: 7.0% ($P < 0.001$)]
Lane et al., 2019 (47)	Significantly more refugees (38.9%) were moderately and severely food insecure than immigrants (22.8%) ($P < 0.05$)	Children with higher intakes of vitamin D had higher serum vitamin D concentrations (β: 0.976 $\pm$ 0.40; $P = 0.01$); calcium intake predicted total body bone mineral content levels ($P < 0.01$); refugees did not commonly have access to milk pre-migration, influencing development of milk consumption habits after resettlement	Refugee children (72.3%) had insufficient (<50 nmol/L) or deficient (<30 nmol/L) serum vitamin D than immigrants (53.2%) ($P < 0.05$); children from the Middle East, Asia, and Africa at higher risk for insufficient serum vitamin D compared with other regions ($P < 0.05$); vitamin D deficiency most common among girls; the highest proportion with deficient vitamin D status observed among females from the Middle East (33.3%), followed by females from Asia (31.0%) and females from Africa (27.3%); refugees had significantly lower mean total body bone mineral content than immigrants ($P < 0.05$); total body fat, serum vitamin D, height, height by calcium intake, total body fat by calcium intake, and total body fat by height predicted total body bone mineral content levels ($P < 0.01$)
Bhatta et al., 2014 (38)	N/A	20.4% reported being vegetarian; 89.8%, 66.8%, and 79.6% reported consuming dairy products, sweetened beverages, and meat, respectively	Excess body weight (BMI $\geq$23.0): 64.8%; abdominal obesity (waist circumference >80 cm): 69.4%; underweight (BMI >18.5): 6%; normal weight (18.5 to <23.0): 28.7%; BMI: 25.2 $\pm$ 4.6 (range: 15.8–40.2)

[1] IHD, ischemic heart disease; N/A, not applicable; NKR, North Korean refugees; OB, obesity; OW, overweight; ref, reference; SKC, South Korea control(s).

(42). In terms of overall malnutrition, approximately 30% of Cambodian refugee women in the United States had at least 1 sign of malnutrition, with almost 22% reporting weight loss as a sign of malnutrition (39).

Nutritional status—undernutrition.

Among refugee children, the prevalence of stunting was between 22% and 45% (42, 44, 45), with approximately 10% of children and adolescents being severely stunted (z score

< −3 SDs) in 1 study (42). It is worth noting that, when compared with immigrant children in Canada, more refugee children (23%) had stunted growth (≤5th percentile) and were shorter than immigrants (4.6%; $P < 0.05$), indicating that refugee children in particular are at a greater risk of lower percentile height (45). Furthermore, the prevalence of underweight was reported as between 12% and 41% in refugee children (42, 44). Only 2 studies assessed the prevalence of wasting (low weight-for-height) and found no children were identified with wasting (42, 44). One study assessed undernutrition in adult refugees, reporting that 6% of the refugee women included in the study were underweight [BMI (kg/m^2) <18.5] (38).

Nutritional status—overnutrition.

The prevalence of OW and OB based on BMI was the most common measure within the overnutrition category (33, 35, 39, 41, 42, 44, 45). In addition to OW/OB prevalence, studies also assessed hypercholesterolemia, hypertension, heart disease, and diabetes (43, 45). The prevalence of OW and OB varied across studies by gender and age; the overall percentage of OW was between 9.1% and 65% (33, 38, 41, 42, 44, 45) and the percentage of OB was between 5.8% and 69% (33, 35, 38, 39, 41, 42, 44, 45). It is worth noting that the highest prevalence of OW/OB among refugees was found in the United States. The percentage of OW (BMI: 25–29.9) among Somalian refugee women in 1 US study was 41% (33), whereas the percentage of OW or OB (CDC standards; BMI ≥25) and percentage of OB (WHO standards; BMI ≥25) among Cambodian refugee women in another US study was approximately 57% (39). In the latter sample, the percentage of OW or OB (WHO standards; BMI ≥23) was approximately 72%. Similarly, 65% and 69% of Bhutanese refugee women in the United States had excess body weight (BMI ≥23.0) and abdominal OB (waist circumference >80 cm), respectively (38). These findings correlated with the high intake of dairy, meat, and sweetened beverages among these refugee groups in the United States.

A limited number of studies evaluated diet-related noncommunicable conditions among refugees, such as hypercholesterolemia, hypertension, heart disease, and diabetes. In a sample of refugee children, 60% had hypercholesterolemia (45). Among adult refugees (>18 y of age), the prevalence of hypercholesterolemia was 2.5%, hypertension was 9.8%, chronic ischemic heart disease was 2%, and diabetes was 6.7% (43).

Nutritional status—micronutrient malnutrition.

Significant deficiencies in various micronutrients, such as thiamin, folate, riboflavin, zinc, calcium, iron, and vitamins A, B-12, C, and D, were apparent among refugees in Australia (44), Ecuador (42), Lebanon (43), Canada (46, 47), Israel (37), and South Korea (36). A higher prevalence of micronutrient malnutrition was observed in refugees compared with immigrant children (46, 47) and local citizens (36, 37). Out of all the micronutrients assessed, the most common deficiencies across the studies were those of iron and vitamin D, in addition to the prevalence of anemia, especially in children (36, 37, 41–44, 46, 47). In particular, hemoglobin concentrations and anemia prevalence among children seem to be alarming as anemia was found in 41% and 59% of refugee children less than 5 y old and 6–24 mo old in Lebanon, respectively (43). Among asylum-seeking children in Israel, 34% were anemic and had hemoglobin concentrations below 11 g/dL, 4-fold more prevalent than reported among local Israeli children of the same age group (OR: 4.15; 95% CI: 2.67, 6.43; $P < 0.005$) (37).

Association between dietary intake and nutritional status.

Although all included studies reported the dietary intake and nutritional status of refugees, most studies did not specifically analyze the association between the 2 measures. Among the 7 studies that did, we summarize these findings in **Table 6**. Three studies assessed the intake of food groups with overnutrition (i.e., OW/OB, BMI, blood pressure, hypertension, cholesterol, type 2 diabetes, cardiovascular disease); 2 studies assessed micro- and macronutrient intake with overnutrition (i.e., body weight, cholesterol); 1 study assessed diet quality with BMI percentile; and 1 study assessed the association between diet diversity and hemoglobin concentrations. None of the included studies assessed the relation between dietary intake and undernutrition (i.e., stunting, wasting, and underweight).

A healthy food intake (i.e., more fruits, vegetables, and beans; fewer grains, etc.) was associated with normal weight (33) as well as a decrease in BMI, blood pressure, hypertension, cholesterol, type 2 diabetes, and cardiovascular disease (40). Consumption of meat was associated with excess body weight (38). An insufficient intake of riboflavin and calcium was associated with body-weight changes (35), and a higher saturated fat intake was associated with a greater risk of unhealthy cholesterol concentrations (45). Poor diet quality was associated with a greater risk of a higher BMI percentile and OW/OB in refugee children (45), while an increase in diet diversity was associated with greater improvement in hemoglobin concentrations (41).

Factors that may affect refugee dietary intake and nutritional status.

In addition to evaluating dietary intake and nutritional status of refugees, several studies also evaluated certain risk factors of these 2 measures, such as food security, acculturation, and SES (**Table 7**). More than half of the included studies reported refugees' food security status. The prevalence of food insecurity among refugees was between 39% and 100% (33–36, 39, 41–43, 47), with most studies reporting that more than 65% of their refugee participants experienced some level of food insecurity. Furthermore, the prevalence of severe food insecurity among refugees was between 44% and 81% (34, 35, 39, 41–43, 47). It is worth noting that, for NKRs, food security status (i.e., food consumption) improved on moving from North Korea to South Korea (35, 36), but more refugees were food insecure than immigrants in Canada ($P < 0.05$) (47). Some studies also evaluated the association

TABLE 6 Associations between dietary intake and nutritional status among refugees in host countries from the selected studies[1]

Measure of association	Specific variable association
Food intake and overnutrition	Intake of beans, fruits, starchy vegetables, green and other vegetables at least once a day less common among OW/OB participants than in normal-weight individuals ($P < 0.05$) (33)
	Shift to alternative food parcel with less grain and more fruits and vegetables was estimated to produce (40): 0.57 kg/m^2 decrease in BMI; 0.12 mmHg decrease in systolic blood pressure; 0.05 mmHg decrease in diastolic blood pressure; 0.004 mmol/L decrease in total cholesterol; 0.03 mmol/L decrease in HDL cholesterol; 0.08 per 1000 person-years decrease in incidence of hypertension; 0.18 per 1000 person-years decrease in incidence of type 2 diabetes; 0.18 per 1000 person-years decrease in the incidence of atherosclerotic cardiovascular disease events
	Consuming meat associated with excess body weight but not abdominal obesity (4.01; 1.14–14.60; $P < 0.05$) (38)
Nutrient intake and overnutrition	Those who lost 3% or more of their body weight (body-weight-loss group) were 5 times (OR: 5.00; 95% CI: 1.51, 16.52) more likely to consume an insufficient amount of riboflavin than those who maintained their body weight (body-weight-maintenance group) (35)
	Both body-weight-loss and body-weight-gain groups were 4 (OR: 4.04; 95% CI: 1.02, 16.00) and 6 (OR: 6.03; 95% CI: 1.71, 21.27) times more likely to consume an insufficient amount of calcium than the body-weight-maintenance group, respectively (35)
	Those with higher saturated-fat intakes at risk of unhealthy cholesterol concentrations (45)
Diet quality and overnutrition	Poor diet quality is associated with a risk of higher percentile BMI (OR: 0.94; 95% CI: 0.90, 0.99; $P = 0.020$) in refugee children (45)
Diet diversity and micronutrient-related malnutrition	Increase in diet diversity paralleled a significantly greater change in hemoglobin ($\beta = +3.44$ g/L; 95% CI: 0.03, 6.85; $P = 0.049$) compared with control group (41)

[1] OW/OB, overweight and obesity.

between food security with diet (33, 39, 43), nutritional status (33, 35, 39, 43), SES (43), and acculturation (33, 43); the association between SES and nutritional status (38, 44, 45); and the association between acculturation and nutritional status (38).

Among food-insecure refugee households, lower diet diversity (43) and a lower intake of fruits and vegetables (33, 43) were observed; however, the intake of meat and fat varied across studies. Two US studies found that the intake of meat and high-fat meat was higher among refugees who are food insecure and with higher past food deprivation, respectively (33, 39). On the other hand, the intake of fats, meat, and sweets was reduced among food-insecure refugees in Lebanon (43). Food-insecure refugees were more likely to have a chronic disease, such as hypertension (43), OW/OB (33, 39), and an imbalance in body weight (e.g., abnormal body weight loss) (35). The 2 studies that assessed food insecurity and acculturation reported contrary findings in terms of length of stay in host countries. One US study found that food insecurity was common among recent arrivals and those who did not speak English (33), while another study found that severely food-insecure refugee households were living in Lebanon for a longer period than food-secure and moderately food-insecure households, although monthly remittances counteracted these effects (43).

Findings from intervention studies

Findings of the interventions are summarized in **Table 8**. The 3 intervention studies comprised the following: classroom-based educational sessions and provision of locally prepared healthy snacks (34); debit card restricted to food purchases, cash, or alternative food parcel (40); and subsidized school snack and nutrition education program (41). Two interventions targeted refugee children, and 1 intervention targeted refugee households. A few of the intervention findings across the 3 studies varied; for example, 1 intervention reported an increased intake of potassium (34) while another reported a decreased potassium intake (40). Similarly, 1 intervention reported an increase in BMI-for-age z score (BAZ) (34), whereas another found no significant changes in BAZ (41). Nevertheless, these interventions generally resulted in increased healthy dietary patterns and diversity as well as improved nutritional status among refugees, such as the decreased likelihood of chronic conditions.

Discussion

This study summarizes and analyzes dietary intake and nutritional status of refugee adults and children who have resettled in host countries worldwide. Regardless of the host country's economic level, refugees faced significant nutrition-related challenges. An insufficient food intake and poor dietary diversity were reported among refugees. Both macro- and micronutrient intakes were mostly insufficient, except for sodium intake, which was in excess. A high prevalence of stunting, underweight, and anemia was reported, particularly among children. Furthermore, a high prevalence of OW/OB, elevated blood cholesterol concentrations, along with the risk of adult-onset cardiovascular diseases (specifically, hypertension attributed to elevated dietary sodium) and significant deficiencies in various micronutrients, most notably iron and vitamin D, were widely observed in both children and adults. In addition, a double burden of malnutrition was observed across and within studies. Therefore, the implications of

TABLE 7 Findings of the factors associated with dietary intake and nutritional status among refugees in host countries from the selected studies[1]

Measure of association	Specific variable association
Food security and dietary intake	Intake of meat and eggs was higher, whereas intake of fruits and vegetables was lower, among food-insecure than food-secure participants (33)
	Food deprivation measure had a high correlation with the number of strategies used to avoid starvation ($P <$ 0.01); those with higher past food deprivation were more likely to eat high-fat meat (OR: 1.14; 95% CI: 1.0, 1.3; $P < 0.05$) (39)
	Severely food-insecure households had a significantly lower mean HDDS than both moderately food-insecure and food-secure households ($P < 0.0001$ and $P < 0.0001$, respectively); consumption of cereals ($P = 0.002$), pulses ($P = 0.0027$), dairy products ($P = 0.0043$), and fats ($P = 0.0005$) was significantly reduced only when food insecurity was severe (43)
	Moderate and severe household food insecurity manifested by a reduction in consumption of fruits ($P = 0.04$ and $P < 0.0001$), meat ($P = 0.0354$ and $P < 0.0001$), fish ($P < 0.0001$ and $P < 0.0001$), beverages ($P = 0.0027$ and $P < 0.0001$), and sweets ($P = 0.0015$ and $P < 0.0001$) compared with food-secure households (43)
Food security and nutritional status	Food insecurity positively related to OW/OB (OR: 2.66; 95% CI: 1.25, 5.69; $P < 0.01$) (33)
	Those with higher past food deprivation were more likely to be OW or OB (OR: 1.28; 95% CI: 1.08, 1.52; $P <$ 0.01) by WHO standards and (OR: 1.18; 95% CI: 1.02, 1.37; $P < 0.05$) by CDC standards (39)
	Severely food-insecure households are more likely to have at least 1 member who had a chronic disease (51.1% vs. 31.4%; OR: 2.3; 95% CI: 1.5, 3.5; $P < 0.0001$), hypertension (20.3% vs. 12.3%; OR: 1.8; 95% CI: 1.0, 3.3; $P = 0.05$), or acute illness in the past 6 mo than food-secure households (68.3 vs. 43.2%; OR: 2.8; 95% CI: 1.9, 4.3; $P < 0.001$), but anemia not associated with food insecurity and did not vary by household food security status or by HDDS (43)
	Body-weight-loss group was less food secure than the body-weight-gain and -maintenance groups ($P = 0.02$) (35)
SES and nutritional status	OW infants and those at risk of OW appeared to be more socioeconomically disadvantaged compared with those of normal weight or wasted (weight-for-length *z* score ←2 SDs from median for age and gender) (median IRSAD decile 2 vs. decile 4 and 6 comparatively; $P = 0.025$) (44)
	Older children and those with better-educated parents were at a higher risk of being overweight or obese (45)
	Not having a formal education and not being currently employed were associated with excess weight and abdominal obesity ($P < 0.05$) (38)
Acculturation and nutritional status	Not being able to read English was associated with excess weight and abdominal obesity ($P < 0.05$), whereas the length of time in the United States was not associated with excess body weight or abdominal obesity (38)
Food security and SES	Of the severely food-insecure households with children <5 y of age, 61.2% had mothers who completed <10 y of schooling, compared with 46.8% of the food-secure households and 24.7% of the moderately food-insecure households ($P = 0.0112$) (43)
	Higher proportion of unskilled workers in the severely food-insecure than in the food-secure households ($P =$ 0.04) (43)
	Severely food-insecure households had a lower mean number of food-related assets ($P = 0.0062$), spent less money on food per capita ($P = 0.0154$), and were less likely to receive monthly remittances (OR: 0.36; 95% CI: 0.13, 0.6; $P = 0.001$) than the food-secure households (43)
	Food-insecure households more likely to receive any kind of food aid than food-secure households ($P <$ 0.0001), with 87% of food aid going to food-insecure households (43)
	Severe food insecurity associated with respondents' very poor housing quality (OR: 3.3; 95% CI: 1.6, 6.5) (43)
Food security and acculturation (i.e., time of arrival, length of residence, language)	Food insecurity is common among recent arrivals and those who spoke only Somali at home ($P < 0.05$) (33)
	Severe food insecurity associated with length of stay as a refugee (OR: 1.1; 95% CI: 1.0, 1.2); severely food-insecure households were living in Lebanon for a longer period than the food-secure and moderately food-insecure households ($P = 0.0288$), but monthly remittances counteract effects of length of stay (43)

[1] HDDS, household dietary diversity score; IRSAD, Index of Relative Socio-economic Advantage and Disadvantage; OB, obesity; OW, overweight; SES, socioeconomic status.

dietary patterns on nutritional health outcomes reinforce the importance of effective nutrition interventions, including nutrition education and policies aiming to address malnutrition among refugees.

Refugees' dietary intake and nutritional status together are a complex, multidimensional process that is impacted by a broad spectrum of SES, cultural, community, and health-related factors, some of which affect each other. This is consistent with a previous review that found certain factors, such as acculturation and SES, are associated with OB-related health behaviors among child refugees following resettlement (8). To better visualize and explore these nuances, we summarized the associations among refugees' dietary intake, nutritional status, and the factors associated with these measures captured from the selected studies in a conceptual model, and we describe these in the following paragraphs (**Figure 2**). As observed in the model, refugees' nutritional status is associated with their post-resettlement dietary intake, and both measures are influenced by factors at the pre- and post-resettlement stages of refugees transitioning

TABLE 8 Main findings of the selected intervention studies targeting dietary intake and nutritional status among refugees in host countries[1]

Study, year (ref)	Target population	Intervention	Food security	Dietary intake	Nutritional status
El Harake et al., 2018 (34)	Syrian refugee children in Lebanon	Classroom-based educational sessions and provision of locally prepared healthy snacks	Household Food Insecurity score: 15.37 ± 0.71; 79.1% severely food insecure; 82.6% received assistance, via food basket (22.1%), e-card (77.9%), or conditional cash (6.2%)	↑: Dietary knowledge and attitude ↑: Total energy (kcal), dietary fiber, protein, saturated fat ($P < 0.05$) ↑: Vitamin K ($P < 0.001$), zinc ($P = 0.037$), calcium ($P = 0.017$), magnesium ($P = 0.007$), vitamin E, phosphorus ($P = 0.05$)	Greater changes in BAZ and HAZ in intervention vs. control groups (0.10 ± 0.06 vs. −0.10 ± 0.08, $P = 0.039$, and 0.39 ± 0.04 vs. 0.24 ± 0.05, $P = 0.024$, respectively) ↑: Mean BAZ scores ($\beta = 0.25$, 95% CI: 0.10, 0.41; $P = 0.001$)
Basu et al., 2018 (40)	Palestinian refugee households in Syria, Jordan, Lebanon, Gaza/West Bank	Debit card restricted to food purchases, cash, or alternative food parcel (less grain and more fruits and vegetables)	N/A	Shift to an alternative food parcel: ↓: calories, sodium, potassium; ↑: MDS[2]	Shift to an alternative food parcel: ↓: BMI, blood pressure, cholesterol, hypertension, type 2 diabetes, and cardiovascular disease[2]
Jamaluddine et al., 2020 (41)	Palestinian refugee children in Lebanon	Subsidized school snack and nutrition education program	21.0% were child food insecure; 48.9% were moderately or severely food insecure; marginally significant decrease in Household Food Insecurity score compared with control group (−0.33 score point; $P = 0.049$)	↑: CDDS and dairy consumption ($P = 0.028$), proteins (meat or chicken) (OR: 1.88; 95% CI: 1.17, 3.00; $P = 0.008$) ↓: Desserts (OR: 0.59; 95% CI: 0.38, 0.92; $P = 0.020$), sweetened beverages (OR: 0.76; 95% CI: 0.59, 0.99; $P = 0.046$)	↑: Hemoglobin ($P = 0.020$) –: Anemia, mean BAZ, HAZ, OW/OB, stunting

[1] BAZ, BMI-for-age *z* score; CDDS, Child Diet Diversity Score; HAZ, height-for-age *z* score; MDS, Mediterranean Diet Score; N/A, not applicable; OB: obesity; OW, overweight; ref, reference; ↑, increased association/odds;
–, no change; ↓, decreased association/odds.
[2] *P* value was not reported

to their host countries. The 5 identified themes representing these influencing factors are pre-resettlement experiences, host country resources, SES, acculturation, and food security.

Pre-resettlement experiences

Prior to resettlement, refugees experience displacement, conflict, or war, all of which impact their access to food in their home country. These pre-resettlement experiences further affect refugees' food choices after migrating to host countries (4, 6, 47–50). For example, low consumption of a high-fat and high-sugar diet in their home country plays a role in refugees' increased cravings for high-fat and high-sugar foods after resettlement, especially in a host country with an abundant food environment such as the United States (6). Nevertheless, pre-resettlement experiences have seldom been measured in the recent literature.

Host country resources

The host country's environment plays an important role in refugees' dietary patterns and nutritional health outcomes. Variations in dietary intake across different host countries may be due to the difference in those countries' resources, which determine the availability and accessibility of food. Even after refugees have been resettled, they may still be in a resource-limited environment, depending on the country's resources, which, in turn, impact refugees' household resources, thus impairing their overall nutritional health. Many host countries are unable to provide basic needs for refugees, such as access to education, employment, and food. For example, Lebanon's residency policy makes it difficult for refugees to maintain legal status in order to receive proper education and seek legal economic opportunities, and this limits their ability to improve their SES, thus increasing their risk of food insecurity (43). Some developing countries, such as Kenya and Rwanda among others, rely on support from the United Nations World Food Program, US Agency for International Development (USAID), and other international organizations to provide food assistance to refugees living in and outside of camps (51–53). Refugees residing in countries with robust welfare systems could benefit from food-assistance programs, such as the food stamp and food-banking systems in the United States.

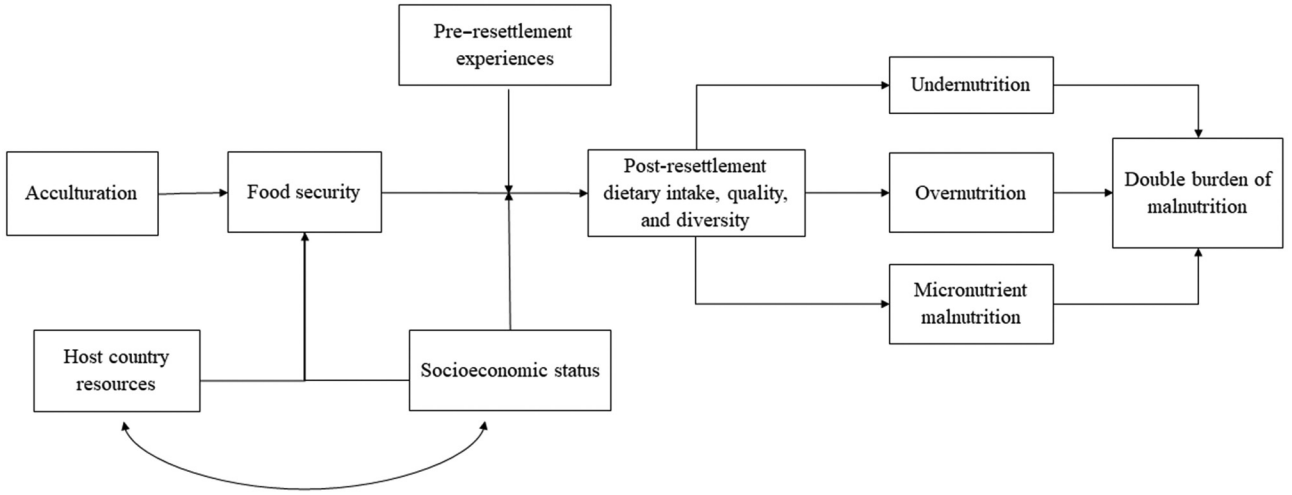

FIGURE 2 Conceptual model representing the multiple domains of dietary intake and nutritional status among refugees in host countries from the selected studies.

However, many of these resources may inadvertently lead to easy access to unhealthy food, rather than varied, fresh, and nutrient-dense food items, especially among low-income families (6, 54, 55).

Socioeconomic status

SES has been associated with nutritional status, specifically OW/OB (38, 44, 45). Research has demonstrated that poverty is a known risk factor for OW/OB and may contribute to the widely observed prevalence of OW/OB (56). As a result of being SES-disadvantaged after resettlement, refugees often reside in low-cost housing that is more likely to be in geographic areas with limited access to affordable and nutritious food as well as with a higher proportion of fast-food restaurants, which offer an array of value meals (i.e., high in calories, fat, sugar, and sodium and low in fiber, vitamins, and minerals) rather than an assortment of nutrient-dense fresh food (e.g., fruits, vegetables, and grains), thus influencing refugees' access to healthy eating (43, 44, 57). These SES outcomes are exacerbated by a lack of formal education and employment as well as poor accessibility to social resources, and all of these are associated with food insecurity (38, 43–45).

Acculturation

Acculturation is a nuanced variable, and researchers may want to consider the time of arrival, length of stay, and language proficiency together, among other indicators, to comprehensively measure acculturation levels in refugee populations (58). Due to linguistic, logistical, and cultural barriers, refugees may face obstacles to accessing healthy foods and maintaining healthy eating behavior, which may lead to poor nutritional health outcomes such as OW/OB (38). For example, the lack of fluency in languages used in host countries and limited time spent locally deter refugees from locating healthy food options (33). On the other hand, there is also a positive relation between acculturation and OB in populations migrating from low- and middle-income countries to high-income countries (14, 20, 45, 59). The greater the acculturation levels, the less likely that traditionally healthy native diets rich in various food groups will be consumed and the more likely that processed, Western-style foods high in fat, sugar, calorie, and salt will be consumed (20, 58, 60, 61). Nevertheless, healthy eating habits are not common among some refugees before resettlement; thus, many refugees may not have necessarily preferred a healthy diet based on their particular cultural perceptions before resettlement (62). Therefore, acculturation in the host country may be an opportunity to modify refugees' pre-resettlement diet into a healthier diet after resettlement.

Food security

Out of all the factors examined, food security was found to be a major factor influencing post-resettlement dietary intake. Many participants from the cohorts of the selected studies experienced some level of food insecurity, and the prevalence of severe food insecurity was high even among refugees who have resettled in high-income countries. Many studies reported associations between food insecurity and inadequate dietary intake (33, 43). In addition, the "food insecurity–obesity paradox," which indicates that food insecurity is paradoxically associated with OB (54, 55), was observed among refugees with low SES in the United States (33, 38, 39).

Insights for future interventions and research

We identified several areas for future interventions and research. Although tailored interventions can effectively improve refugees' food intake and nutritional status, presently there are limited interventions available. We recommend early interventions to assist in the initial stages of resettlement along with the implementation and assessment of these

interventions after long-term residency in host countries. The ability to make appropriate food choices is complex and depends on a variety of factors related to the respective home countries, migration experience, and destination countries. In addition to external environmental factors, acculturation and family environment also play an important role in shaping refugees' food choices. Considering all of these factors, interventions should be implemented at various levels, including individual and interpersonal (e.g., nutrition education to both parents/grandparents and children), community (e.g., community gardening program, market guide to identify and purchase healthy food and navigate grocery stores in the community), and societal levels [e.g., food stamps and Special Supplemental Nutrition Program for Women, Infants, and Children (WIC), etc.] in host countries (63–65). Sustainable interventions with consistent funding support are also warranted to maintain positive changes over time. Nutrition education and counseling should also be tailored based on language proficiency, health, and diet literacy among the target refugee communities.

Although most of the world's refugees reside in low- and middle-income counties, 67% of the selected papers and the majority of the current publications focus on refugees in high-income countries. This could be attributed to an inadequate research environment, including insufficient funding support, qualified personnel, and ethical and regulatory systems for research in lower-income countries (66). In addition to building a sustainable research environment, international collaboration both from the developed as well as within the developing world is suggested to foster research advancement in less-developed countries (66). Additionally, most of the selected studies in our research applied a cross-sectional design with post-migration measures. Cross-sectional designs cannot assess refugees' long-term changes in dietary intake and nutritional status. Similarly, the lack of pre-migration measures (i.e., past food deprivation, war, poverty, insufficient nutrition before migration) eliminates key pieces of information that may better explain post-migration health and dietary behavior. Therefore, longitudinal designs including pre- and post-resettlement measures as well as sufficient follow-up periods are suggested for future studies. The majority of the refugee studies applied non-probability sampling strategies to recruit participants, which may reduce the representativeness of the sample to the population. We suggest that researchers apply certain probability sampling strategies (e.g., respondent-driven sampling), which could draw representative samples from hard-to-reach populations (67). Additionally, 1 selected study applied a simulated sample, and this is a novel approach that has the potential for increased feasibility and practicability of future studies, especially for hard-to-reach populations (40). This type of analysis may better inform future field-based studies to identify unanticipated barriers and challenges.

Last, some primary limitations of this review included the setting of the inclusion and exclusion criteria in this research that may affect the representativeness of this review. For example, the restriction of the sample size may have limited the number of qualitative studies captured. We also limited publications to the English language, which may have excluded publications in other languages.

Conclusions

Our systematic review provides a comprehensive summary of the evidence with a global scope, thus helping researchers and policymakers gain a deeper understanding of the complexity in the diet- and nutrition-related patterns and outcomes among refugee populations after resettling in host countries. Poor dietary diversity and insufficient intakes of specific food groups and nutrients were widely reported among refugees in various host countries. A double burden of malnutrition was also observed as a high prevalence of stunting, underweight, anemia, OW, and OB were reported, with refugees having poorer nutritional outcomes than immigrants and local citizens. Vitamin D and iron deficiencies were the most common micronutrient deficiencies, and hemoglobin concentrations among children were alarmingly low. Refugee dietary patterns and behaviors involve multidimensional interactions between different factors. There is a need for comprehensive dietary and health screening upon resettlement as well as culturally appropriate nutrition education resources and interventions for refugees. Longitudinal studies and novel methodological approaches are suggested to further investigate associations between refugee dietary intake, nutritional health outcomes, and related risk factors.

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