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A Scoping Review of Dietary Intake among Young Adults in Low- and Middle-Income Countries

Abstract

Poor dietary intake during young adulthood can increase the risk of chronic diseases, which are rising concerns in low- and middle-income countries (LMICs). This scoping review examined dietary intake among young adults in LMICs, highlighting their energy and nutrient intakes. Ovid MEDLINE, PubMed, Scopus, Web of Science, and EBSCOhost databases were searched to identify observational studies published in English from 1 January 2014 to 31 July 2024. Rayyan.ai was used to remove duplicates and facilitate the selection process, which two researchers independently carried out. Studies that reported on the energy and nutrient intake of healthy young adults aged 18-30 years in LMICs were included. A total of 14 studies were included (9 from upper-middle-income countries, 5 from lower-middle-income countries, 0 from low-income countries). Most of the studies are cross-sectional studies (71.4%). The energy intake of young adults from upper-middle-income countries ranges from 1700 – 2400 kcal/day, while young adult females in lower-middle-income countries showed trends of low-energy intake and insufficient micronutrient intake. Most of the energy intake reported came from carbohydrates, followed by fat and protein. The findings highlighted a significant gap in data from low-income countries, underscoring the need for further research to inform policies and design effective interventions.

Keywords: dietary intake, young adults, low-income countries, middle-income countries, scoping review

What we already know

- The phase of young adulthood encompasses shifts in lifestyle settings such as living situations, social lives, and financial independence, which could affect their food choices and eating habits.
- Young adults in LMICs face unique nutritional challenges which have potentially led to poor dietary intake.
- Poor dietary intake during young adulthood can increase the risk of noncommunicable diseases, which are growing concerns in LMICs.

What this article adds

- This scoping review provided an overview of dietary intake among young adults in LMICs in terms of energy, macro- and micronutrients.
- Trends of low-energy intake and insufficient micronutrient intake were observed in young adult females from middle-income countries.
- The findings of this scoping review highlighted a significant gap in the dietary data of young adults from low-income countries.

Introduction

Dietary intake of young adults is an important field of research, especially in low- and middle-income countries (LMICs), where rapid urbanization and economic shifts impact food availability, dietary choices, and overall nutrition.[1,2] In these regions, young adults face unique nutritional challenges, including limited access to diverse, nutrient-rich foods and increased exposure to processed high-calorie foods.[1,3] Additionally, this age group, typically ranging from 18 to 30 years, enters a transitioning stage of life from adolescence to adulthood, which often encompasses shifts in lifestyle settings such as living situation, social life, and financial independence, hence affecting their food choices and eating habits.[4,5] Poor dietary intake during this period can increase the risk of noncommunicable diseases (NCDs) that are responsible for 74% of deaths worldwide, including cardiovascular diseases (17.9 million), cancers (9.3 million), chronic respiratory diseases 4.1 million) and diabetes (2.0 million).[6] An imbalance between energy intake and expenditure could also lead to weight gain and increased body mass index (BMI). In 2022, the World Health Organization (WHO) reported that 2.5 billion (43%) adults worldwide aged 18 years and over were overweight, and 890 million (16%) were obese.[7] The global adult obesity rate has increased more than doubled since 1990, and adolescent obesity has quadrupled.[7]

Regarding the current nutritional condition in LMICs, a nutrition transition is taking place due to globalization, urbanization, and the increasing availability of processed and

energy-dense foods. These factors are significantly transforming traditional dietary patterns in LMICs.[8–10] Dietary intake of the general population has shifted toward more refined carbohydrates, sweeteners, oils, and animal protein.[2] Despite that, poorer nutritional intake was observed among young adults compared to other age groups. This population may adopt more processed food due to convenience, which is usually energy-dense and poorly nutritious.[11,12] At the same time, the intake of fruits and vegetables among young adults is often below national recommendations.[13,14] These changes in dietary intake have contributed to the rapid inclination of overweight and obesity rates in LMICs, particularly among young men aged 25 to 29 years.[15] Higher intakes of unhealthy fats, sugars, and salt were also found to be associated with the growing prevalence of NCDs in LMICs.[16,17] Notably, in low-income countries (LICs), studies have reported a dietary pattern high in carbohydrates, primarily from complex carbohydrates and other cereal products (72-78% of total energy intake), with only 4.7-6.7% of energy contributed from sugar.[18] A study that investigated food costs in Afghanistan, Bangladesh, Pakistan, and Sri Lanka found that a vast majority of households overspend on staple foods and underspend on vegetables and dairy products.[19] Most households are failing to meet the recommended consumption for nearly all food groups.[19]

The scarcity of information on the dietary intake of young adults across the world reduces the accuracy of generalizing the findings to the broader population, as most published literature solely focuses on the dietary intake of college and university students. Young adulthood presents distinct challenges in maintaining a healthy dietary intake and nutritional status, particularly in LMICs. Understanding the patterns of dietary intake of young adults becomes essential for informing policies and interventions aimed at improving public health outcomes. Therefore, this scoping review aims to describe the current dietary intake among young adults in LMICs.

Methods

The basis for this scoping review was formed from the methodology described by Joanna Briggs Institute[20] and Arksey and O'Malley et al.[21] The Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews (PRISMA-ScR)[22] has served as the basis for the scoping review's reporting item (see Supplementary Table S1 online). The protocol for this review has been registered on the Open Science Framework (Registration DOI: https://osf.io/xzkba/?view_only=1488ff55c53341bb9b8d9aa5af1b060c).

Eligibility Criteria

This scoping review included original peer-reviewed papers in English, published from 1 January 2014 to 31 July 2024. Observational studies that discussed the dietary intake of young adults in LMICs were included. The context of dietary intake refers to nutrient and calorie composition rather than food group consumption, eating behavior, or dietary practices (i.e., meal frequency, eating-out frequency). Non-observational studies, including but not limited to reviews, validation studies, intervention studies, and case studies, were excluded from

consideration. Additionally, studies conducted on animal subjects or utilizing *in vitro* methodologies were also eliminated from the analysis.

The criteria for inclusion in the studied population were established as follows: (1) participants must be within the age range of 18 to 30 years; (2) individuals must be free-living and physically healthy young adults, possessing no diagnosed physiological or psychological disorders, irrespective of being classified as underweight, overweight, or obese; and (3) participants must originate from low-income countries or middle-income countries as classified by the World Bank.[23] The literature was deemed ineligible for inclusion based on the following criteria: (1) participants with diagnosed eating disorders; (2) participants who adhere to specific dietary practices (e.g., vegetarian, Mediterranean, etc.); (3) studies in which data pertaining to the target population is incorporated within a broader age group without disaggregation; and (4) study populations that do not accurately represent young adults within the general community. This includes studies that exclusively involve college or university students, military personnel, elite athletes, or young adults with specific health conditions such as dental caries.

Information Sources and Search Strategy

The literature search was executed utilizing five electronic databases: Ovid MEDLINE, PubMed, Web of Science, Scopus, and EBSCOhost. This search was conducted on 5 August 2024, employing the Medical Subject Heading (MeSH) terms and keywords: “dietary intake” and “young adulthood.” The relationship between these two concepts was established using Boolean operators, as illustrated in Table 1.

“INSERT TABLE 1 HERE”

Selection Process

During the initial phase of the selection process, all records obtained from a comprehensive literature search utilizing specified electronic databases were imported into Rayyan.ai to facilitate the screening of titles and abstracts. At this stage, duplicate records were eliminated. Subsequently, full-text articles were assessed according to the established inclusion and exclusion criteria relevant to the review. Each stage of the screening process was conducted independently by two researchers, both of whom possess backgrounds in nutrition and dietetics. Any discrepancies that arose between the researchers were addressed by consulting a third opinion from two additional authors.

Data Extraction

Data extraction was systematically documented in Microsoft Excel. A structured template was developed to capture essential information of interest, which encompasses the author(s), publication year, study title, study design, objectives, participant characteristics (age and gender), sample size, setting, outcome measurements, and key relevant findings. The primary finding pertains to dietary intake, while secondary findings include BMI and waist circumference.

Results

Selection of Sources of Evidence

A total of 8,497 records were identified from the databases. Following the removal of 3,892 duplicate entries, 4,605 papers were available for screening based on their titles and abstracts. According to the predetermined inclusion and exclusion criteria, 4,536 papers were deemed irrelevant and were subsequently excluded from further consideration. In the final phase, 69 full-text articles were evaluated for eligibility, resulting in the exclusion of 55 articles. Ultimately, 14 papers were selected for inclusion in the final analysis of this review. The details of the study selection process, encompassing the results from each database and the reasons for exclusion, are summarized in Figure 1 below.

“INSERT FIGURE 1 HERE”

Study Characteristics

A considerable proportion of the studies examined, specifically 64.3%, are sourced from upper-middle-income countries, with Brazil representing the largest portion at 35.7%. South Africa follows as the second highest contributor at 14.3%. It is important to note that there are no studies emanating from low-income countries, and merely five out of fourteen studies originate from lower-middle-income countries, which include Vietnam (14.3%), the Philippines (7.1%), Nigeria (7.1%), and Zambia (7.1%). The representation of the Asian demographic has been notably limited, with only three studies conducted in Asian nations—two from Vietnam and one from the Philippines. Furthermore, the majority of the studies analyzed (71.4%) are cross-sectional, while 28.6% are categorized as longitudinal studies. Additionally, a significant proportion of the studies (78.6%) were published within the past five years; specifically, 42.9% in 2023, 14.3% in 2022, and 21.4% in 2021.

Dietary Intake of Young Adults

Upper-middle-income countries. Out of the nine studies included from upper-middle-income countries, only two investigated both young adults’ macro- and micronutrient intake[24,25], five studies solely reported on macronutrients intake[24,26–29] and two studies solely investigated micronutrients intake.[30,31] The literature revealed that the energy intake of young adults from upper-middle-income countries is either at the lower end around 1700-1800 kcal/day[26,32] or at the higher end of 2200-2400 kcal/day.[24,25,27] Similar findings were reported across all studies where the most consumed macronutrient was carbohydrates, followed by fats and protein.

However, two studies that reported their results based on gender[28,32] found that females consumed more carbohydrates, fiber, and saturated fat, while males consumed more proteins, monounsaturated and polyunsaturated fats. One longitudinal study that looked into the nutritional intake of young men before and during COVID-19 found that there were no differences in their energy intake.[24] However, a lower intake of total fat, sodium, cholesterol, and total sugars was observed during COVID-19, which led to an improvement in food quality among male young adults despite a reduction in fiber consumption.[24] A study with the largest sample size of 1857 participants in Brazil[27] reported that fiber intake was around 20g/day, which was consistent with another Brazilian study included in this scoping review.[24] Conversely, a study from South Africa[28] reported fiber intake as low as 4.6g/day.

The most frequent reporting of micronutrient intake of young adults was in a cross-sectional study by Del' Arco.[31] For both genders, there was a high prevalence (> 83%) of inadequate calcium and magnesium intake.[31] Most of the young adults had sodium intake above the Tolerable Upper Intake Level.[31] The prevalence of iron, zinc, and phosphorus deficiency was low (<50%) in males. However, the frequency of 96.53% calcium insufficiency in female young adults is particularly noteworthy, and approximately 35% of females were at nutritional risk for iron deficiency.[31]

Lower-middle-income countries. Most of the studies (three out of five) from lower-middle-income countries are cross-sectional.[33–35] Tran's study reported a low-energy intake among female young adults compared to the WHO's estimated energy requirement (EER) (1566.8 kcal/day cf 2203.6 kcal/day), where 71.6% of individuals consumed less energy than 85% of EER.[35] Similar findings were reported in Ko's study where the estimated daily energy intake for female young adults with increased high sensitivity C-reactive protein (hsCRP) was 1712.8 kcal/day.[33] Nutritional intake from the high-risk group was focused on as increased hsCRP indicates inflammation in this group of young adults, which can put them at increased risk of NCDs. Furthermore, Asamane's study investigated the diet of young adult men in urban and rural Zambia and found that the energy intake from urban areas was higher than that from the rural (2592 kcal/day cf 2441 kcal/day). Individuals in the urban group also consumed more fat and protein than those in the rural group.[34]

There exists only one longitudinal study[36] conducted in lower-middle-income countries, which is also the study with the largest sample size, tracking participants from childhood at the age of 2 years to young adulthood at the age of 22 years. This study included two distinct points of data collection during young adulthood, specifically at 19 years and 22 years of age. The analysis revealed that dietary intake between the two age groups of young adults was relatively consistent, with total energy intake recorded at 1872 kcal/day at 19 years and 1940 kcal/day at 22 years. Furthermore, there is a retrospective cross-sectional cohort study conducted among Nigerian young adults that reported nutritional findings categorized by gender.[37] The study reported that men consumed less energy than women (2398.8 kcal/day cf 2431.1 kcal/day). Male energy consumption was just 85.7% of the FAO/WHO/UNU (2001) daily energy recommendation (2800 kcal/day), but female energy intake was 110.5% of the recommendation (2200 kcal/day). Consistent among all studies, most of the energy intake came from carbohydrates, followed by fat and protein. For female micronutrients intake, the median intake for most micronutrients was lower than the estimated average requirements (EAR) based on WHO/FAO (2004) recommendations, except for vitamin C, thiamin, and vitamin B6.[35] As for

men, Asamane's study reported that young adult men fulfilled all micronutrient needs (FAO/WHO, 2005), apart from vitamin A, calcium, and folate.[34] A summary of the description and main nutritional findings of each study from the upper- and lower-middle-income countries is presented in Table 2 below.

"INSERT TABLE 2 HERE"

Discussion

The screening results indicate that all studies included in the analysis are from upper- and lower-middle-income countries, with no studies represented from low-income countries (LICs). This absence may reflect the various challenges encountered by LICs, including limited research capacity and resources, as well as deficiencies in infrastructure, funding, and access to research training opportunities.[38,39] The scarcity of data from LICs underscores the need for international collaboration and targeted funding to support research capacity in these countries.[39] Additionally, research priorities in LICs often focus on more pressing health issues, such as infectious diseases.[40,41] The prioritization of vulnerable groups like children and pregnant women may have also contributed to the lack of focus in the related field.[42] With limited data, it is difficult to extrapolate the dietary requirements for young adults in LICs as dietary intake patterns may differ significantly from other countries due to distinct sociocultural factors.[43] This highlights the importance of future research to work on research evidence related to dietary intake among young adults in LICs.

The results from upper-middle-income countries have reflected a high variability compared to lower-middle-income countries, which are relatively consistent. For example, a wide range of energy intake was observed among young adults from upper-middle-income countries. A wide variation was observed with fiber intake as well, ranging from 4.6g/day in South Africa to 20g/day in Brazil. Other than attributing this difference to the higher number of studies included from upper- compared to lower-middle-income countries, this variation may be explained by the influence of urbanization, which could lead to diverse dietary patterns between urban and rural areas in upper-middle-income countries.[44,45] Urbanized areas may contribute to higher energy intakes due to greater access to calorie-dense, processed foods, while rural or transitioning populations may consume lower-calorie traditional diets.[1,46] This is further concurred by evidence from the included studies, which reported a higher prevalence of overweight and obesity among the urban population compared to rural counterparts. A similar trend was observed, as socioeconomic inequalities within upper-middle-income countries can lead to significant variability in dietary intake, with higher-income groups potentially consuming more energy-dense diets while lower-income groups face food insecurity.[47] The difference in socioeconomic status among parents is also associated with different educational attainment of adolescents and young adults.[48] A study from China has reported that young adults with higher education levels have significantly higher food and nutrition literacy, which plays a vital role in their food choices.[49] Furthermore, gender differences and variability in physical activity levels may also play a role, with cultural expectations and lifestyle factors influencing dietary intake.[50,51] These findings underscore the need for targeted public health interventions in upper-middle-income countries that address both ends of the energy intake spectrum.

Among lower-middle-income countries, a low-energy intake trend was observed among female young adults. This can be attributed to a combination of economic, sociocultural, and behavioral factors. Economic constraints in lower-middle-income countries can lead to limited accessibility and availability to nutritious, diverse, and balanced diets, particularly for females, who may have lower purchasing power or lower household food priority.[1,52] Sociocultural norms in lower-middle-income countries that emphasize traditional gender roles and beauty standards may further exacerbate this by influencing young women to practice restrictive eating habits to maintain or achieve a specific body image.[53,54] In addition,

knowledge gaps in nutrition education leave many young women unaware of their actual energy requirements, perpetuating unintentional underconsumption.[55] Of primary importance, the studies have repeatedly revealed that many young adults did not meet their nutritional requirements. However, the included studies solely looked into their energy and nutrient intake but did not report on food choices or the type of food consumed. Therefore, it is plausible that young adults may be consuming diets that are low in energy yet nutritionally adequate. In contrast, this scenario is improbable, given the increasing prevalence of obesity and other NCDs among young adults in lower-middle-income countries.[56,57]

Current findings have shown that female young adults from lower-middle-income countries have insufficient micronutrient intake. In the past decades, many lower-middle-income countries have undergone dietary transitions due to rapid urbanization, where traditional diets high in cereal and fiber are replaced with more processed diets high in sugar, saturated fat, and refined foods.[2,3,58] Increased intake and availability of these highly processed and nutritionally inadequate foods have potentially led to reductions in micronutrient intake among young adults.[10] Besides, the price of energy-dense food, which is usually cheaper, and nutrient-dense food, which is more expensive, such as lean meat, fish, fresh fruits, and vegetables, have also contributed to the consumption of unhealthy foods.[59,60] Many studies have also highlighted the association between lower educational attainment and poorer dietary choices and vice versa.[61,62] Apart from individual education levels, parental education influence is also significant as young adults of educated parents are more likely to have better nutrition due to increased awareness about healthy eating and access to nutritious foods within the home food environment.[63,64] This intergenerational effect highlights the importance of education not just for individual dietary choices but also for family health dynamics.[63]

Other than that, cultural and religious practices heavily influence food choices and dietary patterns in upper- and lower-middle-income countries.[65,66] For example, cultural norms may dictate meal composition, food preferences, and portion sizes.[65] In many LMICs, staple diets are carbohydrate-heavy, with limited protein sources, reflecting cultural preferences and economic realities.[67] Certain religious practices, such as fasting or dietary restrictions, also impact nutrient intake. For instance, prolonged fasting periods or avoidance of specific foods (e.g., pork, beef, or shellfish) may lead to deficiencies in essential nutrients such as iron, zinc, and vitamin B12.[66] Policies should prioritize improving food security and delivering culturally appropriate nutrition interventions that respect religious practices. Public health campaigns could highlight nutrient-dense alternatives within permissible dietary frameworks while promoting balanced diets to ensure the attainment of energy and nutritional needs among young adults, thereby reducing the risk of nutrient deficiencies and associated health complications.[1]

Strengths and Limitations

This study has several notable strengths, including adherence to the PRISMA-ScR guidelines, which ensure a rigorous and transparent methodology. Furthermore, this scoping review addresses an understudied demographic, providing insights for general young adults from the community that are crucial for targeted public health interventions, as many of the studies among young adults solely focus on university students or recruit young adults from a tertiary education setting. Since more than 70% of the studies included are cross-sectional studies, this review identified important gaps in the literature, particularly in longitudinal research on

dietary trends among young adults in LMICs, which can guide future research efforts. The scoping review further identified significant research gaps, particularly emphasizing the necessity for additional studies concerning the dietary intake of young adults in Asian and low-income countries. Nevertheless, several limitations must be acknowledged. The lack of a quality assessment for the included studies could restrict the interpretation of the findings due to variability in study quality. Furthermore, the distribution of the included studies is not sufficiently representative across LMICs, thereby limiting the generalizability of the results to the broader context of all LMICs.

Conclusion

This scoping review provided an overview of nutritional intake among young adults from upper- and lower-middle-income countries. This information is helpful for healthcare professionals and policymakers in tailoring health promotion initiatives and reviewing nutrition policies. However, the absence of data from LICs highlights a critical gap in the understanding of this topic. Most of the evidence to date is also data measured at a single point in time with no causal relationship established. Therefore, targeted studies should be conducted in LICs to address the lack of data, where collaborations with local researchers could be implicated in overcoming logistical and financial barriers. More longitudinal studies are also encouraged to examine how dietary intake evolves during young adulthood and how they contribute to long-term health outcomes, such as the development of NCDs.

Given the gender differences observed, future research can further explore how sociocultural norms, economic factors, and education level influence the dietary intake of males and females. This understanding could guide the development of targeted interventions to address gender-specific nutritional needs, particularly the nutritional challenges faced by females in lower-middle-income countries. Moving forward, instead of focusing on calorie and macronutrient intake, interventions should also prioritize dietary quality, particularly the consumption of micronutrients such as calcium, iron, and magnesium, which are commonly deficient in young adults. Using relatable messaging and social media platforms can help engage this demographic effectively. In view of rapid urbanization, interventions should account for the urban-rural disparities in dietary intake where urban areas need initiatives that discourage the overconsumption of calorie-dense, processed foods, while rural areas require strategies to increase access to diverse and nutrient-rich foods. Future research should focus on more holistic approaches, combining quantitative dietary assessments with qualitative insights to explore their food choices and dietary behaviors; hence, scalable solutions can be identified to improve dietary intake in this transitional life stage.

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Tables

Table 1. Terms used for search strategy.

Concept 1		Concept 2
Dietary intake OR		Young adulthood OR
Diet intake OR		Early adulthood OR
Oral intake OR		Emerging adulthood OR
Food intake OR		Young adults OR
Nutrient intake OR	**AND**	Youth OR
Nutritional intake OR		Young women OR
Macronutrient intake OR		Young men
Dietary pattern OR		
Food pattern OR		
Eating pattern OR		
Dietary consumption OR		
Calories intake OR		
Energy intake OR		
Protein intake OR		
Carbohydrate intake OR		
Fat intake		

Table 2. Studies on dietary intake of young adults from middle-income countries.

(Author, Year of Publication)	Country	Study Design	Sample Size	Age (Years)	Gender	Main Findings
Upper-middle-income countries						
[25]	Iran	Longitudinal study	217	24.9 ± 2.9	N/A	Energy intake: 2440 ± 871 kcal/day Dairy calcium: 212 ± 165 mg/day Non-dairy calcium: 1191 ± 473 mg/day Total calcium: 1403 ± 568 mg/day
[31]	Brazil	Cross-sectional	288	19 - 24.9	44.4% female 55.6 male	Average intake (Prevalnece of Inadequacy) Calcium: 498.98 mg (88.67%) Female [EAR:800]: 426.12 mg (96.53%) Male [EAR:800]: 551.54 mg (82.99%) Iron: 11.06 mg (16.07%) Female [EAR:8.1]: 9.64 mg (34.15%) Male [EAR:6.0]: 12.09 mg (3.03%) Zinc: 11.67 mg (19.00%) Female [EAR:6.8]: 10.01 mg (17.78%) Male [EAR:9.4]: 12.87 mg (19.88%) Magnesium: 228.22 mg (83.91%) Female [EAR:250]: 197.76 mg (84.97%) Male [EAR:330]: 250.19 mg (83.15%) Phosphorus: 1065.35 mg (6.17%) Female [EAR:580]: 896.46 mg (9.43%) Male [EAR:580]: 1187.20 mg (3.82%) Sodium: 2951.6 mg (76.35%) Female [UL:2300]: 2595.51 mg (63.45%) Male [UL:2300]: 3208.51 mg (85.65%) Consumption of all nutrients was statistically different between genders (p<0.001).
[26]	Türkiye	Cross-sectional	1400	21.1 ± 2.0	66.9% female 33.1% male	Total energy intake: 1699.4 ± 565.1 kcal/day Female: 1627.9 ± 510.8 kcal/day Male: 1843.6 ± 638.0 kcal/day
[30]	South Africa	Longitudinal study	325	Female: 25.52 ± 3.13	50.5% female 49.5% male	Sodium intake: 689.84 ± 1036.56 mg/day (11.1% above adequate intake) Female: 717.18 ± 1082.93 mg/day (10.4% above adequate intake)

				Male: 24.79 ± 1.84		Male: 661.45 ± 988.80 mg/day (11.8% above adequate intake) Potassium intake: 754.75 ± 667.16 mg/day (97.8% below adequate intake) Female: 753.27 ± 678.56 mg/day (99.4% below adequate intake) Male: 756.28 ± 657.31 mg/day (96.3% below adequate intake)
[27]	Brazil	Cross-sectional	1857	23 - 25	51.8% female 48.2% male	Total energy intake: 2237.3 ± 705.8 kcal/day Total food intake: 2135.4 ± 751.8 g Carbohydrates: 55.7 ± 6.7 %TCV 139.4 ± 16.6 g/1000kcal Proteins: 16.8 ± 3.2 %TCV 42.1 ± 7.9 g/1000kcal Lipids: 26.1 ± 4.9 %TCV 29.0 ± 5.4 g/1000kcal Fibers: 11.1 ± 3.0 g/1000kcal
[24]	Brazil	Longitudinal study	50	27.7 ± 4.2	100% male	<u>Before Covid-19 (Baseline)</u> Total energy intake: 2267.36±468.3 kcal Carbohydrates: 1104.42±317.9 kcal, 276.1±79.48 g Protein: 360.57±63.81 kcal, 90.14±15.95 g Fat: 799.76±145.5 kcal, 88.86 ±16.17 g Sodium: 3675.75±615.54 mg Cholesterol: 325.85±135.95 mg Fibers: 20.19±8.38 g <u>During Covid-19 (Follow-up)</u> Total energy intake: 2308.83±633.45 kcal Carbohydrates: 1163.33±417.1 kcal, 290.83±104.27 g Proteins: 406.97±106.49 kcal, 101.74±26.62 g Fat: 679.91±173.26 kcal, 75.55 ±19.25 g Sodium: 2345.03±1195.28 mg Cholesterol: 112.86±1.68 mg Fibers: 15.63±5.74 g
[29]	Brazil	Cross-sectional	241	22.11 ± 1.43	44.4% female 55.6% male	<u>95%CI</u> Energy intake: 1893.38 – 2057.15 kcal Carbohydrates: 241.66 – 262.98 g (51.7%TEI) Proteins: 80.65 – 88.52 g (17.5%TEI) Fats: 63.75 – 69.65 g (30.8%TEI)
[32]	Brazil	Cross-sectional	200	21.35 ± 1.67	73.5% female 26.5% male	Energy intake: 1827.81 ± 597.94 kcal/day Female: 1741.52 ± 558.82 kcal/day Male: 2067.15 ± 641.91 kcal/day Carbohydrate intake: 51.09 ± 7.11 %TEI Female: 51.11 ± 7.01 %TEI Male: 51.05 ± 7.44 %TEI Protein intake: 17.11 ± 3.63 %TEI Female: 16.74 ± 3.33 %TEI Male: 18.14 ± 4.24 %TEI Fat intake: 31.66 ± 5.83 %TEI Female: 32.12 ± 5.69 %TEI Male: 30.38 ± 6.08 %TEI Saturated fatty acid: 9.43 ± 5.43 % Female: 9.54 ± 6.03 % Male: 9.14 ± 3.25 % Polyunsaturated fatty acid: 5.13 ± 2.27 % Female: 5.08 ± 2.38 % Male: 5.26 ± 1.92 % Monounsaturated fatty acid: 7.72 ± 2.63 % Female: 7.55 ± 2.55 % Male: 8.19 ± 2.79 %
[28]	South Africa	Cross-sectional	624	18 -30	51% female 49% male	<u>Median (IQR)</u> Energy (kJ): 3310.0 (3591.00) Female: 3474 (3482.00) Male: 3029.0 (3874.00) Carbohydrate (%): 63.0 (31.41) Female: 63.7 (30.91) Male: 62.8 (30.82) Protein (%): 12.3 (11.76) Female: 11.7 (11.19) Male: 12.9 (12.34) Fatty acids (%): 22.3 (23.50) Female: 22.1 (24.26) Male: 22.6 (21.51) SFAs (%): 4.9 (9.36)

						Female: 5.0 (9.91) Male: 4.8 (8.54) MUFAs (%): 6.5 (12.90) Female: 6.4 (14.01) Male: 6.6 (11.75) PUFAs (%): 3.7 (7.95) Female: 3.4 (8.18) Male: 3.7 (7.57) Trans fatty acids (%): 0.1 (0.95) Female: 0.1 (1.17) Male: 0.1 (0.49) Fiber (g): 4.6 (8.40) Female: 5.1 (9.00) Male: 4.3 (7.00)
Lower-middle-income countries						
[35]	Vietnam	Cross-sectional	201	19.8 ± 1.3	100% female	Estimated energy requirement: 2203.6 ± 131.0 kcal Estimated energy intake: 1566.8 ± 620.2 kcal Carbohydrate: 56%, 212g (18.4% insufficient intake, 18.9% excessive intake) Fat: 27%, 47g (26.8% insufficient intake, 20.9% excessive intake) Protein: 17%, 63g (mostly 96% in optimal range, 3.5% insufficient intake, 0.5% excessive intake) *insufficient/excessive intake levels based on AMDRs <u>Median Intakes of Micronutrients</u> Calcium: 386.7mg (EAR = 1100) Iron: 10mg (EAR = 20.5-28.4) Zinc: 8.3mg (EAR = 6.8-7.3) Vitamin C: 86.2mg (EAR = 56-60) Thiamin: 0.9mg (EAR = 0.9) Riboflavin: 0.6mg (EAR = 0.9) Niacin: 9.7mg (EAR = 11) Vitamin B6: 1mg (EAR = 1-1.1) Folate: 165.6mcg (EAR = 320-330) Vitamin B12: 1.4mcg (EAR = 2) Vitamin A: 313.7mcg RAE (EAR = 485-500)
[37]	Nigeria	Retrospective cross-sectional cohort study	240	27.7 ± 5.586	53.3% female 46.7% male	TEI: 2416.0 ± 722.728 kcal/day Female: 2431.1 ± 876.664 kcal/day Male: 2398.8 ± 494.761 kcal/day Carbohydrate 58.2 %TEI Female: 55.1%TEI Male: 61.2%TEI Protein: 13.2 %TEI Female: 12.9%TEI Male: 13.4%TEI Fat: 28.6 %TEI Female: 32%TEI Male: 25.4%TEI Carbohydrates and protein contributed more in males than females; fat contributed more in females
[34]	Zambia	Cross-sectional	40	24.4 ± 3.7	100% male	Energy (kcal/day) Urban: 2592.1 ± 503.4 Rural: 2440.8 ± 913.6 Carbohydrate (g/day) Urban: 310.0 ± 75.2 (48.4 %TEI) Rural: 332.9 ± 97.9 (54.6 %TEI) Protein (g/day) Urban: 100.5 ± 23.6 (15.9 %TEI) Rural: 71.2 ± 24.9 (11.5 %TEI) Fat (g/day) Urban: 99.7 ± 26.2 (34.0%TEI) Rural: 70.6 ± 24.8 (25.0%TEI) Vitamin A (RNI = 1000 μg/day) Urban: 579.1 Rural: 484.0 Vitamin B6 (RNI = 1.3 mg/day) Urban: 1.5 Rural: 1.4 Vitamin B12 (RNI = 2.4 μg/day)

						Urban: 2.5 Rural: 2.4 Iron (RNI = 10.0 mg/day) Urban: 18.8 Rural: 18.0 Zinc (RNI = 10.0 mg/day) Urban: 13.6 Rural: 10.2 Riboflavin (RNI = 1.3 mg/day) Urban: 1.5 Rural: 1.6
[36]	Philippines	Longitudinal	At age 19: 2023 At age 22: 1888	19 and 22	47% female 53% male	<u>At 19 years</u> Energy intake (kcal): 1872 ± 821 Carbohydrates (g): 260 ± 111 Protein (g/kcal body weight): 1.36 ± 0.63 Protein (g): 67 ± 31 Protein (%TEI): 15 ± 4 Fat (g): 61 ± 45 <u>At 22 years</u> Energy intake (kcal): 1940 ± 832 Carbohydrates (g): 264 ± 109 Protein (g/kcal body weight): 1.44 ± 0.67 Protein (g): 73 ± 35 Protein (%TEI): 15 ± 4 Fat (g): 52 ± 40 Mean protein intake exceeded the RDA at every survey. *RDA for years 19 and 22 were 0·80 g/kg body weight
[33]	Vietnam	Cross-sectional	956 (94 high-risk group, 174 moderate risk group, 688 low risk group)	25.0 ± 5.7	100% female	<u>High-risk group</u> Energy (kcal/day): 1712.8 ± 557.1 Carbohydrate: 216.8 ± 77.0 g/day (51%TEI) Protein: 80.4 ± 34.5 g/day (19%TEI) Fat: 58.3 ± 34.5 g/day (30%TEI) Cholesterol (mg/day): 240.9 ± 367.0 Fiber (g/day): 9.0 ± 6.3 Calcium (mg/day): 596.9 ± 449.5 Iron (mg/day): 14.1 ± 9.0 Sodium (mg/day): 4,325.9 ± 2,229.0 Potassium (mg/day): 2,119.8 ± 1,011.2 Zinc (mg/day): 11.9 ± 12.5 Retinol (μgRE/day): 166.9 ± 401.1 Beta carotene (μgRE/day): 6249.3 ± 8053.7 Vitamin C (mg/day): 125.0 ± 115.3 Niacin (mg/day): 11.9 ± 7.2 Folate (μgDFE/day): 269.6 ± 442.1

Abbreviations: AMDRs: acceptable macronutrient distribution ranges; CI: confidence interval; EAR: estimated average requirement; IQR: interquartile range; RAE: retinol activity equivalents; RDA: recommended dietary allowance; RNI: recommended nutrient intake; TCV: total caloric value; TEI: total energy intake; UL: tolerable upper intake level.

Figures

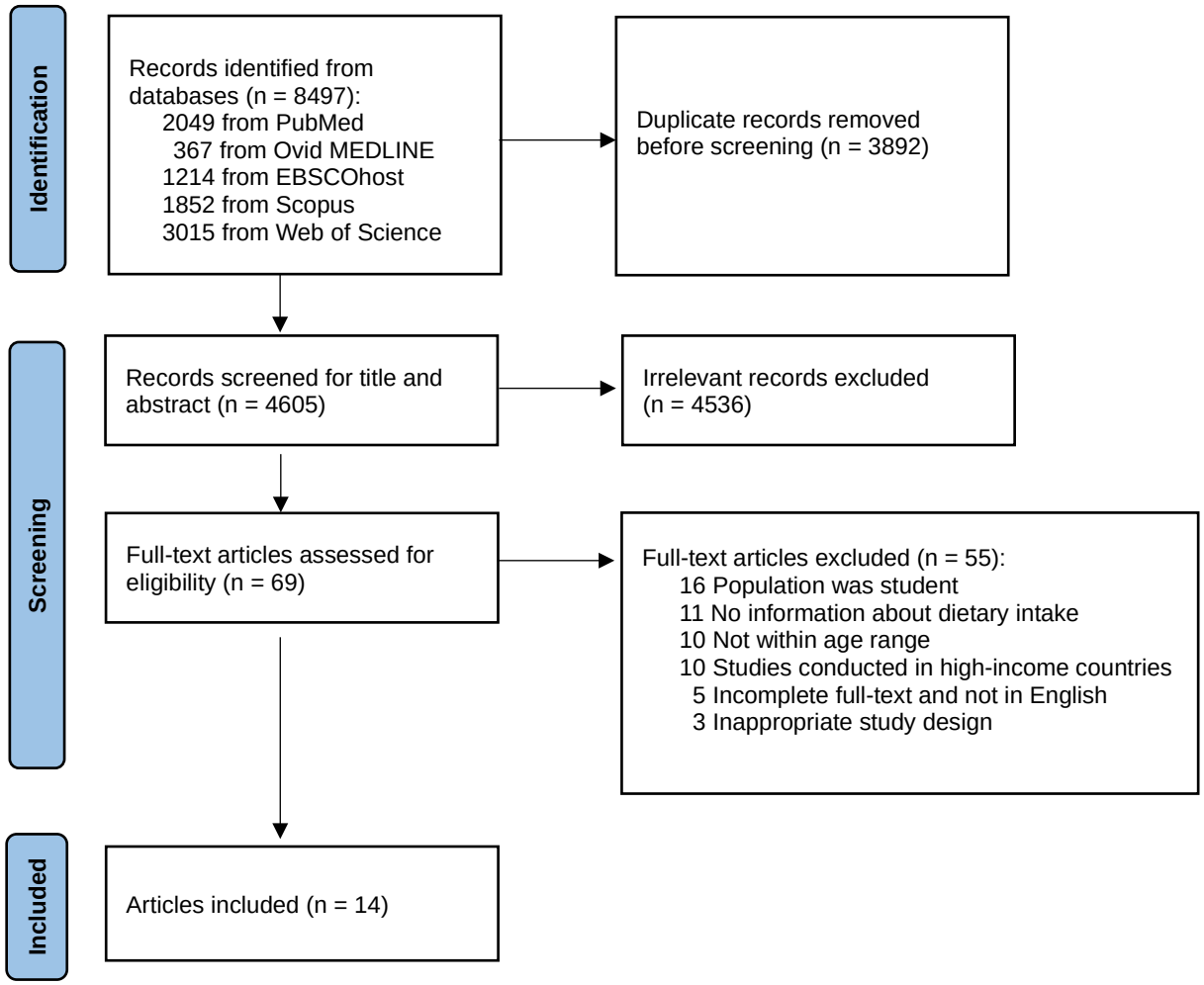

Figure 1. PRISMA flow chart depicting literature search and study selection process.