



Nutrition and Dietary Intake of Adolescent Girls in Indonesia: A Systematic Review

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Abstract

Adequate food and nutrient intake in adolescence is key to optimising adolescent nutritional status. Previous systematic studies that have been conducted on adolescents have generally found that Indonesian adolescents consume inadequate amounts of protein, fruits and vegetables. Aim of this study was to analyse most recent nutritional status in Indonesian adolescent girls analysed by region (urban-rural). The study was conducted using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) method. Two hundred thirty-nine articles were found, then 15 articles met the inclusion criteria and narrative analysis. Articles were assessed against a critical appraisal tool. Adolescent girls had varied energy and macronutrient intakes of calories (908.25 - 2125 kcal), protein (24.16 - 55.7 g), fat (21.89 - 64.29 g), carbohydrate (128.89 - 258.6 g) and fibre (3.88 - 4.9 g). The intake of adolescent girls based on residents (urban and rural) was found to be different. Urban adolescents had higher energy intake (1398.77 - 1815.57 kcal) with protein (41.42 - 80.81 g), fat (64.29 g) and carbohydrate (231.26 g). Rural adolescents had energy intake (1250.2 - 1365.8 kcal) with protein (36.21 - 65.42 g), fat (46.49 g) and carbohydrate (207.15 g). Micronutrient intake of adolescent girls found iron 2.64 mg, zinc 2.09 mg and vitamin C 71.75 mg intake in urban adolescent girls and 979.65 mg in rural adolescent girls. Snacks and fast food were frequently consumed, with frequency > 4x/week for urban (37.7 % snacks, 98.5 % fast food) and rural (46.2 % snacks, 93.5 % fast food) adolescents. Twenty-eight percent of adolescent girls tended to skip breakfast. Macronutrient and micronutrient intakes of adolescent girls were less than the nutritional adequacy of 70 % energy, 50 % protein, < 50 % fat and 86 % carbohydrate and were found to differ between adolescent girls in urban and rural areas.

Key words: Food intake; Female adolescent; Macronutrients; Micronutrients.

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Introduction

Adolescence is a critical period for implementing health and nutrition behaviours, along with significant physical and psychological changes, thus requiring special attention in developing healthy living habits.¹ Indonesian Ministry of Health regulations define adolescents as those in

the age range of 10-18 years.² Failure to achieve optimal nutritional status in adolescence will impact the nutritional status and health of the next generation.³ One of the main nutritional problems of adolescents, especially adolescent girls in developing countries, is undernutrition.⁴

The problem of undernutrition in adolescent girls includes macronutrient and micronutrient deficiencies.⁵ Macronutrient deficiencies directly affect the height and weight of adolescents.⁶ Data from the 2018 Indonesian Basic Health Research showed that 25.75 % of adolescents aged 13-15 years and 26.9 % of adolescents aged 16-18 years had poor and very poor nutritional status. In addition, there were 8.7 % of adolescents aged 13-15 years and 8.1 % of adolescents aged 16-18 years with underweight conditions.⁷

Micronutrient deficiency in adolescents that receive a lot of attention is iron deficiency which can cause anaemia in adolescents.⁸ The prevalence of anaemia both globally and regionally is still high, Indonesia ranks 8th out of 11 countries in Asia after Sri Lanka with an anaemia prevalence of 7.5 million people.⁹ Basic Health Research shows anaemia in adolescent girls has increased from 2013 to 2018 by 18.4 % to 32.0 % in the age group of 15-24 years.¹⁰

Based on the 2019 nutrition adequacy rate, adolescent girls aged 13-15 years need 2025 kcal of energy, 65 g of protein, 70 g of fat and 300 g of carbohydrate. Meanwhile, adolescent girls aged 16-18 years need 2100 kcal of energy, 65 g of protein, 70 g of fat and 300 g of carbohydrates, as well as 26 mg of iron.¹¹ The intake of all nutrients both macronutrients and micronutrients is needed by the body in order to grow properly.¹² Adolescents need adequate food intake in terms of quality and quantity.¹³ This causes adolescents to consume varied or diverse foods to fulfil nutritional needs.^{14, 15} By considering a variety of foods, adolescents can fulfil their nutritional needs, including vitamins, minerals, proteins and essential fats.¹⁶ The positive impacts of a diverse diet include improved nutritional status,¹⁷ prevention of malnutrition¹⁸ and support for overall health.¹⁹ Furthermore, healthy eating habits established in adolescence also bring long-term benefits, creating a foundation for a balanced lifestyle and lifelong health well-being.²⁰

A national study looking at adolescent nutritional intake was conducted by Rachmi et al, by reviewing articles from 2000-2018 and found that Indonesian adolescents consume inadequate amounts of protein, fruits and vegetables, as well as excessive amounts of sodium and fast western foods.²¹ However, the study as a whole evaluated adolescents' intake, but it should be noted that

the nutrient intake and nutrient requirements may vary between adolescent boys and girls.

This study reviewed articles from the last 5 years 2018-2023 by specifically focusing on adolescent girls' intake. In addition, the researcher also sought to analyse regional differences, both urban and rural, to determine if there were significant differences.

Methods

A systematic review was conducted using narrative analysis to provide a comprehensive overview of the nutrition and dietary intake of adolescent girls in Indonesia. This systematic review was conducted using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework.²²

Articles were eligible if they fulfilled the following criteria: (1) cross-sectional (survey) studies, descriptive studies, baseline data from intervention studies and other relevant observational studies; (2) published between 2018 and 2023; (3) published in English and Bahasa Indonesian; (4) study participants were adolescent girls in Indonesia aged 10-19 years; (5) used dietary assessment methods, including 24-h recall, food records, food frequency questionnaires (FFQ) and (6) reported at least one of the following outcome measures: energy and macronutrient adequacy and/or micronutrients and food consumption.

A search strategy was developed for the English database, by entering: (1) prevalence (prevalence OR number* OR case*, incidence OR survey), (2) adolescents (adolescent* OR school-age OR young adult OR teen girls), (3) Indonesia (Indonesian*) and (4) eating pattern (eating habits OR eat* OR fruit OR vegetable OR food recall OR food OR frequency* OR consumption OR dietary intake) (5) nutrient (nutritional status OR food intake) (6) region (urban OR rural OR urban-rural). The results were then combined from 1 to 6 with AND. The search in Indonesian databases used similar/translated terms.

On 2 December 2023, a literature search was conducted through three English-language

databases (Scopus, ProQuest and PubMed). Four Indonesian-language journals (*Jurnal Gizi Masyarakat Indonesia*, *Jurnal Gizi dan Pangan*, *Jurnal Gizi Indonesia* and *Jurnal Kesehatan Badan Penelitian dan Pengembangan Kesehatan*), were also selected because they have been indexed by the Indonesian Ministry of Research and Technology using the Science and Technology Index.

Filters were applied for the time range 2018-2023, full-text articles and human studies. Titles and abstracts were screened, according to the inclusion criteria. A grey literature search was conducted through a customised Google search engine, organisations' websites. First, a Google search was conducted to identify relevant organisations. Such organisations included the Government of Indonesia (eg Ministry of Health and its agencies), non-governmental organisations (eg Nutrition International and Global Alliance for Improved Nutrition) and relevant United Nations agencies (eg World Health Organization). Second, each relevant website was browsed for reports, summaries and other documents that may be relevant. Title-abstract screening of all documents was conducted, followed by full text screening of potentially eligible documents to determine if the full text met the criteria.

Data collection

Data from the included studies were extracted into a template consisting of: (1) author, year; (2) study type; (3) sample size; (4) health condition (if available); (5) age; (6) location (eg district, city); (7) dietary component; (8) dietary assessment method; (9) main findings; (10) comments (if available); and (11) literature type (eg journal article, report). Narrative synthesis was used to summarise the results due to the heterogeneity of the studies and their outcomes.

Included studies were assessed for quality and risk of bias using an instrument developed by Loney et al²³ to score full-text articles based on three main criteria: validity of research methods (six points), interpretation of results (one point) and applicability of results (one point) (Table 1). Included studies scored six points or more. To maintain the quality of presented systematic review, the PRISMA checklist was followed as a guide in writing this review (Figure 1).

Nutrient intake > 80 % of the Indonesian Daily Nutrient Allowance was considered sufficient, while intake ≤ 80 % of the Indonesian Daily Nutrient Allowance was considered insufficient or deficient.

Results

The search identified 239 research articles that had been published in reputable journals both internationally and nationally. Removal of duplicates resulted in 132 full texts being screened, then based on the suitability of title and content 15 articles/documents were selected for inclusion in the analysis.

The included articles were cross-sectional studies (n = 15), with sample sizes ranging from 59 to 40,613 adolescent girls in different age ranges from 10-19 years (Table 2). The most frequently used dietary assessment methods were 24-hour food recall (n = 11), FFQ (n = 3) and Weigh Food Record (n = 1). The studies were conducted in different regions of Indonesia where 6 articles conducted studies comparing urban and rural areas and 9 articles reviewed in general in several regions in Indonesia.

Macronutrient intake

The macronutrient intake of adolescent girls in general is still below the recommended dietary allowances (RDA) for 2019 (Table 3). The average daily energy intake of adolescent girls was 50 %-70 % ie 908.25 kcal,²⁸ 1241 kcal,³⁵ 1353.4 kcal,³¹ 1431 kcal,³² 1467 kcal,³⁶ 1507.9 kcal,²⁴ 1514.4 kcal,²⁶ 1531.3 kcal,³⁴ 1762 kcal²⁹ to 2125 kcal.³⁶ The average daily protein intake of adolescent girls was only 37 %-50 %, ie 24.16 g,²⁸ 32.4 g,²⁴ 38.6 g,³⁵ 41.5 g,³⁶ 42.6 g,³² 43.4 g,³¹ 46.9 g,²⁷ 48.9 g³⁴ to 55.7 g.²⁶

The average daily fat intake of adolescent girls was < 50 % of the RDA, namely 21.89 g,²⁸ 31.2 g,³¹ 41.2 g,³⁵ 43.7 g,³² 49.8 g,²⁴ 51.3 g,³⁶ 52.7 g,²⁶ 59.6 g,³⁴ to 64.29 g.²⁵ The average daily carbohydrate intake of adolescent girls in general was 70 % - 86 %, namely 128.89 g,²⁸ 130 g,³⁶ 166.3 g,³⁵ 197.5 g,³⁴ 201 g,³⁶ 212.8 g,³² 219.6 g²⁶ 229.1 g³¹ to 258.6 g.²⁴ The daily fibre intake of adolescent girls was 3.88 g²⁴ to 4.9 g which was also still less than the RDA.³⁵

Protein and iron intake adequacy among high school girls in Depok, Indonesia (Khoirunnisa M, 2021) ³⁵	Y	Y	Y	Y	Y	Y	Y	Y	8
Problem nutrients in adolescent girls with anaemia versus nonanaemic adolescent girls and the optimised food-based recommendations to meet adequacy of these nutrients in adolescent school girls in East Java, Indonesia (Oy S, 2019) ³⁶	Y	Y	Y	Y	Y	Y	Y	Y	8
Differences of anaemia status, nutritional status and nutritional intake of adolescent girl in urban Andruralareas (Haya M, 2020) ³⁷	Y	Y	Y	Y	Y	Y	Y	Y	8
Social media-based nutrition education improves knowledge and energy-protein intake of adolescent girls with chronic energy deficiency (CED) (Zaki I, 2019) ³⁸	N	Y	Y	Y	Y	N/A	Y	Y	6

Y = yes; N = no; N/A = information not available in the paper;

Table 2: Main findings and characteristics of the included studies

Peer-reviewed literature								
Ref	Study type	Language	Sample (Size)	Specific location	Diary assessment	Nutrient intake	Nutrient adequacy by residence	
							Urban	Rural
24	Cross-sectional	English	Adolescent girls 12-18 years old (n = 222)	Tasikmalaya, Central Java	3 x recall 24 h	Average energy intake 72.8 % (1507.9 kcal).	N/A	N/A
25	Cross-sectional	English	Teenage girls (n = 77 urban; n = 65 rural)	Bogor	3 x recall 24 h	Average intake of urban adolescents 1815.57 kcal and average intake of rural adolescents 1365.80 kcal.	Y	Y
26	Cross-sectional	English	Adolescent girls 15-19 years old (n = 100)	Yogyakarta (Kidul)	3 x recall 24 h	The average energy intake was 1514.4 kcal. Micronutrient intake, especially iron and zinc, was below the nutritional adequacy level.	N/A	N/A

27	Cross-sectional	Indonesian	Islamic boarding school students (n = 96)	Makassar	3 x recall 24 h	Energy intake was 72.9 % deficient and 27.1 % sufficient.	N/A	N/A
28	Cross-sectional	English	Adolescent girls (n = 157)	Bandung (Rural)	FFQ	The average macronutrient intake of adolescents was all below the recommended nutrient intake (< 50 % of the recommended nutrient intake). Energy intake was 908.25 kcal.	N/A	Y
29	Cross-sectional	English	Adolescent girls (n = 323)	Jakarta	2-day weighed food record	Adolescent girls had a daily food consumption of about 2084 g per capita per day. Their average calorie intake was about 1762 kcal per capita per day.	N/A	N/A
30	Cross-sectional	Indonesian	Adolescent girls (n = 88)	Kendal, Central Java	SQ-FFQ and 2 x recall 24 h	Chicken eggs were the most consumed food group of animal protein sources with an average of 41.44 g per day.	N/A	N/A
31	Cross-sectional	Indonesian	Teenage girls (n = 59)	Hammer	2 x recall 24 h	Energy intake was less in respondents as much as (93.2 %) with an average consumption of 1353.4 kcal and had not met the nutritional adequacy rate.	N/A	N/A
32	Cross-sectional	English	Teenage girls (n = 78)	Yogyakarta	SQ-FFQ	The average intake of adolescent girls in Yogyakarta was 1431 kcal.	N/A	N/A
33	Cross-sectional	English	Adolescent girls (n = 40,613)	Indonesia	SQ-FFQ and recall 24 h	The percentage of adolescent girls who consumed sugar-sweetened beverages and foods more than once a day was higher in urban areas (53.9 %) compared to rural areas (46.1 %).	Y	Y
34	Cross-sectional	English	Teenage girls (n = 220)	Central Jakarta	Recall 24 h	The average energy intake of adolescents was 1531.3 kcal/day	Y	N/A
35	Cross-sectional	English	Adolescent girls (n = 211)	Depok	2 x recall 24 h	The average intake of adolescent girls was found to be 1241 kcal. Protein intake was 38.6 g, fat 41.2 g and carbohydrate 166.3 g. Fibre intake was 4.9 g.	N/A	N/A
36	Cross-sectional	English	Adolescent girls (n = 147)	East Java	2 x recall 24 h and 5-day food records	The mean intake of adolescents in the anaemia group was 2125 kcal/day, median protein 41.5 g/day, and the non-anaemia group 1467 kcal/day.	N/A	N/A
37	Cross-sectional	Indonesian	Adolescent girls (rural = 65, urban = 65)	Bengkulu and North Bengkulu	SQ-FFQ	The mean protein intake of adolescent girls in urban areas (80.81 g) was higher than that of girls in rural areas (65.42 g).	Y	Y
38	Cross-sectional	Indonesian	Teenage girls with SEZ (rural = 56, urban = 54)	Baturaden and Purwokerto	2 x recall 24 h	The average energy intake of rural adolescent girls was 1250.22 kcal, while the calorific intake of urban adolescent girls was 1398.77 kcal.	Y	Y

FFQ = food frequency questionnaire; SQ-FFQ = semi-quantitative food frequency questionnaire;

Table 3: The 2019 Indonesian RDA for adolescent girls 10-19 years of age¹¹

Nutrients	Age group (years)			
	10-12	13-15	16-18	19-29
Energy (kcal)	1900	2050	2100	2250
Protein (g)	55	65	65	60
Fat (g)	65	70	70	65
Carbohydrate (g)	280	300	300	360
Fibre (g)	27	29	29	32
Vitamin A (RE)	600	600	600	600
Vitamin C (mg)	50	65	75	75
Vitamin D (mcg)	15	15	15	15
Folic Acid (mcg)	400	400	400	400
Iron (mg)	8	15	15	18
Calcium (mg)	1200	1200	1200	1000
Sodium (mg)	1400	1500	1600	1500
Zinc (mg)	8	9	9	8

¹¹Indonesian Ministry of Health Regulation No 28, 201911; RDA: Recommended dietary allowances;

The macronutrient intake of adolescent girls based on residents (urban and rural) was found to be quite different, namely the daily energy intake of urban adolescents was 90 % of the RDA of 1398.77 kcal³⁸ to 1815.57 kcal²⁵ while the daily energy intake of adolescent girls in rural areas was 1250.2 kcal³⁸ to 1365.8 kcal.²⁵ The daily protein intake of urban adolescent girls was 41.42 g,³⁸ 58.33 g²⁵ to 80.81 g³⁷ while the daily protein intake of rural adolescent girls was 36.21 g³⁸ to 65.42 g.²⁵

The proportion of adolescent girls with insufficient protein intake was higher in rural areas at 16.5 % than in urban areas at 4.6 %.³⁷ The daily fat intake of urban adolescent girls was higher at 64.29 g compared to rural girls at 46.49 g. The daily carbohydrate intake of urban adolescent girls was also higher at 231.26 g compared to rural adolescent girls at 207.15 g.²⁵

Micronutrient intake

Micronutrient intake of adolescent girls in general was found to be less than the RDA in 2019, especially iron (2.64 mg - 7.2 mg) and zinc (2.09 mg - 6.6 mg) intake were below the RDA. Vitamin A intake (77.10- 1082.5 IU); vitamin E (1.40 mg); vitamin B1 (0.19- 1.9 IU); vitamin B2 (0.29 mg - 9.1 mg); vitamin B6 (0.45 mg - 1.1 mg); vitamin B12 (1.9 IU); folic acid (35.13- 118.0 IU); vitamin C (12.60 mg - 21.9 mg); calcium (197.46 mg - 281.8 mg); magnesium (93.72 mg).^{28, 34} Sodium intake was 698 mg and potassium intake was 1015 mg.³² Micronutrient intake, especially vitamin C intake

of adolescent girls in urban areas was lower at 71.75 mg compared to girls in rural areas at 79.65 mg, the proportion of vitamin C deficiency in adolescent girls in urban and rural areas was 49.2 %.³⁷

Food intake

Adolescent girls had a daily food consumption of about 2084 g per capita per day with cereals and cereal products being the main contributors. Beverages, cereals, cereal products and vegetable-based foods were the main contributors to this consumption.²⁹ Eggs, chicken and poultry products were the main sources of protein contributing about 3.6-5.0 % of total protein intake.³⁰ Fat intake varied, for example, fat from bakery products was about 1.99 g per capita per day, while from beverages was about 4.13 g and from cereals was about 10.59 g.²⁹ Respondents also rarely consumed fruits meat and milk.³¹

Intake differences between urban and rural adolescent girls

A comparison of dietary patterns between urban and rural adolescents showed significant differences. Urban girls tended to consume more breakfast, meat and dairy products than rural one.²⁵ In contrast, rural girls had a higher intake of fruits and vegetables (> 5 servings/day).³³ The energy, protein, fat and carbohydrate intake of urban girls was also significantly higher, mainly from breakfast and snacks, compared to rural girls.²⁵

The percentage of adolescent girls who consumed sugar-sweetened beverages and foods more than once a day was higher in urban areas compared to rural areas (53.9 % and 46.1 %, respectively). Adolescent girls in urban areas had a higher percentage of consuming coffee more than once a day (9.2 %) compared to those in rural areas (5.1 %). The percentage of adolescent girls consuming caffeinated drinks and energy drinks more than once a day was slightly higher in urban areas (3.8 %) compared to rural areas (3.4 %).³³

Urban children had significantly higher intakes of energy, protein, fat and carbohydrates, especially from breakfast and snacks, compared to rural children. However, protein intake was below RDA (< 90 %), while fat intake exceeded RDA (> 110 %) for both groups.²⁵

Adolescent girls in urban areas had a higher percentage of consuming fried fatty foods more than once a day (38.8 %) compared to those in rural areas (30.7 %). The percentage of adolescent girls consuming refined carbohydrates more than once a day was higher in urban areas (24.1 %) compared to rural areas (16.8 %). Adolescent girls in urban areas had a higher percentage of consuming processed meat more than once a day (6.5 %) compared to those in rural areas (4.1 %). Adolescent girls in rural areas had a higher percentage of consuming baked goods more than once a day (5.1 %) compared to those in urban areas (4.9 %).³³

Discussion

This study aimed to provide an overview of the adequacy of energy and nutrient intake of Indonesian people, especially adolescent girls and the foods most commonly consumed.

Nutrient adequacy

Indonesian adolescent girls face major challenges in achieving a balanced diet.³⁹ Aspects such as access and availability of nutritious food, tendency to consume unhealthy food, socioeconomic status and environmental impacts are factors that play a significant role.¹⁵ In general, the diets of adolescent girls in Indonesia show a tendency to consume protein from animal sources, fruit and vegetables less than five days a week.³³ In terms of nutrition, adolescent girls adopt a diet high in processed foods, fizzy drinks and flour-based snacks that are low in protein and micronutrients.²⁸ Variety in the diet of adolescent girls is quite limited, with the daily diet dominated by rice, tempeh or tofu, few vegetables, instant noodles and wheat flour crackers.⁴⁰ Although some adolescent girls have knowledge about healthy food, their daily eating practices do not always reflect this knowledge. This condition can have a negative impact on their growth and development.⁴¹

Data on the food and nutrition intake of adolescents in Indonesia reveal that only about 18.8 % of them consume protein from animal sources, fruits and vegetables more than 5 days a week. Analysis of the national Basic Health Survey indicated that 38.1 % of adolescents aged 6-12

years and 27.1 % of adolescents aged 13-19 years experienced nutrient deficiencies. Another finding was that 75.2 % of Indonesian adolescents aged 13-15 years consumed less than 5 servings of fruits and vegetables per day, while 98.4 % of adolescents aged 13-18 years had inadequate fruit and vegetable consumption.²¹

Adolescent macronutrient intake, especially protein analysis showed that many adolescents like chicken eggs. Chicken eggs, is a food group of animal protein sources with an average weight of about 41.44 g per day and a daily frequency of about 0.59 times. Meanwhile, tempeh was the most consumed vegetable protein source food, with an average weight of about 32.62 g per day and a daily frequency of about 0.49 times. The processing of protein source foods favoured by adolescents were processed by frying, grilling, steaming, stir-frying and boiling, respectively.³⁰

The micronutrient intake of adolescent girls in Indonesia is still below the RDA, reflecting significant challenges in fulfilling essential nutrient needs.⁴² Average daily intake data showed that around 53 % of adolescent girls aged 13-18 years consume less than 70 % of the RDA, signalling potential nutrient deficiencies that could negatively impact their health.³¹ Intakes of micronutrients such as vitamin A, vitamin E, vitamin B1, vitamin B2, vitamin B6, folic acid, vitamin C, calcium, magnesium, iron and zinc, were all below the RDA, with rates of less than 50 % of the nutrient intakes.²⁸

It is important to note that these micronutrients play a crucial role in the growth and development of adolescent girls, such as iron which is needed to prevent anaemia that can affect their well-being and daily activities.⁴³ To ensure optimal health and full potential, there needs to be a concerted effort between the government, community and health sector to increase awareness, education and access to micronutrient-rich foods.⁴⁴

Food intake of urban-rural adolescent girls

The lifestyles and dietary habits of adolescents were found to be quite different among adolescent girls in rural and urban areas. In rural areas, adolescents often have eating habits influenced by traditional and local food practices. This includes higher consumption of staple foods such as grains, legumes and vegetables, as well as traditional cooking methods, such as steaming, boiling and

grilling. The study found that adolescent girls in rural areas had a higher percentage of consuming fruits and vegetables (≥ 5 servings/day).³³

In urban areas, teenagers may have access to a variety of food options, including fast food restaurants, convenience stores and supermarkets. This may lead to higher consumption of processed and convenience foods, which are often high in sugar, salt and fat. Preferences for foods such as burgers and street food, which are easily accessible to urban adolescent girls in their neighbourhoods, play an important role in shaping their diets. In the midst of busy urban life, the availability of fast food restaurants and retailers in their neighbourhood gives teenagers more options for convenience foods.⁴⁵

Adolescent intake below the RDA can also be influenced by weight loss diets that many women do to get the ideal weight without knowing what their ideal weight should be.⁴⁶ Adolescent girls exhibit unhealthy eating patterns, including diets that lack variety. This means their food choices are limited and less varied.⁴⁷ The availability of healthy food options, such as fresh fruit and juices, is limited in their school canteens. The girls' eating behaviour is influenced by individual factors such as personal preferences and food prices, as well as environmental factors including family, school and neighbourhood. Although the girls had some knowledge about healthy food, their daily eating practices were not in line with this knowledge.⁴⁸ The percentage of adolescent girls who consumed sugar-sweetened beverages and foods more than once a day was higher in urban areas compared to rural areas. Adolescent girls in urban areas had a higher percentage of consuming coffee more than once a day compared to those in rural areas.³³

The percentage of adolescent girls consuming caffeinated drinks and energy drinks more than once a day was slightly higher in urban areas. Adolescent girls in urban areas had a higher percentage of consuming fried fatty foods, refined carbohydrates and processed meat more than once a day compared to those in rural areas.³³

Adolescent girls in rural areas had a higher percentage of consuming baked goods more than once a day (5.1 %) compared to those in urban areas (4.9 %).⁴⁹ In addition, the eating habits of adolescent girls attending regular schools and boarding schools were also different. Students

in boarding schools are bound to the food served in the boarding school environment. While some fulfil their nutritional needs, there is a tendency to snack more among regular class students.²⁷

The significant variation in energy intake between urban and rural adolescent girls is related to accessibility to food. Urban children tend to have greater access to a variety of food options, including convenient snacks, potentially increasing their daily energy intake. In contrast, rural children may experience limited access to a variety of nutritious foods on a daily basis.

Deficiencies in micronutrients such as iron, zinc and some vitamins are a major problem among adolescent girls, which can result in anaemia and impaired growth. Differences in diet also affect macronutrient intake, with urban adolescents tending to consume more processed foods and fast foods rich in fat and carbohydrates, while rural adolescents rely more on traditional diets rich in fruits, vegetables and plant-based proteins.

Local socio-economic and cultural factors play a role in determining food preferences and access to food. Development of appropriate interventions is needed to improve balanced diets and fulfil the nutritional needs of adolescent girls in both settings, including efforts to increase access to nutritious foods and comprehensive nutrition education.

Snacking frequencies

The consumption of traditional snacks among adolescent girls has declined and they are turning to the consumption of packaged snacks that are less healthy. The habit of consuming unhealthy snacks or snacking especially in the room, has an impact on the habit of skipping main meals, especially dinner.³² Moreover, it is influenced by the perception that skipping meals can help in weight loss or weight maintenance.³³

In the previous systematic review related to adolescent intake conducted by Rachmi et al, it was found that in general adolescents in Indonesia consume snacks such as instant noodles, bakwan, candy, chocolate, fried bananas and fried tofu with a frequency of 3-6 times / week. In this systematic review, it was found that the types of snacks consumed by adolescents were chips, cakes, chocolate and soft drinks. Meanwhile, it was also found that the snack consumption of adolescent girls who attended public schools was

different from that of Islamic boarding school girls. The diet of students tends to follow the menu at the boarding school and they are not freely able to access snacks from outside such as fizzy drinks. In addition, the nutritional intake of snacks consumed by adolescent girls in urban and rural areas was found to be different, snacks contributed significantly higher protein and fat intake for urban groups compared to rural areas. The frequency of snack consumption differed between adolescents in rural and urban areas, with 37.7 % of urban adolescent girls consuming snacks > 4 x per week and 46.2 % of rural adolescent girls. The frequency of snacks for urban girls that were fast food was 98.5 % and rural girls 93.5 %.⁴³

Breakfast habit

In the previous systematic review related to adolescent intake conducted by Rachmi et al showed that as many as 78.9 %- 92.3 % of adolescents aged 10-19 years were used to having breakfast regularly and 16.7 %- 47.5 % were not used to having breakfast.²¹ In this systematic review, it was found that some adolescents (28 %) tended to skip breakfast.³¹ Nutrient intake from breakfast was higher among rural adolescent girls 26.75 % than urban adolescent girls 23.86 %. Meanwhile, the snack intake of urban adolescent girls was higher at 27.55 % compared to rural girls at 25.13 %.²⁵

Habitually skipping breakfast can have a significant negative impact on adolescent girls' energy intake and nutrition.⁵⁰ Breakfast plays an important role in providing the energy source needed for an optimal start to the day.⁵¹ By skipping breakfast, adolescents are likely to lack energy which can impact their concentration levels and academic performance.⁵² In addition, breakfast also provides an opportunity to consume essential nutrients such as vitamins and minerals that are necessary for healthy growth and development.⁵³ The habit of skipping breakfast, if continued, can lead to nutritional imbalances and increase the risk of long-term health problems.⁵⁴ Therefore, it is important to raise awareness of the importance of breakfast and encourage adolescent girls to adopt balanced eating habits and support their overall health.⁵⁵

The habit of skipping breakfast among adolescents, especially in urban environments, is influenced by busy lifestyles and accessibility to

fast food.⁵⁶ This often influences their decisions regarding breakfast at home in favour of snacks outside the home.⁵⁷ Factors such as food accessibility, local preferences and tradition-based diets play a role in shaping adolescents' breakfast habits in different environments.⁵⁸ Therefore, nutrition education and balanced diet promotion efforts should consider these contextual differences to achieve more effective results in improving adolescents' eating habits in general.⁵⁹

Adolescent girls in Indonesia face serious challenges in achieving adequate nutrient intake, especially micronutrients such as vitamin A, vitamin C, calcium, magnesium, iron and zinc. Their diets tend to be dominated by processed foods, fizzy drinks and low-nutrient snacks. Dietary differences between urban and rural adolescents reflect disparities in access to nutritious foods, with urban adolescents tending to have greater access to fast food. The policy implications of these findings emphasise the need for greater interventions to increase nutrition awareness, limit easy access to unhealthy foods around schools and increase accessibility to fresh fruits and vegetables. Collaboration between the government, private sector and civil society is needed to achieve improvements in the diets and nutritional status of adolescent girls in Indonesia.

Strengths and limitations

This systematic is a follow-up systematic to the previous systematic review by Rachmi et al, which reviewed the eating habits of adolescents in Indonesia in general from 2000-2018. This systematic is an update by reviewing articles for the last 5 years (2018-2023) and specifically looking at adolescent girls. In addition, this systematic also more deeply reviewed the eating habits of adolescent girls by region (urban-rural). Therefore, this report is likely to provide the most comprehensive information on the nutrition and dietary intake of adolescent girls in Indonesia. In addition, a wide range of intake data is reported, including macronutrient and micronutrient intakes, as well as food consumption, understanding the adequacy of macronutrient and micronutrient intakes to enable the Government of Indonesia to develop initiatives related to improving adolescent nutrition, also called preconception nutrition, as adolescent girls are future mothers.

Poor reporting of tool validity was noted. Most studies used 24-h recall or FFQ, where the memory of respondents, in this case adolescent girls, becomes very important to reduce information bias. The expertise of the researcher in conducting interviews with adolescent girls may be insufficient. Misreporting of food intake is common in dietary surveys, which can lead to difficulties in estimating adequacy and potential inaccuracies in undernutrition reporting. Therefore, although this review provides a comprehensive picture, the potential for misreporting should still be considered. Limitations of the study were also due to some areas in Indonesia where no monitoring of adolescent dietary intake had been conducted with a large sample.

This review has two main limitations. Firstly, the age grouping between studies was inconsistent, limiting the ability to conduct a review. Differences between the age groups in the studies and the age groups used in the Indonesian RDA also prevented a single comparison between the studies and allowed for relationship bias.

The importance of a national micronutrient survey

Surveys of macronutrient and micronutrient dietary intake among adolescent girls in Indonesia are of immense importance in the context of their health and well-being. Firstly, an in-depth understanding of the diets of adolescent girls allows the identification of trends in the consumption of macronutrients such as carbohydrates, protein and fat. This provides a basis for designing appropriate nutrition programmes, including education on healthy food selection and the importance of nutritional balance in the daily diet.

In addition, the survey provides critical insights into the intake of micronutrients, such as vitamins and minerals, which are essential for adolescent girls' growth and development. Knowing the level of micronutrient consumption can help identify the risk of nutritional deficiencies that can negatively impact long-term health, including the risk of developmental disorders, low immunity and other health problems.

The survey also provides the necessary data base for governments, health agencies and non-governmental organisations to design more effective and targeted nutrition policies. By understanding the nutritional conditions of adolescent girls more specifically, targeted intervention programmes can be implemented to improve the quality of the food they consume. This survey provides a better understanding of the environmental, social and cultural factors that influence adolescent girls' diets.

Opportunities for further research

There are two recommendations for future research in adolescent girl nutrition. Firstly, more regional studies on adolescent girls' nutritional intake are needed to support evidence-based local policy making to improve the nutritional status of adolescent girls. These regional studies would be useful to provide more context, such as the nutritional intake of a particular tribe or community, which is unique. Secondly, future research is needed on the nutritional status of adolescent girls in general and appropriate interventions based on their dietary intake and nutrition.

Conclusion

This systematic review highlights the dietary and nutritional intake of adolescent girls in Indonesia by urban and rural regions. Adolescent girls in Indonesia face challenges in achieving adequate nutrient intake, with diets dominated by rice, tempeh and tofu. Urban adolescents tend to consume more processed foods and fast food, while rural adolescents rely more on traditional diets with more fruits and vegetables. Iron and vitamin deficiencies remain a serious problem. Adolescent nutrition programmes need to be implemented with a focus on integrated nutrition education in education and communities, improving access to nutritious foods and involving stakeholders for monitoring and evaluation. Future research should explore analyses of nutrient consumption, the effectiveness of community-based interventions and factors that influence the availability of nutritious foods in Indonesia.

Ethics

This study was a secondary analysis based on the currently existing data and did not directly involve with human participants or experimental animals. Therefore, the ethics approval was not required in this paper.

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Conflicts of interest

The authors declare that there is no conflict of interest.

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Data access

The data that support the findings of this study are available from the corresponding author upon reasonable individual request.

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