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REVIEW

Anthropometry Indices and Body Composition in Adolescent Girls with Anemia: A Scoping Review

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Abstract: To reduce anemia rates, it is crucial to gain a deeper understanding of anemia and its associated factors. It is essential for teenagers who are going through a period of rapid growth to promptly address anemia since untreated anemia can negatively impact their reproductive health. This literature review investigated the relationship between nutritional and anthropometric status indicators, body composition, and prevalence of anemia in teenage girls. Studies were selected based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) criteria. A comprehensive search across multiple databases (PubMed= 409, ScienceDirect= 3153, Scopus= 4, Sage Journals= 358) and manual citation of five articles yielded 3929 articles, of which 630 were excluded for irrelevance, one was inaccessible, and nine articles were included in the study after assessing their eligibility. The review's findings suggest that indicators such as Body Mass Index (BMI) and Mid-Upper Arm Circumference (MUAC) are indicated as initial assessments to screen the nutritional status of adolescent females and estimate their risk of anemia. Only one article has specifically discussed the connection between fat mass and anemia in terms of body composition. The need for studies on anthropometry and body composition-related anemia underscores the need to broaden investigations to gain a more nuanced understanding of this subject.

Keywords: anthropometry, body composition, female adolescents, anemia

Introduction

Anemia is a pervasive global health concern that contributes substantially to both morbidity and mortality.[1–3] Women of reproductive age account for up to 31.2% of those affected by anemia.[4] Anemia prevalence among women aged 15–49 years is a key indicator in Sustainable Development Goals (SDGs) target 2.2.3, to achieve a 50% reduction in anemia prevalence by 2030.[5] Nevertheless, estimation evaluations indicate that the present rate of anemia reduction is inadequate to attain this objective.[6] Consequently, there is an urgent need to gain a more profound comprehension of anemia and the underlying causes that contribute to its development.

Anemia can arise from multiple sources, such as erythropoiesis abnormalities, hemolysis, and blood loss.[7] Nutritional deficit is the primary cause of anemia in erythropoiesis. This deficiency is characterized by a scarcity of vital elements required to synthesize red blood cells, including iron, folic acid, and vitamin B12.[1,8] Iron deficiency is currently the leading cause of anemia globally and has a significant role in the high prevalence of anemia among adolescent girls aged 10–14 years.[1,9] Untreated anemia in teenage girls can have detrimental effects on physical growth and development, impair cognitive ability, and jeopardize a healthy reproductive life cycle.[10,11] Intensive human development occurs

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primarily during the first twenty years of life. To maximize the potential for improving future maternal and child health, it is essential to sustain and enhance earlier investments by focusing on the health and well-being of adolescents.[9] Ensuring adolescent health to be sufficient has become the goal to secure the future generation.

During adolescence, rapid physical growth and development make it crucial to ensure adequate nutrition. A well-balanced diet is essential and has a significant impact on preventing iron deficiency.[1] Imbalanced nutritional intake can lead to deficits or excesses in various elements of nutritional status, such as food consumption, dietary conditions, body tissue mass, and physical activity levels. Nutritional status pertains to the overall health condition of an individual or a population, which is determined by the intake, assimilation, and use of nutrients obtained from the diet.[12] Comprehending the nutritional status is crucial for assessing the equilibrium between consumption, assimilation, and utilization of food nutrients in the body.

Nutrients are utilized to run the body's metabolism, and they should be consumed in proper amounts. By having a sufficient energy source (fat), the body could avoid starvation and have enough fuel to function as well as rebuild the new erythrocyte. Proteins are building blocks of the body and play crucial roles in the structure, function, and regulation of tissues and organs. In erythropoiesis, proteins play an important role in the synthesis of hemoglobin, regulation by erythropoietin, involvement in intracellular signaling, maintenance of cell structure, and facilitation of correct folding and assembly of protein complexes.

Assessment of nutritional status is necessary for conducting individual-level and population-level clinical evaluations in epidemiological and public health research. These evaluations include anthropometric measures that provide valuable information for formulating public policies.[13] Nevertheless, these measurements by themselves are insufficient to yield precise body composition data.[14] Anthropometry and body composition examinations are frequently employed to detect and diagnose several nutritional problems in adults and adolescents, such as excessive weight, obesity, and inadequate dietary intake.[15] Incorporating body composition assessment into a nutritional evaluation is advised to determine the ratio of fat mass to fat-free mass, which includes skeletal muscle, bones, organs, ligaments, and water that could not be measured by anthropometry assessment.[14]

Some studies have found that underweight conditions are associated with iron deficiency anemia.[16,17] The likelihood of anemia is higher in women with low BMI and upper arm circumference.[18,19] Iron deficiency is also commonly found in individuals with excess nutritional status or obesity.[20–23] Iron deficiency can occur in individuals with excess fat due to adipose tissue inflammation, which suppresses iron absorption in the gastrointestinal tract.[24–26]

Since 2011, the World Health Organization (WHO) has recommended iron supplementation as the drug of choice to prevent and mitigate anemia in adolescents. We try to obtain research that took place after the recommendation. This study examined indicators previously used in research to propose a new method or more precise measurement for screening anemia, aiming to enhance the understanding of its causes.

Methods

This literature review utilized the scoping review method, which is a systematic strategy for examining and mapping research information. We follow the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) guidelines and adopt the search stages of the PRISMA flowchart.[27]

Research Question

The review aimed to understand nutritional status among adolescent girls who suffered from anemia. Therefore, the research formed was, "Is there any correlation between anthropometry measurements of nutritional status also body composition and iron deficiency anemia in adolescent girls?"

Eligibility Criteria

Adolescent females aged 10–19 years were the investigation's focus, per the review's objectives. The exposure included anthropometric and body composition measurements. The outcome of the investigation was iron deficiency anemia. This study was not limited to specific regional boundaries. The article's publication timeframe was restricted to 2011 and 2024. The authors selected 2011 specifically because the World Health Organization (WHO) recommended the implementation of supplementation programs to prevent and reduce anemia among adolescents during that year. To qualify for inclusion, articles were required to meet the following criteria: (1) original articles written in English, (2) indexed journals, (3) peer-reviewed journals, and (4) full-text articles. Furthermore, the author excluded duplicate articles, review articles, thesis/dissertation papers, articles focused on pregnancy, and articles that did not specifically address the correlation between anthropometric measures, body composition, and iron deficiency anemia. Articles with insignificant outcomes or unrelated statistical analyses were included.

Search Strategy

After formulating the research question, the PEO framework terms were adapted using MeSH terms to retrieve search results that were aligned with the study objectives. Following the adjustment of MeSH terms into a Boolean format, keywords were generated in the following sequence: “female adolescents” AND ”body weights and measures” OR ”body composition” AND ”anemia”. Articles were searched between March and April 2024.

Selection Process

We searched PubMed, ScienceDirect, Scopus, and Sage Journals databases. A PRISMA flow diagram (Figure 1) was adapted to identify the articles. This flowchart consists of three stages: identification, screening, and inclusion. During the identification phase (Stage I), the quantity of articles retrieved from a database search and the amount that remains after eliminating duplicates are determined. Automation tools were employed at this stage to filter articles based on criteria such as language (English), full-text availability, research article classification, and open access status. The screening phase (Stage II) involved sorting articles according to research questions and eligibility criteria, specifically using keywords, titles, and abstracts. In the inclusion phase (Stage III), articles were evaluated by examining the full text of the articles that were successfully retrieved. During this stage, the authors screened the eligible articles for review. The considered literature sources must meet specific criteria, including being sourced from indexed journals, being peer-

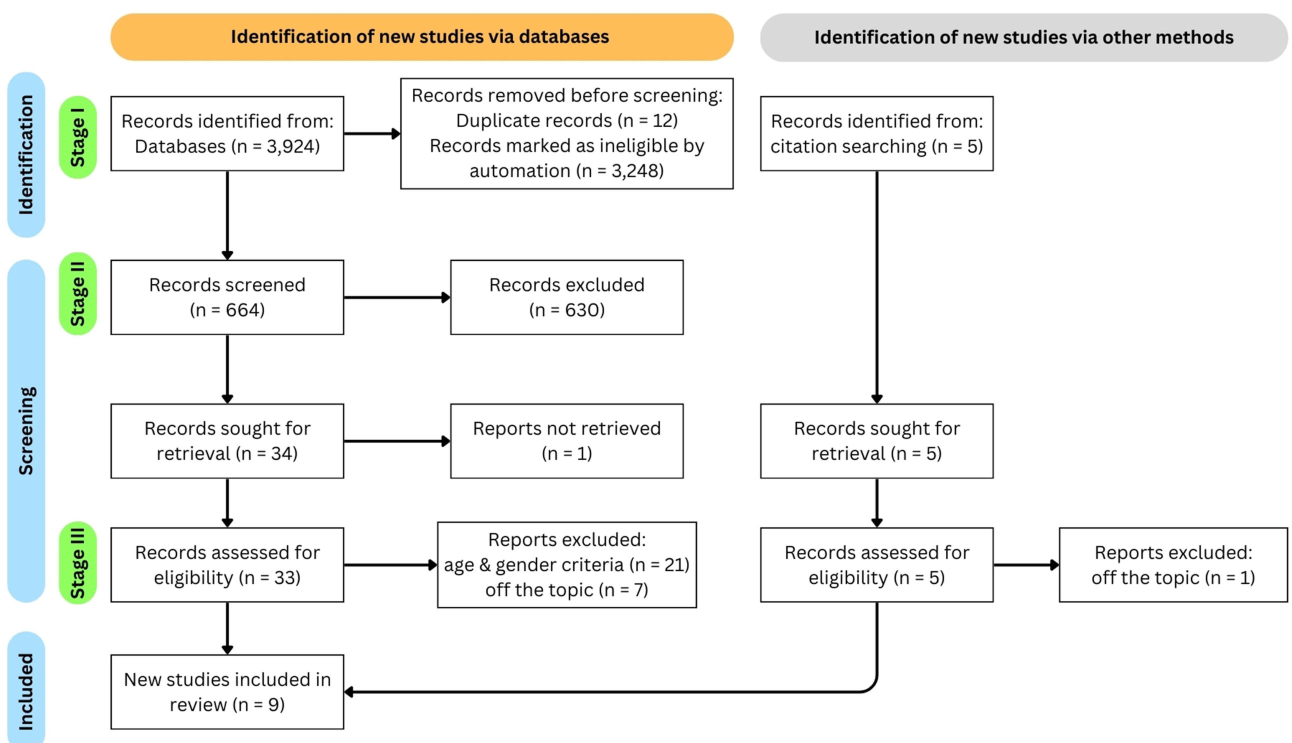

Figure 1 PRISMA flowchart of articles selection process from 2011–2024. Stage I.
Note: Adapted from Page MJ, McKenzie JE, Bossuyt PM et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ* 2021; 372. Creative Commons.

reviewed, having an ISSN number, and having a clearly identified journal number and volume. Only papers that fulfilled these criteria were considered in the final step of the review process.

Results

The results reported findings from studies that explored the relationship between nutritional status through anthropometric measures and body composition with anemia. We determined the articles based on profile, characteristics, demographic profile, and findings from the statistical analysis performed in the articles.

The Study Profile Counts

A total of 3924 articles were identified after a comprehensive search across multiple databases (PubMed= 409, ScienceDirect= 3153, Scopus= 4, Sage Journals= 358), and another five articles from other sources were manually cited. Twelve duplicate articles and 3248 records identified as ineligible by automated criteria were excluded. After screening titles and abstracts, 630 articles were excluded because they were irrelevant to the topic. Additionally, one article could not be retrieved from database because of limited access. After assessing 38 articles for eligibility, nine publications from databases and other sources were deemed suitable for inclusion in the study.

The Study Demographic Profiles

Based on the results, most of selected articles on demographic features came from the Asia-Pacific region (Figure 2). This phenomenon can be attributed to food insecurity and the restricted range of food varieties that are accessible. According to the Food and Agriculture Organization (FAO), the Asia and Pacific area was responsible for 50% of the overall acute food insecurity.[28] It is known that food insecurity presents a significant obstacle to providing adequate nutrition services for adolescent girls.[29] Efforts to combat food insecurity are accompanied by comprehensive research, including studies on the nutritional condition of teenage girls and its correlation with anemia.

Characteristics of the Studies

We identified the characteristics based on the authors' names and publication years, the country where the research was conducted, and the titles, objectives, participant details, and study methods. The profiles of the studies included in this scoping review are presented in Table 1. The number of participants varied between 292 and 10,231. Although the original participants in most studies were not exclusively adolescents, a group of female adolescents was included in the

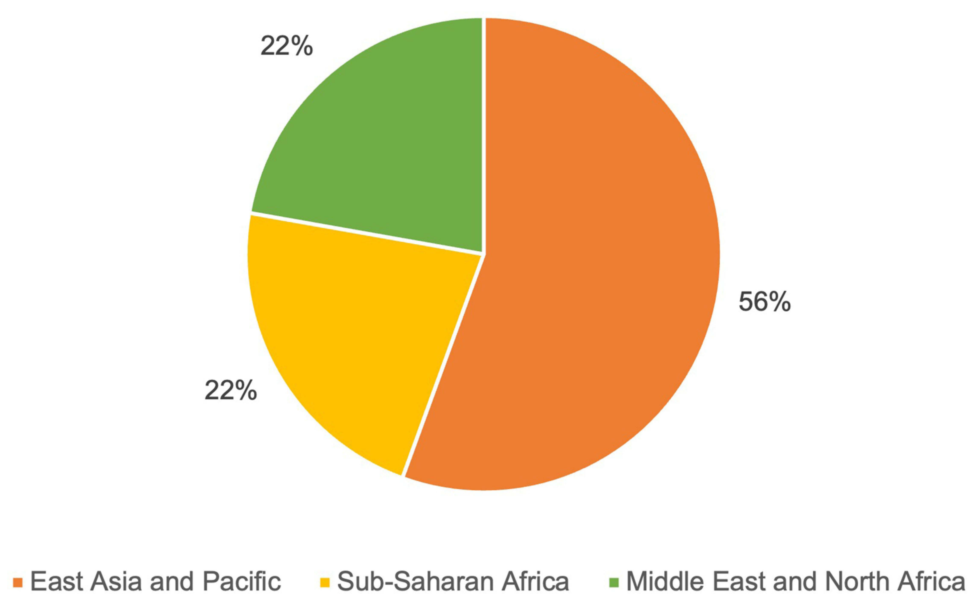

Figure 2 Characteristics of selected articles by continent (n = 9).

Table 1 The Characteristics of Selected Studies (n = 9)

Author (s)/ Year	Country	Title	Objectives	Participation	Methods	Findings
Alquaiz et al (2015)[31]	Kingdom of Saudi Arabia	Prevalence and correlates of anemia in adolescents in Riyadh city, Kingdom of Saudi Arabia	To identify the prevalence and correlates of anemia among male and female adolescents in Riyadh.	203 male and 292 female adolescents aged 13–18 years	A cross-sectional community-based study	In female adolescents, being overweight (OR=3 ·0; 95% CI 1 ·4, 6 ·1) was significantly associated with anemia
Huang et al (2015)[32]	Taiwan	Relationship Between being Overweight and Iron Deficiency in Adolescents	This study aimed to investigate the relationship between overweight status and body iron levels in Taiwanese adolescents.	2099 adolescents (1327 female) aged 12–19 years	Cross-sectional study	The Pearson correlation coefficient of linear regression was positive for BMI-hemoglobin, BMI-Plasma Ferritin, but negative for BMI-Serum Iron. The percentages of anemia declined significantly as body weight increased from underweight to obesity groups (p Z 0.002)
Teji et al (2016)[33]	Ethiopia	Anemia and nutritional status of adolescent girls in Babile District, Eastern Ethiopia	Evaluating the severity of anemia and the nutritional condition of teenage girls in the Babile district of Eastern Ethiopia.	547 adolescent girls aged 10–19 years	Cross sectional study	The correlation between anemia and nutritional status proven to be insignificance.
Mehdad et al (2022)[34]	Morocco	Association between overweight and anemia in Moroccan adolescents: a cross-sectional study	The aim of this research is to assess how often anemia occurs and its relationship with obesity and body fat among adolescents living in Morocco.	292 adolescents (196 girls and 96 boys) aged 11–17 years	A descriptive cross-sectional survey	Among teenage females, the prevalence of anemia is potentially greater in persons with a larger amount of body fat compared to those with lower body fat (odds ratio: 1.64; 95% confidence interval: 0.69–3.87). There was a significant correlation between having too much body fat and decreased hemoglobin levels (P = 0.041). An inverse relationship exists between the concentration of hemoglobin and the body mass index (BMI) in teenage girls suffering from anemia.
Srivastava et al (2022)[30]	India	Effect of change in individual and household level characteristics on anemia prevalence among adolescent boys and girls in India	To investigate how alterations in factors at both the individual and household levels influence the prevalence of anemia among adolescent boys and girls.	4216 and 5974 unmarried adolescent boys and girls aged 10–19 years	A longitudinal study.	The analysis using category underweight (BMI less than 18.5) and thin (BMI-for- age Z-score<-2SD) both was found to be insignificant in adolescent girls.

(*Continued*)

Table 1 (Continued).

Author (s)/ Year	Country	Title	Objectives	Participation	Methods	Findings
Sigit et al (2024)[35]	Indonesia	Factors influencing the prevalence of anemia in female adolescents: A population-based study of rural setting in Karanganyar, Indonesia	The aim of this study is to investigate the occurrence of anemia and its association with anthropometric measurements, dietary habits, and menstrual patterns in adolescent girls.	Female high school students (n = 730), who were generally aged 16–18 years old	A cross-sectional survey on a population-based sample	The research revealed a negative correlation between BMI and MUAC with anemia. The adjusted odds ratio (AOR) with a 95% confidence interval (CI) for BMI is 0.87 (0.79–0.95), and for MUAC it is 0.89 (0.81–0.99). Underweight adolescent girls are twice as likely to develop anemia compared to those who are not underweight.
Tura et al (2020)[36]	Ethiopia	Prevalence of Anemia and Its Associated Factors Among Female Adolescents in Ambo Town, West Shewa, Ethiopia	The research analyzed the frequency of anemia and the contributing factors within Ambo City, located in the West Shewa region of Ethiopia.	551 female adolescents (aged 10–19 years)	Cross-sectional study.	Adolescent girls who were wasted (thin) (AOR=1.67; 95% CI=1.11–2.52) were more likely to be anemic compared to non-wasted group
Jeong et al (2022)[37]	South Korea	Association between Obesity and Anemia in a Nationally Representative Sample of South Korean Adolescents: A Cross-Sectional Study	Investigating the relationship between obesity and anemia among adolescents in South Korea.	A collective of 10,231 male and female participants aged 10 to 21 were categorized into three groups: 1. 10–13 years (early) 2. 14–17 years (middle) 3. 18–21 years (late)	Cross-sectional study.	The incidence of anemia was considerably higher in obese adolescent females aged 10–13 years (adjusted odds ratio [OR], 2.88; 95% confidence interval [CI], 1.20–6.95) compared to the non-obese group.
Sari et al (2022)[38]	Indonesia	Anemia among Adolescent Girls in West Java, Indonesia: Related Factors and Consequences on the Quality of Life	The aim of this study is to investigate the factors influencing the prevalence of anemia and to evaluate its impact on the overall well-being of adolescent girls.	286 female students (15–19 years).	Cross-sectional study.	Anemia has a prevalence rate of 14.3%. This study's factors associated with anemia include the length of blood flow during menstruation, iron intake, body weight, height, and MUAC (Mid-Upper Arm Circumference). According to multivariate logistic regression analysis, the characteristics that have the most significant impact on anemia are mid-upper arm circumference (MUAC) and the length of time blood flows during menstruation.

Abbreviations: MUAC, mid-upper arm circumference; BMI, body mass index.

investigation. Most papers employed a cross-sectional design, except for the study by Srivastava et al, which conducted a longitudinal study with two surveys: the first in 2015–16 and the follow-up in 2018–19.[30]

Another feature that we identified was the analytical method used in these studies. We found that all nine studies employed multivariate analysis, although the specific analysis varied depending on the type of data (Table 2). Most studies have analyzed multiple variables to identify the most influential factors of anemia. This approach provided substantial statistical results.

Synthesis of the Results

Table 3 describes the research findings connecting nutritional status/anthropometric measures and body composition with anemia. It was found that the results of the indicators analyzed were Body Mass Index (BMI), Mid-Upper Arm

Table 2 The Analytical Methods of Selected Studies (n = 9). Selected Studies Applying Analytical Statistics on Their Methodology

Analytical Methods	n	%	References
Multivariate logistic regression	6	66.7	Alquaiz et al (2015)[31] Teji et al (2016)[33] Sigit et al (2024)[35] Tura et al (2020)[36] Jeong et al (2022)[37] Sari et al (2022)[38]
Multivariate linear regression	1	11.1	Huang et al (2015)[32]
General linear model and logistic regression	1	11.1	Mehdad et al (2022)[34]
Random-effect regression analysis	1	11.1	Srivastava et al (2022)[30]
Total	9	100	

Table 3 Summarize of the Findings (n = 9)

	Statistical Results			
Indicator	**Significance**		**Insignificance**	
Nutritional status/ Anthropometry and Body Composition	**Articles (n)**	**References**	**Articles (n)**	**References**
Body Mass Index	6	Alquaiz et al (2015);[31] Huang et al (2015);[32] Mehdad et al (2022);[34] Sigit et al (2024);[35] Tura et al (2020);[36] Jeong et al (2022).[37]	2	Teji et al (2016);[33] Srivastava et al (2022)[30]
Mid-Upper Arm Circumference	2	Sigit et al (2024);[35] Sari et al (2022).[38]	1	Teji et al (2016)[33]
Weight	1*	Sari et al (2022)[38]	-	-
Height	1*	Sari et al (2022)[38]	-	-
Body fat (BIA-4000-Bodystat Quadscan)	1	Mehdad et al (2022)[34]	-	-

Notes: *Bivariate analysis.

Circumference (MUAC), weight, height, and body fat. Statistical analysis of the association between these variables and anemia was conducted using multivariate methods, except for weight and height, which were significant in bivariate analysis.

Discussion

Anemia is a nutritional problem that can negatively affect the growth and development of adolescent girls and is strongly related to their nutritional status. Anthropometric measurements as a marker of nutritional status need to be performed. According to the WHO's framework on the etiology of anemia, micronutrient deficiencies are among the direct causes affecting the physiological mechanisms of an individual's hematological metabolism, leading to anemia.[3] Although the relationship between nutritional status and anemia may seem distant, they are interconnected, as highlighted by several previous studies. To effectively tackle anemia, a better understanding of its causes is necessary. However, diagnosing the cause of anemia currently requires laboratory checkups, which may not be feasible in some countries due to limited accessibility and resources. Therefore, we conducted this review with the hope that nutritional status could serve as a risk factor, narrowing the diagnosis and facilitating more targeted interventions.

A multitude of studies investigating the nutritional status of adolescents with anemia were discovered; however, only nine articles meet the criteria for review. The review suggests limited research on the relationship between nutritional status and anemia among adolescent females worldwide (Table 3). According to the reviewed studies, the evaluation of nutritional status in teenagers is restricted to indicators such as weight, height, body mass index (BMI), and mid-upper arm circumference (MUAC). However, only one study has investigated the correlation between fat mass (FM) and body fat (PBF) percentage and anemia.

Six studies investigated the association between BMI and anemia in teenage girls, possibly because BMI is the most common approach for evaluating nutritional status in community settings. The resulting quantitative data are interpreted as an obesity index and utilized to evaluate risk factors for different diseases.[39] Nevertheless, BMI cannot accurately assess the quantity of body fat present.

Research examining the relationship between BMI and anemia has demonstrated that adolescents who are either underweight or obese have a greater likelihood of developing anemia compared to those with a normal BMI.[31,32,35–37] A study conducted in Morocco revealed a negative association between BMI and hemoglobin levels, suggesting that higher BMI is linked to lower hemoglobin levels.[34] Anemia in overweight and obese individuals can be caused by several mechanisms, such as dilutional hypoferremia (lower iron concentration in the blood), insufficient iron intake, increased iron needs, impaired iron absorption, and heightened inflammation due to hepcidin regulation.[40]

The primary cause of anemia in underweight teenagers is most likely a lack of essential macronutrients and micronutrients.[35] Micronutrient deficiencies are highly prevalent among those who suffer from nutritional deficiencies and are among the most significant contributors to anemia.[5] Furthermore, the body's physiological systems are significantly impacted when there are shortages in macronutrients. Several of these pathways contribute to both overweight and underweight, which are considered risk factors for anemia in adolescents. Thus, BMI can function as an initial assessment tool for nutritional status and aid in identifying adolescents at risk of developing anemia. However, the precise etiology of anemia remains to be elucidated.

MUAC is a frequently employed measurement for evaluating nutritional status. This assessment quantifies the quantity of muscle and subcutaneous fat in the upper arm and is reasonably uncomplicated, as it does not necessitate age-specific information.[41] Arm measurements are obtained in both adults and children at the midpoint between the scapula's acromion process and the ulna's olecranon process.[42] Previous studies have consistently asserted that MUAC is the most crucial factor linked to anemia. Low MUAC (Mid-Upper Arm Circumference) can potentially lead to anemia during pregnancy in the long term.[43] Adolescents with low MUAC are at a higher risk of developing anemia than those with normal MUAC,[38] showing a negative correlation between MUAC and anemia. This suggests that lower MUAC measures are associated with a greater probability of developing anemia in adolescents. This could be linked to the somatic growth of adolescents, although it cannot be conclusively demonstrated because of the inclusion of subcutaneous fat in the measurement of MUAC.[44] Individuals experience varying somatic growth rates due to age and their unique natural adaptation process.

Additional research is required to examine other physical growth attributes, such as muscle mass, considering the notable correlations observed in MUAC measurements. Body composition is a precise tool for assessing an individual's nutritional health. Incorporating body composition measurements into a dietary assessment has been advised.[14] Dual-energy X-ray absorptiometry (DXA) is the prevailing technique for body composition assessment. Nevertheless, DXA is costly and not easily accessible, which hinders its widespread utilization. Alternative approaches for evaluating body composition are more effective, secure, and non-invasive, such as Bioelectrical Impedance Analysis (BIA).[45] The BIA evaluation method utilizes the electrical resistance of fat tissue to estimate the composition of fat-free mass (FFM) and fat mass (FM).[14,46]

Numerous studies have analyzed body composition. However, this analysis included only one publication that examined the relationship between body composition, fat mass, and anemia. Mehdad et al conducted a study indicating a significant correlation between elevated body fat and reduced hemoglobin levels. Obesity or excess fat can lead to adipose tissue inflammation, resulting in increased hepcidin synthesis.[47] Hepcidin is involved in the regulation of iron availability in the intestine, facilitating hepcidin absorption into the bloodstream. Individuals with obesity may consume significant amounts of iron. However, when the levels of hepcidin, a hormone that controls iron metabolism, increase, the body is unable to utilize iron effectively.

However, other causes of anemia may confound the findings of certain studies included in the analysis. Anemia in adolescent females is a multifactorial and complex condition wherein hormonal fluctuations, menstruation, growth-related factors, and inherited genetic state significantly contribute to its etiology.[3,48] During adolescence, significant hormonal fluctuations, including increases in estrogen and progesterone, impact iron metabolism and hematopoiesis, potentially leading to reduced hemoglobin levels.[49,50] Elevated estrogen levels during puberty and the menstrual cycle heighten the body's iron requirements, while progesterone, particularly during the luteal phase, can influence menstrual bleeding volume. The challenge is further compounded in adolescents with genetic disorders such as thalassemia or being carriers of thalassemia.[51]

Additionally, the rapid growth experienced during adolescence necessitates increased iron intake to support expanding blood volume and the development of body tissues.[52] The growth hormone, secreted by the pituitary gland, also impacts hemoglobin concentrations and iron needs. The prevalence of dietary iron deficiencies among adolescent females, coupled with heightened physiological demands related to menstruation and growth, contributes significantly to the high incidence of anemia within this population.

Multiple studies in this review found no evidence relating nutritional status to iron deficiency anemia, which is the primary cause of nutritional anemia in women. The majority of the analyzed articles relied merely on measuring hemoglobin levels to confirm anemia without conclusively identifying the specific kind or underlying etiology of the condition. Further investigation into anemia in adolescent females should be undertaken, specifically focusing on the causes of anemia and the specific factors related to body composition that increase the risk, in order to improve the effectiveness and efficiency of anemia treatment in this group. Healthcare practitioners and policymakers can collaborate to develop programs beyond adding dietary supplements, such as iron tablets, by comprehending the direct nutritional risk factors involved. These programs should target the fundamental variables associated with adolescent physical development to address anemia successfully.

The main advantage of this study is that, to our knowledge, there is still a shortage of research on the nutritional health of anemic adolescent girls. Nevertheless, this study has some limitations. Initially, we included studies with samples of adolescents regardless of their menstrual health, dietary pattern, and genetic erythrocyte disorders. Furthermore, since adolescents are in a period of rapid growth, the anthropometric measurements may have a high risk of bias.

Conclusion

Anthropometric indices, such as Body Mass Index (BMI) and Mid-Upper Arm Circumference (MUAC), can be employed as early assessment tools to identify adolescents at a risk of developing anemia. The body composition results indicate that teenagers with a significant amount of fat are prone to low hemoglobin levels. However, the connection between other body components, such as muscle mass, and the prevalence of anemia must be better understood.

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Disclosure

The authors declare that there are no conflicts of interest in the writing or publishing of this article.

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