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The Relationship between the Nutritional Status of Adolescent Girls and the Incidence of Anemia: Literature Review

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ABSTRACT

Introduction: Nutritional status is an indicator of body condition that is influenced by diet and nutrient utilization. Poor nutrient intake in adolescent girls has the potential to cause anemia where women are more susceptible to micronutrient deficiencies. WHO reports that 30% of women aged 15-49 years are anemic, with the highest prevalence in adolescents 15-19 years. The problem of anemia in adolescent girls has not been resolved, with low adherence to iron supplementation programs and poor nutritional knowledge.
Methods: This study used a systematic literature review following the PRISMA method. Data were searched in several sources, including Scopus, PubMed, and Google Scholar, with the keywords "Nutritional status of adolescent girls" and "Anemia in adolescent girls." The search process started in October 2024, focusing on relevant literature on nutritional status and anemia in adolescent girls and resulted in 20 articles used in this study.
Results: Based on the articles that have been extracted and analyzed, 5 research articles showed an association between nutritional status and the incidence of anemia in adolescent girls, and 6 other articles stated that there was no association between nutritional status and the incidence of anemia in adolescent girls.
Conclusion: The incidence of anemia in adolescent girls is generally caused by iron deficiency, due to irregular eating patterns, and consumption of junk food. In addition, it can also be caused by lack of knowledge, parents' income, mother's education, protein intake, vitamin C intake, breakfast habits, genetic factors, history of infectious diseases, and menstrual conditions.

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INTRODUCTION

Nutritional status is a measure of the condition of a person's body that can be seen from the food consumed and the use of substances in the body. Nutritional status is divided into three categories: undernutrition, good or normal nutritional status, and overnutrition. Nutritional intake in adolescent girls is very influential on the occurrence of anaemia and adolescents who already suffer from anaemia affect activity patterns and learning concentration.[1]

Nutritional status in adolescence impacts height, future quality of life and affects health. In general, women are at higher risk of micronutrient deficiencies such as iron deficiency and iron deficiency anaemia. This is because women are more vulnerable to discriminatory cultural, social and gender norms. These discriminatory norms manifest in increased poverty, inequality and early marriage which can increase the risk of micronutrient deficiencies in adolescent girls globally.[2]

Anemia is a medical condition characterised by low haemoglobin levels in the erythrocytes that impair health. When haemoglobin levels are low, oxygen delivery to the brain, muscles and other vital tissues is impaired leading

to fatigue, impaired cognitive function as well as reduced performance. The World Health Organization (WHO) estimates that by 2019 as many as 30% of women aged 15-49 years will be anaemic. The global prevalence of anemia is highest in the 15-19 age group.[3]

Anemia in adolescent girls remains a serious unresolved problem to date, even with inappropriate Fe tablet programmes, poor compliance and lack of adequate nutritional improvement among adolescent girls. Adolescent girls' knowledge about anaemia also needs to be improved to increase awareness in preventing anaemia. Several studies have suggested that anaemia in adolescent girls occurs due to a lack of nutritional intake, especially iron (Fe) and vitamin C, as well as dietary patterns such as skipping breakfast and inappropriate eating habits. The nutritional status of adolescent girls is a trigger for anaemia, poor nutritional status is one of the risk factors for anemia.[4]

Female adolescents have a ten times greater risk than male adolescents. This is because adolescent girls experience menstruation every month and are in a period of growth that requires more iron intake. Anaemic adolescent girls are at risk of becoming anaemic fertile women, and subsequently anaemic mothers who may experience chronic energy deficiency during pregnancy. Chronic energy deficiency in pregnant women can increase the likelihood of giving birth to low birth weight babies (LBW) and stunting.[5]

The burden of anaemia is increasing over time among women, while decreasing among men. The incidence of anaemia in women is more than double that of men. Based on the results of the Global Burden of Disease study and a study measuring adolescent health in 195 countries, it was found that the prevalence of anaemia among females tends to be higher than males. Consuming eggs daily or weekly can reduce the incidence of anaemia compared to adolescent girls who do not consume eggs at all. Chicken eggs that have macronutrients and micronutrients suitable for human consumption.[6]

However, not all teenage girls experience micronutrient deficiencies that eventually lead to iron deficiency and anaemia. Adolescent women who do not experience anaemia can be because they have received health education about anaemia, one of which is by choosing nutritious foods, rarely consuming junkfood and never skipping breakfast. Adolescent girls who experience heavy menstrual bleeding, exercise less are more likely to experience anaemia. So non-invasive screening should be done to increase awareness and to better understand the risk factors and related symptomatology.[7]

METHOD

This study employs a clear and systematic approach to ensure the reliability and validity of the findings. Below are the components of the methodology:

Research Type

This research method uses a literature review approach:

Literature review:

This study used a systematic literature review approach guided by the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) method and protocol. Database searches were conducted using several sources such as scopus, pubmed, and google scholar. The keywords searched were "Nutritional status of adolescent girls/women" and "Anemia in adolescent girls/women". Table 1 displays the criteria for inclusion and exclusion.

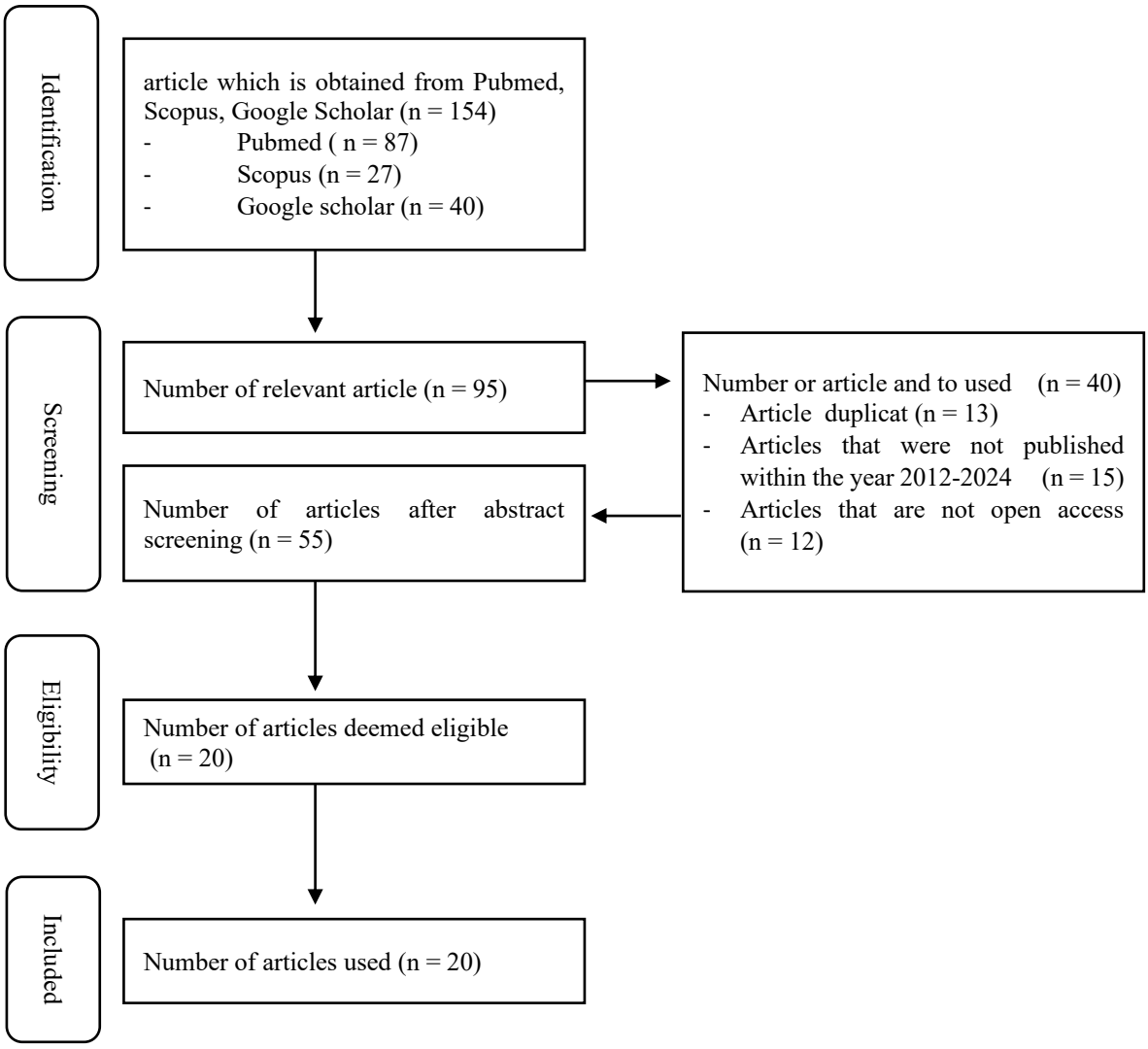
Table 1. Inclusion and Exclusion Criteria

Inclusion Criteria	Exclusion Criteria
Articles that discuss the nutritional status of adolescent females on the incidence of anemia	Articles that not discuss the nutritional status of adolescent females on the incidence of anemia
Scientific and research articles published in the last 12 years 2012-2024 and available in full text and open access	Scientific and not research articles published in the last 12 years 2012-2024 and available in full text and open access
Qualitatif methods	Literature review method or non-quantitative method

Population and Sample/Informants

Data was collected from articles that met the requirements for inclusion in the research findings such as year of publication, research objectives, and research results. Information was obtained from 20 articles that met the criteria for inclusion. Based on search results using keywords and inclusion criteria, a total of 154 articles were retrieved from Pubmed (n = 87), Scopus (n = 27), Google Scholar (n = 40). After sorting relevant titles, 95 articles were obtained. Duplicate articles were removed (n = 13), articles that were not published in the last 10 years or in the range of 2012-2024 (n = 15), and articles that were not open access (n = 12). A total of 95 articles were retained for abstract

screening and it was found that 64 articles did not meet the criteria. Finally, full text screening was conducted to ensure the eligibility of the articles to be used and resulted in 20 articles being used in this study.



Data Collection Procedures

The systematic search began in October 2024 using terms related to the nutritional status of adolescent girls using the keywords *"nutritional status of adolescent girls"* and *"anaemia in adolescent girls"*. The literature search was conducted in October 2024 with data sources from scopus, pubmed and google scholar.

Data Analysis

The results obtained were collated and stored to assist authors in determining titles and abstracts to ascertain eligible and ineligible articles. Eligible articles were further evaluated to avoid duplication. Then the eligible articles were sorted again which met the inclusion criteria.

RESULTS

Table 2. Summary of the Relationship between Adolescent Girls' Nutritional Status and Anemia Occurrence

Title, Author, Year	Aims	Sample Size	Methods	Result
Prevalence of Anaemia and Correlation with Knowledge, Nutritional Status,	To assess the prevalence of anemia and analyze the relationship	This study involved 162 female adolescent respondents from	This study used observational analytical research with a cross-sectional design conducted in November - December.	The prevalence of anemia in female adolescents in Islamic boarding schools is 17.3%.

Title, Author, Year	Aims	Sample Size	Methods	Result
Eating Habits among Adolescent Girls in Islamic Boarding Schools (Aras Utami, Ani Margawati, Dodik Pranomo, Diah Rahayu Wulandari) (2022)[8]	between knowledge, nutritional status, and eating habits with anemia in adolescent girls	3 Islamic boarding schools	Measurement of anemia using hemoglobin levels in the blood with the cyanmethemoglobin method, knowledge and eating habits using a questionnaire, nutritional status using body weight and height then classified using BMI. Bivariate tests using the chi square test and multivariate tests using logistic regression analysis.	From the results of the bivariate analysis, being overweight has a significant relationship with anemia with p = 0.044 while father's education, mother's education, knowledge, frequency of staple foods, breakfast habits, consumption of animal side dishes, consumption of vegetable side dishes, and consumption of sweet tea have no relationship with anemia. Based on the results of the multivariate analysis, being overweight (OR = 3.658; 95% CI = 1.224-10.932; p = 0.020) and knowledge (OR = 3.652; 95% CI = 1.221 - 10.922; p = 0.020) are significantly related to anemia
Anemia and nutritional status of adolescent girls in Babile District, Eastern Ethiopia (Kedir Teji, Yadeta Dessie, Tesfaye Assebe, Meyrema Abdo) (2016)[9]	To assess anemia and nutritional status in adolescent girls in babile district eastern Ethiopia.	547 teenage girls aged 10 – 19 years who live in Babile district	Community-based cross-sectional research design. Data collection using questionnaires, anthropometry and hemoglobin assessment. Data analysis using SPSS 16 by analyzing descriptive statistics, bivariate and multivariate binary logistic regression	The results of the study showed that 21.6% were thin, 4.8% were fat, 1.1% were obese, 32% were anemic, and 15% of adolescents experienced stunting or short stature from normal. The stunting rate was higher in the 17-19 age group and the anemia rate was higher in the 16-year age group. Factors that were independently related to stunting were residence, father's occupation, drinking water source, and adolescent age.
Status of Nutritional Anemia in Adolescent Girls in Raipur Rural Schools, India (Suprava Patel, Puja Dhuppar, Bhattar A (2017)[10]	To estimate the prevalence of anemia among school-going girls and to relate anemia to their demographic profile and nutritional status.	382 adolescent girls aged 10-18 years in rural areas of Ripur district, India	A cross-sectional community observational study using a semi-structured questionnaire. Demographic profiles were collected followed by iron profile estimation and vitamin B12 level estimation.	Hemoglobin concentration was positively correlated with serum fertin ($p<0.001$) and there was no significant correlation with vitamin B12 ($p=0.338$). The logistic regression results illustrated that anemia was significantly associated with serum fertin levels ($p<0.01$) and there was no association of

Title, Author, Year	Aims	Sample Size	Methods	Result
				anemia with vegetarian diet, SES and low serum B12 levels.
Factors Affecting Anemia Status in Adolescent Girls (Misroh Mulianingsih, Winda Nurmayani, Elisa Oktaviani, Ilham, Hayana, Aditiyani Nugraha Pertiwi) (2021)[11]	To determine the relationship between parental income factors, maternal education, tea drinking habits, knowledge, attitudes, iron supplement intake, menstrual conditions with the incidence of anemia in female adolescents at SMAN 9 Mataram in 2018	63 female teenagers from SMAN 9 Mataram in 2018 were identified as having anemia	Quantitative research with cross sectional approach. Sampling technique using nonprobability sampling. Research instrument using questionnaire. Data analysis using univariate, bivariate chi-square test and 95% confidence level.	There is a significant relationship between parental income, maternal education, knowledge, iron supplement consumption, and menstrual conditions on the incidence of anemia in adolescent girls with a p value <0.05. And there is no relationship between tea consumption habits and attitudes towards the incidence of anemia in adolescent girls in 2018 with a p value> 0.05.
The Relationship Between Nutritional Status and Anemia in Adolescent Girls at Muhammadiyah 3 Junior High School, Semarang (Cahya Daris Tri Wibowo, Harsoyo Notoatmojo, Afiana Rohmani) (2013)[12]	To determine whether there is a relationship between nutritional status and anemia in female adolescents at Muhammadiyah 3 Semarang Junior High School	The population consisted of 254 female students with a sample size of 44 female students aged 13-15 years in this study.	Observational analytical research using a cross-sectional approach. Sampling using purposive sampling. Data analysis using bivariate analysis chi-square test.	Based on the results of the study, 17 female students (38.6%) had anemia and 4 female students (12.9%) had good nutritional status with anemia and 27 female students (87.1%) had good nutritional status but did not have anemia. Based on the results of the bivariate test using the chi-square test, the significance value was 0.000, which means that nutritional status has a significant relationship with anemia..
The Relationship between Nutritional Status and the Incidence of Anemia in Adolescent Girls on Jalan Ery Suparjan, Sempaja Utara Village, Samarinda City in 2023 (Rahmawati, Fauziah) (2024)[13]	To determine the relationship between nutritional status and the incidence of anemia in adolescent girls on Jalan Ery Suparjan, Samarinda City in 2023.	The research population was 63 people with a research sample of 54 female adolescents living on Jalan Ery Suparjan, Samarinda City in 2023.	The study used analytical with a cross-sectional research design. The research analysis used univariate analysis and bivariate analysis using the chi-square test.	Based on the results of the study, 28 people (51.9%) had the non-anemic category and 26 people (48.1%) had the anemia category. In the relationship test, there was a relationship between nutritional status and the incidence of anemia in adolescent girls on Jalan Ery Suparjan, Samarinda City in 2023 with a p-value (0.000).
Relationship between Nutritional Status and the Incidence of	To examine the relationship between	The sample size was 90 people selected using	The research design used cross-sectional with univariate analysis, bivariate	. As many as 1.1% had very thin nutritional status, 3.3% thin, 73.3% normal, 15.6%

Title, Author, Year	Aims	Sample Size	Methods	Result
Anemia in Adolescent Girls (Dea Indartanti, Apoina Kartini) (2014)[14]	nutritional status and the incidence of anemia in female adolescents aged 12-14 years at SMP Negeri 9 Semarang.	consecutive sampling.	analysis with chi-square test, and multivariate analysis using logistic regression test.	overweight, 6.7% obese and 26.7% had anemia. Based on the results of the chi-square test, there was no significant relationship between nutritional status and the incidence of anemia in adolescent girls (p = 0.289) and there was a relationship between iron intake (p = 0.000) and folate intake (p = 0.006) with the incidence of anemia. The results of the multivariate test showed that iron intake had an effect on anemia with a p value <0.05.
Relationship Between Nutritional Status and Anemia Incidence in Adolescent Girls at SMP Negeri 2 Garawangi, Kuningan Regency (Siti Nunung Nurjannah, Ega Anggita Putri) (2021)[1]	To determine the relationship between nutritional status and the incidence of anemia in adolescent girls	The research respondents were 110 female students of class IX of SMP Negeri 2 Garawangi, Class 15, Kuningan Regency.	Analytical research method using cross sectional design. Research instrument using checklist sheet using univariate test and chi-square test.	A total of 39 female students experienced poor nutritional status, 63 female students experienced normal nutritional status and 8 female students experienced obese nutritional status. In the results of the univariate test, 82 female students experienced anemia. Based on the chi-square test, nutritional status has a significant relationship with the incidence of anemia in female adolescents at SMP Negeri 2 Garawangi with a p value = 0.000.
The Relationship between Nutritional Status and Nutritional Knowledge with the Incidence of Anemia in Adolescent Girls at Triyasa Ujung Berung Middle School, Bandung (Desi Fadila Syabani Ridwan, Inne Indraaryani Suryaalamsah) (2023)[15]	To analyze the relationship between nutritional status and nutritional knowledge on the incidence of anemia in adolescent girls at Triyasa Ujung Berung Middle School, Bandung City.	The sample in this study amounted to 93 female teenagers. Sampling used the hypothesis test formula of one portion of the population with a one-tail approach.	Data analysis in this study used univariate analysis and bivariate analysis using the chi square test.	The results of the study showed that the prevalence of anemia in adolescent girls reached 47.3%. The majority of adolescent girls who experienced anemia had poor nutritional status, with 45 respondents (48.4%) showing this status. Statistical tests showed p = 0.020, indicating a significant relationship (p <0.05) between nutritional status and the incidence of anemia. Meanwhile, statistical tests on the

Title, Author, Year	Aims	Sample Size	Methods	Result
				relationship between nutritional knowledge and the incidence of anemia produced p = 0.558, indicating that there was no significant relationship (p> 0.05) between nutritional knowledge and the incidence of anemia.
Nutritional status of adolescent girls living in rural areas: A community-based cross-sectional study (Sulakshana S. Baliga, Vijaya A. Naik, Maheshwar D. Mallapur) (2014)[16]	This study aims to evaluate the current nutritional status of adolescent girls	nvolving 400 teenage girls aged between 10 and 19 years	This community-based cross-sectoral study was conducted over a period of one year in Peeranwadi village, Belgaum district, Karnataka. Information on socio-demographic variables was collected through interviews using a pre-designed and pre-tested questionnaire. The 24-hour recall method was used to assess nutritional intake. To compare anthropometric data, standards from the National Centre for Health Statistics and the National Health and Nutrition Examination Survey were used.	The mean age of the population studied was 12.9 ± 2.06 years. Most respondents (73.5%) were Hindu, with a literacy rate of 98.5%, and 90% were studying. Adolescent girls aged 10 to 14 years showed a higher stunting rate (63.82%) compared to the 15 to 19 age group (40.84%) with a P value of 0.0003, as well as a higher prevalence of thinness (60.79% vs 39.43%; P = 0.0009). The average recorded calorie intake was 1272.20 ± 133.28 kcal/day, with a protein intake of 40.99 ± 3.32 grams, and iron of 14.42 ± 2.58 mg.
Determining Factors of Anemia in Adolescent Girls in Kendari City (Irfa Ekasanti, Annis Catur Adi, Mardiyono Yono, Fifi Nirmala G, Muhammad Atoillah Isfandiari) (2020)[17]	This study aims to analyze the factors that influence anemia in adolescent girls in Kendari City.	This study applied a cross-sectional design involving 97 students as a sample.	Data on parental characteristics, breakfast habits, nutritional status, menstrual status, and history of infectious diseases were collected through interviews using questionnaires. Information on nutrient intake (iron, protein, vitamin C) was obtained using the recall method for 2x24 hours and compared with the Nutritional Adequacy Rate (AKG). Hemoglobin levels were measured using the EasyTouch hemoglobin meter. Data analysis was performed using the chi square method and multiple logistic regression.	The results showed that 28.9% of female adolescents experienced anemia. Chi-square analysis indicated a relationship between the incidence of anemia and maternal education (p=0.010), parental income (p=0.017), iron intake (p=0.000), protein intake (p=0.000), vitamin C intake (p=0.023), breakfast habits (p=0.006), menstrual status (p=0.007), and history of infectious diseases (p=0.000). In addition, multiple logistic regression analysis showed that there was a relationship between iron intake (p=0.005, OR=3.009), protein intake (p=0.007, OR=2.012), vitamin C intake (p=0.038, OR=1.167), and menstrual status (p=0.002,

Title, Author, Year	Aims	Sample Size	Methods	Result
				OR=3.181) with the incidence of anemia.
Prevalence of Anemia in Adolescent Girls in Urban Slums (Meenal Vinay Kulkarni, P M Durge, N B Kasturwar) (2012)[18]	To assess the prevalence of anemia among adolescent girls in urban slums and analyze associated socio-demographic and menstrual factors.	The study was conducted on 272 adolescent girls in urban slums, under the Urban Health Training Centre, Department of Community Medicine, NKP Salve Institute of Medical Sciences, Nagpur, from June 2009 to February 2010.	A community-based study with a cross-sectional design. One area was randomly selected from five areas. Information on socio-demographic and menstrual factors was recorded using a previously designed and tested proforma. Hemoglobin measurements were performed using a Sahli hemoglobinometer. Data were analyzed using means, standard deviations, and chi-square tests.	The prevalence of anemia among adolescent girls is very high, reaching 90.1%. Most of them have mild or moderate anemia (88.6%). Research shows a significant relationship between the level of education of adolescent girls and maternal occupation with anemia. However, no relationship was found between menstrual factors and anemia.
Correlation of Hemoglobin Levels with Nutritional Status in Adolescent Girls: A Health Promotion Perspective (Rati Purnama Sari, Evi Maria Lestari Silaban, Yussie Ater Merry) (2023))[19]	The purpose of this study was to identify the prevalence of anemia, assess the nutritional status of adolescent girls, and analyze the relationship between nutritional status and the incidence of anemia in adolescent girls.	The sample consisted of 10th grade female students of the Vocational Program in Makeup and Fashion Design at SMKN 6 Padang City, all of whom were female, in the 2022 academic year. The sample was selected using a purposive sampling technique,	This study is an analytical survey with a cross-sectional design. The population studied were female students in Padang City. The tool used to measure hemoglobin levels was a digital hemoglobin meter. Nutritional status was assessed using the BMI index based on age. Correlation analysis was performed using the Kendall's tau test for ordinal scale data..	The results showed that the majority of adolescents (71.9%) had normal nutritional status. Most female adolescents (87.5%) also had normal hemoglobin levels, while 12.5% had anemia and did not menstruate. It was found that there was no relationship between nutritional status (BMI/age) and hemoglobin levels (p-value = 0.55), so nutritional status is not considered a cause of anemia in female adolescents
Prevalence of anemia among adolescent girls in Warangal urban area (Dr. Sujatha Pambi, Dr. M. Kalyani, Dr. Sravanthi Gilla, Dr. Bhavani K) (2023)[20]	To find out how common anemia is in adolescent girls in urban field practice area of Kakatiya Medical College Warangal, AP. And to identify various socio-demographic elements influencing anemia in adolescent girls	The study was conducted between November 2021 and October 2022. A total of 350 adolescent girls (aged 10 to 19 years)	A cross-sectional study was conducted in three areas under the urban health centre of Warangal, Kakatiya Medical College, which serves as a field practice area. To collect information on socio-demographic variables, a pre-designed and tested proforma was used. Each participant underwent a relevant clinical examination. With the help of cyanomethemoglobin, hemoglobin levels were estimated. When hemoglobin levels fell below 12 gm/dl, anemia was determined as the cause.	Anemia is experienced by 81.1% of the population, with details of 36.9% experiencing mild anemia, 40.9% moderate anemia, and 3.4% severe anemia. When compared to late adolescence (15-19 years), early adolescence (10-14 years) showed a higher prevalence of anemia. Most girls experience moderate anemia. Girls who live in dormitories and have working mothers and illiterate fathers are more likely to experience anemia than those who do not live in dormitories.
Risk Factors and Nutritional Assessment of	To identify risk factors for IDA among school	A total of 240 female students were randomly	This study used a case-control study design and was conducted in one preparatory	Based on multivariate logistic regression analysis, female students with low

Title, Author, Year	Aims	Sample Size	Methods	Result
Adolescent Girls with Iron Deficiency Anemia in Damanhour City (Asmaa Hamed Mohamed, Mahassen Ahmed Abd El-Wahed, Dalia Ibrahim Tayel, Abeer Abd El-Aziz Mohamed Madian, Neama Yousef Mohammed) (2018)[21]	girls and to assess the nutritional status of girls experiencing IDA in Damanhour city.	selected, consisting of 120 female students with anemia as the case group and 120 other female students as the control group.	school in an urban area and eight preparatory schools in a rural area. Data were collected using three instruments: instrument (I) in the form of a structured interview questionnaire for the profile of female adolescent students, instrument (II) in the form of a questionnaire on nutritional practices, and instrument (III) in the form of anthropometric measurements.	parental education, living in rural areas, and being infected with intestinal parasites were identified as predictors of iron deficiency anemia (IDA). In addition, poor dietary habits and menstrual history also contributed significantly to the development of anemia. This study found that there was a highly significant relationship between academic achievement and anemia.

DISCUSSION

The results of this literature review were conducted by analyzing 20 articles with a time limit of 12 years. The articles used in this study are studies conducted in Indonesia and abroad from accredited national journals and reputable international journals. The articles presented discuss the relationship between the nutritional status of female adolescents and the incidence of anemia

1. The occurrence of anemia in adolescents

   Anemia is a condition characterized by a decrease in the amount of hemoglobin from its normal value.[25]Each hemoglobin molecule binds oxygen to be carried throughout the body. This lack of hemoglobin results in disruption of oxygen adequacy to peripheral tissues. Anemia can be caused by several factors, including poor formation of erythrocytes by bone marrow, blood loss from the body, premature destruction of erythrocytes in the body, iron deficiency, vitamin C, vitamin B12 and folate intake. Iron is an important component of hemoglobin. Lack of iron consumption in adolescents is due to food availability, lack of knowledge and wrong eating habits.[19]

   Based on research (Aiman, et al., 2023) it is stated that one of the groups at risk of suffering from anemia is female adolescents.23 Iron deficiency anemia is prone to occur in female adolescents due to the increased need for iron during growth. This is because adolescence is a period of growth and the need for iron in female adolescents is 3 times greater than in males, so they must always consume foods that are sufficient in iron and be good at managing their daily diet.

   Based on an analysis of 20 journals, the highest prevalence of anemia was found in the study (Kulkarni et al., 2012), 90.1% of female adolescents experienced anemia.18 Meanwhile, the lowest prevalence in the study (Utami et al., 2022) was 17.3% of female adolescents experienced anemia.[8] This prevalence of more than 15% causes anemia in adolescent girls to become one of the main health problems in Indonesia.[27]The incidence of anemia is significantly related to excess weight and level of knowledge.8 This is because female adolescents generally pay close attention to their body shape, one of which is by limiting food consumption. The increasing consumption of processed foods that have low nutritional value but have lots of calories is the cause of adolescents being very susceptible to malnutrition. This eating pattern causes a high incidence of anemia in adolescents. Parental income, maternal education, knowledge, consumption of iron supplements, protein intake, vitamin C intake, breakfast habits, and history of infectious diseases and menstrual conditions, academic achievement, also have a significant relationship with the incidence of anemia.[11,17,21]

   In the study (Kulkarni et al., 2012), it was found that menstrual factors were not related to the occurrence of anemia. This result is suspected because the study did not measure the amount of blood lost during menstruation. The amount of iron lost during menstruation depends on the amount of blood lost during each menstrual period. If the amount of iron continues to decrease, hemoglobin levels will begin to decrease, resulting in iron deficiency anemia.

2. Nutritional status of female adolescents towards anemia

Nutritional status is defined as a state of balance between the consumption and use of these nutrients. Based on the BMI/U indicator, nutritional status is more influenced by the intake of macronutrients such as carbohydrates, fats, and proteins. This is because the intake of these macronutrients is the largest supplier of energy for the body. Meanwhile, the intake of micronutrients does not affect nutritional status because it has a small energy content..[23]The lack of macro and micro nutrients will cause nutritional anemia, where the nutrients, especially iron (Fe), are one of the nutritional elements as a component of the formation of hemoglobin (Hb) or red blood cells. Anemia is a nutritional problem that is commonly experienced in adolescence.[14]

Based on the results of the analysis of 20 articles, there were 11 articles that discussed the relationship between nutritional status and the incidence of anemia. Of the 11 articles, 5 articles stated that there was a relationship between nutritional status and the incidence of anemia. Research (Syabani Ridwan & Suryaalamsah, 2023) showed that the prevalence of anemia in adolescent girls reached 48.4% and the majority of these adolescent girls had poor nutritional status. These results are in accordance with research (Sari et al., 2023) which states that the incidence of anemia in adolescent girls is influenced by many factors, one of which is food intake. Adolescent girls generally rarely consume foods that are high in iron and prefer foods that are high in calories and low in iron such as junk food, snacks, soda drinks and others. Reduced iron plays a major role in the incidence of anemia, but deficiencies of other substances, non-nutritional conditions, and genetic disorders (hereditary) also play a role in anemia.[1] Adolescent girls with a good level of knowledge will choose to consume enough food to meet their nutritional needs, compared to adolescents who have poor knowledge.[13]

This result is contrary to research (Indartanti & Kartini, 2014) which states that there is no significant relationship between nutritional status and the incidence of anemia in female adolescents. It is suspected that there are other factors that influence the incidence of anemia, such as the level of nutrient consumption, and several factors that need to be controlled, such as menstrual status, and breakfast habits. Research (Restuti & Susindra, 2016) also states that anemia is not only influenced by nutritional intake, but also by genetic factors. The habit of female adolescents consuming junk food that contains few vitamins and minerals, but contains a lot of energy, allows them to have good nutritional status, but does not eliminate the incidence of anemia. Female adolescents with thin nutritional status are not a risk factor for anemia. However, women with thin nutritional status are a risk factor for deficiency and depletion of iron reserves/stores in the body.[9]

CONCLUSION

Based on the articles that have been extracted and analyzed, 5 research articles showed a relationship between nutritional status and the incidence of anemia in female adolescents, and 6 other articles stated that there was no relationship between nutritional status and the incidence of anemia in female adolescents. The incidence of anemia in female adolescents is generally caused by iron deficiency, due to irregular eating patterns, and consumption of junk food. In addition, it can also be caused by lack of knowledge, parental income, maternal education, protein intake, vitamin C intake, breakfast habits, genetic factors, history of infectious diseases, and menstrual conditions.

AUTHOR'S CONTRIBUTION STATEMENT

The 1st author is the main author and Corresponding Author in this research and the 2nd and 3rd authors as authors in supporting and guiding in this research.

CONFLICTS OF INTEREST

The authors also declare that in this study they have no financial or personal relationships with entities that could affect the objectivity of the study.

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