Mapping of Educational Research Publications on Anemia Prevention in Adolescent Girls: Bibliometric Analysis with Vosviewer from 2014 to 2024

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Abstract: Background: Adolescence marks a phase of rapid growth and demands increased nutritional requirements beyond early infancy. According to the World Health Organization, about 42.3% of women aged 15-59 years and about 49% of school-aged students in developing countries suffer from iron deficiency anemia. Objective: To map anemia prevention education research trends in adolescent girls. Methods: Literature study with bibliometric analysis using VOSviewer 1.6.20 on 18 international journal articles from Scopus (2014-2024). Results: Keyword network: 10 major clusters, including anemia, adolescent girls, education, knowledge, and behavior. Recent trends: educational interventions, antihelmintic therapy, health, older age, altitude, control, amenorrhea. Keyword density: "female", 'adolescent', 'anemia', 'iron', 'folic acid', 'health education', 'adult' were most reviewed. Potential research topics: "adolescent girl", 'iron therapy', 'attitude', 'girl knowledge', 'amenorrhoea', 'menstruation', 'food intake', 'health care planning', 'marriage', 'young adult', 'obesity', 'public health message', 'blood pressure', 'feeding behavior'. Conclusion: Research on anemia prevention education in adolescent girls continues to grow, focusing on education, health, and risk factor interventions. There are still opportunities for research on topics such as iron therapy, adolescent girls' knowledge, and amenorrhea.

Keywords: Anemia, Adolescent Girls, Education, Prevention, Bibliometric Analysis, VOSviewer.

INTRODUCTION

Adolescence marks a phase of rapid growth and demands increased nutritional requirements beyond early infancy. The World Health Organization (WHO) defines this period as between the ages of 10 and 19 (Nair & Doibale, 2023). During this time, nutrition-related challenges are exacerbated by factors such as menstrual blood loss and unexpected pregnancy. Currently, adolescent fertility accounts for 11% of global births, and 95% of these occur in low- and middle-income countries (Jolly et al., 2023). According to the World Health Organization about 42.3% of women aged 15-59 years and about 49% of school-age students in developing countries suffer from iron deficiency anemia (Jafari et al., 2023).

WHO estimates that anemia affects 33% of women of childbearing age globally (about 613 million women between the ages of 15 and 20). The highest rates of 35% are found in Africa and Asia, as well as in South Asian countries such as Indonesia at 30%, Nepal at 46%, and Bhutan at

58% (Austa Nusra et al., 2022). The prevalence of anemia among adolescent girls has increased from 37.1% in 2013 to 48.9% in 2018 (Austa Nusra et al., 2022). Anemia remains a major public health problem, affecting one-fifth of the world's population, with the number of people with anemia worldwide increasing from 1.4 billion in 1990 to 1.8 billion in 2019 (Ma et al., 2023).

Women have a higher risk of anemia occurrence and a decreased risk of anemia remission (Rai et al., 2023). Anemia is characterized by low hemoglobin (Hb) concentration, Low Hb concentration in humans is an indicator of anemia, which is often associated with iron deficiency (Belay et al., 2023). Increased nutritional requirements are essential for adolescent growth and well-being. Nutrition education has been shown to improve adolescents' nutrition knowledge, attitudes and healthy eating practices in various countries (Wiafe et al., 2023). Nutrition is a serious problem that hampers (Raharjo et al., 2016).

High non-fatal disability due to conditions such as anemia, infectious diseases, and other types of health loss can have a higher percentage of disability. disability due to these conditions, not injury (James et al., 2020). According to the latest Global Burden of Disease, a study of children and adolescents, iron deficiency anemia is the only non-fatal disease in the top 10 global leading causes of disability-adjusted life years of injury (Cheung et al., 2023). Iron deficiency is one of the health problems that eating disorders, impaired iron absorption, insufficient intake of iron-rich foods, menstrual bleeding, acute and chronic infections, parasitic infections, genetic diseases. In addition, iron deficiency is a major cause of anemia. Iron deficiency anemia in middle school girls can cause physical dysfunction and is most common in adolescents, especially adolescent girls, due to physiological and menstrual changes. There are many causes of anemia, including reduced anti-infective ability, physical fitness, learning ability and academic performance.

Anemia is characterized by low hemoglobin (Hb) concentrations, younger age, illiteracy of the household head and low serum concentrations of ferritin, Co, Cu and folate are associated with anemia. The causes of low Hb are multifactorial, with nutritional (vitamins and minerals) and non-nutritional (infection, blood loss, pregnancy) risk factors being the most widely recognized. malnutrition and anemia are more prevalent among adolescent girls.

Pemerintah telah mengimplementasikan program suplementasi zat besi untuk remaja putri sekolah menengah untuk mengurangi prevalensi anemia. Dari 80,9% remaja putri yang menerima suplemen zat besi, hanya 1,4% yang mengonsumsi suplemen zat besi secara teratur (Silitonga et al., 2023). Iron requirements peak at 14-15 years of age among adolescent girls due to rapid pubertal growth with sharp increases in lean body mass, blood volume, and red blood cell mass

(Jolly et al., 2023). About 45% of students reported that no educational program was held for them, and only 28% of students received educational content or media about iron supplements (Jafari et al., 2023).

Nutrition-sensitive interventions that have been carried out by the government through relevant ministries or agencies include providing sexual and reproductive health education and nutrition to adolescents (Nugroho & Puput Arisma Wanti, Cahyani Wulan Suci, Bambang Budi Raharjo, 2023). The role of school is directly related through knowledge to reproductive health behavior where policies and activities have the highest influence on knowledge (Handayani et al., 2019). Childhood is a critical period for growth and reproductive maturity. The demand for nutrients increases during this period, making adolescents more vulnerable to nutritional deficiencies (Ma et al., 2023). Among all the proposed interventions in reducing anemia, nutrition education may be economically friendly and more effective if adhered to by adolescents. Health promotion programs are oriented towards improving the healthy living behavior of the community through various activities to encourage clean and healthy living behaviors (Hermawan, Dwi Yunanto, Heny Widyaningrum et al., 2023). Cooperation and coordination between stakeholders are key to the success of the program (Hermawan, Dwi Yunanto, Heny Widyaningrum et al., 2023).

One way that researchers can determine research keywords is through literature review. In addition to observations and interviews, literature studies help researchers understand trends in research keywords related to a particular field. Bibliometric analysis is a popular literature study that includes mathematical and statistical analysis of patterns obtained in publications with journal metadata as the unit of analysis. Researchers used VOSviewer software to map research trends in the field of scientific writing studies in this study. this is because VOSviewer is easy to understand and use for analysis. The results of this study are expected to provide information and describe current research trends on the relationship between keywords for anemia prevention education in adolescent girls (Suntoro & Setyaningsih, 2022).

METHOD

The method used in this research is a literature study. There are 4 stages in the literature study, namely identification, screening, feasibility testing, and analysis. In the identification stage, the author searches for publications of international journal articles from the Scopus database used in bibliometric analysis, In the screening stage, the author selects and separates articles that match the search keywords including the completeness of the data, Based on the search, 18 articles from

2014-2024 were obtained that met the qualifications for analysis. The articles were then grouped in one folder and saved in comma separated values (CSV) format. Data analysis was conducted using VOSviewer 1.6.20 software. Bibliographic data analysis was conducted using co-occurrence or keyword analysis with the number of keywords read by one keyword. The analysis output is in the form of network visualization (research keyword network), overlay visualization (research keyword trend), and density visualization (research keyword density). Retrieval strategy for journal article publications on the Scopus database using keywords: (TITLE-ABS-KEY (anemia AND prevention) AND TITLE-ABS-KEY (education) AND TITLE-ABS-KEY (adolescent AND girls)) AND PUBYEAR > 2013 AND PUBYEAR < 2025 AND (LIMIT-TO (SUBJAREA , "MEDI") OR LIMIT-TO (SUBJAREA , "NURS") OR LIMIT-TO (SUBJAREA , "SOCI")) AND (LIMIT-TO (DOCTYPE , "ar")) AND (LIMIT-TO (LANGUAGE , "English")) AND (LIMIT-TO (EXACTKEYWORD , "Adolescent") OR LIMIT-TO (EXACTKEYWORD , "Female") OR LIMIT-TO (EXACTKEYWORD , "Anemia") OR LIMIT-TO (EXACTKEYWORD , "Article") OR LIMIT-TO (EXACTKEYWORD , "Human"))

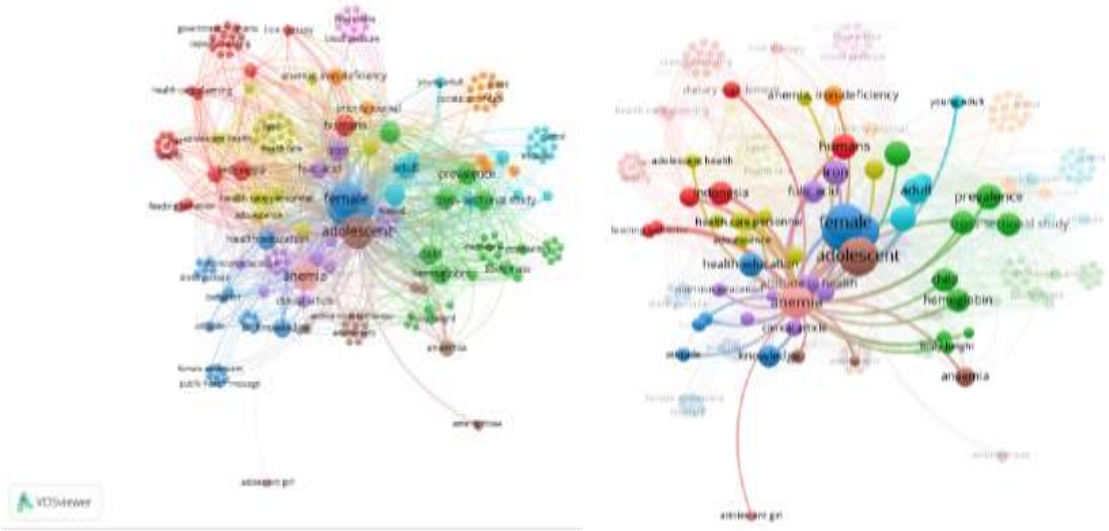
RESULTS

There are three general findings of this research, namely network visualization (research keyword clusters), overlay visualization (recent research keyword trends), and density visualization (research keyword trends by number) in Educational Research on Anemia Prevention in Adolescent Girls.

Network Keywords anemia prevention education for adolescent girls

Based on the analysis by looking at the minimum number of occurrences of 1 keyword from 18 articles, 212 keywords were found. The keywords are divided into 10 keyword clusters of anemia prevention education research in adolescent girls. These clusters in detail can be seen in the following figure.

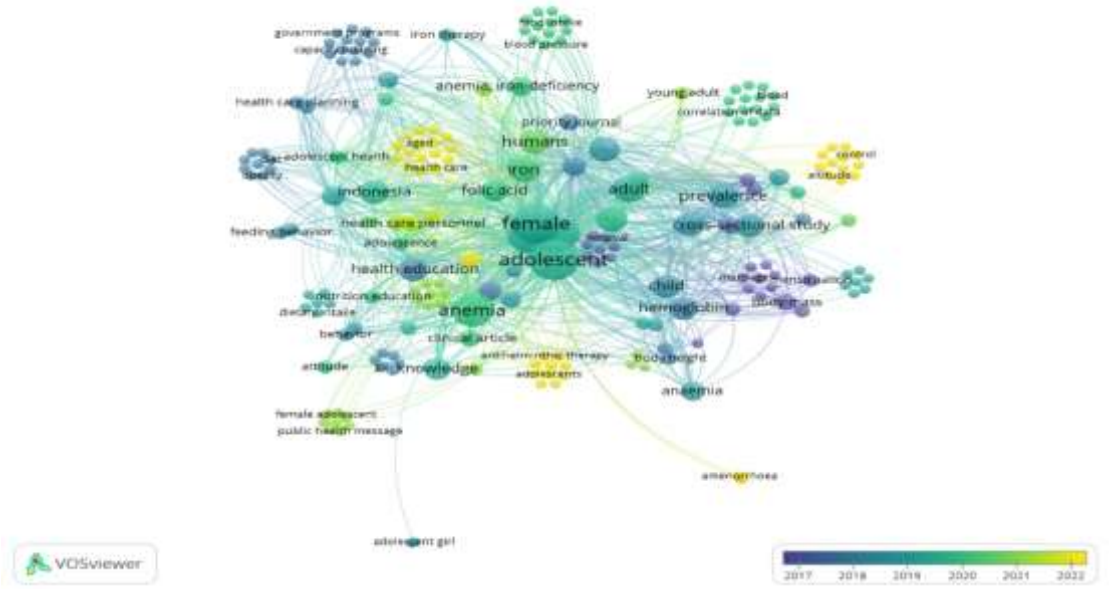
Fig.1 Network visualization (research keyword cluster)



Recent Trends Keyword anemia prevention education for adolescent girls

Recent trends in VOSviewer output can be seen from the overlay visualization. The latest research trends are marked with a dark yellow color. The latest trends in research in the field of scientific writing can be seen in the following figure.

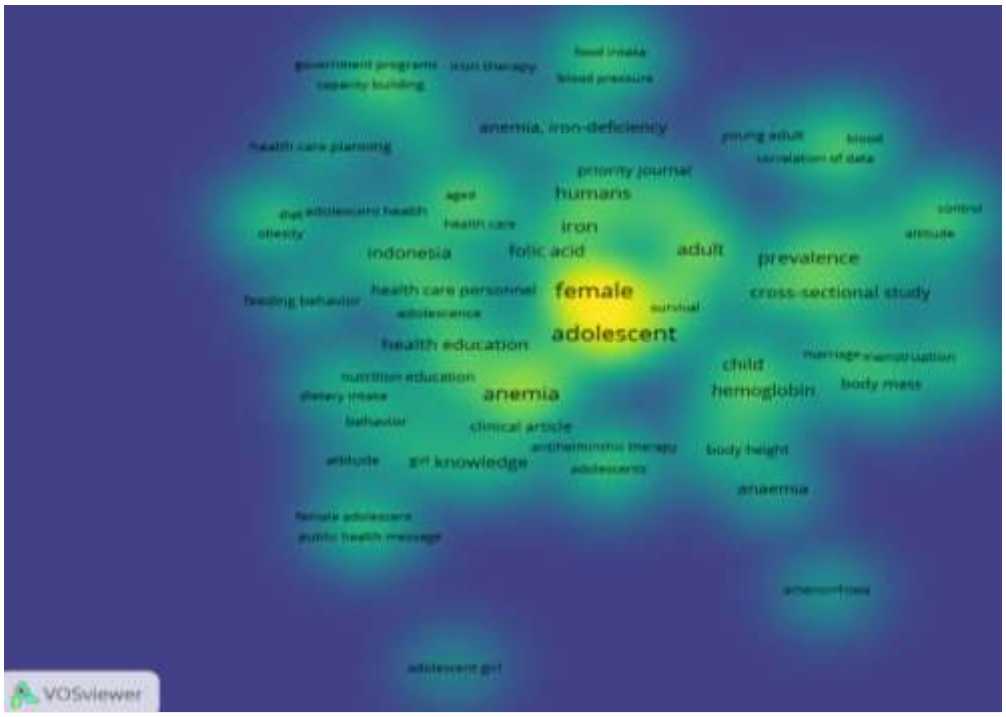
Figure 2. Overlay visualization (latest research keyword trends)



Keyword Density of anemia prevention education research on adolescent girls

The keyword density is shown by the density visualization output. The higher the keyword density illustrates that the research topic in that field has been studied a lot. Conversely, if the density is low, it can be an opportunity for new research. The complete keyword density of anemia prevention education research on adolescent girls can be seen in the figure below.

Figure 3. Density visualization (research keyword trends by number) can be seen in the figure below**.**



DISCUSSION

Based on the figure above, there are several keywords that are directly related to anemia research, namely adolescent, female, anemia, human, article, iron, Indonesia, adult, iron deficiency anemia, prevalence, folic acid, health education, knowledge, attitude, behavior, adolescent girl. Keywords that are not directly related to anemia research are body mass, amenorrhea, obesity, dietary supplement, risk factor, menstruation. Keywords that are not directly related are usually related by intermediate variables or keywords.

Some of the latest trending research keywords include adolescents, antihelminthic therapy, health care, age, altitude, control, amenorrhea. Other keywords such as anemia, adolescent, female, adult, human, iron, folic acid, iron deficiency, young adult, knowledge, attitude, adolescent girls, public health messages, personal health care, nutrition education are trending in 2019-2022. Meanwhile, the keywords marriage research, menstruation, body mass, survival, capacity building, government programs, health care planning, obesity, diet, hemoglobin, child and booklet were the popular keywords in 2019 and below.

The keywords above show that the most studied keywords include female, adolescent, anemia. If you look at the distribution of data in the figure above, research on iron, folic acid, health education, adult, is also a topic that has been widely studied before. As researchers, we can examine research topics that are still not widely studied in order to provide benefits for the development of science. The following keywords are still possible to be used as research topics, Based on the figure above, some topics related to anemia that are still not widely studied. Research topics that have not been widely studied are marked with inconspicuous colors and smaller font sizes. Some of them are adolescent girl, iron therapy, attitude, girl knowledge, amenorrhoea, menstruation, food intake, health care planning, marriage, young adult, obesity, public health message, blood pressure, feeding behavior.

CONCLUSION

Anemia is characterized by low hemoglobin (Hb) concentration, Low Hb concentration in humans is an indicator of anemia, which is often associated with iron deficiency (Belay et al., 2023). Iron deficiency is one of the health problems that eating disorders, impaired iron absorption, insufficient intake of iron-rich foods, menstrual bleeding, acute and chronic infections, parasitic infections, genetic diseases. In addition, iron deficiency is a major cause of anemia. On the mapping of this article

Keyword Clusters: There are 10 main keyword clusters in the research of anemia prevention education in adolescent girls, namely: Adolescent, Female, Anemia, Human, Article, Iron, Indonesia, Adult, Iron deficiency anemia, Prevalence.

1. Recent Trends: Recent trends in research focus on: Adolescents, Antihelmintic therapy, Health care, Aged, Altitude, Control, Amenorrhoea
2. Keyword Density: The most reviewed keywords were: Female, Adolescent, Anemia, Iron, Folic acid, Health education, Adult.

3. Research Topics Worthy of Study: Based on the results of the study, there are several topics related to anemia in adolescent girls that have not been widely studied, including: Iron therapy, Attitude, Girl knowledge, Amenorrhea, Menstruation, Food intake, Health care planning, Marriage, Young adult, Obesity, Public health message, Blood pressure, Feeding behavior.

Conflict of Interest

The authors declare that they have no conflict of interest.

Acknowledgment

A thank you to the agencies and parties who supported this research

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