

The Effectiveness of Nutritional Educational Comics in Increasing Haemoglobin Level among Anemic Adolescent Girls

Annasari Mustafa, SKM, MSc,¹ Sugeng Iwan, STP, MKes,¹ Carissa Cerdasari, SGz, MPH, RD,¹
Rani Nurmayanti, SST, MGizi¹ and Muchtaruddin Mansyur, MD, PhD^{2,3}

¹Health Polytechnic of Malang, Malang City, Indonesia

²Occupational Medicine Study Program, Faculty of Medicine, Universitas Indonesia, Jakarta, Indonesia

³Department of Community Medicine, Faculty of Medicine, Universitas Indonesia, Jakarta, Indonesia

ABSTRACT

Objective. This study aimed to determine the effectiveness of comic-based nutrition education in increasing haemoglobin (Hb) levels in adolescent girls with anaemia by improving their energy, protein, vitamin C, calcium, iron, zinc, and folic acid intake.

Methods. A pre-test–post-test quasi-experimental design was used. Over four months, nutrition education was delivered through the comic Balanced Nutrition, Lost Anaemia as an intervention for nutritional problems. Nutritional issues were assessed via 24-hour dietary recalls and six-day food records, analyzed using Nutrisurvey 2008 and Linear Programming. Effectiveness was measured by comparing energy, folic acid, and zinc intake using paired t-tests, and protein, iron, vitamin C intake, and Hb levels using the Wilcoxon test, before and after the intervention. The study was conducted at an Islamic boarding school (*pesantren*) in Malang, Indonesia. A total of 84 adolescent girls with anaemia (Hb <12 g/dL) were included. Hb levels were validated via venous blood examination using cyanometry.

Results. After nutrition education, participants had significantly higher energy, protein, and vitamin C intake ($P < 0.001$) and increased Hb levels ($P < 0.001$). Among the participants, 69 (82.15%) achieved normal Hb levels.

Conclusion. Nutrition education using comics with colorful images facilitates understanding and application of nutritional guidance, effectively increasing nutrient intake and reducing the prevalence of anaemia among adolescent girls.

Keywords: nutrition comics, nutrient intake problem, nutritional anaemia, adolescents, boarding school

INTRODUCTION

Anaemia remains a significant public health concern in Indonesia, with a national prevalence of 26.7%, and even higher in some regions, reaching 36.7% in Semarang and 42% in Makassar.^{1–3} According to the World Health Organization, a prevalence above 40% indicates a severe public health problem. Anaemia among young women is influenced by several factors, particularly dietary intake of iron and other essential nutrients. Studies have shown that 63.3% of adolescent girls have iron levels below the recommended intake.^{1,2,4}

Islamic boarding schools, or *pesantren*, are residential educational institutions where students, called *santri*, receive both religious and formal education. In *pesantren*, the *Kyai* (school owner) and *Nyai* (wife of the *Kyai*) play a central role in managing education and daily activities, including food



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Corresponding author: Muchtaruddin Mansyur, MD, PhD
Department of Community Medicine
Faculty of Medicine
Universitas Indonesia
Jl. Pegangsaan Timur No. 16, Pegangsaan,
Menteng, Jakarta 10310, Indonesia
Email: muchtaruddin.mansyur@ui.ac.id

provision.^{5,10} These institutions provide a unique, close-knit environment suitable for health promotion and nutrition education, particularly for adolescents at risk of anaemia.

Studies in Islamic boarding schools in Ciamis, Jombang, Depok, and Malang revealed infrequent consumption of iron-rich foods among students. Eggs and chicken were consumed only 1–3 times per week by 69%–71% of respondents, while beef and fish consumption ranged from 37%–49%.^{6–8} These findings highlight a persistent deficit in nutrients associated with anaemia, including energy, protein, vitamin C, folic acid, and iron.

Furthermore, nutritional knowledge among adolescent girls remains limited. Only 19.1% of girls demonstrated good knowledge about nutrition and anaemia, which contributes to unbalanced dietary choices, even when complete meals are available in *pesantren*.^{8,9} According to the PDPP–Ministry of Religion (2018–2019), Indonesia has 25,615 Islamic boarding schools with 1,261,120 students. In East Java, there are 4,452 *pesantren* with 323,293 students, and in Malang City, 46 *pesantren* with 7,427 students. One school, Nurul Ulum, houses 490 female students, with an additional 225 female adolescents commuting from surrounding areas.

Comics have emerged as an innovative medium for nutrition education. Studies in Indonesia show that nutrition education delivered via comics can increase knowledge scores more effectively than traditional methods, particularly regarding anaemia.^{11–13} Educational comics are most effective when based on local nutrition issues and food consumption patterns, analyzed using tools such as Linear Programming and Nutrisurvey.^{14–16}

This study is unique in directly linking consumption and anaemia incidence among adolescent girls living in a homogeneous setting (*pesantren*). Female students living in Islamic boarding schools are at risk of nutritional deficiencies and urgently need effective interventions. Nutrition education using comics provides an engaging, culturally appropriate approach to improve knowledge, dietary behavior, and haemoglobin levels.

OBJECTIVE

This study aimed to determine the effectiveness of comic-based nutrition education in raising awareness and improving dietary intake of protein, iron, and vitamin C, thereby increasing energy and haemoglobin levels among anaemic adolescent girls.

METHODS

Study Design and Setting

This study employed a quasi-experimental one-group pre-test–post-test design without a control group. The intervention was conducted at one Islamic boarding school (*pesantren*) in Malang City, Indonesia, over six months starting in April 2018. *Pesantren* are Islamic educational

institutions with dormitory systems, with the *Kyai* (owner) as the central figure and the mosque serving as the center for educational activities.⁵

Ethical Clearance

This research was conducted in accordance with the recommendation of the Ethics Commission for Health Research at the Polytechnic of Health Malang (157/KEPK-POLKESMA/2018). Written informed consent was obtained from all adolescent girls who agreed to participate after receiving a full explanation of the study.

Participants

Screening was conducted among 281 female adolescents using capillary blood tests to identify anaemia. Inclusion criteria were: Students in grades 1 and 2 of Junior and Senior High School; haemoglobin level <12 mg/dL; already had menarche; not menstruating at the time of screening; not on a special diet; and willing to participate.

A total of 84 students met the criteria and were included in the study. Exclusion criteria included non-cooperative students, resulting in incomplete data, and students who moved or no longer lived in the boarding school.

Blood Sample Collection and Validation

Capillary blood samples were used for initial Hb screening. Venous blood samples were collected to validate Hb levels using the cyanometry method.

Baseline Data Collection

Baseline data were collected on: haemoglobin levels, food consumption, via 24-hour recall and six-day food records, and knowledge and attitudes about nutrition and anaemia. Alumni from the Department of Health's Nutrition Polytechnic in Malang collected dietary data, which were analyzed using Nutrisurvey 2008 and Linear Programming to estimate energy and nutrient intake.

Nutrition Education Intervention

Nutrition education was delivered over four months using a comic titled *Balanced Nutrition, Lost Anaemia*, which addressed local nutritional problems. The comics were developed with a professional artist and adapted for junior (Tsyawiyah) and senior (Aliyah) high school students. A pre-test trial with seven students led to revisions in color and font size.

The intervention consisted of four sessions of 60 minutes each. Students were divided into four groups of 21. Sessions included discussion, demonstration, and question-and-answer activities related to healthy eating and anaemia prevention.

Post-intervention Data Collection

After the intervention, the following were collected: haemoglobin levels, food consumption data, and knowledge, attitudes, and skills assessments.

Skills were evaluated by having students select foods they normally consumed and prepare sample menus. Knowledge and attitudes were measured via a 20-question questionnaire, categorized as: Low knowledge (score <60); Moderate knowledge (score 60–80); and Good knowledge (score >80).

Energy and nutrient intake were compared with recommended adequacy (AKG) for female adolescents, categorized as: Very low (<70%); Low (70–<100%); Adequate (100–<130%); Above recommended (>130%).^{17,18}

Data Analysis

Paired t-tests were used to analyze changes in energy intake. Wilcoxon tests were used to assess changes in haemoglobin levels and other nutrient intakes, based on the data distribution.¹⁹

RESULTS

The age range of the adolescent girls with anaemia in this study was 13–18 years, with girls in the Tsyawiyah level being in grades 7 and 8 and those in the Aliyah level in grades 10 and 11 (Table 1). Every day, in addition to attending general education lessons, their activities were accompanied by religious practices. All daily activities of these female students, including receiving meals and monitoring by a mother responsible for their boarding, were conducted at the pondok.

Based on Nutrisurvey and Linear Programming analyses, the adolescent girls with anaemia consumed a total of 80 food items, divided into 15 groups. Foods consumed most frequently included items with added fat, particularly palm oil, indicating frying as a common cooking method. Traditional snacks made from rice flour were less commonly consumed, whereas sugar, biscuits, wafers, and crackers were frequent snack choices. The students also consumed more tea and milk compared with other drinks. For meals, most students chose rice as a staple, tempeh as a protein source, and processed meat (mainly sausage) for animal-based protein. Among the 80 food items, 78.4% were consumed at a fair level, and only 4.5% of respondents consumed food items in the good category.

Before the nutrition education, most adolescent girls (n = 76; 90.47%) had low knowledge levels regarding nutrition, with an average score of 64.38. After the comic-based nutrition education, only 1 participant (1.19%) remained at a low knowledge level, while the proportion of students with moderate knowledge increased from 7.14% to 84.52%, and those with good knowledge increased from 2.38% to 14.28%. The average knowledge score after education increased to 75.95%. In terms of attitude, 77.06% of the girls initially agreed with messages in the comics about balanced nutrition; this proportion increased to 81.34% after the education.

Nutritional problems identified among the adolescent girls included severe deficits in energy, protein, vitamin C, zinc, calcium, iron, and folic acid. Following the comic-

Table 1. Distribution of Adolescent Girls Based on Level of Education

Educational Level	n	%
1. <i>Tsanawiyah</i> (junior high school)	173	61.5
2. <i>Aliyah</i> (senior high school)	108	38.5
Total	281	100.0

Table 2. Educational Effectiveness on Santri Energy and Nutrition Intake

Intake variable	Education		p
	Before	After	
Energy (kcal)*	1248.1 (431.7)	1540 (335.3)	<0.001
Protein (g)†	32.9 (11.8–72.2)	41.6 (19.9–80.2)	<0.001
Folic Acid (µg)*	19.7 (8.1)	23.7 (10.0)	0.087
Zinc (mg)*	26.0 (8.1)	29.5 (10.2)	0.062
Calcium (mg)†	245.6 (35.9–896.1)	284.6 (59.2–870.3)	0.010
Iron (mg)†	8.9 (2.01–29.9)	9.6 (3.7–23.1)	0.060
Vitamin C (mg)†	16.4 (0.05–100.7)	67.8 (0.9–194.9)	<0.001

* Paired t-test: mean (SD).

† Wilcoxon test: median (min-max).

Table 3. Distribution of Adolescent Girls Based on Nutritional Status (Haemoglobin Levels) before and after Education

Nutritional Status	Before Education		After Education		Sig.
	n	%	n	%	
1. No anaemia (>12)	0	0	69	82.15	<0.001
2. Anaemia (<12)	84	100.00	15	17.85	
Total	84	100.00	84	100	

based nutrition education, intake of energy and all nutrients improved, including protein, vitamin C, zinc, iron, calcium, and folic acid. Significant increases were observed in energy, protein, vitamin C, and calcium intake (P <0.05), while zinc, iron, and folic acid showed a nonsignificant increase (P >0.05) (Table 2).

Before the nutrition education, all 84 students were classified as anaemic. After the intervention, only 15 students (17.85%) remained in the anaemia category, while 69 students (82.15%) transitioned to the non-anaemia category (Table 3), indicating a substantial improvement in haemoglobin levels among the adolescent girls.

DISCUSSION

Deficits in nutrition among young women can often be traced to a lack of knowledge about nutrition and anaemia.⁹ Therefore, interventions are needed to improve nutrition knowledge, one of which is through comic media. In this study, the comic media were designed to convey messages related to the prevention of anaemia in adolescents, with characters and scenarios tailored to the students' conditions

to make the messages easier to understand. Comics that combine written content and illustrations generate more interest and interaction among students. This comic has not yet been standardized for adolescent girls as a treatment for anaemia, which is a limitation of this study. Another limitation is the tight schedule of student activities, which requires adjusting research activities to fit the students' programs.

Education delivered through comics during weekly group discussions over eight sessions increased knowledge scores on average by 11.37 points, from 64.63 before the intervention to 76 after. These results are consistent with several studies in Indonesia, which have proven that there is an increase in participants' knowledge scores after receiving education using comic media.¹¹⁻¹³

In this study, students' knowledge and attitudes increased significantly after receiving nutrition education using the comics *Balanced Nutrition*, *Lost Anaemia*. Improved knowledge impacted students' attitudes and influenced their daily food and snack choices. Participants demonstrated the ability to choose foods that contributed sufficient energy, protein, and iron. Positive changes included increased consumption of milk, reduced consumption of soft drinks, greater intake of animal-source foods, and reduced consumption of snacks and seasoned foods. This is important because deficits in energy, protein, vitamin C, zinc, iron, and folic acid are commonly found in anaemic adolescent girls.²⁰ Similar findings were reported in Cambodia, where calcium, folic acid, and iron were identified as problem nutrients among adolescent girls.²¹

To further improve nutritional intake, researchers provided guidance to boarding school managers to ensure healthier, more nutritious meals for female students. Some managers routinely accompanied students during the education sessions, allowing them to receive the same information and apply it to meal planning. Positive changes were observed in the menu composition: before the intervention, animal-source dishes were served three times a week and green vegetables rarely; after the intervention, animal-source dishes increased to four times a week, and the frequency of green vegetables improved.

There was a significant increase in energy, protein, vitamin C, calcium, iron, folic acid, and zinc intake, although intake levels had not fully reached recommended adequacy. Interestingly, vitamin A intake was already above recommended levels before the intervention, but approached the recommended adequacy after education.^{17,18} The students primarily received meals from the cottage, which had been guided by the research team, leading to immediate improvements in the quality of food served.

After the nutrition education, there was a significant decrease in the number of students with anaemia, indicating that comic-based education can meaningfully increase haemoglobin levels. Assuming students are in normal health and have properly functioning spines, significant Hb changes can occur within 4–6 months if food intake improves, since red blood cells form within 5–9 days and have a lifespan of

approximately 120 days. Reading materials in the pondok are limited compared to public schools, so introducing one comic as a learning tool is feasible and appealing to adolescents. Providing nutrition education through comics over four months enabled students to increase knowledge and attitudes, improve food consumption, and ultimately enhance Hb levels.

While studies have noted variations in haemoglobin levels related to menstruation, the timing of this study (screening students and following inclusion criteria) ensured that these factors were accounted for.

CONCLUSION

The results indicate that nutrition education using comics is an effective strategy to improve knowledge, attitudes, and skills in consuming a balanced diet, thereby reducing the prevalence of anaemia among adolescent girls. Comics can serve as a practical and engaging tool for nutrition counseling in Islamic boarding schools.

Data Availability Statement

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

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Statement of Authorship

All authors certified fulfillment of ICMJE authorship criteria.

Author Disclosure

All authors declared no conflicts of interest.

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