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Anemia prevention attitudes and behavior as determinants of anemia status in deaf adolescent girls

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ABSTRACT

Anemia remains a major nutritional problem among adolescents, especially girls, due to physiological changes and inadequate dietary intake. Deaf adolescents are particularly vulnerable due to limited access to health information, yet few studies have examined the role of attitude and behavior in this population. This study was to determine the relationship between attitudes and behaviors toward anemia prevention and anemia status among deaf adolescent girls. A cross-sectional analytical study was conducted at Public Special Needs School 1 Bantul, Yogyakarta, Indonesia involving 28 deaf adolescent girls aged 10–19 years using total sampling. Data were collected through validated questionnaires assessing attitudes and behaviors toward anemia (Cronbach's α: 0.746 and 0.827, respectively). Hemoglobin levels were measured using the EasyTouch GCHb device. Data were analyzed using Spearman Rho correlation with a significance level of $p < 0.05$. A strong positive correlation was found between attitudes and anemia status ($r = 0.681$, $p = 0.000$) and between behavior and anemia status ($r = 0.708$, $p = 0.000$). Most anemic participants had poor behavioral scores and came from low-income families. Additionally, all anemic participants had begun menstruating, suggesting physiological and socioeconomic risk factors. Attitudes and behaviors are significantly associated with anemia status among deaf adolescent girls. Despite having positive attitudes, environmental and socioeconomic barriers may hinder healthy behavior implementation. Tailored and accessible health education, alongside cross-sectoral interventions, is needed to reduce anemia prevalence in adolescents with disabilities.

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Jurnal Kesehatan Ibu dan Anak Vol.18, No.1, pp. 1~12
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INTRODUCTION

Anemia is one of the world's nutritional problems. The increasing incidence of anemia is still the focus of public health problems today, especially iron deficiency anemia.(1) Anemia that does not receive proper treatment can cause various health complications, such as fatigue, decreased cognitive function, decreased immune system, increased risk of bleeding both before and after giving birth, giving birth to children with low birth weight (LBW), as well as birth defects.(2)

Adolescents, especially adolescent girls, are a very vulnerable group due to increased iron requirements during growth and menstruation.(3) According to World Health Organization (WHO) data, the prevalence of anemia among adolescents worldwide ranges from 40-88% of a population of 1.2 billion. The incidence of anemia among adolescent girls in developing countries is approximately 53.7% of all adolescent girls. The adolescent population is estimated at 1.2 billion, or 18% of the global population. Based on basic health research data (RISKESDAS), the prevalence of anemia in teenagers in Indonesia is 32%, meaning that out of 10 teenagers there are likely to be 3-4 teenagers suffering from anemia. Teenage girls are more at risk of developing anemia. RISKESDAS data for 2018 shows that the prevalence of anemia in adolescent girls aged 12-18 years has reached 23% with an increase of 11.8% over the last 5 years.(4) Where in 2013 it was 37.1%, rising to 48.9% in 2018[3]. A survey on the incidence of anemia was also carried out by the DIY Health Service in 2018 with a target of 1500 young women in 5 districts and cities. The data results showed that as many as 19.3% of young women in DIY experienced anemia (Hb below 12 g/dl). Based on this survey, anemia prevalence data was obtained in each district, namely Kulon Progo Regency (73.8%), Bantul Regency (54.8%), Yogyakarta City (35.2%), Sleman Regency (18.4%), Gunungkidul Regency (18.4%).(5)

Adolescents are at high risk of anemia due to increased iron requirements during periods of rapid growth and menstruation, combined with inadequate or inconsistent dietary intake.(6,7) Among vulnerable groups, adolescents with special needs—particularly those with hearing impairments—may face even greater challenges, as limited access to health information can reduce their awareness of proper nutrition. Deaf adolescent girls may be less exposed to educational resources regarding balanced diets and the importance of iron intake, placing them at increased risk for iron-deficiency anemia.(8) Despite the Indonesian government's efforts to distribute weekly iron supplements (Fe tablets) through schools, adherence remains critically low; only 1.4% of adolescent girls consume the recommended 52 tablets per year.(9) The most cited reason is the perception that supplementation is unnecessary, which reflects a broader issue of inadequate knowledge, attitudes, and preventive behavior.(10,11) Studies have shown that adolescents with poor understanding and attitudes toward anemia are over twice as likely to develop the condition.(12) This underscores the importance of addressing both behavioral and informational barriers in anemia prevention strategies, particularly among adolescents with disabilities.(13,14)

While positive attitudes and health behaviors—such as consuming iron-rich foods and adhering to iron supplementation—have been consistently associated with reduced anemia prevalence among adolescents, recent international studies further emphasize their critical role. For instance, research from Bangladesh (2022) linked irregular dietary habits with higher anemia rates, while an Indonesian study (2021) highlighted strong associations between knowledge, attitudes, practices (KAP), and anemia status in adolescent girls.(15,16) Web-based educational interventions have also been shown to improve adolescent awareness and attitudes toward anemia prevention.(17) Despite these advances, there remains a significant research gap regarding adolescents with disabilities—particularly deaf adolescents—who face unique communication barriers that limit access to nutritional education. Current literature predominantly focuses on the general adolescent population or broadly defined special needs groups, leaving the specific needs

Jurnal Kesehatan Ibu dan Anak Vol.18, No.1, pp. 1~12
ISSN: 2599-3224 (Online), ISSN: 2302-6014 (Print)

and risks of deaf adolescents underexplored. Addressing this gap is essential to developing inclusive and effective anemia prevention strategies.

Anemia prevention through education and behavior modification has been shown to be effective in the general population but has not been evaluated in adolescents with hearing impairments, who have distinct communication and educational needs. Therefore, this study recommends an approach that evaluates attitudes and behaviors toward anemia as the basis for inclusive and targeted interventions.

METHOD

This study employed an analytical observational design with a cross-sectional approach to investigate the relationship between attitudes and behavior towards anemia and the incidence of anemia among deaf adolescent girls. Data collection was conducted in March 2023 at Public Special Needs School 1 Bantul, a special needs school located in Yogyakarta, Indonesia. The population consisted of 28 deaf adolescent girls aged 10–19 years enrolled at Public Special Needs School (SLB Negeri) 1 Bantul. The total sampling technique was applied, where all eligible individuals were included in the study. Inclusion criteria were deaf adolescent girls aged 10–19 years; Enrolled at Public Special Needs School 1 Bantul (SLB Negeri 1 Bantul) during the time of data collection; Able to understand and complete the questionnaire independently or with assistance; Willing to participate and provide informed consent. Exclusion criteria included: adolescents with acute illness at the time of data collection; known hematological disorders not related to nutritional anemia (e.g., thalassemia, sickle cell anemia). Data were collected using two primary instruments: (1) Sociodemographic Questionnaire, including age, class level, and menstruation history; (2) Attitudes and Behavior Questionnaire related to anemia prevention, consisting of 10 items each. The questionnaire was adapted from the Guidelines for the Prevention and Management of Anemia in Adolescent Girls and Women of Reproductive Age by the Ministry of Health, Republic of Indonesia (2018). The instrument was pre-tested for validity and reliability on 21 deaf adolescent girls at Public Special Needs School 2 Bantul. The Cronbach's alpha coefficient was 0.746 for the attitudes section and 0.827 for the behavior section, indicating acceptable internal consistency. Hemoglobin levels were measured using a point-of-care test with the EasyTouch GCHb hemoglobin meter (model and manufacturer to be specified), which provides quick results in grams per deciliter (g/dL). Anemia was defined as hemoglobin <12 g/dL, in accordance with WHO standards for adolescent females. The procedure was conducted under standard precautions by trained personnel. Data were analyzed using IBM SPSS version 26. Descriptive statistics (frequencies, percentages, means, and standard deviations) were used to describe participant characteristics and variable distributions. The Spearman Rho test was performed to assess the association between attitudes/behavior and anemia status because the data were not normally distributed. A p-value < 0.05 was considered statistically significant. This study received ethical approval from the Health Research Ethics Committee (KEPK) of Poltekkes Kemenkes Yogyakarta with reference number DP.04.03/e-KEPK.1/065/2023, issued on February 9, 2023. All participants and/or their guardians signed informed consent forms prior to data collection.

Jurnal Kesehatan Ibu dan Anak Vol.18, No.1, pp. 1~12
ISSN: 2599-3224 (Online), ISSN: 2302-6014 (Print)

RESULTS

Characteristics and description of respondent's anemia status below:

Table 1. Distribution of characteristics and description of the incidence of anemia in respondents

Characteristic Variables	Anemic Status				Amount	
	Yes		No		F	%
	F	%	F	%		
Age						
Early Adolescents (10-13 Years)	5	17.9	5	17.9	10	35.7
Middle Adolescents (14-16 Years)	2	7.1	9	32.1	11	39.3
Late Adolescents (17-19 Years)	2	7.1	5	17.9	7	25.6
Adolescents Education Level						
<High School	7	25	13	46.4	20	71.4
≥ High School	2	7.1	6	21.4	8	8.6
Job of Head of Family						
Non-Permanent Work	7	25	10	35.7	17	60.7
Permanent Workers	2	7.1	9	32.1	11	39.3
Family Income						
Height	2	7.1	15	53.6	17	60.7
Low	7	25	4	14.3	11	39.3
Parents' Last Education						
Father						
Finished Elementary School	3	10.7	0	0	3	10.7
Finished Middle School	4	14.3	3	10.7	7	25.0
Finished High School	2	7.1	11	39.3	13	46.4
Graduated From College	0	0	5	17.9	5	17.9
Mother						
Finished Elementary School	1	3.6	1	3.6	2	7.1
Finished Middle School	5	17.9	2	7.1	7	25
Finished High School	3	10.7	12	42.9	15	53.6
Graduated From College	0	0	4	14.3	4	14.3
Nutritional Status						
Thin (BMI < 18.5)	6	21.4	4	14.3	10	35.7
Normal (BMI 18.5 – 25.0)	3	10.7	13	46.4	16	57.1
Obese (BMI >25.1	0	0	2	7.1	2	7.1
Menstrual Status						
Already Menstruating	9	32.1	15	53.6	24	85.7
Not Menstruating Yet	0	0	4	14.3	4	14.3
Total	**9**	**32.1**	**19**	**67.9**	**28**	**100**

Based on Table 1, the results showed that the incidence rate of anemia was 32.1 %, where the characteristics of respondents who experienced anemia were generally early adolescents (17.9%) with an education level <high school (25%). Most respondents had a thin nutritional status (21.4 %) and had menstruated (32.1%). Most of the respondents came from families with a non-permanent job for the head of the family (25%) and low income (25%) with the respondent's father and mother's last education being at junior high school level.

Table 2. Description of respondents' attitude, behavior and Hb level values

Variable	N	*Mean*	*SD*
Attitude	28	74.3	13.99168
Behavior	28	74	14.74205
Hb level	28	13,639	1.75295

Table 2 presents the average value of each variable. Based on the data above, the frequency of respondents who have attitude and behavior scores above the average (61%)

Jurnal Kesehatan Ibu dan Anak Vol.18, No.1, pp. 1~12
ISSN: 2599-3224 (Online), ISSN: 2302-6014 (Print)

is greater than respondents who have scores below the average (39%). Almost all respondents who experienced anemia had attitude and behavior scores below average.

Table 3. Normality test result

	Sig	Statistics
Hb level	0.008	0.894
Attitude Value	0.002	0.865
Behavioral Values	0.005	0.883

The Normality Test is carried out to test the prerequisites for numerical scale data. From the results of the test of normality, it was found that all variables, both independent variables (attitude and behavior values) and dependent variables (Hb levels) were not normally distributed because the significance value was < 0.05. Based on this, the statistical test used to determine the correlation test between the independent variable and the dependent variable is the Spearman rho test.

Table 4. Correlation test analysis results

	r	p-value
Relationship between attitude and Hb levels	0.681	0,000
Behavioral Relationship with Hb Levels	0.708	0,000

The Spearman Rho test with a significance level of < 0.05, illustrates that there is a significant relationship between attitudes and behavior towards anemia and anemia status ($p<0.05$). The level of relationship between the variables studied is a strong level of relationship with a positive (unidirectional) nature of the relationship. This is proven by the r value which is in the coefficient interval (0.51 – 0.75) and does not have a minus sign (-). A positive relationship means that the more positive the attitude and behavior towards anemia, the better the possibility of Hb levels being achieved due to good preventive measures so that anemia can be avoided.

DISCUSSION

Anemia is a condition where the hemoglobin level in the blood is less than normal limits. In adolescence, the normal limit for hemoglobin levels to determine the diagnosis of anemia is less than 12gr/dL. Many factors influence the occurrence of anemia, one of which is indirect factors such as teenagers' attitudes and behavior towards anemia.

The relationship between attitudes towards anemia and anemia status in deaf adolescent girls

This study found a statistically significant and strong positive correlation between attitudes toward anemia and anemia status among deaf adolescent girls. This is proven by the results of the correlation test using *Spearman Rho* with a p-value of 0.000 and a *correlation coefficient* (r) of 0.681. Participants with more positive attitudes were less likely to be anemic, highlighting the role of psychosocial factors in anemia prevention among adolescents with special needs. This finding supports the idea that attitude serves as a cognitive predisposition that can shape behavior and health outcomes.

This finding aligns with recent international studies emphasizing the importance of reinforcing attitudes to improve anemia outcomes. In Jordan, a quasi-experimental nutrition education program targeting adolescent girls significantly increased their knowledge, attitude, and practice (KAP) scores, leading to a decrease in anemia prevalence among participants (44.5% mild anemia, 10% moderate). Similarly, in Shiraz, Iran, a Theory of

Jurnal Kesehatan Ibu dan Anak Vol.18, No.1, pp. 1~12
ISSN: 2599-3224 (Online), ISSN: 2302-6014 (Print)

Planned Behavior–based intervention achieved measurable improvements in nutritional behaviors and attitudes, demonstrating that attitude-driven interventions can effectively reduce iron-deficiency anemia in adolescents.(18) Moreover, a pre-post school feeding and education program in Indonesia reduced anemia prevalence from 42.6% to 21.7% within nine months, with significant improvements in KAP scores and hemoglobin levels.(19) The present study demonstrates a significant correlation between attitudes and anemia status among deaf adolescent girls, aligning with previous research conducted in general adolescent populations. For instance, studies in Central Java (Titin, 2020; SMA Muhammadiyah 1 Karanganyar) also reported that positive attitudes were significantly associated with a lower incidence of anemia ($p = 0.002$).(20,21) Conversely, Subagja (2021) found no such correlation in middle school students, suggesting that contextual and population-specific factors may influence the strength of this relationship.(22)

Attitude is widely recognized as a cognitive predisposition that shapes subsequent behavior.(20,23,24) Consistent with our findings, a study in Medan reported that adolescent girls with negative attitudes were 7.9 times more likely to develop anemia compared to those with positive attitudes.(25) The literature further highlights that attitude formation is influenced by developmental stage, social environment, and parental education.(1,12,26,27) Our study corroborates this, as participants with below-average attitude scores were predominantly early adolescents with lower educational backgrounds, and many came from families where parents had only elementary or middle school education.

These findings underscore two key points. First, adolescence—particularly early adolescence—is a critical period in which psychosocial changes and increased iron requirements interact with limited health literacy, making attitudes toward health behaviors especially influential.(28,29) Second, while previous studies have focused on general adolescent populations, the present study emphasizes the unique vulnerabilities of deaf adolescents, who face additional barriers to accessing health information due to communication challenges.(22,30) This population-specific focus represents a notable research gap in the literature.

Importantly, our results confirm that fostering positive attitudes alone is insufficient unless accompanied by supportive environments and practical health behaviors, such as regular iron supplementation, balanced dietary intake, and the avoidance of iron absorption inhibitors.(3,13,23) This highlights the need for tailored interventions that combine attitude modification with accessible health education, particularly through family involvement, school-based programs, and mass media campaigns. By situating these findings within both national and international evidence, this study advances the field by documenting how psychosocial determinants of anemia extend to adolescents with disabilities—a group largely overlooked in prior research. This originality not only justifies the present work but also calls for inclusive anemia prevention strategies that account for the specific needs of marginalized adolescent populations.

The findings of this study have significant implications for the development of inclusive health interventions, particularly among deaf adolescents—a group often overlooked in public health programs. Given the strong correlation between attitudes and anemia status, it is essential to design targeted strategies that address both cognitive and environmental barriers to health behavior change. First, school-based interventions must be tailored to the communication needs of deaf adolescents. This includes utilizing visual communication tools, such as infographics, pictorial modules, and video content in sign language, to effectively convey information about anemia, iron-rich diets, and iron supplementation. Studies have shown that health education adapted to visual or sign-based communication significantly improves knowledge retention and engagement among hearing-impaired students. Second, the involvement of parents and teachers is critical. Deaf adolescents are often more dependent on their immediate social environment for accessing

Jurnal Kesehatan Ibu dan Anak Vol.18, No.1, pp. 1~12
ISSN: 2599-3224 (Online), ISSN: 2302-6014 (Print)

and interpreting health information. Parental modeling and teacher support play a significant role in shaping attitudes and reinforcing behaviors, especially in students with limited autonomy or access to mainstream media. Integrating family-centered approaches in health programs can amplify the impact of school-based efforts. Third, these findings reinforce the urgency of embedding health literacy—including anemia prevention—into the curriculum of special education schools. Health education should not be standardized across all student populations but must be contextualized to the needs of students with disabilities, including deaf learners. This aligns with the principles of the UN Convention on the Rights of Persons with Disabilities, which emphasizes the right to accessible health information and inclusive education.

The relationship between behavior towards anemia and anemia status in deaf adolescent girls

This study highlights that positive behaviors toward anemia prevention significantly reduce the risk of anemia in deaf adolescent girls, a group often excluded from mainstream health education efforts. This study found that deaf adolescent girls who demonstrated better behavior in anemia prevention—such as dietary practices and iron supplement compliance—were significantly less likely to be anemic. Most anemic girls had poor behavioral scores and came from socioeconomically disadvantaged families, with poor nutritional status. The correlation test between behavior towards anemia and anemia status showed a p-value of 0.000 and an r value of 0.708, meaning that the hypothesis was accepted and there was a significant relationship between behavior towards anemia and anemia status in deaf adolescent girls at SLB Negeri 1 Bantul.

Our results demonstrate a strong and significant association between preventive behaviors (dietary practices, iron tablet adherence) and anemia status among deaf adolescent girls. This aligns with previous research showing that targeted health behaviors significantly reduce anemia prevalence. A school-based iron and nutrition program in Indonesia saw nutrition intake to prevent anemia increase more than tenfold (OR = 11.9) in female adolescents, influenced by social, intrapersonal, and programmatic factors.(31) Moreover, a recent global systematic review underscores that despite variations in supplementation studies, well-designed iron interventions often yield improvements in hemoglobin, compliance, and associated behaviors.(32) Internationally, attitude- and behavior-driven interventions consistently demonstrate efficacy. In Jordan and Iran, behaviorally based educational programs improved iron-related practices and lowered anemia rates significantly, indicating that shaping positive preventive behaviors can have tangible health impacts across diverse adolescent populations.(33,34)

The findings of this study confirm a significant relationship between behavior and anemia status among deaf adolescent girls, consistent with previous research in general adolescent populations. For example, studies conducted in Singaraja(35), Pematang Siantar(36), and Cimahi(15) reported significant associations between health behaviors and anemia incidence ($p < 0.05$), while Lestari (2021) found that good knowledge, attitudes, and behaviors were linked to a lower prevalence of anemia among adolescent girls.(37) These consistent results underscore the central role of behavior in anemia prevention.

Nutritional status emerged as an important factor in our study, with most anemic participants classified as underweight (BMI <18.5).(38,39) This aligns with previous reports indicating that underweight adolescents have a 1.5-fold higher risk of anemia compared to their peers with normal nutritional status.(40) However, our study did not assess dietary intake in detail, representing a limitation and pointing to the need for future research on specific nutritional determinants of anemia in this population.

Socioeconomic conditions further influenced behavior and anemia outcomes.(41) Most anemic respondents came from families with low income or irregular employment, which restricted access to iron-rich foods and shaped adolescents' dietary habits.(42) This

Jurnal Kesehatan Ibu dan Anak Vol.18, No.1, pp. 1~12
ISSN: 2599-3224 (Online), ISSN: 2302-6014 (Print)

finding is consistent with evidence that family income and parental education strongly determine nutritional behavior and anemia risk.(43) While prior studies have acknowledged these factors, our research highlights how they interact with the unique communication barriers faced by deaf adolescents, intensifying their vulnerability.

In addition, menstruation was found to be a critical risk factor, as all anemic respondents had reached menarche. This underscores the importance of preventive behaviors such as regular Fe supplementation during adolescence.(44) Yet, many adolescents remain unaware of these needs before menarche, reinforcing the urgency of early and targeted health education.

Importantly, while previous research has emphasized the general role of knowledge, attitudes, and behaviors in anemia prevention(45), few studies have focused on adolescents with disabilities. This study therefore addresses a significant research gap by demonstrating that the behavioral determinants of anemia observed in the general population also apply to deaf adolescents, who are often excluded from mainstream health promotion programs. The originality of this work lies in its focus on a marginalized group with limited access to health information, emphasizing the need for inclusive, school-based, and family-supported interventions.(46)

Our results support the call for multisectoral approaches to anemia prevention, including the integration of nutrition education into special school curricula, collaboration between schools and health centers, and community empowerment strategies to improve food security. Such tailored interventions are critical to ensure that adolescents with hearing impairments receive equitable opportunities to maintain their health and prevent anemia.

Crucially, although much literature supports the behavior–anemia link, few recent studies focus specifically on adolescents with sensory disabilities. Literature on behavior change and anemia prevention largely targets general youth populations. Yet, evidence from hearing-impaired adolescents is virtually absent. This represents a substantial research gap. Our study—by identifying a clear behavioral–health relationship in deaf adolescent girls—provides new evidence that prevention must account for disability-specific barriers, such as limited access to mainstream health education channels. Despite differences in setting and methodology, a stable pattern emerges adolescents who adopt anemia-preventive behaviors are less likely to be anemic—regardless of region, socioeconomic context, or study design. This consistency supports the argument for developing inclusive, behaviorally oriented interventions targeting both attitudes and practices, especially in under-researched groups like deaf adolescents.

The findings underscore the importance of targeted behavioral interventions in anemia prevention, especially among deaf adolescents. Schools for children with special needs should collaborate with public health centers to provide accessible, inclusive, and repeated education sessions. Moreover, multi-sectoral efforts—such as supporting families in developing home gardens or subsidizing iron-rich foods—may help overcome economic barriers to anemia prevention. This study was limited by its small sample size and focus on a single school. The cross-sectional design also limits causal interpretation. Future studies should involve a larger sample, assess knowledge levels, and consider longitudinal or interventional approaches to evaluate the effectiveness of tailored health education in deaf populations.

CONCLUSION

This study confirmed a significant relationship between attitudes and behaviors toward anemia and the incidence of anemia among deaf adolescent girls. Positive attitudes and preventive health behaviors, such as consuming iron-rich foods and adhering to iron supplementation, were associated with lower rates of anemia. However, socioeconomic challenges and limited access to health information due to communication barriers may inhibit the adoption of healthy behaviors, despite positive attitudes. These findings highlight

Jurnal Kesehatan Ibu dan Anak Vol.18, No.1, pp. 1~12
ISSN: 2599-3224 (Online), ISSN: 2302-6014 (Print)

the need for inclusive, visually accessible, and family-centered health education strategies, especially in special education settings. Future efforts should focus on integrated health promotion, involving schools, families, and cross-sectoral support to reduce the risk of anemia among adolescents with disabilities.

AUTHOR CREDIT STATEMENT

AFZ: Conceptualization, Methodology, Data Collection, Formal Analysis, Writing – Original Draft, Writing – Review & Editing, Visualization; **HSK, AK, SS**: Supervision, Validation.

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The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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