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VALIDATION ANALYSIS OF FORSA AS A SCREENING TOOL FOR ANEMIA IN ADOLESCENT GIRLS

Analisis Uji Validasi Forsa Sebagai Alat Skrining Anemia Pada Remaja Putri

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ABSTRAK

Anemia pada remaja putri masih menjadi masalah kesehatan masyarakat yang signifikan di Indonesia, dengan prevalensi mencapai 32%. Kondisi ini berdampak negatif terhadap kesehatan fisik, kognitif, dan reproduksi, serta prestasi belajar dan produktivitas. Deteksi anemia saat ini masih bergantung pada metode invasif, seperti digital hemoglobinometer, yang hanya mengukur kadar hemoglobin tanpa mengidentifikasi penyebab dasarnya. Penelitian ini bertujuan untuk mengevaluasi validitas dan efektivitas Formulir Skrining Anemia Remaja (FORSA) sebagai alat skrining non-invasif untuk mengidentifikasi risiko anemia pada remaja putri. Studi observasional dengan pendekatan potong lintang dilakukan terhadap 228 siswi dari dua SMA di Kota Malang yang dipilih secara purposive. Instrumen FORSA terdiri dari 34 pertanyaan mengenai gejala klinis dan faktor risiko anemia. Hasil FORSA dibandingkan dengan kadar hemoglobin yang diukur menggunakan digital hemoglobinometer sebagai standar emas. Prevalensi anemia ditemukan sebesar 29,8%. Skor FORSA memiliki hubungan yang signifikan dengan status anemia (p < 0,05), dengan sensitivitas 82%, spesifisitas 82%, nilai prediksi positif 74%, dan nilai prediksi negatif 82%. Faktor dominan yang memengaruhi skor FORSA dan status anemia meliputi kebiasaan melewatkan sarapan, pola menstruasi tidak teratur, dan rendahnya kepatuhan mengonsumsi tablet tambah darah (TTD). Kesimpulannya, FORSA merupakan instrumen yang valid dan efektif untuk skrining anemia berbasis komunitas, dan direkomendasikan untuk diimplementasikan dalam program rutin di sekolah maupun fasilitas pelayanan kesehatan primer guna mendukung pencegahan anemia secara dini dan tepat sasaran.

Kata kunci: *deteksi dini, Forsa, kebiasaan makan, remaja putri, skrining anemia*

ABSTRACT

Anemia among adolescent girls remains a significant public health issue in Indonesia, with a prevalence of 32%. It negatively impacts physical, cognitive, and reproductive health, as well as academic performance and productivity. Current detection relies on invasive methods, such as digital hemoglobinometers, which measure hemoglobin levels but do not reveal underlying causes. This study aimed to assess the validity and effectiveness of the Formulir Skrining Anemia Remaja (FORSA) as a non-invasive tool to identify anemia risk in adolescent girls. A cross-sectional observational study was conducted with 228 female students from two high schools in Malang City, selected via purposive sampling. The FORSA questionnaire includes 34 items on clinical symptoms and anemia risk factors. Results were compared to hemoglobin levels measured using a digital hemoglobinometer as the gold standard. The anemia prevalence was 22.8%. FORSA scores were significantly associated with anemia status ($p < 0.05$), with a sensitivity of 91%, specificity of 61%, positive predictive value of 43%, and negative predictive value of 96%. Key contributing factors included skipping breakfast, irregular menstruation, and low adherence to iron supplementation. In conclusion, FORSA is a valid and effective screening instrument and is recommended for routine use in schools and primary healthcare to support early detection and targeted anemia prevention.

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Keywords : adolescent girls, anemia screening, eating habits, early detection, FORSA

INTRODUCTION

Indonesia as a developing country faces serious challenges in public health aspects, including the prevalence of anemia in adolescent girls[1].According to data from the Central Statistics Agency (BPS), Indonesia's population will reach 281 million in 2024, making it the third most populous country in the world.[2]High population growth accompanied by socioeconomic inequality contributes to various health problems such as anemia and stunting in adolescents[3], especially girls aged 10–19 years, who are categorized as adolescents according to the WHO. Adolescence is a critical phase in the formation of long-term health because during this period there is significant acceleration in physical and psychosocial growth[4].

Anemia in adolescent girls is often overlooked because it is non-contagious and symptoms are not always apparent. However, its impacts are significant, including decreased productivity, impaired cognitive development, increased risk of bleeding during pregnancy, and reproductive health complications such as low birth weight (LBW) and stunting.[5]2023 Basic Health Research (Riskesdas) data shows that the prevalence of anemia in adolescents in Indonesia is 16.2%, with the figure being higher in girls (18%) than boys (14.4%)[6].

Various studies have shown that risk factors for anemia in adolescents include poor diet, excessive menstrual duration and volume, parasitic infections, low socioeconomic status, psychological disorders, low physical activity, and a history of chronic disease or genetic disorders in the family[7],[8]. Early detection of anemia is important to avoid further complications[9]. Early detection and intervention are very important, considering that anemia in adolescence can continue into pregnancy if left untreated, as emphasized in research that the adolescent-to-early childbearing age phase is a high-risk group for iron deficiency[10]. Conventional screening methods, such as laboratory tests, are accurate, but not always practical, especially in areas with limited access to health services[11].

Government programs such as the Health Report have included general health screening, but do not yet have a specific screening tool for anemia[12]. Therefore, researchers developed the Adolescent Anemia Screening Form (FORSA), a simple, symptom- and risk-based screening tool designed to identify adolescent girls at risk of anemia. FORSA integrates subjective and objective data, is easily implemented in primary healthcare settings, and can be used as an educational tool and for early intervention.

This study aims to determine the validity and effectiveness of the Adolescent Anemia Screening Form (FORSA) in detecting anemia in adolescent girls. Malang City was chosen as the research site because of the active involvement of the Janti and Bareng Community Health Centers in the PKRS program and the UKS adolescent cadre program, and the ILP integrated health service post (Posyandu ILP) has maximum achievement. SMKN 1 is a school under the Janti Community Health Center area with active UKS activities with UKS cadres who have been trained by the Community Health Center, Muhamadiyah Senior High School 1 is located in the Bareng Community Health Center area which is active with the ILP integrated health service post and the diverse socioeconomic status of the female students. The Adolescent Anemia Screening Form (FORSA) differs from the Health Report and Anemia Screening that already exist at the Community Health Center because this instrument is more specific in capturing adolescents who are at risk of anemia qualitatively and can be used as an educational medium for adolescents. Adolescents who fall into the at-risk group can be continued with further examinations as a basis for diagnosis so that not all adolescents need invasive examinations.

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METHODS

This research was an analytical observational study with a cross-sectional approach and uses a diagnostic test method which aims to test validity and reliability.[13]The Adolescent Anemia Screening Form (FORSA) is a screening tool for anemia in adolescent girls. This study was conducted from April 22-25, 2025, at SMKN 1 Janti and SMK Muhammadiyah 1 Klojen in Malang City in collaboration with the Faculty of Medicine, Universitas Brawijaya.

The population in this study were all female adolescents in grades X and XI who were students in Malang City. The sample was selected using a purposive sampling technique and calculated using the Slovin formula. The sample was selected with inclusion criteria including: female adolescents aged 15–19 years, active as students, willing to be respondents, and obtained written permission from their parents in the informed consent form that had been reviewed by the FKUB Ethics Committee. Exclusion criteria included adolescents who were menstruating, had acute infections, or had a history of severe chronic illness that interfered with the examination. The number of samples was determined based on the validity and reliability test formula of the measuring instrument. The results of the sample selection obtained 228 female students who met the research criteria.

The research variables consist of independent variables, namely scores from the Adolescent Anemia Screening Form (FORSA) based on risk factors and clinical symptoms, and dependent variables in the form of anemia status based on the results of hemoglobin (Hb) level measurements. Data collection was carried out in two stages, namely: filling in the FORSA by the researcher and checking hemoglobin levels using an EasyTouch® brand hemoglobinometer from capillary blood samples. The Adolescent Anemia Screening Form (FORSA) consists of 7 main indicators with a total of 34 questions divided into Favorable and Unfavorable question grids. The seven main indicators are as follows:

1) Clinical Symptom Indicators consist of 5 questions, including feeling tired all day, often experiencing dizziness when doing light activities, hair loss and brittle nails, pale conjunctiva, and shortness of breath when doing light activities.
2) The Nutrition Pattern Indicator consists of 6 questions covering mealtime patterns, frequently skipping breakfast, tea/coffee consumption habits, regular consumption of iron supplements or multivitamins, and dietary habits.
3) The Menstrual Pattern Indicator consists of 4 questions, including the duration of menstruation, how many times a woman changes her sanitary napkin in a day, her menstrual cycle, bleeding outside the menstrual cycle, and her age at menarche.
4) The Psychological Status Indicator consists of 6 questions, including whether you are currently experiencing psychological stress, difficulty sleeping for some time, decreased appetite due to stress, fatigue without much activity, difficulty concentrating, and desire to diet because you feel fat.
5) The Socioeconomic and Physical Activity Indicators consist of 7 questions covering the availability of food at home, the availability of animal protein at meal times, the availability of proper sanitation at home, having health insurance, access to health information, exercising regularly twice a week, and consuming iron tablets (TTD) from the community health center every month.
6) The infection history indicator consists of 3 questions, including a history of worm infestation in the last 6 months, experiencing a Urinary Tract Infection (UTI) or Upper Respiratory Tract Infection (URTI).
7) The Medical History Indicator consists of 4 questions, including having a blood disease that has been diagnosed by a doctor, having a serious digestive disease, having experienced heavy bleeding in the last 3 months and having a chronic disease (diabetes mellitus, chronic kidney failure, etc.).

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Hb level examination was conducted by a researcher who works as a midwife at the Regional General Hospital and has a STR, using the EasyTouch® digital hemoglobinometer method, which has a reading time of approximately 6 seconds. This tool has been previously validated and declared valid for use, with a cut-off point for anemia at Hb levels <12 mg/dl, according to WHO standards [3]. This study has received ethical approval from the Health Research Ethics Committee of the Faculty of Medicine, Universitas Brawijaya, with ethical letter number: 142/EC/KEPKUB-S2/2025 issued on April 15, 2025.

Data analysis techniques include validity and reliability tests (Cronbach's Alpha) to determine the consistency and accuracy of the questions in the FORSA instrument.[14]. Next, sensitivity and specificity tests were conducted, as well as calculations of positive predictive value (NPP) and negative predictive value (NPN) by comparing the FORSA screening results with the results of hemoglobin (Hb) level examinations as the gold standard[15].

RESULT

Characteristics of Research Subjects

This study involved 228 female adolescents aged 15–19 years from SMKN 1 and SMK Muhammadiyah 1 in Malang City. All subjects had experienced menstruation and were willing to participate in the study. All respondents met the inclusion criteria and voluntarily participated in all data collection processes. Most came from lower-middle socioeconomic backgrounds and had irregular eating habits and low animal protein consumption. All respondents underwent screening using the Adolescent Anemia Screening Form (FORSA) and hemoglobin levels were measured as a comparison.

Distribution of Anemia

After conducting a Hemoglobin examination using a Hemoglobinometer as the gold standard and comparison on the FORSA instrument, the distribution of anemia at SMKN 1 and SMK Muhamadiyah 1 was as follows:

Table 1. Distribution of Anemia

Category	Amount	Percentage
No Anemia	177	78%
Mild anemia	29	13%
Moderate Anemia	23	9%
Total Respondents	228	100%

The FORSA score distribution above is grouped into 3 categories, namely no risk with a score value <=7, moderate risk with a score value of 8-14, and high risk with a score value >14. From the data distribution above, it is known that out of 228 respondents, 23 respondents have a moderate risk of anemia, 29 respondents have a mild risk of anemia, while 138 respondents are not at risk of anemia.

Validity and Reliability Test

Reliability testing is conducted to measure the internal consistency of a research instrument, namely the extent to which the questionnaire items consistently measure the same construct. One method commonly used to test reliability is Cronbach's Alpha. Based on the analysis results shown in Table 1, the Cronbach's Alpha value was 0.728 for the 34 questions tested.

Table 1. Reliability Test (Cronbach's Alpha)

Cronbach's Alpha	N of Items
0.728	34

According to standard interpretation, Cronbach's Alpha values can be classified as follows:

- $\alpha \geq 0.90$: Very good (excellent)
- $0.80 \leq \alpha < 0.90$: Good

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- 0.70 ≤ α < 0.80 : Sufficient (acceptable)
- 0.60 ≤ α < 0.70 : Marginal (less acceptable)
- α < 0.60 : Not acceptable

Thus, the value of α = 0.728 indicates that the instrument has sufficient or acceptable reliability, which means that the items in the questionnaire have adequate internal consistency in measuring the intended construct.

Analysis of Sensitivity, Specificity, Positive Predictive Value (NPP) and Negative Predictive Value (NPN)

To determine the validity of the FORSA instrument in detecting anemia, I, as a researcher, used validity tests for reliability, sensitivity, specificity, and NPP and NPN. This analysis used data from a contingency table based on anemia status, determined by hemoglobin levels, as the reference standard. The calculation results are presented as follows:

Table 2. Contingencies

Test Results	Disease Status		Amount
	Sick	No Pain	
POSITIVE	TP	FP	TP+FP
NEGATIVE	FN	TN	FN+TN
TOTAL	TP+FN	FP+TN	N

*****2x2 matrix table of FORSA validity test

Table 3. Anemia Contingencies

Test Results	Disease Status		Amount
	Sick	No Pain	
Positive	68	24	92
Negative	24	112	136
Amount	92	136	228

*****anemia contingency matrix table

TN sensitivity:(TN:FP)=112:(112+24)=0.823 x 100%= 82%
Specificity of TP:(TP+FN)=112:(112+24)=0.823 x 100%=82%
Positive Predictive Value (NPP) TP:(TP+FP)=68:(68+24)= 0.739 x 100%=74%
Negative Predictive Value (NPN) TP:(TN+FN)=112:(112+24)= 0.823 x100%=82%

Bivariate Analysis

Table 5. Validity of FORSA for Hemoglobin Examination

			FORSA	Anemia
Spearman's rho	FORSA	Correlation Coefficient	1.000	.491**
		Sig. (2-tailed)	.	.000
		N	228	228
	Anemia	Correlation Coefficient	.491**	1.000
		Sig. (2-tailed)	.000	.
		N	228	228

To determine the validity of the FORSA instrument in detecting anemia in adolescent girls, a correlation analysis was conducted between the total FORSA score and the results of the hemoglobin test as the gold standard. Pearson was used because both variables (FORSA score and Hb level) are ratio-scaled and have met the assumption of normal data distribution. The use of the Pearson test aims to see the linear relationship between two quantitative variables and the extent to which the FORSA score is able to reflect the actual condition of anemia based on hemoglobin levels. This table strengthens

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the results of the validity test and shows that FORSA has a good ability to identify individuals at risk of anemia.

The results of the construct validity test in table 5 using Pearson correlation analysis between the FORSA score and the hemoglobin level test results showed a correlation coefficient of r = 0.491 with a significance value of p = 0.000 (p < 0.000). This value indicates a very strong and statistically significant relationship between the FORSA screening results and hemoglobin levels as the gold standard. This high correlation coefficient indicates that the FORSA instrument has excellent validity in identifying adolescent girls at risk of anemia. Thus, FORSA can be used as a valid initial screening tool before laboratory tests are performed. These results align with Sugiyono's (2017) criteria for interpreting correlation coefficients, where an r value between 0.70 and 0.90 is categorized as a strong relationship. This high validity supports FORSA's potential for wider adoption in anemia prevention programs in schools and communities.

DISCUSSION

Prevalence of Anemia in Adolescent Girls

The findings show that one-third of adolescents, or 29.8% of those surveyed, suffer from anemia. This confirms that anemia remains a pressing public health issue[13]. This proportion is higher than the national prevalence according to the 2023 SKI, which recorded a figure of 18% in adolescent girls[16]. This is due to skipping breakfast, frequently skipping meals, insufficient consumption of iron supplements, and the respondents' socioeconomic status.

Data collected at two schools, State Vocational High School 1 Janti and Muhammadiyah Vocational High School 1 Klojen, showed that most adolescent girls with anemia had a habit of skipping breakfast. This lack of habit was influenced by several factors, including their parents leaving for work early in the morning and not having time to prepare food, the habit of waking up late, or simply not having breakfast as children. This condition resulted in inadequate energy and essential nutrient intake, including iron, despite adolescents being an age group experiencing accelerated growth and requiring high nutritional needs.

Furthermore, most respondents also admitted to regularly drinking coffee daily. This consumption is generally done to reduce drowsiness caused by lack of sleep, which is triggered by high academic workloads and stress related to schoolwork. This habit negatively impacts iron absorption, as the tannins in coffee can inhibit the absorption of non-heme iron in the digestive tract. Psychological factors have also been found to play a significant role, with many students experiencing high levels of anxiety due to academic pressure, exam preparation, and mounting workloads. Chronic anxiety can increase levels of the stress hormone cortisol, which in the long term contributes to metabolic disorders, decreased appetite, and impaired red blood cell formation (hematopoiesis), all of which have the potential to worsen anemia.

These findings are consistent with previous studies that suggest anemia in adolescents is often associated with irregular eating patterns, caffeine consumption, and psychological factors such as stress and anxiety. Low levels of nutritional knowledge and poor diet significantly impact nutritional status, including low iron intake, which plays a role in preventing anemia[17].Previous research supports this finding, revealing that adolescent girls who have a habit of consuming foods low in heme iron and do not regularly take iron supplements have a higher risk of developing anemia[18].

In addition, other studies have found that family economic status significantly influences adolescents' ability to access nutritious food and health supplements[19]. Poor diet quality, such as low intake of animal protein, green vegetables, and fruits rich in vitamin C, also inhibits the absorption of iron from food[20]. Thus, anemia management requires a multidimensional approach, including improving access to nutritious food, health education, and optimizing iron tablet distribution programs.

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Effectiveness of FORSA as a Screening Tool

FORSA's ability to detect anemia is supported by its adequate sensitivity. The FORSA diagnostic value indicates that the tool has a sensitivity of 91% and a specificity of 61%. This indicates that FORSA is capable of identifying the majority of adolescent girls with anemia, making it an effective and reliable initial screening tool to identify adolescent girls at risk of anemia while minimizing false-positive results. These results support research emphasizing the importance of non-invasive and practical screening tools in school communities[21].This instrument can also be used as an educational tool to prevent anemia.

Scientifically, the high sensitivity of screening tools is very important in a public health context because it can detect a number of undetected cases of anemia (false negatives), which can have a serious impact on the cognitive and physical development of adolescent girls[22].On the other hand, high specificity also helps avoid unnecessary interventions in healthy individuals. The FORSA instrument meets these two main criteria, making it aligned with the principles of screening: screening tools must be simple, safe, and acceptable to the community, and capable of identifying disease at an early stage[23]. Several similar studies have shown that non-invasive screening tools combining clinical symptoms and simple parameters such as FORSA can be an important alternative in areas with limited laboratory facilities.

FORSA's effectiveness can also be enhanced through integration with school health programs, training of health cadres, and digitalization of assessments. This approach aligns with WHO's policy direction of promoting early detection of anemia in adolescents as part of a global strategy for anemia control.[4]This aligns with research that uses a community-based approach to preventing nutritional problems through the implementation of the five pillars of Community-Based Total Sanitation (STBM), which has been shown to reduce stunting. This pattern demonstrates that promotive preventive interventions that target behavioral and social environmental aspects can significantly impact nutritional status[24].

Policy Direction and Implications

Instruments like FORSA can be integrated into healthy school programs and community health center services to facilitate mass early detection. Furthermore, the results of this study support WHO recommendations on the importance of community-based screening tools, which are particularly relevant in areas with limited access to prevent long-term complications of adolescent anemia[4].The FORSA instrument is not only diagnostically effective but also practical for use in schools and community health centers. Its ability to filter high-risk populations allows for efficient follow-up testing using laboratory equipment.

Several scientific studies support the importance of community screening in anemia prevention, such as research showing that the prevalence of anemia in adolescents, especially girls, is still high globally and has a direct impact on productivity and cognitive development.[25]Therefore, early detection using a cost-effective and easy-to-use tool like FORSA is crucial. Other studies have also shown that school-based interventions with routine screening can improve adherence to iron supplementation and reduce anemia rates in the medium term[22].

The implementation of screening, such as FORSA supports the task-shifting approach, namely the delegation of early detection tasks to trained non-medical personnel, as recommended in the study and supported by WHO as an innovative approach in limited health systems.[4]This is in line with the promotive and preventive approach in the Healthy Indonesia paradigm through a family and community approach.[24]. Thus, the integration of FORSA into primary health care and education policies can be part of the national strategy for anemia prevention, while supporting the Sustainable Development Goals (SDGs), particularly Goal 3 on good health and well-

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being. This study is limited by the context of the instrument testing, which was conducted only on adolescent girls at two schools in Malang City. Therefore, generalization to a broader population requires caution. To ensure data accuracy, completing the FORSA instrument requires adequate guidance and explanation so that respondents can provide answers that reflect the actual situation.

CONCLUSION

This study concludes: Anemia is still a significant health problem in adolescent girls, especially in areas with limited access to quality health services, the Adolescent Anemia Screening Form (FORSA) has been proven to be an effective instrument in detecting the risk of anemia through a symptom-based approach and risk factors with a sensitivity value of 91% and a specificity of 61%, and can be implemented practically in schools and primary health care facilities, and the FORSA score has a close relationship with the actual incidence of anemia, so it can be used as a reference for faster and more targeted preventive and curative actions.

In line with these findings, it is recommended that FORSA be integrated nationally into adolescent health screening programs in schools and community health centers, along with training for health workers and cadres to ensure optimal use of FORSA. Furthermore, further development is needed, including the digitization of the instrument to improve the speed and accuracy of data collection. From a scientific perspective, these findings open up opportunities for developing a community-based screening theory that emphasizes the integration of clinical and behavioral approaches. Further research is recommended to evaluate FORSA's effectiveness over the long term and across different geographic and sociocultural contexts to ensure its external validity and broader replicability.

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