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Empowering Adolescent Girls in Anemia Prevention to Prepare Healthy Brides in Pamorah Village, Tragah, Bangkalan, Indonesia

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ABSTRACT Anemia remains a major public health problem among adolescent girls and, if left untreated, may persist into pregnancy and increase the risk of maternal and infant complications. This risk is compounded in Bangkalan Regency by the prevalence of early marriage and limited reproductive health knowledge among young women. This community service program aimed to improve adolescent girls' knowledge of anemia, reproductive health, and early marriage as part of preparing healthy brides in Pamorah Village, Tragah District, Bangkalan, Indonesia. The program was conducted in October 2024 with 30 participants, comprising 14 prospective brides and 16 engaged adolescent girls. The methods included health education delivered through lectures, question-and-answer sessions, and brainstorming supported by slide presentations and leaflets, followed by interactive discussion, hemoglobin (Hb) examination, and iron tablet supplementation. The education session took place on October 23, and the Hb examination followed on October 29. Knowledge was assessed using a pre-test and post-test and classified as good, moderate, or poor. Before the intervention, 63.3% of participants had poor knowledge and 36.7% had moderate knowledge, while none had good knowledge. After the intervention, 70% achieved good knowledge, 30% moderate knowledge, and none remained in the poor category. Hb examination showed that 63.3% of participants had below-normal Hb levels, whereas 36.7% had normal levels. All participants actively took part in the iron supplementation activity, indicating that the program was well accepted. In conclusion, structured education and assistance improved adolescent girls' knowledge and raised their awareness of anemia prevention, reproductive health, and the importance of delaying marriage. Integrating health education, Hb screening, and iron supplementation is therefore a promising approach to preparing healthy brides.

INDEX TERMS Anemia, Adolescent Girls, Healthy Brides, Reproductive Health, Early Marriage

I. INTRODUCTION

Anemia remains one of the most persistent nutritional problems worldwide, and adolescent girls and women of reproductive age bear a disproportionate share of its burden [1], [2]. Adolescent girls are particularly susceptible because rapid growth increases iron requirements, while menstrual blood loss and inadequate dietary intake deplete iron stores [3], [4]. In Indonesia, anemia affects approximately 18.4% of adolescent girls [5]. Beyond fatigue and reduced concentration, anemia that persists into pregnancy is associated with postpartum hemorrhage, preterm delivery, and low birth weight [6]. Adolescence is therefore a critical window for prevention before young women enter marriage and pregnancy.

This problem is aggravated by limited awareness and poor adherence to preventive measures. Qualitative evidence shows that many adolescent girls do not understand anemia and rarely take iron tablets [7]. Studies in several regions of Indonesia report low acceptance of iron-folic acid (IFA) supplementation, with adherence as low as 17.6% to 19.5% in some settings [8]–[10], while irregular breakfast habits and poor supplementation compliance have been linked to anemia [11]. Early marriage adds a further layer of risk. Child marriage prevalence among Indonesian females aged 15–20 years was estimated at 12.53% [12], and parental education, which shapes reproductive health knowledge, is associated with early marriage [13]. Although causal evidence remains limited, child marriage is consistently linked to earlier childbearing and lower use of skilled birth care [14]. Premarital screening in Indonesia also shows that many prospective brides enter marriage with preconception health risks, including anemia [15], [16].

Current approaches to preventing adolescent anemia combine nutrition education, IFA supplementation, and hemoglobin (Hb) screening. A systematic review and meta-analysis found that nutrition education improves anemia knowledge but does not significantly change Hb levels [17]. A quasi-experimental study in an Islamic boarding school reached a similar conclusion and

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attributed the absence of an Hb effect largely to low adherence [18]. Community-based programs that integrate education, Hb screening, and iron supplementation have reported improved knowledge and Hb levels among junior high school students, although without a control group [19], whereas school-based screening has revealed a high prevalence of anemia and very low IFA use [20].

Despite these efforts, most interventions target school-attending adolescents. Among the studies reviewed here, few address prospective brides and engaged adolescents, who are on the verge of marriage, in rural communities, or link anemia prevention with reproductive health and early marriage prevention within a single program. This gap is relevant in Bangkalan, Madura, where early marriage and limited reproductive health knowledge remain concerns.

Therefore, this community service program aimed to improve the knowledge of adolescent girls about anemia, reproductive health, and early marriage as part of preparing healthy brides in Pamorah Village, Tragah District, Bangkalan, Indonesia. The contributions of this article are as follows:

1. An integrated community-based model that combines education on anemia, reproductive health, and early marriage with Hb screening and iron supplementation for prospective brides and engaged adolescents.
2. Empirical evidence on participants' knowledge before and after education and on their Hb status in a rural Madurese setting.
3. A participatory implementation approach, developed with the district health office, the primary health center, and village authorities, that can be adapted in similar communities.

The remainder of this article is organized as follows. Section II describes the planning stage and participants. Section III presents the implementation and results of the knowledge evaluation and Hb examination. Section IV discusses the findings in relation to previous studies, and Section V concludes the article.

II. METHODS

A. STUDY DESIGN

This community service program used a prospective, non-randomized, one-group pretest-posttest design without a control group. The design follows earlier Indonesian community-based education programs that assessed knowledge before and after a single educational session [21], [22]. Participants were not randomly allocated, and no blinding was applied. The program had three components: (1) health education and discussion on anemia, reproductive health, and early marriage; (2) hemoglobin (Hb) examination; and (3) collective iron supplementation. Education and knowledge testing took place on October 23, 2024, and Hb examination and iron supplementation on October 29, 2024. The primary outcome was the change in knowledge level before and after education. Secondary outcomes were Hb status and participation in the iron supplementation activity.

B. SETTING AND PARTICIPANTS

The program was conducted in Pamorah Village, Tragah District, Bangkalan Regency, Indonesia. The education session was held at the Pamorah Village Hall, and the Hb examination at the Village Health Post (Polindes). The target population was adolescent girls who were prospective brides or already engaged. Participants were recruited with the approval of the Head of Pamorah Village, and the sample consisted of 30 girls (14 prospective brides and 16 engaged adolescents. The implementation team consisted of three lecturers and three students from the Diploma III Midwifery Program, Bangkalan Campus, Poltekkes, Ministry of Health, Surabaya.

C. PLANNING AND APPROVALS



FIGURE 1. Planning and Permission Process Documentation

The planning stage involved coordination with several stakeholders to ensure that the program ran smoothly (FIGURE 1). The District Health Office was consulted on permits and facility support for the activities, and the Tragah Primary Health Center on permission and technical assistance for Hb examination. Formal approval was obtained from the National Unity and Politics Agency (BAKESBANGPOL) of Bangkalan Regency (permit number 00.9.2/503/433.207/2024), addressed to the Head of Tragah District with copies to the Pamorah Village authorities. Coordination with the Head of Pamorah Village then produced approval for participant recruitment. Fig. 1 documents these coordination meetings and the permission process, which were completed before the education session.

D. EDUCATION SESSION AND MATERIALS

On the day of the activity, participants registered on arrival and received stationery for the pre-test. The lecturers then delivered the content through lectures, question-and-answer sessions, and brainstorming. The media were PowerPoint slides projected with an LCD projector onto a screen, and printed leaflets, which are commonly used in similar programs [22]. Three topics were covered: early marriage, reproductive health for prospective brides, and anemia. Participants asked questions and took part in discussion during the session, as shown in FIGURE 2. A post-test was administered immediately after the session.

E. KNOWLEDGE ASSESMENT

Knowledge of early marriage, reproductive health, and anemia was measured with a written questionnaire. Scores were converted to percentages and classified as good (76%–100%), moderate (56%–75%), or poor (below 56%). Individual changes were categorized as improved (post-test

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score higher than pre-test score), unchanged (no difference), or decreased (lower post-test score). The program target was an increase in knowledge of at least 60%.



FIGURE 2. Educational Session and Discussion Activities

F. DATA ANALYSIS

Data were analyzed descriptively. Knowledge levels before and after education, and Hb status, were summarized as frequencies and percentages and are presented in Section III. No inferential statistical test was applied, so pre-test and post-test differences are described and not tested for significance.

III. RESULTS

A. PREPARATION

Participants registered upon arrival at the village hall and were provided with stationery to complete the pre-test.

a. Pre-Test

A pre-test was conducted to assess participants' baseline knowledge regarding early marriage, reproductive health, and anemia before the educational intervention. Educational Session and Discussion, Educational materials were delivered by the lecturers using lecture methods, question-and-answer sessions, and brainstorming techniques. The media used included PowerPoint presentations, LCD projectors, screens, and leaflets. The topics covered early marriage, reproductive health for prospective brides, and anemia.

b. Post-Test

At the end of the session, a post-test was administered to evaluate participants' knowledge after receiving the educational intervention. Knowledge evaluation on anemia was conducted before and after the health education session to determine changes in participants' understanding.

B. KNOWLEDGE EVALUATION CRITERIA

Changes in participants' knowledge were assessed by comparing pre-test and post-test scores and were categorized as follows:

1) Improved knowledge, defined as an increase in test scores after the educational intervention;
2) Unchanged knowledge, defined as no difference between pre-test and post-test scores; and
3) Decreased knowledge, defined as a reduction in test scores after the intervention.

Knowledge levels were further classified into three categories based on percentage scores:

1) Good, with scores ranging from 76% to 100%;
2) Moderate, with scores ranging from 56% to 75%; and
3) Poor, with scores below 56%.

C. INITIAL EVALUATION (PRE-TEST)

A pre-test was conducted to assess the baseline knowledge of prospective brides and engaged adolescent girls regarding early marriage, reproductive health, and anemia prior to the educational intervention. The results of the pre-test are presented in TABLE 1. Based on the pre-test results, 11 participants (36.7%) demonstrated moderate knowledge, while 19 participants (63.3%) had poor knowledge regarding reproductive health, early marriage, and anemia.

TABLE 1
Pre-test Results on Knowledge of Early Marriage, Reproductive Health, and Anemia Among Prospective Brides and Engaged Adolescent Girls in Pamorah Village, Tragah District, Bangkalan Regency

Knowledge Level	Pre Test	
	n	%
Good	0	0
Moderat	11	36,7
Poor	19	63,3

D. SECOND EVALUATION (POST-TEST)

At the end of the information and education session, a post-test was conducted to assess participants' knowledge regarding early marriage, reproductive health, and anemia. The results of the post-test are presented in TABLE 2. Based on the post-test results, the majority of participants demonstrated good knowledge. A total of 21 participants (70%) had good knowledge, while 9 participants (30%) had moderate knowledge. No participants were categorized as having poor knowledge. These findings indicate a substantial improvement in participants' knowledge following the educational intervention.

TABLE 2
Post-test Results on Knowledge of Early Marriage, Reproductive Health, and Anemia Among Prospective Brides and Engaged Adolescent Girls in Pamorah Village, Tragah District, Bangkalan Regency

Knowledge Level	Second Evaluation	
	N	%
Good	21	70
Moderat	9	30
Poor	0	0

E. HEMOGLOBIN EXAMINATION AND IRON SUPPLEMENTATION ACTIVITY

The hemoglobin (Hb) examination and collective iron supplementation activity were conducted on October 29,

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2024, at the Village Health Post (Polindes) of Pamorah Village, Tragah District. Participants included the academic community of the Diploma III Midwifery Program, Bangkalan (three lecturers and three students), as well as 30 adolescent girls consisting of prospective brides and engaged adolescents. TABLE 3 showed that 11 participants (36.7%) had normal Hb levels, while 19 participants (63.3%) had Hb levels below normal. Participants were then classified as having normal or low Hb. FIGURE 3 shows the examination activity.

TABLE 3
Hemoglobin Examination Results Among Prospective Brides and Engaged Adolescent Girls in Pamorah Village, Tragah District, Bangkalan Regency

Hb Level	n	%
Normal	11	36,7
Low	19	63,3



FIGURE 3. Hemoglobin Examination Activity

IV. DISCUSSION

A. INTERPRETATION OF THE FINDINGS

The most prominent finding of this program is the shift in participants' knowledge of anemia, reproductive health, and early marriage. Before the education session, no participant had good knowledge and 63.3% had poor knowledge (Table 1). Immediately afterwards, 70.0% had good knowledge, 30.0% had moderate knowledge, and none remained in the poor category (Table 2). This pattern suggests that the combination of lectures, question-and-answer sessions, brainstorming, slide presentations, and leaflets (Fig. 2) suited a group with very low baseline knowledge. The topics were also directly relevant to participants who were about to marry, which may have increased their attention to the material. However, the post-test was administered immediately after the session. The results therefore reflect short-term knowledge acquisition and do not show whether the knowledge was retained or translated into behavior.

The Hb results should be interpreted differently. Table 3 shows that 63.3% of participants had low Hb. Because the Hb examination preceded the iron tablet administration (Fig. 3 and Fig. 4), these values describe participants' status at baseline and are not an outcome of the program. This proportion is considerably higher than the national estimate of 18.4% among Indonesian adolescent girls [5] and the 24.3% reported among premarital women in Sukoharjo [16]. The comparison is only indicative, since the present sample was small and drawn from one village, and the device and cut-off values may differ across studies. Nevertheless, the finding indicates that a substantial proportion of young women in this community may enter marriage with low Hb. Such a condition is plausible given the high iron requirements of adolescence, menstrual losses, and inadequate dietary intake [3], [4]. It is also important because anemia during pregnancy is associated with postpartum hemorrhage, preterm delivery, and low birth weight [6].

All participants took part in the iron supplementation activity, which suggests that the program was well accepted. Acceptance of a single supervised activity, however, does not guarantee sustained adherence. Reviews of iron-folic acid supplementation report Hb gains after repeated daily, weekly, or twice-weekly dosing [26], [27]. The effect of the present activity on Hb cannot be inferred without information on the dosing regimen and follow-up measurements.

B. COMPARISON WITH PREVIOUS STUDIES

The knowledge gain observed here is consistent with other education-based programs in Indonesia. A school-based study in Palu, which also used slides and leaflets, reported that the proportion of students with good knowledge of iron tablets rose from 14.7% to 69.1% [28]. This is close to the increase from 0% to 70.0% in our participants. Similarly, a community education activity in Cilacap reported an increase in the mean knowledge score from 68.4 to 83.6 [22], and premarital education among prospective brides and grooms improved readiness scores in a pretest-posttest design [21]. Together, these findings support the use of simple, face-to-face education with printed and projected media to raise knowledge in adolescent and premarital groups.

The relationship between education and Hb is less straightforward. A systematic review and meta-analysis found that nutrition education improved anemia knowledge but did not significantly change Hb [17]. A quasi-experimental study in an Islamic boarding school likewise found that education combined with weekly supplementation improved knowledge but not Hb, which the authors linked to low compliance [18]. Our results agree with the knowledge component of these studies, but we did not measure Hb change and therefore cannot confirm the second component. In contrast, a community program in Jember that combined education, Hb screening, and two months of iron supplementation with periodic monitoring reported an increase in the proportion of girls with normal Hb from 40% to 64% [19]. This difference suggests that longer supplementation with monitoring may be necessary to influence Hb, although that study had no control group either.

Studies of supplementation adherence provide further context. Low acceptance and adherence have been reported in several regions [8]–[10], and a scoping review attributed

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them to limited resources, weak monitoring, irregular supervision, and untimely distribution [25]. A quasi-experimental study in Jambi found that adding educational reinforcement, reminder tools, and peer monitoring to weekly supplementation produced larger gains in knowledge and adherence than routine school distribution [29]. A study of Jakarta students found that family, peer, and teacher support were each positively correlated with adherence [30]. A quasi-experimental study in Palangka Raya reported that a mobile application produced larger knowledge gains than booklets [31]. These findings suggest that the education used in our program could be strengthened with follow-up reminders, social support, and digital media.

Finally, our participants differ from those in most of the studies cited above, which enrolled school-attending adolescents [10], [18], [20], [28]–[31]. Prospective brides and engaged adolescents are close to pregnancy, so low knowledge and low Hb in this group have more immediate consequences. Early marriage in Indonesia is associated with low parental education and economic disadvantage [12], [13] and with earlier childbearing and lower use of skilled birth care [14]. Premarital screening in Malang likewise found that a large share of prospective brides were at risk for preconception health problems [15]. The present findings therefore support addressing anemia and early marriage together in this population.

C. LIMITATIONS AND IMPLICATIONS

Several limitations should be considered. First, the one-group pretest-posttest design has no control group and no randomization. Improvements in knowledge cannot be attributed with certainty to the intervention, because they may also reflect repeated exposure to the questionnaire or other influences during the session. Second, the sample was small (n = 30), recruited from a single village with the approval of the village head, so the results cannot be generalized to other populations. Third, the post-test was conducted immediately after education, and no follow-up was performed to assess retention, behavior change, or adherence to iron tablets. Fourth, only descriptive statistics were used, and no significance test was applied. Fifth, Hb values obtained with point-of-care devices and capillary blood are subject to measurement error, especially near the diagnostic threshold [23], [24], and Hb was measured only once. Finally, details of the questionnaire's validation, the Hb cut-off, and the tablet regimen need to be reported fully for the results to be reproduced.

Despite these limitations, the findings have practical implications. Premarital and adolescent health services could integrate education, Hb screening, and iron supplementation into a single package, as suggested by studies of premarital screening [15], [16]. Collaboration among village authorities, primary health centers, and midwifery institutions, as in this program, offers a feasible delivery model for rural areas. To address the likely gap between acceptance and sustained adherence, follow-up should include scheduled reminders, adherence monitoring, and involvement of family and peers [25], [29], [30]. Future studies should use controlled or comparative designs, validated instruments, and repeated Hb measurements after a defined supplementation period, together with delayed post-tests to assess retention. Such studies would show whether the short-term knowledge gains observed here lead to lasting improvements in Hb and in readiness for healthy marriage.

V. CONCLUSIONS

This community service program aimed to improve the knowledge of adolescent girls about anemia, reproductive health, and early marriage as part of preparing healthy brides in Pamorah Village, Tragah District, Bangkalan, Indonesia. Thirty participants, comprising 14 prospective brides and 16 engaged adolescent girls, received health education and discussion, Hb examination, and iron supplementation using a one-group pretest-posttest design. Before the education session, none of the participants had good knowledge, 11 (36.7%) had moderate knowledge, and 19 (63.3%) had poor knowledge. After the session, 21 participants (70.0%) had good knowledge, 9 (30.0%) had moderate knowledge, and none remained in the poor category. This indicates a substantial short-term improvement in knowledge following the educational intervention. The Hb examination showed that 11 participants (36.7%) had normal Hb levels, whereas 19 (63.3%) had low Hb levels, which suggests that many young women in this community may enter marriage with a risk of anemia. All 30 participants took part in the iron supplementation activity, indicating that the program was well accepted by the target group. Taken together, these findings show that structured education combined with screening and supplementation can raise adolescent girls' knowledge and awareness of anemia prevention, reproductive health, and the importance of delaying marriage. However, the findings should be interpreted with caution because of the small sample, the absence of a control group, and the immediate post-test, which does not show whether the knowledge is retained or leads to changes in behavior and Hb status. Future work should therefore apply controlled or comparative designs with larger and more diverse samples, validated knowledge instruments, and appropriate statistical testing. Follow-up measurements are also needed to assess knowledge retention, adherence to iron supplementation, and changes in Hb levels after a defined supplementation period. In addition, future programs could examine the contribution of family and peer support, reminder systems, and digital media to sustained adherence, and could integrate the program into premarital health services in cooperation with village authorities and primary health centers.

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DATA AVAILABILITY

The anonymized participant dataset analyzed in this study is available from the corresponding author upon reasonable request.

AUTHOR CONTRIBUTION

Conceptualization, A.N.L., E., and U.K.; methodology, A.N.L., E., and U.K.; investigation and data collection, A.N.L., E., and U.K.; formal analysis, A.N.L. and L.F.; writing, original draft preparation, A.N.L.; writing, review and editing, J. and L.F.; supervision and project administration, A.N.L. All authors have read and agreed to the published version of the manuscript.

DECLARATIONS

ETHICAL APPROVAL

The program was conducted with formal permission from the National Unity and Politics Agency (BAKESBANGPOL) of Bangkalan Regency (permit number 00.9.2/503/433.207/2024) and the approval of the Head of Pamorah Village.

CONSENT FOR PUBLICATION PARTICIPANTS

Participants were informed of the objectives of the program and took part voluntarily. Personal data were kept confidential and analyzed under anonymized codes, and photographic documentation was used only with participant consent.

COMPETING INTERESTS

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

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