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Community-Based Research-Based Moringa Corn Milk Innovation for the Prevention of Anemia in Adolescent Girls in Orphanages

Meta Rikandi
Politeknik 'Aisyiyah Sumatera Barat, Indonesia
e-Mail: meta.rikandi@gmail.com

Asmeri Lamona
Politeknik 'Aisyiyah Sumatera Barat, Indonesia
e-Mail: asmeri.ftp01@gmail.com

Chintia Pratama Putri
Politeknik 'Aisyiyah Sumatera Barat, Indonesia
e-Mail: pratama_chintia@yahoo.com

Suci Sintia Dewi
Politeknik 'Aisyiyah Sumatera Barat, Indonesia
e-Mail: sucisintiadewi0397@gmail.com

Silvia Nengcy
Politeknik 'Aisyiyah Sumatera Barat, Indonesia
e-Mail: silvianengcy@gmail.com

Esiska Afifah
Politeknik 'Aisyiyah Sumatera Barat, Indonesia
e-Mail: esiska@gmail.com

Linda Wati
Universitas Alifah Padang, Indonesia
e-Mail: lindawati.akbid@gmail.com

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Abstract

Anemia in adolescent girls remains a public health problem that impacts cognitive function, productivity, and future reproductive health. Adolescent girls in orphanages are a high-risk group due to limited access to nutritious food and low nutritional literacy. This paper is a research-based community service project that uses a Community-Based Research (CBR) approach to develop an anemia prevention intervention model through the integration of nutrition education and

local food innovation in the form of moringa-corn milk. The activity was carried out in an orphanage in Padang City on September 4–14, 2025, involving 24 caregivers and 30 adolescent girls. The CBR stages included needs assessment, co-designed intervention, collaborative implementation, and participatory evaluation and sustainability strengthening. Nutrition education was provided to the caregivers with pre- and post-tests, followed by training on making moringa-corn milk and testing its acceptability among the adolescent girls. The results showed a significant increase in the caregivers' knowledge, marked by an increase in the good knowledge category from 17% to 46%. Organoleptic testing showed that 40% of the adolescents said they somewhat liked the product and 26.67% said they really liked it. These results show that moringa-corn milk innovation is well accepted and has the potential to be an economical and applicable alternative source of iron. The novelty of this program lies in the integration of nutrition education, community empowerment, and CBR-based local food innovation, thereby increasing community capacity while strengthening the sustainability of anemia prevention interventions in adolescent girls in orphanages.

Keywords: Adolescent Anemia, Community-Based Research, Moringa Leaves, Corn, Functional Food

INTRODUCTION

Anemia remains a significant global public health challenge that must be addressed due to its widespread impact on quality of life, cognitive function, productivity, and women's reproductive health. This condition is characterized by low hemoglobin levels in the blood, which are generally caused by iron deficiency, chronic bleeding, infection, chronic disease, and inadequate dietary patterns. In developing countries, iron deficiency is the dominant cause of anemia due to limited access to animal-based iron sources, poor diet quality, and high burden of infectious diseases. (Black et al., 2013). World Health Organization (WHO) data from 2021 shows that the global prevalence of anemia in women aged 15–49 years is 29.9%, making it a public health issue that has not yet been fully resolved (1,2). This figure reflects the continuing gap in access to preventive nutritional interventions and health services, as well as the uneven distribution of nutritious food in various regions of the world.

In Indonesia, anemia remains a serious concern. The 2018 Basic Health Research (Riskesdas) reported that the national prevalence of anemia reached 23.7%, with a higher proportion among women (27.2%) than men (20.3%). Among adolescents aged 15–24 years, the prevalence of anemia reached 32%, indicating that approximately one in three adolescent girls is anemic (Riskesdas, 2018). Adolescent girls are a particularly vulnerable group because this phase is characterized by rapid growth (growth spurt), increased iron requirements, and the onset of menstruation, which causes regular blood loss. This imbalance between iron requirements and intake makes adolescent girls more prone to iron deficiency.The effects of anemia in adolescents are not limited to fatigue, paleness, dizziness, and decreased stamina, but are also associated with concentration disorders, poor academic performance, and long-term decreased productivity. Furthermore, anemia in adolescent girls has long-term consequences for reproductive health. A number of studies report that women who experience anemia

as adolescents have a greater risk of anemia during pregnancy, giving birth to low birth weight (LBW) babies, and contributing to an increased risk of stunting in children

The risk of giving birth to low-birth-weight (LBW) infants is reported to increase by up to 1.5 times among women who experienced anemia earlier in life (Black et al., 2013; Aguayo & Menon, 2016). This condition demonstrates that anemia is a critical link in the cycle of intergenerational malnutrition (Black et al., 2013). Therefore, preventing anemia among adolescent girls represents an important investment in long-term health development.

In West Sumatra Province, the burden of anemia is reflected in nutritional indicators that continue to require attention. Data from the Indonesian Nutrition Status Survey (SSGI) indicate that the prevalence of stunting among children under five remains high, reaching 24.7%, which reflects persistent chronic nutritional problems (Kementerian Kesehatan RI, 2022). At the same time, iron tablet consumption coverage among adolescent girls has only reached 45.9%, suggesting that more than half of adolescents have not received or consumed iron supplementation as recommended. In Padang City, the highest prevalence of anemia was reported in the Andalas Community Health Center service area, reaching 41.7%, with SMK Negeri 2 Padang recording the highest number of cases throughout 2023 (Sari, 2024; Astuti et al., 2023). These data indicate that anemia among adolescents remains a significant public health problem that requires effective, structured, and sustainable intervention strategies.

The Indonesian government has implemented various strategies to prevent anemia, one of which is the provision of iron supplementation programs for adolescent girls in schools. This program aligns with the Sustainable Development Goals (SDGs), particularly Goal 2 (Zero Hunger) and Goal 3 (Good Health and Well-Being). Scientifically, the effectiveness of iron supplementation in increasing hemoglobin levels has been well documented. Previous studies have shown that weekly iron supplementation can increase mean hemoglobin levels by approximately 1.01 g/dL and reduce anemia prevalence substantially (Gutema et al., 2024).

However, the main challenge lies not in the effectiveness of iron supplementation but in adherence to regular consumption. Evidence indicates that adherence to iron tablet consumption among adolescent girls remains low and is influenced by side effects such as nausea, gastrointestinal discomfort, and unpleasant taste and odor, as well as limited knowledge and environmental support (Simbolon et al., 2023; Sri Sat Titi Hamranani & Permatasari, 2020). Consequently, although iron supplementation policies are well established, the acceptability and sustainability of these interventions remain key issues. This situation highlights the need for alternative or complementary interventions that are more acceptable, accessible, and socially contextualized for adolescents.

In the context of orphanages, the problem of anemia becomes more complex. Adolescent girls in orphanages largely depend on food provided by caregivers, and operational budget limitations often result in inadequate dietary diversity, particularly in animal protein and micronutrient intake. Limited access to nutrition education, health services, and psychosocial support further increases vulnerability to

anemia in this population (Notoatmodjo, 2012). Therefore, interventions targeting orphanage settings must consider food availability, independent production capacity, sustainability, and sensory acceptance.

To address anemia through a food-based approach, the utilization of nutrient-rich local foods represents a relevant, economical, and sustainable strategy. One local food with considerable potential is moringa leaves (*Moringa oleifera*), which are widely recognized as a nutrient-dense "superfood" containing protein, calcium, vitamins A and C, and iron. The iron content of moringa leaves has been reported to reach 17.2 mg per 100 g, exceeding that of many commonly consumed vegetables (Puspitasari et al., 2024). However, moringa consumption remains limited due to its distinctive taste and aroma, which are not preferred by some consumers (Khanza et al., 2023; Dharma, 2018).

Sweet corn, on the other hand, is a widely consumed local food that serves as a source of energy and fiber. It also contains beta-carotene, vitamins, and iron with relatively good bioavailability (Astawan, 2009). Studies have reported that the bioavailability of iron in corn ranges from 85.54 to 122.81 ng ferritin per mg of total cell protein, indicating that iron from corn is relatively easy to absorb (Setyani et al., 2009; Iskandar, 2021; Yuniarti et al., 2022; Aina et al., 2021).

Previous studies have demonstrated that moringa leaf consumption can effectively increase hemoglobin levels in anemic adolescent girls, while biofortified corn has been shown to be a good source of bioavailable iron. Therefore, combining moringa leaves and sweet corn in the form of functional beverages such as moringa–corn milk offers a strategic opportunity to increase iron intake through locally available foods that are more acceptable in terms of sensory properties. Moreover, beverage-based processing facilitates regular consumption and enables independent production by communities or institutions such as orphanages (Rikandi et al., 2022; Lamona et al., 2024)..

Research Gap

Based on these findings, it can be concluded that efforts to combat anemia in adolescents have so far focused on iron tablet supplementation and health education. However, there has not been much work to develop a model for anemia prevention based on functional local foods combined with participatory nutrition education in orphanages. In fact, a community-based approach that integrates increased nutrition literacy, food processing training, and the empowerment of adolescents in independently producing healthy foods has the potential to increase the sustainability of interventions.

In other words, the gap in community service lies in the lack of intervention models that are applicable, low-cost, can be produced independently, and are based on local food ingredients that are rich in iron and acceptable to adolescents in terms of sensory properties.

Novelty of the Service

Therefore, the novelty of this community service is the development of a community-based intervention model for the prevention of anemia in adolescent girls

through the integration of nutrition education and training in the production of moringa-corn milk as a local functional food that is easy to produce, economical, and applicable for regular consumption in orphanages. This intervention not only increases nutritional knowledge but also empowers caregivers and adolescent girls in healthy food management, thereby potentially increasing the sustainability of the intervention compared to a single supplementation approach.

With this approach, the community service is expected to contribute to strengthening adolescent anemia prevention strategies through local food innovation, improved nutrition literacy, and community empowerment within the framework of food security and sustainable health.

METHOD

This Community Service (PkM) activity was carried out at an orphanage in Padang City on September 4-14, 2025, involving 24 caregivers (administrators and nursemaids) and 30 adolescent girls as the main beneficiaries. The program was implemented using the Community-Based Research (CBR) approach, which is a research-based community service model that places the community as active partners in the entire process, from problem identification, intervention design, program implementation, to sustainability evaluation.

The CBR approach was chosen because the problem of anemia among adolescent girls in orphanages is a community health issue that requires participatory, contextual, and sustainable solutions. Thus, the program is not only oriented towards knowledge transfer, but also towards community empowerment through increasing the capacity of orphanage administrators in managing healthy food based on local ingredients.

Operationally, the implementation of PkM follows four main stages in CBR, namely: (1) need assessment, (2) co-designed intervention, (3) collaborative implementation, and (4) participatory evaluation and sustainability strengthening.

1. Needs Assessment (Identification of Needs and Initial Data)

The initial stage focused on mapping problems through field surveys, informal interviews, and structured observations using observation sheets. Data collection was conducted on the general condition of adolescent girls in the orphanage, food consumption habits, availability of daily food ingredients, access to health programs, and data on adolescent Hb levels based on health center examinations. This information was used to determine the root causes of anemia. The results of the need assessment were then discussed with the orphanage to ensure that the intervention designed was in line with the real needs of the community.

2. Co-Designed Intervention

Based on the results of the problem mapping, the community service team and the orphanage management agreed on interventions in the form of (a) nutrition and anemia education for female adolescent caregivers and (b) training in making moringa-corn milk as a local functional food. This stage reinforced the CBR principle, namely that the program was designed together with partners to strengthen the sense of ownership and commitment to implementation.

3. Collaborative Implementation

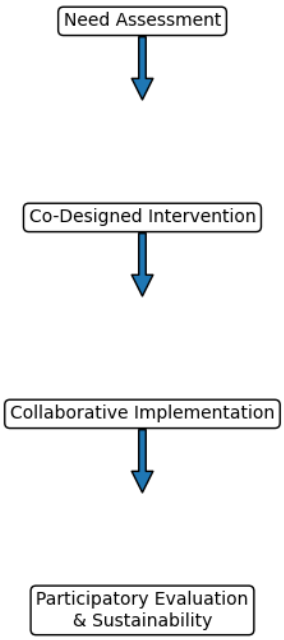
The program was implemented through three main components: (a) nutrition and anemia education for mentors, accompanied by pre-tests and post-tests, (b) training on the for making moringa-corn milk through demonstrations and hands-on practice, and (c) product acceptance testing by 30 adolescent girls. During the training process, the service team acted as facilitators, while the assistants became active implementers, thereby establishing a two-way learning process.

4. Participatory Evaluation and Sustainability Strengthening

This stage was carried out through joint reflection with the orphanage administrators on the results of the activities, supporting and inhibiting factors, and plans for program sustainability. As a form of sustainability strengthening, the community service team handed over modules, posters, and ready-to-process raw materials, and facilitated independent practice by the assistants. Thus, the intervention did not stop at the training activities but continued as a routine practice of nutritional services at the orphanage.

With this approach, this paper is a research-based community service that integrates the research process, collaborative action, and community empowerment simultaneously.

CBR Method Flowchart



RESULTS AND DISCUSSION

This section describes the results of Community-Based Research (CBR) community service conducted at an orphanage in Padang City on September 4-14, 2025. This activity involved 24 caregivers (administrators and guardians) and 30 teenage girls from the orphanage. As explained in the Introduction and Methods sections, this program was designed to address the problem of anemia in adolescent girls through a nutritional education approach and the development of local functional foods in the form of moringa corn milk. The results of the activity are presented in the form of empirical findings regarding the increase in the knowledge of the assistants, the acceptance of moringa corn milk products by the adolescent girls, and the dynamics of the participatory community assistance process.

The CBR model allows for the active involvement of partners from the problem identification stage to the program sustainability evaluation. Thus, the changes that occur are not only in the dimensions of knowledge and consumption behavior, but also in the collective awareness of the community about the importance of nutrition management based on local foods. The following results and discussion are outlined in several thematic sections to facilitate understanding and show the logical relationship between the findings of the activities and the conceptual framework of anemia in adolescent girls.

1. Results of Nutrition Education on Improving the Knowledge of Caregivers

Health education activities were provided to 24 orphanage caregivers who are responsible for the daily care, provision of food, and guidance of adolescent girls. This intervention aimed to increase caregivers' knowledge about anemia in adolescent girls, balanced nutritional needs, the role of iron, and the potential of local foods such as moringa leaves and corn as sources of nutrition. The education was conducted in the form of interactive counseling accompanied by pre-tests and post-tests.

Before the material was delivered, an initial knowledge assessment was conducted. The pre-test results showed that most of the caregivers were in the adequate knowledge category (75%), only 17% were in the good category, and 8% were in the poor category. After the education and interactive discussion, another measurement was conducted through a post-test. The results showed an increase in the proportion of good knowledge to 46%, while adequate knowledge remained at 46%, and poor knowledge remained at 8%. Thus, there was a significant increase in the good category group, from 17% to 46%.

In addition to the category distribution, an analysis of the average knowledge score was also conducted. The average score increased from 62.00 before education to 86.00 after education. This shows that the material presented was well understood by the participants, even though some of them were in the older age range. These findings are consistent with previous research and community service results, which show that health education can increase public knowledge about anemia and its prevention when the material is delivered using visual, interactive methods that are relevant to everyday life.

Figure 1 below illustrates the atmosphere of the education session, which took place in a dialogical setting. Participants actively asked questions about appropriate consumption patterns for adolescent girls and how to process moringa leaves to make them more palatable.

Figure 1. Education on anemia and nutrition for adolescent girls

Although the increase in knowledge was quite significant, post-training discussions showed that some caregivers still needed continuous reinforcement. This was due to age, long-standing habits in providing meals at the orphanage, and limited access to nutritional information. However, these results prove that health education remains effective as a means of increasing the capacity of caregivers, especially when combined with hands-on practice as was done in this program.

2. Implementation of Training on Making Moringa Corn Milk as a Local Functional Food

The next stage of the program was training in making moringa corn milk. This activity was carried out with the involvement of all orphanage caregivers. Moringa corn milk was developed as a functional food product based on local ingredients rich in iron, vitamins, and fiber, and is expected to be consumed regularly by adolescent girls as part of an anemia prevention strategy.

The training was conducted practically through demonstrations, mentoring, and independent practice. The ingredients used were easily obtainable and economical, namely moringa leaves, sweet corn, sugar, water, and a limited amount of other additional ingredients. The manufacturing process was carried out using simple kitchen tools so that it could be easily replicated by the orphanage. Figure 2 shows the participants practicing the manufacturing of the product directly.

Figure 2. Moringa corn milk production practice

Observations showed that the assistants were very enthusiastic about the training process. They discussed alternative processing techniques, ingredient hygiene, flavor adjustment, and storage methods. This is in line with the CBR principle of placing partners as active participants, not just beneficiaries. The assistants began to see that moringa leaves,

which were previously rarely used, actually have great potential as a nutritious food ingredient when processed properly.

3. Acceptance of Moringa Milk by Teenage Girls

After the product was manufactured, an organoleptic test was conducted on 30 adolescent girls. The assessment covered taste, aroma, color, thickness, and overall liking. Based on the results, the majority of respondents rated the product as somewhat liked (40%), while 26.67% said they liked it very much. A small number of respondents gave a rating of dislike (30%), and only 3.33% stated that they were neutral. No respondents stated that they strongly disliked the product.

These results indicate that moringa corn milk is generally acceptable to most adolescent girls. Open discussions with participants revealed that products made with moringa powder were preferred because they had a milder taste. Meanwhile, products made with fresh moringa leaves were considered to have a bitter taste by some. However, respondents stated that they would still be willing to consume these products if the taste was adjusted through the right formulation.

These findings are in line with various studies showing that moringa leaf-based food products have a good level of acceptance when combined with other ingredients that have a neutral or sweet taste. This shows that the acceptance of functional foods based on local ingredients is greatly influenced by processing, formulation, and adaptation to the preferences of young consumers.

4. Participatory Evaluation and Program Sustainability Plan

The final stage of CBR implementation is participatory evaluation through discussions with partners. At this stage, it was found that the facilitators felt more confident in providing healthy menus for adolescent girls. They also expressed their willingness to try incorporating moringa corn milk as a weekly menu item. The service team then handed over modules, guidance posters, and raw material packages to support initial implementation.

From an empowerment perspective, the success of this program is not only measured by increased knowledge and product acceptance, but also by the growth of a sense of ownership of the program. This can be seen from the facilitators' suggestions to develop other product variants such as pudding or soup, which are also moringa-based.

5. Discussion and Implications for the Prevention of Anemia in Adolescents

The results of this activity reinforce the understanding that anemia in adolescent girls cannot be addressed solely through a clinical approach of iron supplementation. Complementary strategies are needed in the form of improving nutritional literacy and utilizing local foods rich in nutrients. Community-based approaches such as CBR have proven to be capable of integrating research, education, and social action into a comprehensive program.

The increase in knowledge among caregivers from 17% to 46% indicates that education has a real impact on their readiness to carry out their role as caregivers. This is important because caregivers are influential figures in determining the menu, eating habits, and health care patterns in orphanages. With increased knowledge, it is hoped that the practice of providing nutritious food will also improve.

On the other hand, the acceptance test results show that moringa-based food innovations have great potential to be adopted by adolescents. The moringa-corn milk formulation not only increases the nutritional value of the drink but also increases the likelihood of regular consumption of iron-rich foods. In other words, this community service

provides a more realistic and contextual alternative solution compared to top-down interventions.

In the context of scientific development, these results support the idea that the integration of nutrition education, simple food technology, and community empowerment is an effective strategy for preventing anemia in adolescents. This activity also shows that orphanages are a potential setting for public health interventions, as they have a social structure that supports the systematic implementation of programs.

The CBR approach also makes an important methodological contribution. Through the active involvement of partners, the intervention process becomes more adaptive to local needs. Dialogic communication enables two-way knowledge exchange between the service team and the community, thereby strengthening program sustainability.

In general, this activity has achieved its main objectives, namely increasing the knowledge of caregivers, introducing local functional food innovations, and raising community awareness of the importance of anemia prevention. The sustainability of the program is expected to be realized by making moringa corn milk a regular menu item at orphanages and developing a variety of derivative products based on moringa leaves and other local foods.

Thus, it can be concluded that research-based community service through the Community-Based Research (CBR) approach is a relevant, applicable, and sustainable intervention model in efforts to prevent anemia among adolescent girls in orphanages, while also contributing to strengthening local food security and public health more broadly.

CONCLUSION

This community service activity proves that nutrition education combined with training in making moringa corn milk as a functional drink based on local foods can increase the knowledge of female youth mentors about anemia, as shown by an increase in the good knowledge category from 17% to 46% and a fairly good level of product acceptance, with 40% of female youth stating that they somewhat like moringa corn milk. The novelty of this program lies in the integration of health education with community empowerment through the processing of moringa leaves and corn into a healthy, affordable, and applicable alternative source of iron as a regular menu item in orphanages. Thus, this intervention not only improves nutrition literacy but also offers a sustainable anemia prevention model based on local food potential that is easy to replicate among adolescent girls in similar environments.

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