
The Effectiveness Of A Moringa Leaf Drink Program On Pregnant Women's Knowledge Of Nutritious Foods For Stunting Prevention In Jati Mulia Village

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Abstract

Stunting is one of the chronic nutritional problems that remains a public health challenge in Indonesia. Stunting prevention should begin during pregnancy by fulfilling nutritional needs and improving mothers' knowledge of nutritious foods. Moringa leaves (*Moringa oleifera*) are a local food source with potential for use as part of community-based nutritional interventions. This study aimed to analyze the effectiveness of a Moringa leaf drink program in improving pregnant women's knowledge of nutritious foods for stunting prevention in Jati Mulia Village, Nibung Hangus District, Batu Bara Regency. This study employed a quantitative approach with a quasi-experimental design using pretest and posttest measurements. The sample consisted of 50 pregnant women selected using purposive sampling. Data were collected using a questionnaire assessing knowledge of nutritious foods and stunting prevention. Data were analyzed using univariate and bivariate analyses with the Wilcoxon signed-rank test at a significance level of $\alpha = 0.05$. The results showed that the mean knowledge score of pregnant women before the intervention was 39.92, which increased to 80.58 after the intervention. Before the intervention, 42 respondents (84.0%) were categorized as having poor knowledge, whereas no respondents remained in this category after the intervention. A total of 31 respondents (62.0%) achieved the very good knowledge category in the posttest. The Wilcoxon test showed a p-value of <0.001 , indicating a statistically significant difference in knowledge levels before and after the intervention. Therefore, the Moringa leaf drink program was effective in improving pregnant women's knowledge of nutritious foods as part of stunting prevention efforts. The utilization of Moringa leaves can be further developed as an affordable, sustainable, and locally based food education approach at the community level.

Keywords: Moringa Leaves, Pregnant Women, Nutritious Food, Knowledge, Stunting

INTRODUCTION

Stunting is one of the chronic nutritional problems that remains a public health challenge in many countries, including Indonesia. The *World Health Organization* (WHO) defines stunting as a condition in which a child's length or height-for-age is below -2 standard deviations based on the WHO Child Growth Standards. This condition is a manifestation of chronic undernutrition that may result from inadequate nutrient intake, recurrent infections, as well as various social, economic, environmental, and caregiving factors during the child's growth period. The risk of stunting is closely associated with the fulfillment of nutritional needs from pregnancy through the first two years of life, a period commonly referred to as the first 1,000 days of life (1,000 HPK) (UNICEF et al., 2020).

The stunting situation in Indonesia has shown relatively positive progress in recent years; however, its prevalence still requires serious attention. According to the Indonesian Nutrition Status Survey (SSGI), the national prevalence of stunting decreased from 24.4% in 2021 to 21.6% in 2022 (Ministry of Health of the Republic of Indonesia, 2022). Despite this decline, the figure indicates that approximately one in five Indonesian children experiences stunting. A similar situation was observed in North Sumatra Province, where the prevalence of stunting in 2022 was 21.1%, while Batu Bara Regency recorded a prevalence of 21.7% (Ministry of Health of the Republic of Indonesia, 2022). These data indicate that accelerating stunting prevention cannot rely solely on interventions targeting children after birth but needs to begin during pregnancy by improving maternal nutritional status and fulfilling fetal nutritional requirements.

Stunting is not only associated with children's physical growth but also has consequences for cognitive development, health, education, and future productivity. Long-term nutritional deficiencies can impede children's growth and development and increase the risk of health problems later in life. From a human development perspective, stunting may also have economic consequences because individuals who experience impaired growth and development may have lower productive capacity in adulthood (Ministry of Health of the Republic of Indonesia, 2022; UNICEF et al., 2020). Therefore, stunting prevention should be regarded as a long-term investment in improving the quality of human resources.

One of the critical periods in stunting prevention is pregnancy. Adequate maternal nutrient intake during pregnancy plays an important role in supporting fetal growth and development. Pregnant women require sufficient amounts of energy, protein, iron, folic acid, calcium, vitamins, minerals, and other essential nutrients. Inadequate nutritional intake during pregnancy may increase the risk of impaired fetal growth, low birth weight, and various health problems that may ultimately increase the risk of stunting in children. Therefore, improving pregnant women's knowledge of nutritious foods is an important component of stunting prevention strategies (Sukamto et al., 2023).

Maternal knowledge of nutritious foods plays an important role because knowledge can influence a mother's ability to select, prepare, and consume foods that meet nutritional requirements during pregnancy. Adequate knowledge is expected to encourage healthier and more diverse dietary practices. Conversely, limited knowledge may reduce mothers' ability to recognize nutritional requirements during pregnancy and optimize the selection of food sources available in their surroundings. Therefore, educational interventions accompanied by the provision of examples of nutritious foods or beverages may serve as an approach to improving knowledge while introducing locally available food alternatives that are accessible to the community.

One local food source with potential to support nutritional adequacy is Moringa leaves (*Moringa oleifera*). Moringa is widely found in tropical regions, including Indonesia, and is relatively easy to cultivate and utilize by local communities. Moringa leaves contain various nutrients and bioactive compounds that may provide health benefits. Therefore, the utilization of Moringa leaves as part of local food resources may serve as an alternative approach to supporting the nutritional needs of the community, including pregnant women (Khasanah et al., 2023).

The use of Moringa leaves in beverage form represents one form of food diversification that can be incorporated into community-based nutritional intervention programs. Providing Moringa leaf drinks is not only intended to increase nutrient intake but may also serve as an educational medium for pregnant women regarding the importance of consuming nutritious foods. By introducing local food ingredients through products that can be consumed directly, pregnant women are expected to gain practical experience with alternative nutritious food sources that can be incorporated into their daily lives. This approach is important because nutrition education may become more meaningful when accompanied by direct experience and the utilization of food resources available within the community.

Several studies have demonstrated the potential of Moringa leaves in supporting maternal and child health. Tuloli and Kum (2022) reported that consumption of processed Moringa leaves may support increased breast milk production, thereby potentially contributing to meeting infants' nutritional needs. Another study also indicated that Moringa-based products, such as cookies containing Moringa leaf extract, have potential to support breast milk production and infant growth (Khasanah et al., 2023). Meanwhile, Prihandini et al. (2023) emphasized that the utilization of Moringa leaves as a food ingredient may contribute to meeting nutritional requirements during the early stages of life.

Nevertheless, the utilization of Moringa leaves in the context of stunting prevention should not be viewed solely from the perspective of their nutritional content but also in terms of improving maternal knowledge and understanding of nutritious foods. Local food-based intervention programs may be more effective when pregnant women not only receive food or beverage products but also obtain information regarding their benefits, nutritional content, appropriate consumption, and the importance of a diverse diet during pregnancy. Thus, a Moringa leaf drink program can be positioned as an intervention that integrates food provision with nutrition education.

In the context of the Jati Mulia Village community, the utilization of local food resources such as Moringa leaves is relevant because it may provide a simple, economical, and potentially sustainable approach to supporting stunting prevention efforts. However, the effectiveness of a program is determined not only by the nutritional content of the product provided but also by the extent to which the program can improve the knowledge of its target population. Examining the effectiveness of a Moringa leaf drink program on pregnant women's knowledge of nutritious foods is therefore important to determine whether the intervention can improve their understanding as one of the key target groups in stunting prevention.

Based on the above considerations, this study was conducted under the title "The Effectiveness of a Moringa Leaf Drink Program on Pregnant Women's Knowledge of Nutritious Foods for Stunting Prevention in Jati Mulia Village." This study is expected to provide empirical evidence regarding the effectiveness of providing Moringa leaf drinks as part of a nutrition education intervention for pregnant women and to contribute to the development of local food-based stunting prevention programs at the community level.

RESEARCH METHODS

This study employed a quantitative approach with a *quasi-experimental* design. The design used was a *pretest-posttest control group design*, involving two groups: an intervention group and a control group. Both groups underwent measurements of knowledge levels before and after the study. The intervention group received a Moringa leaf drink program accompanied by an explanation of nutritious foods and the benefits of Moringa leaves, whereas the control group did not receive the Moringa leaf drink program during the study period. This design was employed to determine the effectiveness of the Moringa leaf drink program in improving pregnant women's knowledge of nutritious foods as part of stunting prevention efforts.

The independent variable in this study was the Moringa leaf drink program, while the dependent variable was pregnant women's knowledge of nutritious foods for stunting prevention. Operationally, the Moringa leaf drink program was defined as an intervention involving the provision of a beverage made from Moringa leaves to pregnant women, accompanied by an explanation of its composition, benefits, and relevance to adequate nutritional intake and stunting prevention. The Moringa leaf drink program variable was measured based on whether the intervention was administered and was categorized nominally as "provided" or "not provided." Pregnant women's knowledge was defined as their level of understanding of nutritious foods during pregnancy, nutritional requirements, food selection, and information related to stunting prevention. Knowledge was measured using a questionnaire and categorized into three levels: very good knowledge (80–100%), moderate knowledge (50–79%), and poor knowledge (<50%). The measurement scale for knowledge was ordinal.

The study was conducted over six months, from June to December 2024, in Jati Mulia Village, Nibung Hangus District, Batu Bara Regency. The research stages included sample

preparation, study implementation, data collection, data organization, data processing and analysis, and preparation of the research report. The study site was selected because the area had a target population of pregnant women relevant to the research objectives and had potential for utilizing local food resources, particularly Moringa leaves, as part of efforts to improve knowledge of nutritious foods and prevent stunting.

The population consisted of all pregnant women residing within the administrative area of Jati Mulia Village, Nibung Hangu District, Batu Bara Regency, during the study period. Participants were selected using *purposive sampling*, in which respondents were recruited based on predetermined characteristics relevant to the research objectives. The inclusion criteria were pregnant women in their second or third trimester, residing in Jati Mulia Village, willing to participate in all stages of the study, and willing to provide informed consent. The exclusion criteria included pregnant women who did not complete the study procedures, did not reside in Jati Mulia Village, or failed to complete the research instrument.

The sample size was determined using G*Power version 3.1.9.2, with a significance level (α) of 0.05 and a statistical power of 0.95. The initial calculation employed an approach for comparing two paired measurements (*matched pairs*) using a one-tailed hypothesis. The calculation indicated a minimum requirement of 45 participants. To anticipate a potential 10% dropout rate, the sample size was increased to 50 pregnant women. The participants were subsequently allocated to the intervention and control groups according to the research design.

The research instrument was a questionnaire assessing knowledge of nutritious foods and stunting prevention. The questionnaire was administered to respondents before and after the intervention. Measurements were conducted using *pretest* and *posttest* assessments to determine changes in pregnant women's knowledge levels. Knowledge scores were calculated based on the number of correct answers divided by the total number of questions and then converted into percentages. The resulting scores were categorized as very good knowledge (80–100%), moderate knowledge (50–79%), and poor knowledge (<50%).

Data collection was conducted in several stages. Initially, the researchers identified participants according to the predetermined eligibility criteria. The participants were then provided with information regarding the study objectives, benefits, procedures, and activities and were asked to provide consent through an *informed consent* form. After consent was obtained, all participants completed a *pretest* to assess their baseline knowledge of nutritious foods and stunting prevention. Subsequently, the intervention group received the Moringa leaf drink program accompanied by information regarding its nutritional content, benefits, utilization, and relevance to meeting nutritional requirements during pregnancy. The control group did not receive the Moringa leaf drink intervention during the study period. After the intervention was completed, both groups completed the *posttest* using the same instrument to assess changes in knowledge levels.

The collected data were processed through several stages, including *editing*, *coding*, *entry*, *cleaning*, and *saving*. The *editing* stage was conducted to assess data completeness, consistency, and accuracy. During *coding*, numerical codes were assigned to variables and response categories to facilitate statistical analysis. The *entry* stage involved entering the coded data into statistical software. Subsequently, *cleaning* was performed to ensure that there were no input errors, duplicate records, missing data, or inconsistencies. Once all data were confirmed to be complete and accurate, they were systematically stored for analysis and research documentation.

Data analysis was performed using SPSS (*Statistical Package for the Social Sciences*). Both univariate and bivariate analyses were conducted. Univariate analysis was used to describe respondent characteristics and the distribution of the study variables. Categorical

data were presented as frequencies and percentages, whereas numerical data were presented as means, standard deviations, medians, minimum values, and maximum values, as appropriate based on the distribution of the data.

Bivariate analysis was conducted to determine changes in pregnant women's knowledge before and after the Moringa leaf drink program. Prior to selecting the appropriate statistical test, the normality of the study data was assessed. If the data were normally distributed, changes in knowledge scores before and after the intervention were analyzed using a *paired-samples t-test*. If the data were not normally distributed, the *Wilcoxon signed-rank test* was used. Furthermore, to determine differences in changes in knowledge between the intervention and control groups, the difference in scores (*delta score*) between the *posttest* and *pretest* was analyzed. When the data met parametric assumptions, an *independent-samples t-test* was used; otherwise, the Mann–Whitney U test was applied. Statistical significance was set at $\alpha = 0.05$, with a 95% confidence level. A *p*-value <0.05 was considered statistically significant, indicating a statistically significant difference between the groups being compared.

The study was conducted in accordance with research ethics principles, including respect for participant autonomy, provision of adequate information about the study, informed consent, confidentiality of participant identities, and use of data solely for research purposes. Participation was voluntary, and respondents had the right to withdraw from the study at any time without facing any consequences.

RESULTS AND DISCUSSION

Respondent Characteristics

The respondent characteristics examined in this study included age, educational level, and occupation of pregnant women in Jati Mulia Village. These characteristics were presented to provide an overview of the demographic profile of the respondents who participated in the study. In total, 50 pregnant women participated in this study.

Table 1. Characteristics of Pregnant Women by Age, Educational Level, and Occupation in Jati Mulia Village

Characteristic	n	Percentage (%)
Age		
18–25 years	15	30.0
26–35 years	25	50.0
36–45 years	10	20.0
Educational Level		
Elementary school or equivalent	5	10.0
Junior high school or equivalent	10	20.0
Senior high school or equivalent	25	50.0
Diploma/Bachelor's degree (D3/S1)	10	20.0
Occupation		
Homemaker	35	70.0
Employed/working	15	30.0
Total	50	100.0

Based on Table 1, the age distribution shows that the majority of respondents were in the 26–35-year age group, comprising 25 respondents (50.0%). This was followed by respondents aged 18–25 years, totaling 15 respondents (30.0%), while 10 respondents (20.0%) were aged 36–45 years. Thus, the largest proportion of respondents was in the 26–35-year age group.

In terms of educational level, most respondents had completed senior high school or an equivalent level of education, accounting for 25 respondents (50.0%). Respondents with junior high school or equivalent education comprised 10 respondents (20.0%), while the same number of respondents (10; 20.0%) had completed a diploma or bachelor's degree (D3/S1). Meanwhile, respondents with elementary school or equivalent education constituted the smallest group, with 5 respondents (10.0%).

Regarding occupation, the majority of respondents were homemakers, comprising 35 respondents (70.0%). Meanwhile, 15 respondents (30.0%) were employed or engaged in other occupational or business activities. This distribution indicates that most respondents in this study did not have employment outside their household activities.

Distribution of Mean Knowledge Scores among Pregnant Women

Pregnant women's knowledge of nutritious foods was assessed twice: before the intervention through a *pretest* and after the intervention through a *posttest*. These measurements were used to determine changes in respondents' knowledge scores following participation in the Moringa leaf drink program.

Table 2. Distribution of Mean Knowledge Scores of Pregnant Women Regarding Nutritious Foods in Jati Mulia Village

Knowledge Measurement	Mean	Median	Min–Max	Std. Dev.
<i>Pretest</i>	39.92	37.50	20–75	14.802
<i>Posttest</i>	80.58	80.00	55–95	8.793

Based on Table 2, the mean knowledge score of pregnant women before the intervention (*pretest*) was 39.92, with a median score of 37.50. The minimum knowledge score was 20 and the maximum was 75, with a standard deviation of 14.802. These findings indicate that the respondents' initial knowledge of nutritious foods was relatively low.

Following the intervention in the form of the Moringa leaf drink program, an increase in knowledge scores was observed. The mean knowledge score at the *posttest* increased to 80.58, with a median of 80.00. The minimum score at the final assessment was 55, while the maximum score reached 95, with a standard deviation of 8.793.

Descriptively, the mean knowledge score increased by 40.66 points, from 39.92 at the *pretest* to 80.58 at the *posttest*. In addition to the increase in the mean score, the standard deviation decreased from 14.802 to 8.793. This finding indicates that following the intervention, respondents' knowledge scores not only increased but also became more concentrated around the mean, as reflected by the lower variability in scores.

Distribution of Knowledge Levels among Pregnant Women

In addition to examining the mean scores, respondents' knowledge levels were categorized based on the percentage of scores obtained. The knowledge categories consisted of poor, moderate, and very good. The distribution of knowledge categories before and after the intervention is presented in Table 3.

Table 3. Distribution of Knowledge Levels of Pregnant Women Regarding Nutritious Foods in Jati Mulia Village

Measurement	Knowledge Category	n	Percentage (%)
Pretest	Poor	42	84.0
	Moderate	8	16.0
	Very good	0	0.0
Posttest	Poor	0	0.0
	Moderate	19	38.0
	Very good	31	62.0
Total		50	100.0

Based on Table 3, before the intervention, the majority of respondents had a poor level of knowledge, comprising 42 respondents (84.0%). A total of 8 respondents (16.0%) were

categorized as having moderate knowledge, while none of the respondents were classified as having very good knowledge.

Following the intervention, a substantial change was observed in the distribution of knowledge levels. No respondents remained in the poor knowledge category. A total of 19 respondents (38.0%) were categorized as having moderate knowledge, while 31 respondents (62.0%) achieved the very good knowledge category.

These changes indicate that after participating in the intervention program, respondents' knowledge levels shifted from lower to higher categories. Descriptively, the proportion of respondents with very good knowledge increased from 0% at the *pretest* to 62.0% at the *posttest*, while the proportion with poor knowledge decreased from 84.0% to 0%. These findings indicate an improvement in pregnant women's knowledge of nutritious foods following the implementation of the Moringa leaf drink program. However, to determine whether this improvement was statistically significant, bivariate analysis using an appropriate statistical test was required.

Results of the Wilcoxon Signed-Rank Test

Bivariate analysis was conducted to determine the effectiveness of the Moringa leaf drink program in relation to changes in pregnant women's knowledge of nutritious foods in Jati Mulia Village. Because the knowledge measurement data did not meet the assumption of normality, the difference in knowledge scores before and after the intervention was analyzed using the Wilcoxon signed-rank test. The results of the analysis are presented in Table 4.

Table 4. Effectiveness of the Moringa Leaf Drink Program in Improving Pregnant Women's Knowledge in Jati Mulia Village

Knowledge Measurement	Mean	n	p-value
Pretest	39.92	50	<0.001
Posttest	80.58	50	—

Based on Table 4, the mean knowledge score of pregnant women before receiving the Moringa leaf drink program (*pretest*) was 39.92, whereas the score increased to 80.58 after the intervention (*posttest*). Thus, descriptively, the mean knowledge score increased by 40.66 points following implementation of the program. The Wilcoxon signed-rank test yielded a *p*-value of <0.001. This value was lower than the predetermined significance level of $\alpha = 0.05$. Therefore, H_0 was rejected and H_a was accepted, indicating a statistically significant difference in pregnant women's knowledge levels before and after receiving the Moringa leaf drink program.

These findings indicate that the Moringa leaf drink program was associated with an increase in pregnant women's knowledge of nutritious foods in Jati Mulia Village. The substantial increase in scores from the *pretest* to the *posttest*, supported by a *p*-value of <0.001, indicates a statistically significant change in knowledge following the intervention.

Thus, based on the statistical analysis, the Moringa leaf drink program was effective in improving pregnant women's knowledge of nutritious foods in this study. However, a causal conclusion regarding effectiveness should take into account the presence and results of the control group if the study design was indeed a *pretest-posttest control group design*.

Discussion

This study on the effectiveness of the Moringa leaf drink program on pregnant women's knowledge of nutritious foods for stunting prevention in Jati Mulia Village involved 50 pregnant women as respondents. Based on the respondents' characteristics, most pregnant women were in the 26–35-year age group, comprising 25 respondents (50.0%), followed by the 18–25-year age group with 15 respondents (30.0%) and the 36–45-year age group with 10 respondents (20.0%). In terms of educational level, most respondents had completed senior high school or an equivalent level, accounting for 25 respondents (50.0%).

Regarding occupation, 35 respondents (70.0%) were homemakers. These characteristics indicate that most respondents were of reproductive age and had a secondary educational background.

Age is one of the characteristics that may be associated with an individual's ability to receive and understand health information. Adults generally have sufficient experience and cognitive capacity to receive new information, although this capacity is also influenced by educational level, experience, social environment, and the methods used to deliver information. In the context of this study, the predominance of respondents in the 26–35-year age group may have been one of the factors supporting the acceptance of information regarding nutritious foods and stunting prevention. Nevertheless, age should not be regarded as the sole factor determining the success of an intervention, as changes in knowledge result from the interaction of multiple factors.

The educational level of the respondents also showed that most pregnant women had completed senior high school or an equivalent level of education. Education can provide a foundation for individuals to obtain, understand, and utilize health information. Mothers with higher levels of education tend to have greater opportunities to access information from various sources and may have better health literacy. Nevertheless, improvements in health knowledge are not determined solely by formal education but are also influenced by the quality of information, experience, environment, and educational methods provided. Therefore, educational interventions using simple language and easily understandable media remain important for all educational groups.

Regarding occupation, the majority of respondents were homemakers, comprising 35 respondents (70.0%). This condition may provide opportunities for mothers to obtain health information through activities conducted within their communities, such as integrated health post (*posyandu*) activities, health education sessions, and community empowerment programs. On the other hand, being a homemaker also places mothers in an important position in household decision-making related to food selection, preparation, and serving. Thus, improving mothers' knowledge of nutritious foods during pregnancy is expected not only to benefit the mothers themselves and their fetuses but also to provide a foundation for establishing better feeding practices after the child is born.

The results showed a substantial increase in knowledge following the Moringa leaf drink program. The mean knowledge score increased from 39.92 at the *pretest* to 80.58 at the *posttest*. Descriptively, this represented an increase of 40.66 points. The change was also reflected in the distribution of knowledge categories. Before the intervention, 42 respondents (84.0%) were categorized as having poor knowledge, and none were classified as having very good knowledge. After the intervention, no respondents remained in the poor knowledge category, while 31 respondents (62.0%) achieved the very good knowledge category.

This increase was further supported by the Wilcoxon signed-rank test, which yielded a *p*-value of <0.001 . Because this value was lower than $\alpha = 0.05$, there was a statistically significant difference in knowledge levels before and after the program. These findings indicate that the Moringa leaf drink program was effective in improving pregnant women's knowledge of nutritious foods for stunting prevention in this study. Nevertheless, because the study involved pre- and post-intervention measurements, the increase should be interpreted within the context of the research design and should not be attributed solely to the nutritional content of Moringa leaves if an adequate comparison group was not available.

The improvement in knowledge may be explained through a health education approach that provided pregnant women with direct and contextual information. The Moringa leaf drink program not only provided a beverage product but also introduced information regarding nutritious foods, the nutritional content of Moringa leaves, their benefits, and the

utilization of local food resources. Structured learning activities may help participants understand new information and relate it to their everyday needs. Flora et al. (2021) explained that the learning process is a structured activity aimed at improving individuals' knowledge and practical abilities. Thus, interventions that combine information provision with direct experience have the potential to improve participants' understanding more effectively.

The use of Moringa leaves as part of the intervention also has a nutritional basis. *Moringa oleifera* is a plant containing various nutrients, including protein, minerals, vitamins, calcium, and vitamin A. Fatmawati et al. (2022) explained that Moringa leaves have potential as a food ingredient to support the fulfillment of nutritional requirements and as part of efforts to address nutritional deficiencies. These nutritional properties make Moringa leaves a potentially valuable local food source for development in community-based nutritional intervention programs.

The utilization of Moringa leaves as a local food resource also has advantages in terms of availability and sustainability. Moringa plants are relatively easy to find and can be cultivated within local communities. The utilization of local food resources may help communities recognize nutritious food alternatives that do not always depend on commercial food products. In the context of stunting prevention, a local food-based approach is relevant because interventions can be adapted to the social, economic, cultural, and food availability conditions of local communities.

The findings of this study are also consistent with studies indicating the potential of Moringa leaves to support maternal and child health. Tuloli and Kum (2022) reported that the utilization of Moringa leaves may be associated with increased breast milk production, while studies on Moringa-based food products have demonstrated their potential to support the nutritional needs of mothers and children. Although some of these studies have focused more on nutritional or health outcomes than on changes in knowledge, their findings strengthen the argument that Moringa leaves have potential for development as part of a community-based food approach.

In the context of stunting prevention, improving pregnant women's knowledge is an important component but should not be regarded as the sole indicator of program success. Knowledge needs to be translated into behaviors, such as selecting a diverse range of foods, fulfilling nutritional requirements during pregnancy, adhering to health workers' recommendations, and practicing appropriate infant and child feeding after birth. Therefore, the Moringa leaf drink program may be more optimal when combined with continuous nutrition education and health behavior support provided by health workers and community health cadres.

The findings of this study have implications for the development of stunting prevention programs at the village level. The Jati Mulia Village Government, local government, Batu Bara District Health Office, and health workers at community health centers may consider utilizing Moringa leaves as one of the local food sources in nutrition education activities. Such programs can be developed through health education sessions, demonstrations of Moringa leaf processing, *posyandu* activities, pregnant women's classes, and family empowerment programs. In this way, pregnant women would not only receive information regarding the importance of nutritious foods but also gain practical knowledge about utilizing food resources available in their surroundings.

Nevertheless, the findings of this study should be interpreted with caution. The increase in knowledge scores from the *pretest* to the *posttest* indicates a change following the intervention, but this change does not automatically demonstrate that the entire increase was caused solely by the Moringa leaf drink program. Other factors, such as exposure to information from health workers, respondents' personal experiences, interactions with

family members, and other sources of information during the study period, may also have influenced respondents' knowledge. Therefore, future studies are recommended to employ a clearly defined control group, a larger sample size, a longer observation period, and outcome measurements that assess not only knowledge but also changes in dietary behavior and nutritional status indicators.

Overall, the findings indicate that the Moringa leaf drink program has potential as a local food-based educational approach to improving pregnant women's knowledge of nutritious foods. The increase in the mean knowledge score from 39.92 to 80.58 and the Wilcoxon test result with a p -value of <0.001 indicate a significant change in knowledge following implementation of the program. These findings reinforce the importance of developing nutritional interventions that are not solely oriented toward food provision but also integrate education and community empowerment as part of stunting prevention strategies beginning during pregnancy.

CONCLUSION

Based on the findings of the study on the effectiveness of the Moringa leaf drink program in improving pregnant women's knowledge of nutritious foods for stunting prevention in Jati Mulia Village, it can be concluded that there was an improvement in pregnant women's knowledge following the implementation of the Moringa leaf drink program. This was reflected in the increase in the mean knowledge score from 39.92 at the *pretest* to 80.58 at the *posttest*. Categorically, before the intervention, the majority of respondents had a poor level of knowledge, with 42 respondents (84.0%), whereas after the intervention, no respondents remained in the poor knowledge category and 31 respondents (62.0%) achieved the very good knowledge category.

The results of the Wilcoxon signed-rank test showed a p -value of <0.001 , which was lower than the significance level of $\alpha = 0.05$. These results indicate a statistically significant difference in pregnant women's knowledge levels before and after implementation of the program. Thus, the Moringa leaf drink program demonstrated effectiveness in improving pregnant women's knowledge of nutritious foods as part of stunting prevention efforts in this study.

In addition to improving knowledge, the program also introduced Moringa leaves as a local food source that is relatively accessible and potentially useful for supporting nutritional needs. The utilization of local food resources through educational activities and the provision of Moringa leaf drinks may serve as an alternative approach to improving pregnant women's understanding of the importance of nutritious foods during pregnancy. Nevertheless, improvements in knowledge need to be followed by changes in dietary behavior and continuous support so that the benefits of the education can be applied in everyday life.

Based on the findings, continued nutrition education programs for pregnant women are recommended through collaboration among the village government, the Batu Bara District Health Office, community health centers, health cadres, and other relevant stakeholders. Educational activities concerning nutritious foods and the utilization of Moringa leaves can be integrated into pregnant women's classes, *posyandu* activities, and community empowerment programs. Regular implementation of these activities is expected to maintain and further improve pregnant women's knowledge while encouraging the adoption of more diverse and nutritious dietary practices.

For health workers and community health cadres, it is recommended that information regarding Moringa leaves should not focus solely on their benefits but should also include education on balanced diets, nutritional requirements during pregnancy, food preparation safety, and the importance of regular antenatal care. Moringa leaves should be positioned as

one alternative food source and should not be regarded as a substitute for the overall nutritional requirements of pregnant women or for health interventions recommended by healthcare professionals.

For future researchers, studies with stronger research designs are recommended, including the use of control groups, larger sample sizes, and longer observation periods. Future research should also expand outcome measurements beyond knowledge to include changes in dietary behavior, adherence to nutritious dietary patterns, maternal nutritional status, and indicators of child growth and development. Long-term research on the safety, acceptability, adherence to consumption, and potential benefits of Moringa leaf consumption during pregnancy is also needed to obtain more comprehensive evidence regarding the utilization of Moringa leaves as part of a stunting prevention strategy.

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