



Education on the Utilization of Herbal Phytotherapy Moringa Aloifera as an Alternative Nutritional Intervention for the Prevention of Stunting in Toddlers

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Abstract. Stunting remains a major chronic nutritional issue in Indonesia, including the Yogyakarta region. One preventive approach is nutrition education during the pre-marital period. *Moringa oleifera* is recognized as a highly nutritious local plant with potential in preventing stunting. This study employed a double-blind randomized controlled trial design involving 46 prospective brides in Yogyakarta. The intervention group received herbal phytotherapy education through an online pocketbook focused on the benefits of *Moringa oleifera*, while the control group received standard education from the Religious Affairs Office (KUA). Knowledge levels were assessed before and after the intervention using a structured questionnaire. There was a significant increase in knowledge scores in the intervention group (pre-test: 48.55 ± 0.93 ; post-test: 75.09 ± 0.95 ; $p = 0.016$), while the increase in the control group was not statistically significant. An independent *t*-test showed a significant difference in post-test scores between the two groups ($p = 0.003$). Online pocketbook-based education on *Moringa oleifera* herbal phytotherapy effectively increased knowledge of stunting prevention among prospective brides. This approach has strong potential as a community intervention strategy that is locally sourced, low-cost, accessible, and sustainable.

Keywords: stunting, prospective bride, phytotherapy, *Moringa oleifera*, preconception nutrition

Abstrak. Stunting merupakan masalah gizi kronis yang masih menjadi tantangan besar di Indonesia, termasuk di wilayah Yogyakarta. Salah satu pendekatan pencegahan yang dapat dilakukan adalah edukasi gizi sejak masa pranikah. *Moringa oleifera* (daun kelor) dikenal sebagai tanaman lokal yang sangat bergizi dan berpotensi dalam mencegah stunting. Penelitian ini menggunakan desain *double blind randomized controlled trial* yang melibatkan 46 calon pengantin wanita di Yogyakarta. Kelompok intervensi mendapatkan edukasi fitoterapi herbal melalui *pocketbook* daring yang membahas manfaat *Moringa oleifera*, sementara kelompok kontrol menerima edukasi standar dari Kantor Urusan Agama (KUA). Tingkat pengetahuan diukur sebelum dan sesudah intervensi menggunakan kuesioner terstruktur. Terdapat peningkatan skor pengetahuan yang signifikan pada kelompok intervensi (pre-test: $48,55 \pm 0,93$; post-test: $75,09 \pm 0,95$; $p = 0,016$), sementara peningkatan pada kelompok kontrol tidak signifikan. Uji *independent t-test* menunjukkan perbedaan skor yang signifikan antara kedua kelompok ($p = 0,003$). Edukasi berbasis *pocketbook* daring tentang fitoterapi herbal *Moringa oleifera* efektif dalam meningkatkan pengetahuan calon pengantin mengenai pencegahan stunting. Pendekatan ini berpotensi menjadi strategi intervensi komunitas yang berbasis sumber daya lokal, mudah diakses, berbiaya rendah, dan berkelanjutan.

Kata kunci: stunting, calon pengantin, fitoterapi, *Moringa oleifera*, gizi prakonsepsi

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INTRODUCTION

Stunting is a chronic nutritional problem that occurs due to prolonged malnutrition, repeated infections, and lack of psychosocial stimulation, especially in the golden period of the first 1,000 days of life. Children who are stunted have a height below the age standard and are at risk of impaired cognitive development, decreased immunity, low productivity in the future, and increased risk of non-communicable diseases as adults.[1, 2] This impact is not only felt by individuals but also affects the quality of human resources and the nation's competitiveness. According to data from the Indonesian Nutrition Status Survey (SSGI) in recent years, the prevalence of stunting in Indonesia is still above the threshold set by WHO, which is 20%.[3] Despite the downward trend, stunting rates in some regions, including the Special Region of Yogyakarta, still show alarming numbers. This is ironic considering Yogyakarta is known as an area rich in biodiversity, including local food plants and herbs that have the potential to support the nutritional status of the community.[4, 5]

Stunting prevention ideally starts before pregnancy. The preconception period is an important moment to ensure that prospective brides, especially women of reproductive age, are in optimal nutritional and health conditions. Nutrition and health education for brides-to-be is an important strategy to shape a healthy generation from upstream.[6, 7] With adequate knowledge, brides-to-be can prepare for a healthy pregnancy, support the fertility process, maintain health during pregnancy and breastfeeding, and meet the nutritional needs of babies from an early age. One educational approach that has great potential but has not been optimally utilized is the introduction and utilization of herbal phytotherapy as a nutritional intervention.[8, 9] The people of Yogyakarta have long recognized the use of herbal plants as part of traditional medicine. However, the utilization was mostly done by the previous generation. With the shifting times and the influx of modern lifestyles, there has been a decline in herbal knowledge and utilization among the younger generation. In fact, several types of herbal plants have high nutritional content that can support stunting prevention efforts.[3, 10]

One of the potential herbal plants is Moringa oleifera or Moringa leaves. This plant contains high protein, vitamin A, vitamin C, iron, calcium, and antioxidants that support child growth, strengthen the immune system, and prevent anemia. Moringa oleifera's mechanism of action in preventing stunting is related to improving micro and macro nutritional status and improving the body's metabolic functions.[11, 12] Another advantage is the flexibility of processing moringa in the form of food and beverages that can be consumed by children, adolescents, adults, and the elderly. For women, moringa has an important role throughout their life cycle. In adolescents, moringa helps maintain reproductive health and prevent anemia. Moringa consumption in brides-to-be contributes to preparing the body for pregnancy with good nutritional status, increasing the chances of fertility, and supporting a healthy pregnancy. During the postpartum period and breastfeeding, moringa plays a role in improving the quality and quantity of breast milk. In the complementary feeding phase, moringa can be processed into nutrient-dense foods to support optimal growth of babies. [13, 14]

Seeing the importance of this education, there is a need for an effective, flexible method of delivering information that reaches the younger generation, especially for prospective brides. One of the innovative educational media is an online pocketbook, which can be accessed anytime and anywhere through digital devices. The advantages of online pocketbooks include ease of distribution, cost efficiency, quick information updates, and visual appeal that can increase user understanding. Through online pocketbook-based education, it is hoped that prospective brides will gain practical and applicable knowledge about the use of herbal phytotherapy, especially Moringa, in supporting family nutrition and preventing stunting from an early age. With a structured and local resource-based educational approach, this study aims to develop a preventive intervention strategy against stunting through empowering the knowledge of brides-to-be on the utilization of herbal phytotherapy, especially Moringa (*Moringa oleifera*). [15, 16]

METHOD

Study Design

This study used a double blind Randomized Controlled Trial (RCT) design. This study aims to evaluate the effectiveness of Herbal Phytotherapy education through an online pocketbook on increasing the knowledge of female brides-to-be about stunting prevention. The assessment was conducted by

measuring the level of knowledge before (pre-test) and after (post-test) the educational intervention. Participants were divided into two groups, an intervention group that received herbal phytotherapy education, and a control group that received standard education from the Ministry of Religious Affairs (KUA). Both groups were blinded to the purpose of the study (double blind), and evaluation was based on differences in knowledge scores.

Population and Sample

The target population in this study were all brides-to-be who live in the Yogyakarta area. The sampling technique was carried out using purposive sampling method, namely the selection of samples intentionally based on predetermined inclusion and exclusion criteria. The inclusion criteria in this study include brides-to-be who live in the Yogyakarta area, are willing to participate in the entire series of research for at least eight days, have access to digital devices such as gadgets or laptops, and have an internet connection and a basic level of digital literacy to access and understand educational content online. Exclusion criteria included potential participants who experienced health problems that could hinder active participation, did not complete the pre-test or post-test, and did not follow or complete the daily quiz according to the predetermined schedule. After the screening process based on these criteria, a total of 46 brides-to-be qualified as samples were obtained. The allocation of participants into the control group and intervention group was done randomly using a computerized randomization system to ensure objective and unbiased distribution.

Research Procedure

The recruitment process of participants in this study began with socialization through various social media platforms. Interested potential participants were then asked to fill out an online informed consent form to participate in the study. After the recruitment process, participants were randomly allocated into two groups, the intervention group and the control group, using a computerized randomization program. The control group was given the standard education that brides-to-be usually receive from the Ministry of Religious Affairs (KUA), while the intervention group was given access to an online pocketbook in PDF flipbook format titled Herbal Phytotherapy Education for Stunting Prevention. To measure the level of knowledge, a pre-test was conducted online before the intervention began. Over the next seven days, the intervention group participants studied the material in the pocketbook consisting of seven chapters, with monitoring through the completion of daily quizzes corresponding to each chapter. On the 8th day, all participants again completed the post-test to assess changes in knowledge after the intervention.

Instrument

The instruments used in this study consisted of two chapters, namely the respondent characteristics chapter and the knowledge chapter. Respondent characteristics data included demographic and health data, including age, education level, occupation, income, and Body Mass Index (BMI), health history such as anemia and chronic diseases, history of low-birth-weight babies (LBW), teenage pregnancy, anemia, history of previous nutrition education. The knowledge questionnaire was structured based on seven sub-items that corresponded to the contents of the seven chapters in the educational handbook used in the intervention group. The sub-items included: (1) definition and concept of stunting, (2) impact and medical implications of stunting, (3) risk factors and causes of stunting, (4) symptoms and diagnosis of stunting, (5) prevention and treatment of stunting, (6) *Moringa oleifera* and its nutritional content, and (7) mechanism of action of moringa in preventing stunting. Before being used in the main study, the questionnaire was tested for validity and reliability on 20 prospective brides in the Bantul area. The validity test results showed that all items had a p-value <0.05, indicating a significant correlation with the total score. In addition, the reliability test resulted in a Cronbach's Alpha value > 0.7, indicating that the questionnaire has good internal consistency and is reliable as a measuring tool in this study.

Data Analysis

Data analysis in this study began with a normality test using the Shapiro-Wilk test to determine whether the knowledge score data was normally distributed. The test results showed that the pretest and post-test scores in both the intervention and control groups were normally distributed, with the respective p-values as follows: intervention group pretest ($p = 0.223$), intervention group post-test ($p = 0.198$), control group pretest ($p = 0.275$), and control group post-test ($p = 0.184$). All p-values > 0.05 indicate that the normality assumption is met. Furthermore, the homogeneity of variance between groups was tested using Levene's Test, and the results showed that the variance between groups was homogeneous ($p = 0.319$), so the data met the requirements for parametric analysis. To test the effectiveness of the educational intervention, a paired t-test was used to compare knowledge scores before and after treatment in each group. Independent t-test was used to compare knowledge scores between intervention and control groups after the intervention, with significance ($p < 0.05$).

RESULTS AND DISCUSSION

Based on Figure 1, the distribution of respondent characteristics, most brides-to-be involved in this study were in the age range of 21-25 years (60.9%), followed by the age groups of 17-20 years (21.7%) and 26-30 years (17.4%). These characteristics indicate that the respondents have good cognitive capacity and motivation to receive and understand the educational information delivered, including the benefits of herbal phytotherapy as a promotive and preventive effort in preventing stunting. In terms of education, most of the respondents had a Diploma or bachelor's degree (52.2%), while the rest were high school graduates (43.5%) and only a small proportion were junior high school graduates (4.3%). Higher education is generally associated with a better understanding of nutrition and health, thus strengthening the effectiveness of education. Most respondents were employed (60.9%), followed by students (26.1%) and housewives or not working (13%). Most respondents had a monthly income in the range of Rp1,000,000 - Rp3,000,000 (43.5%), while 39.1% had an income below Rp1,000,000 and 17.4% above Rp3,000,000. Respondents who are employed and have a middle income are also more likely to be able to access the health services and food needed to support their nutritional status and that of their future children.

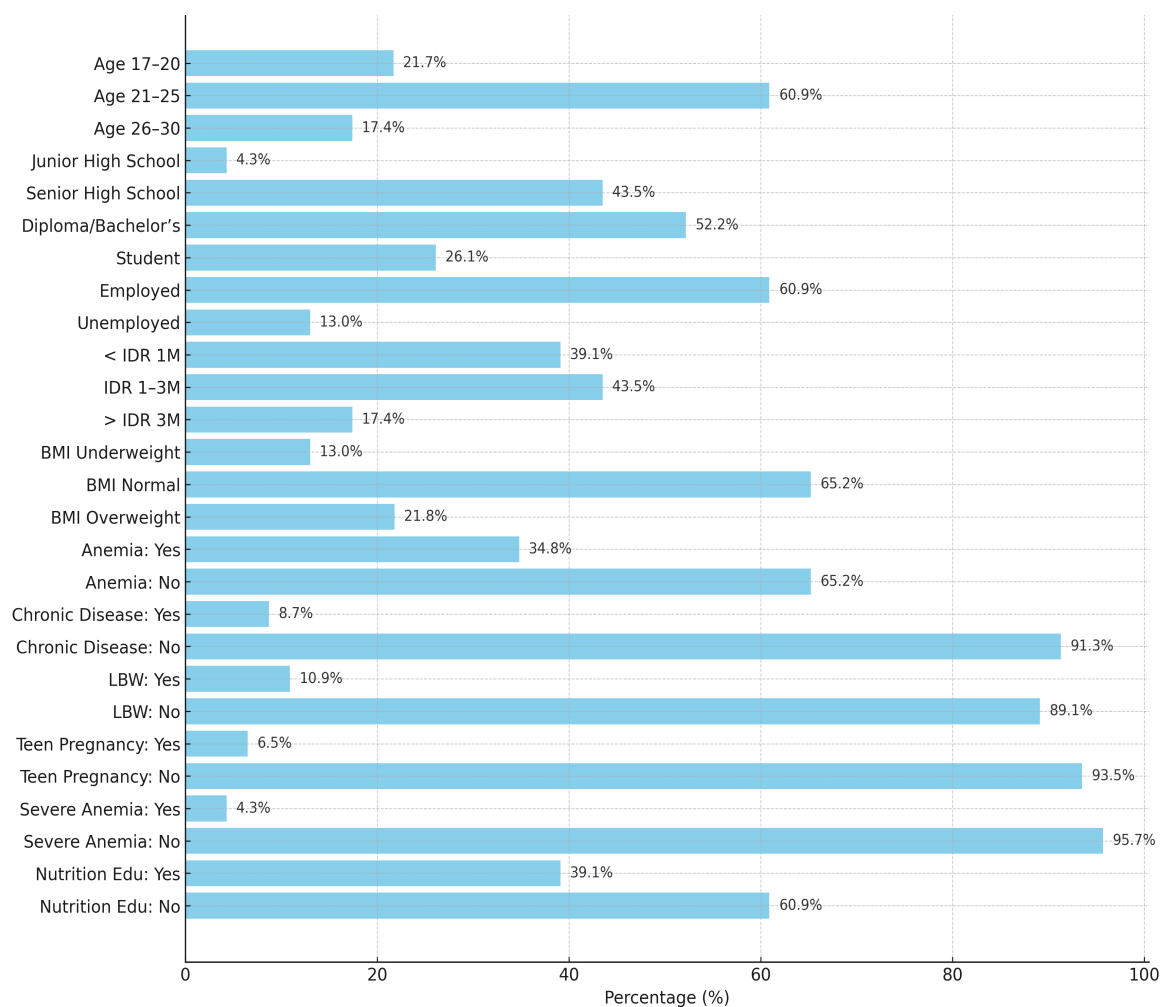


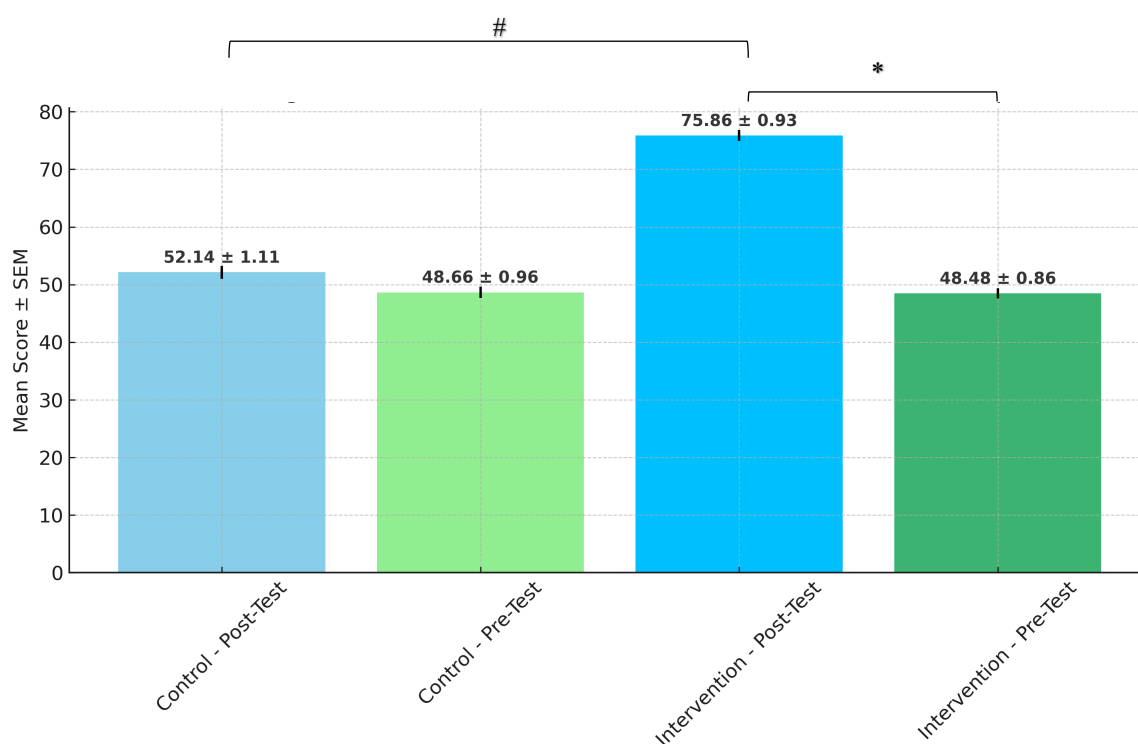
Figure 1 Respondents Characteristic Distribution

Based on nutritional status, most respondents had a normal BMI (65.2%), but there were also those classified as underweight (13%) and overweight/obese (21.8%). Underweight mothers-to-be may represent insufficient nutritional reserves, leading to a high risk of low birth weight (LBW), a factor strongly associated with stunting. Overweight and obesity can increase the risk of pregnancy and metabolic complications that negatively impact fetal health. In terms of health history, 34.8% of respondents had a history of anemia, and 8.7% had a history of chronic disease. A total of 10.9% of respondents had a history of giving birth to low-birth-weight babies (LBW), 6.5% had experienced pregnancy in adolescence, and 4.3% had a history of severe anemia.

Anemia during adolescence, premarital and pregnancy, can disrupt the supply of oxygen and nutrients to the fetus, increasing the risk of stunted fetal growth (IUGR) which is a major contributing factor to stunting.[17] Similarly, LBW, often the result of poor maternal nutritional status or suboptimal pregnancy conditions, is strongly correlated with stunted physical growth and brain development in the early years of life. Adolescent pregnancy is a double risk factor because biologically, adolescents' bodies are not fully prepared for pregnancy, while psychosocially they tend to be unprepared to manage pregnancy and childcare.[18, 19] This unpreparedness often leads to suboptimal care practices and consumption patterns, which have direct implications for the nutritional status of the child.[1, 20]

The accumulation of these factors can reinforce the intergenerational cycle of stunting, where children born with poor nutritional status have the potential to become parents with the same risk in the future.[21] These factors can increase the vulnerability to stunting in the next generation. Therefore, providing comprehensive education, including natural approaches such as evidence-based herbal phytotherapy, is essential to prepare expectant mothers to be more physically and knowledgeably prepared for a healthy pregnancy.[20, 22]

Regarding nutrition education, 39.1% of respondents had received education before, while 60.9% had not. This data shows the importance of structured educational interventions, such as digital pocketbooks, to improve the knowledge and nutritional readiness of brides-to-be to prevent stunting.[23, 24] Most respondents (60.9%) had never received nutrition education before, indicating an information gap that can be filled through digital interventions such as the digital pocket guide delivered in this study. Education not only increases knowledge but also forms long-term awareness about the importance of nutrition and reproductive health, which directly impacts the prevention of stunting since the premarital period.[25] The effectiveness of education is not only determined by its content but is also strongly influenced by the characteristics of the recipients of the information, which in this context are relatively supportive of the success of the intervention.[6, 22]



*paired t test <0.05

#independent t test <0.05

Figure 2 Knowledge Score Pre-Post test, Control and Intervention Group

Based on Figure 2, there was a significant increase in knowledge scores in the intervention group, with an average pre-test score of 48.55 ± 0.93 and increased to 75.09 ± 0.95 in the post-test. The paired t-test results showed that this increase was statistically significant with a p value = 0.016*. In the control group, the average pre-test score of 48.57 ± 0.87 only increased to 52.42 ± 1.07 in the post-test, and this increase was not statistically significant at p = 0.058. The results of the independent t-test of the

post-test scores of both groups showed a significant difference with a value of $p = 0.003\#$. This finding indicates that the intervention significantly improved participants' knowledge compared to standard education.

Herbal phytotherapy education that integrates *Moringa oleifera* as the main ingredient in stunting prevention has shown a significant impact in increasing the knowledge of prospective brides. Through a structured, interactive, and evidence-based educational approach, participants not only obtain scientific information, but also build a comprehensive understanding of the important role of nutritional intake from preconception to pregnancy.[13, 26] This change in knowledge is very influential in shaping a more proactive attitude towards healthy pregnancy planning, as well as increasing motivation to adopt healthy behaviors in everyday life. Targeted education can stimulate participants' awareness of the importance of preventive measures, including the use of local plants such as *Moringa oleifera*, which has been known as a source of nutrition for generations, but has not been maximally utilized in a modern medical context. The increased motivation after the educational intervention shows that the information received is not only cognitively understood but also internalized emotionally and practically.[23, 25] Participants were encouraged to try, process, and consume *Moringa oleifera* in various forms, ranging from fresh leaves, powder, capsules, to processed foods such as pudding, meatballs, or herbal tea. The effectiveness of this education is reinforced by the fact that many of the participants have never previously received nutrition education, so the new material becomes more meaningful and has the potential to cause long-term changes in behavior. This educational strategy, if carried out in a sustainable manner and accompanied by mentoring, can be a strong community intervention in preventing stunting from upstream, namely in prospective mothers.[12, 27]

Moringa oleifera contains various active compounds such as flavonoids (quercetin, kaempferol), polyphenols, vitamin A, vitamin C, iron, calcium, and essential amino acids that play an important role in supporting child growth and development. The high iron content helps prevent and overcome iron deficiency anemia common among women of childbearing age and pregnant women, which if left untreated can cause fetal growth retardation and increase the risk of stunting.[28, 29] Vitamins A and C as antioxidants play a role in cell protection against oxidative stress that can interfere with the growth of bone and brain tissue. The polyphenols in *Moringa* are also known to have anti-inflammatory effects, which is important as low-level chronic inflammation has been shown to inhibit growth hormone (IGF-1) which is crucial in the early growth phase of a child. In addition, *Moringa* also contains compounds that can regulate genetic expression through epigenetic mechanisms such as DNA methylation, which supports the development of the immune and central nervous systems.[28, 30]

Regular administration of *Moringa* leaves to pregnant women reduced the incidence of low-weight babies and significantly increased hemoglobin levels. Consumption of *Moringa* preparations in the form of puddings and snacks improved the weight and appetite of children under five, which directly impacted on reducing the prevalence of stunting.[31] *Moringa* supplementation during pregnancy contributed to increased child height at age 2, reduced respiratory infections, and improved biomarkers of maternal nutritional status.[32] This proves that *Moringa* not only acts as a nutritional complement but has broad functional and protective effects in supporting child growth. In terms of implementation, *Moringa oleifera* has the advantage of being a plant that is easy to cultivate, resistant to extreme environmental conditions, and has high productivity. It can also be processed in simple ways without significant loss of nutritional value.[33, 34] This makes it a sustainable and low-cost local solution for community-based nutrition interventions. In the context of education, the use of *Moringa* not only enriches the material provided but also opens space for a cross-sectoral approach between health, agriculture, and education. *Moringa oleifera*-based phytotherapy education provides a holistic approach that not only increases the knowledge of brides-to-be about stunting but also increases their biological and social readiness for a healthy pregnancy.[35, 36] This approach is very relevant to be applied in various regions with a high prevalence of stunting, especially with the support of promotive-preventive policies and active involvement of community leaders and health workers. This intervention can create a positive domino effect not only for the mother and child, but also in long-term efforts to reduce stunting.[37]

CONCLUSION

The online pocketbook education on *Moringa oleifera* herbal phytotherapy provides an effective holistic approach to enhance the biological and social readiness of prospective brides for healthy pregnancies and stunting prevention. By improving understanding of the role of nutrition especially from locally accessible and sustainable sources participants are encouraged to proactively adopt healthy lifestyle behaviors. *Moringa oleifera*, as a nutrient-rich source of active compounds, holds great potential in supporting child growth and preventing nutritional deficiencies, while offering an affordable and easily

implementable local solution for community interventions. However, the sample size and intervention duration in this study were relatively limited, which restricts the ability to assess long-term impacts and effectiveness across broader populations. Therefore, further research with a longitudinal design and a more representative sample is recommended, alongside continuous mentoring to ensure sustained behavioral changes. Cross-sector collaboration involving community leaders and health workers is also crucial to strengthen program implementation and expand its reach. This approach has the potential to become an innovative intervention model in national efforts to reduce stunting.

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