

Increasing Knowledge, Self-Efficacy and Hemoglobin Levels in Pre-Conception Women through Nutrition Assistance Program

Jumrah Sudirman*¹, Rosdianah Rosdianah², Qonita K. Anjani³, Karolus Wangi⁴,
Abdul M. Iskandar⁵, Nurjannah Bachri⁶

^{1,2} Department of Midwifery, Megarezky University, Makassar, Indonesia

³ School of Pharmacy, Queen's University Belfast, Belfast, United Kindom

⁴ Ross and Carol Nese College of Nursing, Pennsylvania State University, University Park, United States

⁵ Department of Sociology Education, Megarezky University, Makassar, Indonesia

⁶ Department of Pharmacy, STIKES Tarumanegara, Jakarta, Indonesia

DOI: [10.24252/al-sihah.v15i1.34843](https://doi.org/10.24252/al-sihah.v15i1.34843)

Received: 4 March 2023 / In Reviewed: 28 May 2023 / Accepted: 16 June 2023 / Available online: 29 June 2023

©The Authors 2023. This is an open access article under the CC BY-NC-SA 4.0 license

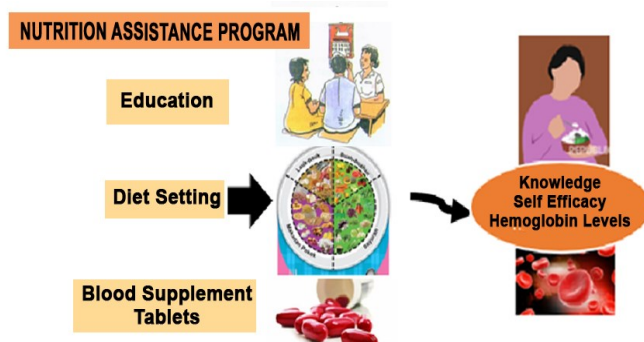
ABSTRACT

Anemia, which is associated with various complications during pregnancy and childbirth can be prevented, especially in pre-conception or pre-pregnancy women, by fulfilling nutrition needs. One way to achieve this is by implementing nutrition assistance programs specifically designed for pregnant women or those planning to conceive. Therefore, this study aims to examine the impact of a dietary support program on the knowledge, self-efficacy, and hemoglobin level of pre-conception women. The design used was a non-randomized controlled trial with a pretest-posttest approach, while the sample consisted of married women preparing to get pregnant, with a total of 67 people meeting the inclusion criteria. Data obtained were analyzed using the Wilcoxon Signed Ranks Test and Independent sample T-test. The results demonstrated a significant difference in knowledge levels ($p=0.000$), self-efficacy ($p=0.000$), and hemoglobin levels ($p=0.000$) between the intervention and control groups. Therefore, it is essential to address the readiness of pre-conception women, particularly regarding their nutrition status, to prevent potential complications that may arise during pregnancy and childbirth.

ABSTRAK

Anemia dapat menyebabkan berbagai komplikasi selama kehamilan dan persalinan. Anemia dalam kehamilan dapat dicegah sedini mungkin, terutama pada masa sebelum hamil atau prakonsepsi dengan memenuhi kebutuhan nutrisi. Program pendampingan gizi harus dilakukan untuk membantu mengatasi masalah gizi pada ibu hamil atau sebelum hamil. Penelitian ini bertujuan untuk mengetahui perubahan pengetahuan wanita prakonsepsi, self-efficacy, dan kadar hemoglobin yang dapat dipengaruhi oleh program pendampingan gizi. Rancangan yang digunakan adalah non-randomized controlled trial dengan pendekatan pretest-posttest. Sampel dalam penelitian ini adalah wanita prakonsepsi yang sedang mempersiapkan kehamilannya sebanyak 67 orang memenuhi kriteria sampel. Data dianalisis menggunakan Wilcoxon Signed Ranks Test dan independent sample T-test. Temuan pada penelitian ini menunjukkan perbedaan yang signifikan antara tingkat pengetahuan antara kelompok intervensi dan kontrol ($p=0,000$), terdapat perbedaan self-efficacy pada kelompok intervensi dan kontrol ($p=0,000$), serta kadar hemoglobin pada kedua kelompok terdapat perbedaan yang signifikan ($p=0,000$). Kesiapan status gizi perempuan sedini mungkin sebelum kehamilan perlu dipersiapkan untuk mencegah berbagai komplikasi yang mungkin timbul selama masa kehamilan dan persalinan.

GRAPHICAL ABSTRACT



Keyword

Anemia
female
hemoglobins
nutritional status
pregnant women

* Correspondence

BTN Sakinah Blok E20 No. 9, Makassar, P.O. Box
90241, South Sulawesi, Indonesia
Email: jumrah.mega.rezky@gmail.com

INTRODUCTION

Women of childbearing age are expected to be prepared for the responsibilities of motherhood, and their nutritional needs differ from those of childhood, youth, and old age (Wiafe et al., 2022). The importance of meeting these specific nutritional requirements becomes even more critical as women prepare for pregnancy and breastfeeding. The quality of offspring is determined by the maternal nutrition before and during pregnancy (Christiany et al., 2021), hence, the pre-conception period is an opportunity to prepare for the first 1000 days of a child's life. Poor maternal nutrition before pregnancy has been linked to adverse outcomes and an increased risk of nutrition-related problems, such as anemia (Safitri et al., 2021).

Unmarried women are particularly at risk of anemia due to their monthly menstrual cycles (Dineti et al., 2022). The prevalence of anemia globally among women aged 15-49 years was estimated at 29.9% in 2021 (Aulya et al., 2022). Furthermore, the prevalence among women over 15 years in Indonesia was 22.7%, with an estimated value of 13.7% among pregnant women in Makassar (Rahmawati et al., 2017). Anemia has detrimental effects on the growth and development of the fetus, leading to complications during pregnancy and childbirth, as well as increased maternal and infant mortality (Mustafa & Maulidiana, 2019).

Various factors affect the dietary habit of pre-conception women including age, education, knowledge, and nutrition status (Tramontt & Jaime, 2020). Access to nutrition information plays an essential role in ensuring adequate nutrition. Furthermore, knowledge significantly affects an individual's self-efficacy (Seguin-Fowler et al., 2021). Self-efficacy refers to an individual's belief in controlling their behaviors to achieve certain goals (Prasitwattanaseree et al., 2019). This belief supports behavioral changes in women to transition from anemic

conditions to non-anemic ones (Carfora et al., 2017).

A previous study on pre-conception women highlighted the significance of nutrition consumption in raising hemoglobin levels (Dieny et al., 2019). The amount of energy, protein, iron, and overall nutrition status consumed by pre-conception women affects their hemoglobin (Hb) levels. However, calorie consumption and nutrition status reportedly have the most significant impact (Wiafe et al., 2022). Another study (Kusnadi, 2021) showed the relationship between knowledge levels and the frequency of anemia among young women. Well-informed young women tend to be more vigilant in preventing anemia compared to those with lower levels of knowledge (Nonguierma et al., 2022). Previous studies have underscored the importance of fulfilling nutrition needs and providing education to prevent anemia. In this particular study, the intervention not only focused on improving the knowledge of participants through education but also provided assistance and monitoring to ensure changes in their attitudes and consumption behavior.

Knowledge about nutrition and anemia is crucial for understanding related concepts, principles, and information (Girard & Olude, 2012). Therefore, women can actively engage in nutrition education to enhance their knowledge and self-efficacy. Adequate knowledge about the importance of nutrition will increase the awareness of expectant mothers regarding nutrition fulfillment even before pregnancy (Sari et al., 2019). Women also need to be informed about dietary modifications to improve their nutrition status and adherence to blood supplement administration programs, both of which support the enhancement of maternal nutrition before pregnancy.

However, knowledge only does not bring about changes in dietary behavior or nutrition fulfillment. It is also necessary to increase

pre-conception maternal self-efficacy or self-confidence, as it empowers the ability to make crucial behavioral changes (Lönnberg et al., 2020). Assistance provided by families or health workers, especially midwives, is vital in supervising and assisting pre-conception women to manage their diet. Therefore, this study aims to assess the effectiveness of a nutrition assistance program on knowledge, self-efficacy, and hemoglobin levels of pre-conception women.

METHODS

This study was conducted using a non-randomized controlled trial design with a pre-test-posttest approach. The population included all pre-conception women who visited Puskesmas in the Working Area of Makassar City, while the samples were married women preparing to get pregnant totaling 67 people who met the sample criteria. The purposive sampling method was used with inclusion criteria namely, women who had never been pregnant or had a miscarriage, were in their first marriage, and had mild to moderate anemia. Furthermore, the samples were divided into two groups, namely the intervention, and control. The intervention group received a nutrition assistance program with a total of 32 respondents (3 dropped out before completion), while the control group consisted of 35 respondents who received education using leaflet media. This study was conducted in the Makassar City Region from October 2021 to August 2022. The intervention group's mentoring program was carried out for eight weeks. During the first and second weeks, education was conducted using PowerPoint and educational modules, then from the third to the eighth week, mentoring was implemented to monitor eating patterns and administer iron tablets (Fe) to the respondents. The pre-test was performed before the mentoring program, while the post-test was administered during the

ninth week after the program's implementation.

The nutrition assistance program implemented in this study consisted of 1) Educational activities regarding anemia, the need for balanced nutrition before pregnancy, and good eating habits. 2) Nutrition assistance was carried out by midwives through face-to-face meetings and monitoring through the WhatsApp group to supervise the types of food and eating behavior of the respondents. 3) Provision of additional blood tablets (Fe) to help treat anemia. Meanwhile, in the control group, educational leaflets with the same content as the intervention group were administered once in the first week, and monitored through the WhatsApp group.

The dependent variables in the study included self-efficacy, knowledge, and hemoglobin levels. Self-efficacy was assessed with the Pre-conception Women's Self-Efficacy Questionnaire consisting of 12 statements measured with a Likert scale. Meanwhile, the knowledge questionnaire consisted of 15 questions with a "true" or "wrong" scale and an observation sheet for recording. Hemoglobin examination was conducted using Hemoglobin Meter (Nesco multi-check) and a food frequency of 1 x 24 hours was used to monitor the type of food consumed by respondents. The data obtained were then evaluated with the Wilcoxon Signed Ranks Test to compare the results of each group before and after therapy. Subsequently, an independent sample T-test was carried out to determine the differences between all variables in the two groups.

RESULTS

Table 1 shows that the age of the respondents in the intervention group averaged 24.03 years with a standard deviation of 3.68. Similarly, the control group's average age was 23.82 years, with a standard deviation of 2.94. The majority of respondents in both groups

Table 1
Distribution of Respondents' Characteristics

Variable	Intervention Group ^a		Control Group ^b	
	n / Mean±SD	%	n / Mean±SD	%
Age of Respondent (years)	24.03 ± 3.68		23.82 ± 2.94	
Employment Status				
Not Working	17	53.13	21	60.00
Working	15	46.88	14	40.00
Education				
Primary School	4	12.50	6	17.14
Junior High School	6	18.75	6	17.14
Senior High School	16	50.00	19	54.29
Higher Education	6	18.75	4	11.43
Arm Circumference (cm)	23.87±2.26		24.47±2.13	

Note: ^a = 32 respondents; ^b = 35 respondents; n= number of respondents; SD= standard deviation; %= percentage

were unemployed with 17 (53.1%) and 21 (60%) in the intervention and control groups respectively. In terms of education, most of the respondents had completed senior high school with 16 (50%) and 19 (54.3%) in each respective group. The average Lila measurements in the intervention group averaged 23.87 cm with a standard deviation of 2.26, and in the control group, the average was 24.47 cm with a standard deviation of 2.13.

Table 2 presents the results of knowledge measurement in the intervention and control groups. In the intervention group, 32 respondents demonstrated an increase in knowledge, while in the control, three respondents showed persistent knowledge. The results also showed that 31 respondents had increased self-efficacy in the intervention group, while one had persistent self-efficacy. Meanwhile, in the control group, eight respondents experienced a decrease in self-efficacy, and three had persistent self-efficacy. Hemoglobin levels measurement results showed that in the intervention group, 30 respondents had increased levels, while two had persistent levels. In the control group, 14 respondents had decreased hemoglobin levels, and two had persistent levels.

The data analysis results showed that knowledge in the intervention ($p=0.000$) and the

control group ($p=0.000$) had differences before and after the intervention. For self-efficacy, there was a significant difference between the intervention ($p=0.000$) and the control group ($p=0.001$) after the intervention. There was also a significant difference in the results of hemoglobin levels in the intervention group ($p=0.000$) after the intervention, but in the control group ($p=0.134 > 0.05$), there was no significant difference in the post-test measurements.

Table 3 presents the analysis results of differences between the intervention and control groups. The intervention group exhibited an increase in knowledge with a difference of 30.63, while the control group only experienced a difference of 16.58. Similarly, the intervention group showed a significant increase of 9.15 in self-efficacy, compared to 2.97 in the control group. Regarding hemoglobin values, the intervention group experienced an increase of 0.95 g/dL, compared to 0.07 g/dL in the control group. The data analysis results showed that there were significant differences ($p=0.000$) in knowledge, self-efficacy, and hemoglobin levels between the intervention and control groups.

DISCUSSION

Mentoring Program with Knowledge of Pre-conception Women

The mentoring program in this study

Table 2*Changes in Knowledge, Self-Efficacy, and Hemoglobin Levels in the Intervention and Control Groups*

Variable	Intervention Group ^a		Control Group ^b	
	n	P-value	n	P-value
Knowledge				
Negative rank	0		0	
Positive rank	32	0.000*	32	0.000*
Ties	0		3	
Self-Efficacy				
Negative rank	0		8	
Positive rank	31	0.000*	24	0.001*
Ties	1		3	
Hemoglobin Levels				
Negative rank	0		14	
Positive rank	30	0.000*	19	0.134
ties	2		2	

Note: ^a = 32 respondents; ^b = 35 respondents; n= number of respondents; * = significant with $p \leq 0.05$

had a significant effect on the knowledge of respondents. Based on the results, the use of various media and methods increased their ability to receive the information provided. This mentoring program consisted of educational activities and guidance regarding the diet of the respondents (Skolmowska et al., 2022). PowerPoint presentations and media modules were used to deliver education to the intervention group, while the control group received education through leaflet media. The baseline knowledge of the respondents was evaluated before and after the intervention using a pre-test and a post-test, respectively. A significant increase was observed in the intervention group compared to the control. Midwives provided education to the intervention group four times over two months (Sari et al., 2019).

In contrast, the control group received education from leaflets distributed to respondents. Based on the results, providing education within a certain period led to changes in knowledge (Kye et al., 2019). A previous study (Ghaffari et al., 2017) found that providing a 30-45-minute intervention to the experimental group for two months significantly increased their knowledge.

Educational methods and media are considered the main factors in the success of

nutrition education (Kamalaja et al., 2018). The attractiveness and interest of women can be quickly captured in the process of providing education by utilizing multiple senses to facilitate the effective reception of information (Jalambo et al., 2018). According to Edgar Dale, approximately 75% and 13% of learning experiences are acquired through the sense of sight (eyes) and hearing (ears) respectively, while the remaining 12% are learned through other senses (da Silva Lopes et al., 2021). Education solely by hearing increased the ability to remember by 20%, while the use of demonstration methods improved retention by 30% (De Villiers et al., 2016).

Moreover, knowledge was found to be influenced by the education levels of the respondents. According to a previous report, education tends to affect how pre-conception women receive and process information (Santoso et al., 2021). In this study, higher levels of education facilitated a better understanding of the information provided. The employment status was also found to affect the knowledge of the respondents (Rahmah et al., 2023). Working mothers often need more time to participate in educational and other information-gathering activities, resulting in inadequate access to information. On the other hand,

Table 3
Analysis of Differences in Knowledge, Self-Efficacy, and Hemoglobin Levels

Variable	Post-test (Mean±SD)	Δ	P-value
Knowledge			
Intervention ^a	76.88±9.27	30.63	0.000*
Control ^b	63.05±9.12	16.58	
Self-Efficacy			
Intervention ^a	78.28±4.64	9.15	0.000*
Control ^b	72.45±4.26	2.97	
Hemoglobin Levels ^c			
Intervention ^a	11.78±0.47	0.95	0.000*
Control ^b	11.02±0.49	0.07	

Note: ^a= 32 respondents; ^b= 35 respondents; ^c= in g/dL; *= significant with $p \leq 0.05$; SD= standard deviation; Δ= delta value.

homemakers are mostly occupied with household responsibilities, which might hinder their participation in various educational activities (Herliani & Yustiana, 2017).

To enhance pre-conception women's access to quality information, it is essential to use more varied media and receive strong support from health workers, especially midwives. This will ensure that education is not limited to a single activity but becomes a repetitive process, including mentoring activities. However, this study has limitations in measuring knowledge during each educational session, as post-test measurements were conducted only once at the end of the activity session.

Mentoring Program with Self-efficacy of Pre-conception Women

High self-efficacy encourages people to work hard and be optimistic about positive results or success (Putri et al., 2015). In contrast, people with low self-efficacy tend to show a pessimistic attitude and a lack of motivation, quickly giving up in difficult situations (Nuutila et al., 2021). According to previous studies, setting goals can foster greater commitment (Shafaei et al., 2020; Tramontt & Jaime, 2020).

After participating in the mentorship program, the self-efficacy of the respondents increased significantly compared to the control group. In the intervention group, 31 respondents

experienced increased self-efficacy, and one respondent had a persistent level. Meanwhile, the control group had eight respondents with reduced self-efficacy and three with persistent levels. According to (Shafaei et al., 2020), self-efficacy in mothers is influenced by factors such as performance achievement (previous experience), increased knowledge, and verbal persuasion from friends or family (Wiafe et al., 2022). The control group experienced increased self-efficacy due to the use of interventions through leaflet media (McFadden et al., 2021).

The results also showed that self-efficacy in the respondents was closely related to their levels of knowledge. In the intervention group, there was a significant increase in knowledge, resulting in higher self-efficacy than in the control group. Additionally, respondents in the intervention group had greater self-efficacy due to the assistance received from healthcare professionals. (Ghaffari et al., 2017). Mothers with higher awareness showed greater confidence in pregnancy preparedness than those with less knowledge (Girard & Olude, 2012). Levels of knowledge and understanding greatly determine a woman's confidence in preparing to conceive. This result was consistent with (Safitri et al., 2021), which showed differences in mothers' self-efficacy based on their knowledge levels. Aside from knowledge, various additional factors, such as relationship sup-

port and sociocultural influences, affect self-efficacy (Metwally et al., 2020). Successful experiences also play a crucial role in shaping mothers' self-efficacy, as they are based on real-life encounters (Goode et al., 2018).

In the intervention group, one 20-year-old respondent had persistent self-efficacy due to the age factor. Age plays a role in mothers' mental maturity, which in turn affects their psychological condition, hence, even though the respondent received the intervention, self-efficacy did not change. In the control group, eight and three respondents experienced decreased and persistent self-efficacy respectively. According to previous reports, self-efficacy is greatly influenced by support, from both family and health workers (Agampodi et al., 2019). There was no mentoring for the control group, hence, a reduction in the respondents' self-efficacy occurred due to their lack of confidence in managing eating behavior with the information obtained (Goetz et al., 2020; Rahmah et al., 2023).

Another crucial factor is the social modeling experienced by the respondents. According to a previous study, mothers tend to observe the success and experiences of family and friends in dealing with pregnancy as well as childbirth, which then become rooted in their way of thinking (Fealy et al., 2020). In addition, trust is usually undermined when economic factors create fear in mothers who may struggle to afford prenatal care and meet their child's needs (Wan-Lin et al., 2019).

It is important to emphasize the significance of social support for pre-conception women in making lifestyle behavior changes, especially eating patterns. This support not only includes providing informational guidance but also psychological support to bolster pre-conception women's confidence and self-efficacy as they prepare for the pregnancy period.

Assistance Program with Hemoglobin Levels of Pre-conception Women

The results showed that 30 respondents in the intervention group had increased hemoglobin levels, and two had persistent levels. In the control group, 14 respondents had decreased hemoglobin levels, while two had persistent levels.

According to a study conducted by (Sunuwar et al., 2019), one of the main reasons for nutrition issues is a lack of nutrition knowledge. This ignorance often leads to poor dietary choices and can result in several issues, including anemia (Kim et al., 2012). Nutrition coaching plays a crucial role in equipping pre-conception women with sufficient knowledge and motivation to make informed decisions about their health. Practical nutrition education can effectively address these issues depending on socioeconomic circumstances, eating patterns, and local food sources (Skolmowska et al., 2022; Yusoff et al., 2013).

Adolescents need nutrition education to comprehend the value of food and nutrition, as well as develop a preference for a healthy lifestyle (Dieny et al., 2019). However, changing ingrained patterns requires more effort, time, and a strong desire, such as healthy attitudes and practices (McLoughlin, 2020). The nutrition assistance program provided by midwives encouraged behavioral changes among the respondents, leading to an increase in hemoglobin levels (Wiafe et al., 2022). Nutrition education can assist pre-conception women in increasing their knowledge, attitudes, and appropriate practices to reduce the prevalence of anemia (Marfuah & Dyah Kusudaryati, 2016). A study conducted by (Kamalaja et al., 2018) also mentioned that nutrition education resulted in a significant increase in iron consumption among female teenagers by approximately 15.5 mg ($p < 0.001$).

Women of childbearing age often have low iron intake due to insufficient consumption of iron-rich sources (Khani Jeihooni et al., 2021). Meanwhile, iron is essential for growth, especially for young people, as it rapidly increases blood volume, muscle mass, and enzymes. Iron deficiency primarily affects the function of hemoglobin, the oxygen transporter required by numerous bodily metabolic processes (Christiany et al., 2021). Hemoglobin levels have been closely linked with children's learning capacity, hence, anemia conditions tend to reduce the ability to concentrate and learn effectively (De Villiers et al., 2016). In theory, dietary changes can help treat iron deficiency by improving food quality and enhancing iron bioavailability, as these are key factors contributing to anemia (Kamalaja et al., 2018). Additionally, the provision of funding for blood supplement pills as part of nutrition programs will encourage participants to consume more iron, thereby raising their hemoglobin levels (McLoughlin, 2020).

In this study, two respondents in the intervention group had persistent hemoglobin levels. This condition was due to the respondents' low education factor, which affected their levels of understanding in receiving information. Iron metabolism factors in the body can also affect hemoglobin levels (Mégier et al., 2022). Meanwhile, in the control group, 14 respondents experienced a decrease in hemoglobin levels, and two had persistent levels. This condition can be attributed to their employment status, which led to being underweight. According to previous reports, being underweight is often a consequence of excessive workload, increasing the risk of weight loss. Uncontrolled eating behavior and inadequate energy intake affect the availability of macronutrients in the body (Dieny et al., 2019). The body requires energy to facilitate physiological processes and aid the metabolism of nutrients involved in the

formation of hemoglobin. In pre-conception women with low energy availability, the activities of glycolytic enzymes such as hexokinase, pyruvate kinase, and glucose 6-phosphate dehydrogenase (G6PD) may be disrupted. This disruption can alter membrane permeability, leading to red blood cell breakdown (Grace & Glader, 2018). These results imply that pre-conception women who lack energy are more prone to iron deficiency, evident in their low hemoglobin levels.

The nutrition assistance program conducted by midwives in this study was used to educate the respondents on how to adjust their diet to meet specific needs, especially in preparation for pregnancy. Additionally, this program helped participants administer blood-supplement tablets, leading to a significant increase in hemoglobin levels of the intervention group compared to the control. In Ghana, a similar study demonstrated that nutrition education initiatives administered by companions or caregivers significantly increased children's food intake (Marquis et al., 2018). A randomized experiment that included dietary education reported an improvement in pregnant women's hemoglobin levels (Sunuwar et al., 2019). Adolescents who received nutrition instruction consumed more calories, protein, vitamin C, thiamine, and calcium in their diets (Nonguierma et al., 2022).

Based on the results, knowledge only cannot significantly cause changes in the eating behavior of pre-conception women. Mentoring also plays a crucial role in providing support for maternal dietary modifications. Therefore, changing behavior requires a combination of methods, and it is beneficial to provide additional resources such as leaflet media. It was also noted that not all pre-conception women who had good knowledge experienced changes in dietary behavior.

CONCLUSIONS

In conclusion, the nutrition assistance program in this study increased knowledge, self-efficacy, and hemoglobin levels in pre-conception women. The combination of interventions given to the treatment group, including educational activities, assistance with food management, and administration of iron supplement tablets for 8 weeks, proved effective in preparing pre-conception women to face pregnancy with a lower risk of anemia. However, this study has limitations in the post-test evaluation which was conducted only once rather than every week. Nutrition intake consumed by the respondents was also not evaluated, with more emphasis on the results of examining hemoglobin levels. Further studies are needed to assess the type of food intake before and after the intervention. The results of this study provide valuable insights for policymakers in the health sector, suggesting the importance of implementing comprehensive assistance programs for pre-conception women and families. These programs should go beyond merely providing education on dietary choices and extend to practical support and resources.

ACKNOWLEDGEMENT

The research team's gratitude goes to the Head of LPPM Megarezky University, who has helped implement this research, the respondents who have been involved in the mentoring program, health agencies that have supported it, and all parties who have helped so that part carried out this activity.

FUNDING

The article was supported by internal funding from the Megarezky University.

AUTHORS' CONTRIBUTIONS

Jumrah Sudirman designed the study, formulated the concept, and wrote the manuscript. Rosdianah Rosdianah collected data, analyzed the data. Qonita K. Anjani reviewed the manuscript. Karolus Wangi reviewed the manuscript, tested the manuscript-test similarity. Abdul M. Iskandar reviewed, edited, read and approved the final manuscript. Nurjannah Bachri validated and collected data.

AUTHORS' INFORMATION

Dr. Jumrah, S.ST.,M.Keb is an Assistant Professor in Department of Midwifery, Megarezky University, Makassar, Indonesia. Rosdianah., S.ST.,M.Keb is an Assistant Professor in Department of Midwifery, Megarezky University, Makassar, Indonesia. Qonita Anjani is a PhD Student School of Pharmacy, Queen's University Belfast, Medical Biology Centre, 97 Lisburn Road, Belfast BT9 7BL, UK. Karolus Wangi, MS, BSN, RN is a PhD Student, Ross and Carol Nese College of Nursing, Pennsylvania State University, University Park, USA. Abdul Malik Iskandar is an associate professor in Sociology Education, Megarezky University, Makassar, Indonesia. Nurjannah Bachri is an Assistant Professor in Department of Pharmacy, STIKES Tarumanegara, Jakarta, Indonesia.

COMPETING INTERESTS

The authors confirm that all of the text, figures, and tables in the submitted manuscript work are original work created by the authors and that there are no competing professional, financial, or personal interests from other parties.

REFERENCES

- Agampodi, T., Katumuluwa, S., Pattiyakumbura, T., Rankaduwa, N., Dissanayaka, T., & Agampodi, S. (2019). Feasibility of incorporating mindfulness-based mental health promotion to the pregnancy care program in Sri Lanka: A pilot study. *F1000Research*, 7, 1-15. <https://doi.org/10.12688/f1000research.17049.1>
- Aulya, Y., Siauta, J. A., & Nizmadilla, Y. (2022). Analisis Anemia pada Remaja Putri. *Jurnal Penelitian Perawat Profesional*, 4(4), 1377-1386. <https://doi.org/10.37287/jppp.v4i4.1259>
- Carfora, V., Caso, D., & Conner, M. (2017). Randomized controlled trial of a text messaging intervention for reducing processed meat consumption: The mediating roles of anticipated regret and intention. *Appetite*, 117, 152-160. <https://doi.org/10.1016/j.appet.2017.06.025>
- Christiany, I., Waluyo, K. O., & Muafiro, A. (2021). Peer Education, Nutritionist Education and Combination Education on Intake Nutrition and Iron (Fe) Against Changes of Hemoglobin in a Girls Adolescent Irine. *Health Notion*, 5 (7), 248-252. <http://heanoti.com/index.php/hn/article/view/hn50704>
- da Silva Lopes, K., Yamaji, N., Rahman, M. O., Suto, M., Takemoto, Y., Garcia-Casal, M. N., & Ota, E. (2021). Nutrition-specific interventions for preventing and controlling anemia throughout the life cycle: an overview of systematic reviews. *Cochrane Database of Systematic Reviews*, 2021(9). <https://doi.org/10.1002/14651858.CD013092.pub2>
- De Villiers, A., Steyn, N. P., Draper, C. E., Hill, J., Gwebushe, N., Lambert, E. V., & Lombard, C. (2016). Primary school children's nutrition knowledge, self-efficacy, and behavior, after a three-year healthy lifestyle intervention (HealthKick). *Ethnicity and Disease*, 26(2), 171-180. <https://doi.org/10.18865/ed.26.2.171>
- Dieny, F. F., Maadi, A. K., Wijayanti, H. S., Tsani, A. F. A., & Nissa, C. (2019). Asupan Zat Gizi Dan Kadar Hemoglobin Wanita Prakonsepsi Di Kabupaten Semarang. *Indonesian Journal of Human Nutrition*, 6(2), 70-83. <https://doi.org/10.21776/ub.ijhn.2019.006.02.2>
- Dinetti, A., Maryani, D., Purnama, Y., Asmariyah, A., & Dewiani, K. (2022). Hubungan Pola Menstruasi dengan Kejadi-

- an Anemia pada Remaja Putri di Wilayah Pesisir Kota Bengkulu. *Jurnal Surya Medika*, 8(3), 86-91. <https://doi.org/10.33084/jsm.v8i3.4503>
- Fealy, S., Attia, J., Leigh, L., Oldmeadow, C., Hazelton, M., Foureur, M., Collins, C. E., Smith, R., & Hure, A. (2020). Demographic and social-cognitive factors associated with gestational weight gain in an Australian pregnancy cohort. *Eating Behaviors*, 39, 101430. <https://doi.org/https://doi.org/10.1016/j.eatbeh.2020.101430>
- Ghaffari, M., Hatami, H., Rakhshanderou, S., & Karimi, H. (2017). Effectiveness of snack-centered nutrition education on promoting knowledge, attitude, and nutritional behaviors in elementary students. *International Journal of Pediatrics*, 5(12), 6495-6502. <https://doi.org/10.22038/ijp.2017.24531.2067>
- Girard, A. W., & Olude, O. (2012). Nutrition education and counseling provided during pregnancy: Effects on maternal, neonatal and child health outcomes. *Pediatric and Perinatal Epidemiology*, 26(SUPPL. 1), 191-204. <https://doi.org/10.1111/j.1365-3016.2012.01278.x>
- Goetz, M., Schiele, C., Müller, M., Matthies, L. M., Deutsch, T. M., Spano, C., Graf, J., Zipfel, S., Bauer, A., Brucker, S. Y., Wallwiener, M., & Wallwiener, S. (2020). Effects of a brief electronic mindfulness-based intervention on relieving prenatal depression and anxiety in hospitalized high-risk pregnant women: Exploratory pilot study. *Journal of Medical Internet Research*, 22(8). <https://doi.org/10.2196/17593>
- Goode, R. W., Kalarchian, M. A., Craighead, L., Conroy, M. B., Wallace, J. J., Eack, S. M., & Burke, L. E. (2018). The feasibility of a binge eating intervention in Black women with obesity. *Eating Behaviors*, 29, 83-90. <https://doi.org/10.1016/j.eatbeh.2018.03.005>
- Grace, R. F., & Glader, B. (2018). Red Blood Cell Enzyme Disorders. *Pediatric Clinics of North America*, 65(3), 579-595. <https://doi.org/10.1016/j.pcl.2018.02.005>
- Herliani, S., & Yustiana, I. (2016). Hubungan Status Pekerjaan dan Pendidikan dengan Pengetahuan Ibu Hamil Tentang Tanda Bahaya Kehamilan. *Jurnal Obstetrika Scientia Vol*, 4(1). <https://dx.doi.org/10.55171/obs.v4i1.165>
- Jalambo, M., Karim, N., Naser, I., & Sharif, R. (2018). Effects of iron supplementation and nutrition education on hemoglobin, ferritin, and oxidative stress in iron-deficient female adolescents in Palestine: Randomized control trial. *Eastern Mediterranean Health Journal*, 24(6), 560-568. <https://doi.org/10.26719/2018.24.6.560>
- Kamalaja, T., Prashanthi, M., & Rajeswari, K. (2018). Effectiveness of Health and Nutritional Education Intervention to Combat Anemia Problem among Adolescent Girls. *International Journal of Current Microbiology and Applied Sciences*, 7(09), 3152-3162. <https://doi.org/10.20546/ijemas.2018.709.393>
- Khani Jeihooni, A., Hoshyar, S., Afzali Harsini, P., & Rakhshani, T. (2021). The effect of nutrition education based on PRE-CEDE model on iron deficiency anemia among female students. *BMC Womens Health*, 21(1), 1-9. <https://doi.org/10.1186/s12905-021-01394-2>
- Kim, H. J., Mok, H. J., Hong, J. I., & NamGung, S. A. (2012). Effects of Custom Nutrition Education on Dietary Intakes and Clinical Parameters in Patients Diagnosed with Iron Deficiency Anemia. *Journal of the Korean Dietetic Association*, 18(1), 72-80. <https://doi.org/10.14373/jkda.2012.18.1.072>
- Kusnadi, F. N. (2021). Hubungan Tingkat Pengetahuan Tentang Anemia dengan Kejadian Anemia pada Remaja Putri. *Jurnal Medika Hutama*, 03(01), 1293-1298. <http://www.jurnalmedikahutama.com/index.php/JMH/article/view/266/181>
- Kye, S. Y., Hwang, S. Y., Oh, K. H., & Jun, J. K. (2019). Effects of a cancer prevention education program on elementary school student's knowledge, attitude, self-efficacy, and intentions in South Korea. *Epidemiology and Health*, 41, e2019027. <https://doi.org/10.4178/epih.e2019027>
- Lönnberg, G., Jonas, W., Unternaehrer, E., Bränström, R., Nissen, E., & Niemi, M. (2020). Effects of a mindfulness-based childbirth and parenting program on pregnant women's perceived stress and risk of perinatal depression-Results from a randomized controlled trial. *Journal of Affective Disorders*, 262(October 2019), 133-142. <https://doi.org/10.1016/j.jad.2019.10.048>
- Marfuah, D., & Dyah Kusudaryati, D. P. (2016). Efektifitas Edukasi Gizi Terhadap Perbaikan Asupan Zat Besi Pada Remaja Putri. *Profesi (Profesional Islam): Media Publikasi Penelitian*, 14(1), 5. <https://doi.org/10.26576/profesi.129>
- Marquis, G. S., Colecraft, E. K., Kanlisi, R., Aidam, B. A., Atuobi-Yeboah, A., Pinto, C., & Aryeetey, R. (2018). An agriculture nutrition intervention improved children's diet and growth in a randomized trial in Ghana. *Maternal and Child Nutrition*, 14(July), 1-10. <https://doi.org/10.1111/mcn.12677>
- McFadden, S. M., Ko, L. K., Shankar, M., Ibrahim, A., Berliner, D., Lin, J., Mohamed, F. B., Amsalu, F., Ali, A. A., Jang, S. H., & Winer, R. L. (2021). Development and evaluation of an online continuing education course to increase healthcare provider self-efficacy to make strong HPV vaccine recommendations to East African immigrant families. *Tumour virus research*, 11, 200214. <https://doi.org/10.1016/j.tvr.2021.200214>
- McLoughlin, G. (2020). Intermittent iron supplementation for reducing anemia and its associated impairments in adolescent and adult menstruating women. *International Journal of Evidence-Based Healthcare*, 18(2), 274-275. <https://doi.org/10.1097/XEB.0000000000000212>
- Mégier, C., Peoch, K., Puy, V., & Cordier, A. G. (2022). Iron Metabolism in Normal and Pathological Pregnancies and Fetal Consequences. *Metabolites*, 12(2). <https://doi.org/10.3390/metabo12020129>
- Metwally, A. M., Hanna, C., Galal, Y. S., Saleh, R. M., Ibrahim, N., & Labib, N. A. (2020). Impact of nutritional health education on knowledge and practices of mothers of anemic children in el othmanya village - Egypt. Open Access Macedonian Journal of Medical Sciences [revista en Internet] 2020 [acceso 10 de septiembre de 2021]; 8(2020): 458-. *Macedonian Journal of Medical Sciences*, 8(August 2018), 458-465. <https://oamjms.eu/index.php/mjms/article/view/4570/5047>
- Mustafa, A., & Maulidiana, A. R. (2019). The effectiveness of nutrition education about local specific food-based balanced nutrition recommendation on dietary intake level and anemia status in female adolescents at the hidayatullah arrohman Islamic boarding school malang. *KnE Life Sciences*, 23-31. <https://doi.org/10.18502/cls.v4i15.5730>
- Nonguierma, E., Lesco, E., Olak, R., Welch, H., Zar Alam, N., Bonyadi, J., & Hopkins, L. (2022). Improving Obesogenic Dietary Behaviors among Adolescents: A Systematic Review of Randomized Controlled Trials. *Nutrients*, 14(21), 4592. <https://doi.org/10.3390/nu14214592>
- Nuutila, K., Tapola, A., Tuominen, H., Molnár, G., & Niemivirta, M. (2021). Mutual relationships between the levels of and changes in interest, self-efficacy, and perceived difficulty

- during task engagement. *Learning and Individual Differences*, 92, 102090. <https://doi.org/10.1016/j.lindif.2021.102090>
- Prasitwattanaseree, P., Sinsuksai, N., Prasopkittikun, T., & Viwatwongkasem, C. (2019). Effectiveness of breastfeeding skills training and support program among first-time mothers: A randomized control trial. *Pacific Rim International Journal of Nursing Research*, 23(3), 258-270.
- Putri, V. P., Priyatama, A. N., & Karyanta, N. A. (2015). Hubungan antara Efikasi Diri dan Optimisme dengan Keterikatan pada Karyawan PT. Bank Tabungan Negara (Persero) Cabang Solo Relationship between Self-Efficacy and Optimism on The Employees of PT. Bank Tabungan Negara (Persero) Branch of Sol. *Jurnal Wacana*, 67-81. <https://jurnalwacana.psikologi.fk.uns.ac.id/index.php/wacana/article/download/77/77>
- Rahmah, A. A., Yani, D. I., Eriyani, T., & Rahayuwati, L. (2023). Hubungan Pendidikan Ibu Dan Keterpaparan Informasi Stunting Dengan Pengetahuan Ibu Tentang Stunting. *Journal of Nursing Care*, 6(1), 1-10.
- Rahmawati, R., Umar, S., & Meti. (2017). Hubungan Anemia Pada ibu Hamil dengan Kejadian Bayi Berat Lahir Rendah di Klinik Pratama Fatimah Medan. *Media Kebidanan*, 27-32.
- Sari, H. P., Subardjo, Y. P., & Zaki, I. (2019). Nutrition education, hemoglobin levels, and nutrition knowledge of adolescent girls in Banyumas district. *Jurnal Gizi Dan Dietetik Indonesia (Indonesian Journal of Nutrition and Dietetics)*, 6 (3), 107. [https://doi.org/10.21927/ijnd.2018.6\(3\).107-112](https://doi.org/10.21927/ijnd.2018.6(3).107-112)
- Safitri, R. W., Ningrum, E. W., & Suryani, R. L. (2021, November). Hubungan Tingkat Pengetahuan dengan Efikasi Diri Pemberian Kolostrum pada Ibu Hamil Trimester III di Puskesmas Purwokerto Selatan. In *Seminar Nasional Penelitian dan Pengabdian Kepada Masyarakat* (pp. 854-861). <https://prosiding.uhb.ac.id/index.php/SNPPKM/article/view/752>
- Seguin-Fowler, R. A., Hanson, K. L., Jilcott Pitts, S. B., Kolodinsky, J., Sitaker, M., Ammerman, A. S., Marshall, G. A., Belarmino, E. H., Garner, J. A., & Wang, W. (2021). Community supported agriculture plus nutrition education improves skills, self-efficacy, and eating behaviors among low-income caregivers but not their children: a randomized controlled trial. *International Journal of Behavioral Nutrition and Physical Activity*, 18(1), 1-19. <https://doi.org/10.1186/s12966-021-01168-x>
- Shafaei, F. S., Mirghafourvand, M., & Havizari, S. (2020). The effect of prenatal counseling on breastfeeding self-efficacy and frequency of breastfeeding problems in mothers with previous unsuccessful breastfeeding: A randomized controlled clinical trial. *BMC Womens Health*, 20(1), 1-10. <https://doi.org/10.1186/s12905-020-00947-1>
- Skolmowska, D., Głabaska, D., Kołota, A., & Guzek, D. (2022). Effectiveness of Dietary Interventions in Prevention and Treatment of Iron-Deficiency Anemia in Pregnant Women: A Systematic Review of Randomized Controlled Trials. *Nutrients*, 14(15), 1-15. <https://doi.org/10.3390/nu14153023>
- Sunuwar, D. R., Sangroula, R. K., Shakya, N. S., Yadav, R., Chaudhary, N. K., & Pradhan, P. M. S. (2019). Effect of nutrition education on hemoglobin level in pregnant women: A quasi-experimental study. *PLoS ONE*, 14(3), 1-12. <https://doi.org/10.1371/journal.pone.0213982>
- Tramontt, C. R., & Jaime, P. C. (2020). Improving knowledge, self-efficacy and collective efficacy regarding the Brazilian dietary guidelines in primary health care professionals: a community controlled trial. *BMC Family Practice*, 21(1), 1-9. <https://doi.org/10.1186/s12875-020-01245-3>
- Wan-Lin, P., Chang, C.-W., Shin-Ming, C., & Gau, M.-L. (2019). Assessing the effectiveness of mindfulness-based programs on mental health during pregnancy and early motherhood - a randomized control trial. *BMC Pregnancy and Childbirth*, 19. <http://dx.doi.org/10.1186/s12884-019-2503-4>
- Wiafe, M. A., Apprey, C., & Annan, R. A. (2022). Effectiveness of nutrition education and counseling program on iron deficiency anemia among adolescents: A study protocol of a randomized trial. *Nutrition and Health*, 28(3), 301-309. <https://doi.org/10.1177/02601060221074433>
- Yusoff, H., Wan Daud, W. N., & Ahmad, Z. (2013). Effectiveness of nutrition education vs. non-nutrition education intervention in improving awareness about iron deficiency among anemic adolescents. *Iranian Journal of Public Health*, 42 (5), 467-471. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3684454/>