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The Efficacy of Nutrition Education on Anemia and Upper Arm Circumference among Pregnant Women in Aceh Besar District of Indonesia during the Covid-19 Pandemic

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ABSTRACT

This study aimed to analyze the effects of nutrition education on anemia and upper arm circumference in pregnant women. It was a cluster-randomized control study involving 110 pregnant women. The nutrition education interventions, was a combination of offline and online sessions, conducted by trained Nutrition education staffs with a 1:5 ratio to pregnant women. Twelve education sessions were conducted for three months utilizing a nutrition booklet for pregnant women, food monitoring cards, and flyers shared on a social media WhatsApp group. The socio-demographic data were obtained through an interview method. The nutritional status collected, by measuring Mid Upper Arm Circumference (MUAC), and anemia was determined through a diagnosis by the family doctor. Data were analyzed using the chi-square test and the paired and independent t-tests, the confidence interval was set at 95%. Hemoglobin levels in the intervention group experienced a higher increase than in the control group. The MUAC in the intervention group increased by 0.8 cm while in the control group it was decreased by -2.7 cm. However, the Difference in Difference (DID) analysis did not show significant different for both parameters (p=0.198 and p=0.274). Chi square analysis showed that the prevalence of anemia at the end line point in the intervention group (3.6%) was significantly lower compared to the control group (14.5%) (p=0.047). The prevalence of the Chronic Energy Deficiency (CED) measured by MUAC decreased by 9% in the intervention group, and 1.8% in the control group. However, the difference in prevalence of CED was not statistically significant (p=0.696). The nutrition education within three months did not significantly increase the mean hemoglobin and MUAC. But considering the trend in decreasing anemia and CED prevalence in the intervention group, structured and routine nutrition education can be implemented as part of nutritional intervention in pregnant women to prevent anemia and CED to observe effects in a longer-term intervention.

Keywords: anemia, covid-19 pandemic, food monitoring card, nutrition education, pregnant woman

INTRODUCTION

The Covid-19 pandemic has disrupted various sectors, including health care. In Indonesia, SEMERU study showed that the Covid-19 pandemic has generally reduced the number of visits to nutrition, Maternal, and Child Health (MCH) services, changed the implementation of nutrition and MCH services, and influenced access to technology and the internet supports to monitor and consult about nutrition and MCH services (Saputri *et al.* 2020).

The Indonesia Basic Health Research Survey in 2018 reported that Chronic Energy Deficiency (CED) and anemia in pregnant women remain a big nutrition problem in Indonesia. One in three pregnant women suffers from anemia and the trend has been increasing overtime from

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24.5% to 37.10% and 48.9% in 2018 (MoH RI 2019). Study by Tanziha *et al.* also showed similar figure where 38.1% pregnant women in Indonesia suffer from anemia, 38.2% in urban and 37.9% in rural area (Tanziha *et al.* 2016). In addition to anemia, 17.3% of pregnant women in Indonesia suffer from CED (MoH RI 2019).

Malnutrition, including in pregnant women is associated with poor access to nutritious diets, poor access to essential nutrition services, feeding, and dietary practices (UNICEF 2020). The poor nutrition practices started before and continues throughout pregnancy, this includes insufficient intake of energy, nutritional consumption, and micronutrient intakes, such as iron, zinc, calcium, and folic acid (Mousa *et al.* 2019). The compliance of pregnant women in consuming >90 iron and folic acid tablets during pregnancy is low; the number were only 33.3% and 38.1% in 2013 and 2018 respectively (MoH RI 2019). Another risk factor is protein intake, 49.6% of pregnant women in urban areas and 55.7% of pregnant women in rural areas fulfilled only had 80% of the Recommended Dietary Allowance (RDA) for protein (MoH RI 2019).

Ahmad *et al.* (2020b) found that 14.3% pregnant women in Aceh Besar district suffer from malnutrition including wasting or severe wasting. Moreover, the CED prevalence was 12.7%; more than a third (35.7%) of pregnant women suffered from anemia (Hb 11 g/dl), and nearly a third (29.1%) never took iron tablets. Nutritional practices in pregnant women were not optimal because more than a third of pregnant women never consumed multivitamin supplementation during the pregnancy, and more than a third of pregnant women (39.2%) did not use iodized salt.

Pregnant women, in general, still require appropriate nutrition, thorough and detailed information about nutritional practices, and a balanced diet throughout pregnancy. During the Covid-19 pandemic, communications strategies for maternal nutrition programs focuses on consuming healthy and hygienic food and identifying innovative channels to support culturally appropriate messaging on a healthy meal, hygiene, and physical activities, such as social media, television, radio, digital platforms/ mobile phones, and woman needs (WFP/ UNICEF/Global Nutrition Cluster 2020). The joint nutrition statement for maternal, infant, and young child nutrition during the Covid-19 pandemic in Asia and Pacific regions aims to communicate accurate information on maternal, infant, and young child nutrition (FAO/UNICEF/ WFP/WHO *et al.* 2020).

Adapting to the Covid-19 pandemic, nutrition education requires combination of offline and online nutrition education method. Social media interventions was found to be positively associated with increasing physical activity levels, making healthy food choices, and affecting body composition or weight (Goodyear *et al.* 2021). Our preliminary study has developed a nutrition pocketbook for pregnant women as a medium for nutrition education for mothers, cadres, and health workers, and a food monitoring card for a pregnant woman (FMC-PW) that functions as a self-assessment tool to measure nutritional practices (Ahmad *et al.* 2019). The current study will further develop educational media for online platform, such as flyers. This online media will then be delivered through a combination of limited direct education and undirect education via telephone and WhatsApp. It is expected that the developed nutrition education, using the mix of offline and online strategies would increase adherence to iron and folic acid tablet and nutrients intake from daily food which will improve their nutritional status, especially anemia and CED. Therefore, this study aimed to analyze the effects of nutrition education on anemia and upper arm circumference in pregnant women.

METHODS

Design, location, and time

This study aimed to examine the effects of the nutritional education model on nutritional status and anemia in pregnant women, using a cluster randomized control trial design. The sampling method consisting of two stages: choosing a village as a cluster with criteria for the CED prevalence in pregnant women >10% and randomizing the cluster to be assigned as an intervention or control group. This study was conducted from October 2020 to March 2021 at Darul Imarah Public Health Center in Aceh Besar District. The location was chosen considering that pregnant women in this location had a high prevalence of CED and anemia. The preliminary study in the ares found that 12.7% of pregnant women had CED, 14.3% were undernourished before pregnancy, and 35.7 % had anemia.

Sampling

The research subjects were pregnant women in the first trimester at Darul Imarah Health Center Aceh Besar District. The inclusion criteria for the subject were pregnant women in the first and second trimesters with normal pregnancies. Meanwhile, the exclusion criterion was pregnant women with pregnancy complications based on the medical doctor's diagnosis.

The minimum sample size of the study was determined using the assumption of an error rate (α)=5% (Z=1.96) and power of the test (β)=90% (Zβ=1.28). The calculation of sample size employed the following formula (Lemeshow *et al.* 1990). Referring to the research results of Sunuwar *et al.* (2019) in Nepal that the variable of hemoglobin (Hb) levels increased by 0.56±0.40 g/dl in the education group and 0.16±0.82 g/dl in the control group. The minimum sample size was 114. Ethical approval was issued by the Health Research Ethics Commission of Universitas Sumatra Utara No.2251/IX/SP/2020 dated September 14, 2020.

Nutrition education intervention and follow up. The nutrition education in this study combined an offline and online strategies adapted to the Covid-19 pandemic where direct contact between health staffs and research subjects were limited. The nutrition education was followed by monitoring on food consumption (Table 1).

Nutrition education was delivered by combining direct and indirect techniques (offline and online) and utilizing mobile communication devices (cellphones) and WhatsApp. WhatsApp was used to deliver information and nutrition education, the nutrition booklet for pregnant women which has been developed in the previous research stages was used as a reading reference, and

Table 1. Educational model for monitoring food consumption in pregnant women

Nutrition education model	Implementation of nutrition education model
Educational form	Nutrition education is carried out by indirect methods, namely using phone call and social media applications
Key message (key massage)	1. Staple food (three Servings/day): Rice/bread/noodles/potatoes or other staple food 2. Animal side dishes (three servings/day): Fish/egg/shrimp/meat/chicken/duck/other animal side dishes 3. Vegetable side dish (three servings/day): Nuts/tofu/tempe or other preparations 4. Vegetables (three servings/day): Spinach, kale, katuk leaves, tomatoes, long beans, bean sprouts and others 5. Fruits (three Servings/day): Banana, papaya, mango, watermelon, avocado, *sawo*, guava, orange/other 6. Additional meals or snacks: Two times a day, such as; fruit juice one cup/porridge and two slices of cake or biscuit or staple food 100 g rice + one egg 7. Consumption of iron and folic acid supplement: one tablet daily 8. Drink enough water: At least eight glasses a day 9. Clean living behavior: Maintaining personal hygiene and washing hands with soap 10. Actively moving: Routine physical activity every day for at least 30 minutes until sweating/exercise for pregnant women
Message delivery method (delivery platform)	Community-based approach (community-base-platform) with interpersonal/counselling through ofline and online delivery platform
Number of educational sessions	Conducted as many as 12 sessions with a duration of 45 minutes/session for three months
Educational staff (facilitator)	Educational staff are nutritionists with a ratio of 1:5 (one nutritionist assists five pregnant women)
Tools and media	Food Card Monitoring Consumption for pregnant women (FMC-PW) as a tool for nutrition education, maternal nutrition pocket book as a supporting educational media (reading resources for pregnant women and educational staff)
Behavior change theory	Plan Behavior Theory

a food monitoring card (FMC-PW) was used as a self-assessment tool for daily nutrition practices.

The implementation was divided into three forms. First, the distribution of educational media and nutrition practice evaluation tools was carried out directly by trained nutrition education personnel and nutrition staff as field supervisors. In this activity, the team distributed nutrition booklet for pregnant women and FMC-PW and explained how to use them. Direct and face-to-face activities were only conducted at the beginning and the end of intervention activities by implementing health protocols (using masks, maintaining distance, and washing hands with soap or using hand sanitizers before and after direct contact with participants) by both pregnant women and the research team. Second, online nutrition education, namely delivery of key nutritional education messages, was made in flyers and shared on WhatsApp group, through several stages; the researcher sent the flyer to the supervisor then sent it to the educational staff's on the WhatsApp group. Each education staff sent the research target to the WhatsApp group, with a ratio of 1:5. Third, direct phone call in which education personnel provided education about the application of dietary practices based on FMC-PW and information based on the nutrition booklet for pregnant women and provide consultation for problems experienced by mothers.

The eleven nutrition staffs who have been trained before the intervention was supervised by the field supervisors who monitored the implementation of nutrition education in several stages: 1) Input monitoring was conducted on distribution and delivery of education packages in nutrition booklet for pregnant women, FMC-PW, flyers, and key messages via telephone; 2) Process monitoring evaluated pregnant women's compliance with FMC-PW; 3) Output monitoring referred to data collection results (Figure 1).

Data collection

The collected data included socio-demographic characteristics of pregnant women and families using a structured questionnaire, nutritional status with anthropometric measurements of MUAC using standardized measurement procedures (Tang *et al.* 2016) by trained nutritionist. The CED was categorized based on the MUAC <23.5 cm (MoH RI 2020), and anemia status by examining hemoglobin levels using the by Hemocue® by the Family Doctor. Blood sample was drawn using finger-prick capillary blood carried out and interpreted by trained laboratory personnel in the Community Health Center. Anemia is defined as a hemoglobin concentration level below 11.0 g/dl (WHO 2011).

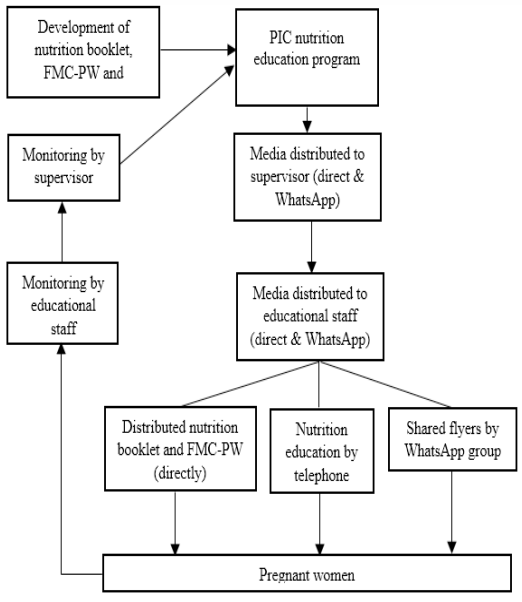
Data analysis

A univariate analysis was used to establish the mean, median, and standard deviation of the MUAC and hemoglobin level, as well as the percentage of anemia prevalence and the CED before and after the intervention. The impacts of the educational intervention were evaluated using an independent t-test for the different mean of the MUAC and hemoglobin and a different in proportion test. To control the confounding variables, the Difference in Difference (DID) test was also conducted. The chi-square test was used to examine the different in prevalence decreases in the CED and anemia. All tests were performed at 95% of confidence level (α=0.05).

RESULTS AND DISCUSSION

Characteristics and socio-demographic family of pregnant women

This study involved 110 pregnant women: 55 of them in the intervention group, and 55 in



FMC-PW: Food monitoring card for pregnant woman; PIC: Person in charge of nutrition education progran

Figure 1. Stages of the nutrition education process

the control group. The study was conducted in the Darul Imarah community health center in Aceh Besar district. The findings (Table 2) showed no significant difference in the socio-demographic characteristics of pregnant women, such as gestational age, education, occupation, family income, number of family members, number of children, and anthropometric status of the mother before pregnancy (p>0.05), only the occupation variable of husbands had significant

Table 2. Characteristics of pregnant women and socio-demographic family

Characteristics of subjects	Intervention group	Control group	p*
Trimester of pregnancy			
First trimester	16 (29.1)	19 (34.5)	0.683
Second trimester	39 (70.9)	36 (65.5)	
Mother's education			
Low (≤SD)	5 (9.1)	8 (14.5)	0.674
Middle/Junior high school	29 (52.7)	27 949.1)	
High (diploma/bachelor)	21 (38.2)	20 (36.4)	
Mother's work			
Housewife	46 (83.6)	45 (81.8)	0.801
Worker	9 (16.4)	10 (18.2)	
Husband's job			
Government	8 (14.5)	4 (7.3)	0.009**
Farmers & fishermen	0 (0.0)	4 (7.3)	
Merchants/entrepreneurs	31 (56.4)	19 (34.5)	
Labour/builder and others	16 (29.1)	28 (50.6)	
Husband's education			
Low (≤elementary school)	2 (3.6)	4 (7.3)	0.662
Middle/junior high school	36 (65.5)	33 (60.0)	
High (diploma/bachelor)	17 (30.9)	18 (32.7)	
Fixed family income (IDR)			
<Rp. 2.7 million	39 (79.1)	38 (69.1)	0.835
≥Rp 2.7 million	16 (29.1)	17 (30.9)	
Number of family members			
4 people	49 (89.1)	46 (83.6)	0.405
5 people	6 (10.9)	9 (16.4)	
Number of children			
Not yet	22 (40.0)	17 (30.9)	0.496
1–2 people	28 (50.9)	30 (54.5)	
3 people	5 (9.1)	8 (14.5)	
Anthropometric status before pregnancy (BMI)			
Wasting	8 (14.5)	6 (10.9)	0.449
Normal	33 (60.0)	29 (52.7)	
Overweight and obesity	14 (25.5)	20 (36.4)	

*: Chi-square test; BMI: Wasting BMI<18.5; Normal: 18.5–27.0; Overweight; BMI>27.0; ** p<0.05; IDR: Indonesian Rupiah

difference ($p<0.05$). This result indicated that the characteristics of the research subjects in the intervention and control groups were relatively similar. Therefore, the influence of the intervention was not expected to be affected.

The effect of nutrition education on pregnant women's anemia and nutritional status

The results (Table 3) indicated no significant difference in the mean of the Hemoglobin (Hb) level between the intervention and control groups in the baseline ($p=0.372$) and after the intervention or end line ($p=0.354$). However, the average increase in Hb levels in the intervention group was slightly higher (0.19 g/dl) than in the control group. After three months of nutrition education intervention, there were no significant effects of the nutrition education on hemoglobin levels (DID: 0.376; 95% CI:0.19–0.95). Similarly, the MUAC in the baseline and in the end line between both groups were also statistically not significant ($p>0.05$) and the MUAC DID analysis was also not significant (DID:1.127; 95% CI:-0.89–3.15). However, in the intervention group's mean MUAC increased by 0.84.00 cm, whereas in the control group it decreased by -2.784.14 cm but the difference was also not statistically significant ($p=0.150$).

However, the analysis of the anemia prevalence (Table 4) before and after the intervention indicated that pregnant women with anemia in the intervention group had decreased by 30.9%, from 34.5% (baseline) to 3.6% (end line). Meanwhile, the control group it decreased by only 16.4%, from 30.9% to 14.5%. In addition, chi square test showed higher chance for anemia in the control groups compared to the intervention group ($p<0.05$).

The findings showed the nutrition education utilizing a combination of offline and online strategies did not significantly increase the average hemoglobin and MUAC level, but significantly reduced the prevalence of anemia. Generally, pregnant women will experience a decrease in hemoglobin with increasing gestational age. The reason is, during pregnancy the blood volume will increase by up to 50 percent to provide important nutrients to the developing fetus. Then starting at eight weeks of gestation, blood plasma levels will be higher than red blood cells in pregnant women. Due to a decrease in the concentration of red blood cells in the blood. Study showed the decrease in hemoglobin during pregnancy is on the order of 1.4 g/dl or 11% of the first trimester level (Churchill *et al.* 2019).

Similar to those of Sunawar et al, our finding also shows that nutrition education interventions and a strict diet in iron sources could increase hemoglobin levels during pregnancy (Sunuwar *et al.* 2019). Another study found individual

Table 3. The effects of nutrition education on the mean of hemoglobin and MUAC in pregnant women before and after the intervention

Haemoglobin and MUAC	Intervention (Mean±SD)	Control (Mean±SD)	p*
Haemoglobin level			
Baseline	11.16±0.90	11.35±1.25	0.372
End line	12.14±0.96	11.95±1.16	0.354
Change	0.97±1.13	0.59±1.53	0.147
DID	0.376 (-0.19–0.95)		0.198
Mid upper arm circumference			
Baseline	26.31±3.41	27.38±3.38	0.100
End line	27.15±4.23	27.10±4.13	0.940
Change	0.8±4.00	-2.78±4.14	0.150
DID	1.127 (-0.89–3.15)		0.274

Independent t-test; Significant $p<0.05$; FMC-PW: Food Monitoring Card Consumption for pregnant women; MUAC: Mid Upper Arm Circumference; DID=Different in different in 95% confidence interval

Table 4. The effects of nutrition education on the anemia and chronic energy deficiency (CED) status in the pregnant mother before and after intervention ntion

Anaemia status and CED status	Intervention group	Control group	p*
Anaemia Status[1]			
Baseline			
Anemia	19 (34.5)	17 (30.9)	0.684
Normal	36 (65.5)	38 (69.1)	
End line			
Anemia	2 (3.6)	8 (14.5)	0.047**
Normal	53 (96.4)	47 (85.5)	
CED status[2]			
Baseline			
CED	8 (14.5)	5 (9.1)	0.376
Normal	47 (85.5)	50(90.9)	
End line			
CED	3 (5.5)	4 (7.3)	0.696
Normal	52 (94.5)	51 (92.7)	

*Chi-square test; [1]: Anemia if Hb<11.0 g/ dl; [2]: Using Mid Upper Arm Circuference (MUAC); CED: Chronic Energy Deficiency; **Statistical significance p<0.05

anemia education using a pictorial handbook in conjunction with a counseling intervention program improved hemoglobin and hematocrit levels in anemic pregnant women in their third trimester of pregnancy (Nahrisah 2020). Another study of nutrition intervention education based on the PRECEDE model positively improved iron deficiency anemia (Khani Jeihoon *et al.* 2021) and increased nutritional intake, gain weight, and hemoglobin levels (Soylu 2019).

Nutrition education during the pregnancy promotes maternal and child health, pregnancy outcomes, food intake, micronutrient supplements, and the use of nutrition safety nets (Girard & Olude 2012). Nahrisah *et al.* (2020) examined anemic pregnant women in Indonesia and showed that counseling using handbooks was useful to increase knowledge, maintain adequate nutritional intake, and prevent anemia, as described by the increasing hemoglobin and hematocrit levels.

The results of this study are almost similar to those of Ahmad *et al.* (2020a), researching in Aceh, Indonesia. He discovered that the nutrition education using a structured home visit method coupled with educational media in a pocketbook and an independent evaluation tool in a Food Monitoring Card (FMC) for children aged 6–23 months in undernourished toddlers could improve nutritional status and reduce the prevalence of anemia in undernourished children under five years old (Ahmad *et al.* 2020a).

A study in Southeast Sulawesi showed that nutrition education using Android-based application media improved knowledge, attitudes, and behavior of pregnant women with CED (Lestari *et al.* 2021). Pregnant women's knowledge, attitudes, and practices were improved when the nutrition and reproductive health education administered in small groups using interactive methods (Permatasari *et al.* 2021). Nutrition education is effective if the pregnant women follow the dietary requirements and the food guide pyramid (Khani Jeihoon *et al.* 2021). A systematic review by Chau *et al.* (2018) found that social media was a promising nutrition intervention platform for adolescents and young adults.

Others studies conducted in Purwokerto, Indonesia showed there is an increase in knowledge of nutrition, energy intake, and protein after social media-based nutrition education in rural and urban areas (Zaki *et al.* 2019). A study among young women in Pontianak showed that nutrition education on Facebook significantly increased knowledge of anemia, protein consumption, iron consumption, and vitamin C consumption among participants (Khotimah 2019).

A systematic review by Lroche *et al.* discovered that social media is possibly considered a possible means of communication to promote healthy lifestyle habits in organizations; however, several authors have recommended additional research into this technology to evaluate the incremental impacts of social media and promote healthy lifestyles (Laroche *et al.* 2020).

Some of the differences between this study and other studies are in the educational methods and strategies used. This study employed a hybrid learning approach, essentially a combination of constrained face-to-face education and education on social media. The nutrition pocketbook for pregnant women and the food monitoring card were used as self-assessment tools to assess daily nutrition practices. Meanwhile, online education was conducted by sharing nutritional information in the form of flyers on social media, such as WhatsApp, structurally and systematically.

The hybrid learning education method is most suitable applied during the pandemic, such as the current Covid-19 pandemic. It requires only limited direct contacts of individuals to prevent disease transmission. Therefore, the health services, particularly nutrition education can be accessed by pregnant women with less anxiety. Essentially, such strategy model can also be utilized in normal conditions in the future once the pandemic ends to optimize the restricted resources and costs. This can help increase the reach of educational materials through alternative communication means, such as social media. Despite its rigorous sampling and systematic approach in nutrition education, this research only involved limited populations, with a limited number of samples. The duration of the educational intervention was short for only three months, the number of direct sessions was only twice, and the remaining 12 sessions were conducted on the WhatsApp group. Consequently, the educational impacts on pregnancy outputs, such as Hb levels and MUAC might not be insufficient. Future research must improve the design of online education models, especially the frequency of message delivery, the length of intervention time, and a larger number of simples. Moreover, further research should improve the message content and delivery modes. It is suggested however that the District Health Office and related agencies necessarily change their policies of nutrition education strategies by combining face-to-face methods and using social media as a means of delivering nutrition education messages systematically and structurally to ensure sustainability.

CONCLUSION

Nutrition education did not significantly increase the mean hemoglobin and MUAC levels but reduced the prevalence of anemia in pregnant women in the intervention group. Thus, a structured education program for mothers during pregnancy can help improve the application of nutrition and health practices to prevent anemia and CED during pregnancy. The District Health Office and community health centers are expected to develop a structured educational model with a contextually appropriate and beneficial messages, strategies to harvest the benefit from the advent of information technology.

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DECLARATION OF INTERESTS

There was no conflict of interest among the authors.

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