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The Effect of Supplementary Feeding Program for Chronic Energy Deficiency Pregnant Women on Hb Concentration, MUAC, and Gestational Weight Gain in Indonesia

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ABSTRACT

Maternal and child health problems in Indonesia are alarming, such as mortality, chronic energy deficiency (CED) among pregnant women, low birth weight and stunting among infants. These problems can be addressed by taking early precautions during pregnancy. Supplementary feeding (PMT) program is available for CED pregnant women. This study aims to examine the effect of PMT program on pregnancy output. A total 211 of pregnant women in Parepare municipality were selected as study participants. The design of this study was cohort. This study compared between CED pregnant women who get PMT program and non-CED pregnant women who did not get PMT program. Both of these groups also obtained iron folic acid (IFA) tablets. The measurements of Hb were conducted in each trimester, while weight and mid-upper arm circumference (MUAC) twice. Determination of Hb used HemoCue (Hb201⁺ system). Weight measurement using *weight scale* owned by Community Health Centre. This study was conducted from March 2017 to May 2018. Results of anthropometric measurements, in both CED and non-CED groups, there was a significant changes from baseline to endline measurement ($p < 0.001$). Gestational weight gain in CED group (5.07 ± 1.56) was higher than that of non-CED (3.89 ± 1.75 , $p < 0.001$). Similarly in MUAC, CED group was higher (1.88 ± 0.93) than non-CED (1.41 ± 1.28 , $p = 0.01$). For haemoglobin, there is no difference in Hb between these groups in either on the 2nd measurement (-0.35 ± 1.63 vs -0.29 ± 1.68 , $p = 0.887$) or the 3rd measurement (-0.09 ± 1.45 vs -0.06 ± 1.98 , $p = 0.218$). This study shows PMT program impacts on weight and MUAC but not in Hb.

Keywords: food additives, pregnant women, chronic energy deficiency, anaemia

INTRODUCTION

Maternal and child mortality problems in Indonesia are extremely high. According to the IDHS in 2012, maternal mortality reached 359 per 100,000 live births and infant mortality 32 per 1,000 live births¹. In fact, maternal and infant mortality does not necessarily occurred if the nutritional problems in pregnant women can be resolved. Lack of nutrition during pregnancy can affect foetal nutritional status represented by the birth

weight that is not optimal². Low nutrient intake and poor nutritional status in pregnant women during pregnancy can lead to various adverse effects for the mother and baby³. One of the effects is a baby born with low birth weight (LBW). Retrospective cohort studies show that LBW is associated with the incidence of coronary heart disease, hypertension, and type 2 diabetes. The incidence of noncommunicable diseases is a result of failure of growth and development during foetal periods that are permanent to the structure, physiology, and metabolism of the body^{4,5}.

The infants born with LBW have an odds of suffering 35 times higher than those born with normal weight or above 2500 grams⁶. The occurrence of LBW is closely

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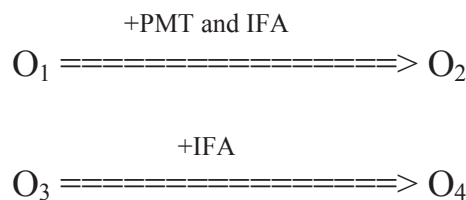
related to nutritional status of the mother. Nutritional status of pregnant women in both before and during pregnancy, can illustrate the availability of nutrients in the mother's body which will be used to support foetal growth. Predictors of maternal nutritional status during pregnancy can be done with measurements of MUAC and haemoglobin concentration⁷. MUAC measurement in pregnant women is associated with chronic energy deficiency (CED). CED is a problem that often occurs in pregnant women. CED below 23.5 cm should be treated to avoid complications to the foetus⁸. Underweight nutrition in pregnant women can cause maternal risks and complications, such as anaemia, bleeding and maternal weight not increasing normally and infectious diseases. Women with CED will likely to deliver LBW baby⁹.

Thus, CED pregnant women also likely to have anaemia and will be at risk of giving birth to LBW babies¹⁰. In Parepare municipality in 2015, the prevalence of pregnant women reached 48,6 %, while in 2016 the number of LBW babies was 6.08%. At the same year, the number of CED pregnant women were 281 and increased to be 422 in 2017. Since then, the government has been promoting the National Food Supplement (PMT) program for CED pregnant women. The purpose of this program is encourage pregnant women and their foetus meet their nutritional needs. However, this PMT program seems to be less effective, because the prevalence of anaemia in Parepare is still very high, even exceeding the national prevalence of 48.6 %¹¹. This PMT program not only contains macronutrient but also multi-micronutrients. It is because that nutrition problem among pregnant mother is not only related to chronic energy deficiency but also micronutrient deficiencies. This study aimed to investigate the effects of PMT program on pregnancy output of pregnant women in Parepare municipality.

MATERIAL AND METHOD

The design of this study was a cohort to see the outcome of the existing PMT program in Parepare. This study compared between CED pregnant women group who are getting PMT program (in the form of biscuits) and non-CED program who did not get the PMT (**Figure 1**). However, in this group, iron folic acid (IFA) supplement was provided for both groups. The cut-

off point for determining CED is MUAC which below 23.5 cm. The study participants criteria were maximum 16 weeks, without pre-eclampsia diagnosis. The number of samples in this study was 211 pregnant women.



Information:

- O₁ = CED group before giving supplementation program
- O₂ = CED group after supplementation program
- O₃ = Non-CED group before giving supplementation program
- O₄ = Non-CED group after provision of supplementation program

Figure 1. Supplementary feeding scheme

The variables measured include the characteristics of pregnant women, namely age, education level, work status, and income; previous pregnancy history, gravida, para, and abortus; consumption of IFA; haemoglobin (Hb) concentration; and anthropometry that includes gestational weight gain and mid-upper arm circumference (MUAC). Age at risk is pregnant women with age <20 years and > 35 years. The enumerators have received training before data collection. The enumerators were recruited from local nurses and nutritionist.

Haemoglobin measurement were performed three times (each trimester), while weight and MUAC were twice. The measurement for Hb used Hemocue (Hb 201+ systems). Weight was measured by using weight scales from Community Health Center (Puskesmas), while MUCA by using MUAC tape issued by Indonesian Ministry of Health. The measuring instruments were standardized to all Puskesmas in Parepare municipality. This study was conducted from March 2017 to May 2018 at six Puskesmas in Parepare municipality.

RESULTS

Table 1. Study participant characteristics

Variables	CED pregnant women n=49	Non-CED pregnant women n=162	Total N=211	p
Age				
At risk	11 (24.4)	34 (75.6)	45 (100)	0.827
Not risk	38 (22.9)	128 (77.1)	166 (100)	
Education level				
Low	14 (21.5)	51 (78.5)	65 (100)	0.699
High	35 (24.0)	111 (76.0)	146 (100)	
Occupation status				
Unemployed	34 (21.7)	123 (78.3)	157 (100)	0.358
Employed	15 (27.8)	39 (72.2)	54 (100)	
Income				
<Regional minimum wage	40 (25.0)	120 (75.0)	160 (100)	0.279
>=Regional minimum wage	9 (17.6)	42 (82.4)	51 (100)	
Gravida	1.84±0.99	2.67±1.34	2.48±1.31	0.000*
Parity	0.78±0.96	1.44±1.18	1.28±1.17	0.000*
Abortus	0.16±0.37	0.26±0.49	0.24±0.47	0.265*
IFA consumption	50.41±29.83	62.46±31.33	59.66±31.34	0.025*
PMT consumption	76.78±86.35			

p= Chi-Square Test; *=Mann-Whitney U Test

The characteristics of pregnant women can be seen in **Table 1**. There are three variables significantly different between CED and non-CED groups, namely gravida, parity, and the amount of IFA consumption ($p < 0.05$). IFA consumption, more in CED group than non-CED (62.46 vs 50.41 capsules).

Table 2. The measurements of study participant

Variable	1 st Measurement	2 nd Measurement	△ (Changes)	p ¹
Gestational Weight				
CED	44.67±6.45	49.75±5.98	5.07±1.56	<0.001
Non-CED	54.57±8.68	58.46±8.78	3.89±1.75	<0.001
p ²	<0.001	<0.001	<0.001	
MUAC				
CED	21.83±1.44	23.71±1.07	1.88±0.93	<0.001
Non-CED	26.60±2.62	28.01±2.66	1.41±1.28	<0.001
p ²	<0.001	<0.001	0.01	

p¹= Wilcoxon Signed Rank Test; p²= Mann-Whitney U Test

In **Table 2**, showing the results of anthropometric measurements (gestational weight and MUAC) during pregnancy. In both CED and non-CED groups, there was a significant difference between the 1st measurement and 2nd measurement ($p < 0.001$). Gestational weight in CED group was higher than those non-CED (5.07 ± 1.56 vs. 3.89 ± 1.75 , $p < 0.001$). Likewise, an increase in CED groups was greater than non-CED (1.88 ± 0.93 vs 1.41 ± 1.28 , $p = 0.01$).

Table 3. The changes of Hb concentration

Variable	Hb1	Hb2	Hb3	Δ Hb1-Hb2	Δ Hb1-Hb3	Δ Hb2-Hb3	p1	p2	p3
CED	11.22±1.56	10.87±1.27	10.96±1.10	-0.35±1.63	-0.26±1.74	-0.09±1.45	0.103	0.501	0.295
Non-CED	11.63±1.39	11.34±1.38	11.27±1.81	-0.29±1.68	-0.35±2.29	-0.06±1.98	0.019	0.001	0.468
p4	0.036	0.012	0.145	0.887	0.332	0.218			

$p^{1,2,3}$ = Wilcoxon Signed Rank Test; p^4 = Mann-Whitney U Test; *Independent T-Test

p^1 = Hb1-Hb2; p^2 = Hb1-Hb3; p^3 = Hb2-Hb3

The change of Hb concentration is shown in **Table 3**. Although it was not statistically significant, CED groups showed a lower decline from 1st to 3rd measurement (-0.26 ± 1.74 vs. -0.35 ± 2.29), as well as 2nd to 3rd measurements (-0.09 ± 1.45 vs. -0.06 ± 1.98).

Table 4. Multivariate analysis of gestational weight gain

Variable	Coefficient Beta	t	95% CI	p
Age	-0.077	-3.314	-0.124 to -0.031	0.001
Gravida	0.473	0.786	-0.714 to 1.660	0.433
Parity	-0.519	-0.872	-1.693 to 0.655	0.384
Abortus	-0.473	-0.760	-1.698 to 0.753	0.448
IFA consumption	0.002	0.424	-0.006 to 0.009	0.672
R ²	0.081			

In **Table 4**, it can be seen that only maternal age contributes to gestational weight gain during pregnancy ($p = 0.001$). However, the value of R² was merely 0.081 which means that only about 8.1% of gestational weight gain can be explained by this model.

Table 5. Multivariate analysis of MUAC changes

Variable	Coefficient Beta	t	95% CI	p
Age	-0.007	-0.398	-0.040 to 0.027	0.691
Gravida	-0.154	-0.761	-0.552 to 0.245	0.448
Parity	0.203	0.477	-0.637 to 1.044	0.634
Abortus	-0.311	-0.738	-1.141 to 0.520	0.462
IFA consumption	-0.118	-0.269	-0.986 to 0.749	0.788
R ²	0.033			

The result of multivariate analysis in **Table 5** shows there was no variables that statistically significant to the changes of pregnant women MUAC ($p > 0.05$). It can be seen that the R^2 value was 0.033 which means that only 3.3% of MUAC changes are explained by the model.

DISCUSSION

The main findings of this study were the better gestational weight gain and MUAC changes in CED group who received PMT and IFA compared to non-CED who only received IFA ($p < 0.001$). Factors that affect maternal weight gain during pregnancy are nutritional status before pregnancy¹² Indian Journal of Public Health Research and Development. All rights reserved. Pregnancy is the most critical period of growth and development change. Low and high birth weight infant would be having in the future the risk of many health problems. Adequate gestational weight gain (GWG and dietary intake during pregnancy¹³ 26% gained suboptimal and 34% excessive weight during pregnancy. Women in late pregnancy with at least optimal, compared with women with suboptimal, weight gain were eating more (OR = 3.32, confidence interval (CI. One of the purposes of PMT program for pregnant women is to fulfil the nutritional needs during pregnancy. The results of the study conducted in Karawang regency showed that PMT program successfully lowered CED among pregnant women¹⁴. Gestational weight gain and MUAC changes are likely to occur because of the intake of pregnant women's macronutrients can be met. If looking at the nutritional content of the biscuit PMT, the macronutrients and micronutrients are high. For each packaging (5 pieces), it contains 500 kcals, 53 grams of carbohydrates, 15 grams of protein, 25 grams of fat, and 11 types of vitamin and 7 types of mineral⁸. Thus, this program can contribute in improving the nutritional status of pregnant women.

The other important finding that there was no significant changes for Haemoglobin, among the changes from 1st to 2nd measurement, 1st to 3rd measurement, and 2nd to 3rd measurement, between CED and non-CED pregnant women. It means that in addressing anaemia among CED pregnant women, IFA tablets would be enough. Whereas in non-CED pregnant women, the consumption of IFA tablets was significantly higher than those CED ($p = 0.025$). The similar result between CED and non-CED might be due to the multi-micronutrients containing in PMT improving CED Hb and matching to

non-CED Hb concentration. Besides, there are several factors that cause no impact on Hb levels, one of which is adherence to consuming Fe tablets. In a study, there was a significant relationship between adherence to TTD consumption and the incidence of anaemia in pregnant women¹⁵ the capital city of Nepal, has considerably high prevalence of anemia, which is attributed to inadequate dietary iron and problems of compliance to iron and folic acid supplementation. Objective This descriptive study aimed to identify the levels of and determinants associated with compliance regarding Iron and folic acid supplementation among pregnant women in Kathmandu, Nepal. Method The study was conducted in Paropakar Maternity and Women's Hospital in Kathmandu. Systematic random sampling was done to select a total of 406 samples that were either handed questionnaire for self-administration or interviewed. The χ^2 test and multiple linear regressions were used for statistical analysis. Result The findings showed 73.2% of the respondents had high compliance, 12.8% moderate compliance, and 14% low compliance to iron and folic acid supplementation. More than half of the respondents had insufficient knowledge regarding anemia, iron deficiency and iron and folic acid supplementation. Multiple linear regression revealed that perceived severity, perceived barriers and social support were determinants of compliance to iron and folic acid supplementation ($p < 0.05$ and and birth weight of infant¹⁶. Hb concentration in early pregnancy have a positive correlation or a determinant of the final Hb rate¹⁷. Thus, if anaemic mothers do not improve their Hb concentrations earlier during pregnancy, it will then negatively impact to the outcome of pregnancy.

Another possibility is that as the gestational age increases, oxidative stress results in problems during pregnancy¹⁸. However, it can be prevented by the provision of MMN as found in the PMT program. Previous study showed the greater effect of MMN on Hb concentration compared to only IFA tablets¹⁹ South Sulawesi Indonesia from June to December 2012. The subjects were 70 pregnant women with anemia were randomly allocated into two equal groups. The first group ($n = 35$). Even not only Hb concentration, another study showed that MMN gave positive effect on the prevention of DNA damage among pregnant women, although the rich of micronutrients come from Moringa oleifera extract²⁰. In addition, a study also showed the micronutrient content in moringa can prevent the

decrease of Hb concentration in those who are anaemic but not in non-anaemic pregnant¹⁷.

It can be concluded that Hb concentration of pregnant women in this study was not influenced by the consumption level of IFA tablets because of the low number of tablets consumed by the mother during pregnancy. The average IFA consumption ranged from 50 tablets for CED and 62 tablets for non-CED pregnant women, whereas the amount of IFA tablets given were 90 tablets. Basic Health Research results show that only about 30% of pregnant women consumed all of the given IFA tablets²¹.

CONCLUSION

This study shows the significant impact of the program on gestational weight gain and MUAC. Although it was not significant, but Hb concentration among CED who received PMT could be on the same concentration with non-CED pregnant women. It can be concluded that the PMT program is effective to prevent nutrition problem in macro and micronutrient problems. It needs to conduct an efficacy study to examine the effect of PMT biscuits on nutritional problems among pregnant women.

Ethical Clearance: This study has obtained ethical approval from the Ethics Committee of the Faculty of Medicine, Hasanuddin University in 2017 with the protocol number UH17030143. Each respondent who was recruited were asked for approval through the informed consent form.

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Conflict of Interest : No conflict of interest during this study.

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