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# Efficacy Of Eel Cookies On Improving Nutritional Status Of Pregnant Women With Chronic Energy Defifiency

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## ABSTRACT

A high prevalence chronic energy deficiency (CED) in pregnant women exist in Indonesia, which approximately 16.2%. The government had made various efforts to eliminate CED in pregnant women. Therefore, our study aimed to analyze the efficacy of eel cookies on improving nutritional status of pregnant women with CED risk. An experiment with a pre-post design of 36 pregnant women with risk of CED in Ciletuh, Sukabumi was carried out for 30 days. Pregnant women in intervention group were given eel cookies, while control group were given cookies without eel. At the beginning and end of the study, MUAC were measured and food intake was assessed through a 24 hour recall. The research data was analysed using t-test, Mann-Whitney test and chi square. Significant difference in body weight between intervention and control groups was not found ($p > 0.05$). The mean bodyweight in intervention group after intervention (48.5) was higher than in control group (48.3). The Mean bodyweight and MUAC in the two groups before and after intervention also did not show a significant difference ($p> 0.05$). The risk of CED in pregnant women who received eel cookies were lower compared to the control group. Consumption of eel cookies can reduce CED risk in pregnant women by 35%, while cookies without eel only reduce the risk by 29.4%. Eel cookies had higher efficacy compared to cookies without eel on reducing CED risk in pregnant women.

**Keywords: Pregnant Women; Eel Cookies;Risk of Energy Chronic Deficiency;Nutritional Status**

## INTRODUCTION

Chronic energy deficiency (CED) in pregnancy were one of the malnutrition issues during pregnancy which directly affect the mother, the fetus, the puerperium period, and the born baby (Worttesley et al, 2016). Malnutrition during pregnancy has undoubtedly led to stunted fetal growth, low birth weight, and fetal and maternal mortality (Black et al, 2013; Bhuta et al, 2013; Victora et al, 2012). Pregnant women with CED were characterized by various indicators, one of which is the Measurement of Upper Arm Circumference (MUAC) <23.5 cm.

Efforts have been made by the government through the Health Ministry of the Republic of Indonesia to provide ready-to-use supplementary food (RUTF) for pregnant women with CED (Kemenkes, 2012). RUTF was given in the form of sandwich biscuits which contained 270 kcal of energy, 6 gram of protein, and 12 gram of fat. As much as 60 gram biscuits consumed daily by pregnant women with CED for 90 days. The

achievement rate of RUTF target in 2016 was 79.1%, this percentage is greater than the target set by the Ministry of Health, which is 50% (Ministry of Health, 2017). However, the RUTF program has not been able to reduce the incidence of CED in pregnant women. The prevalence of pregnant women with CED in 2016 was higher (16.6%) than in 2015 (13.3%). Increased prevalence of CED in pregnancy showed that nutritional problems in pregnancy need a preventive intervention (Ministry of Health, 2015). Additionally, the amount of energy and protein adequacy in pregnant women is still far from the Nutrient Adequacy Ratio (NAR) for pregnant women.

The results of a preliminary study conducted in Ciwaru Village, Ciemas Subdistrict, Sukabumi District, on 39 pregnant women indicated that 28/39 or 71.8% of them had nutritional problems such as anemia and CED. It is necessary to develop the diversification of RTFU types for pregnant women with CED as an effort to improve the nutritional status of pregnant women.

Several studies have shown that adequate supplementary food for pregnant women can overcome malnutrition problems in pregnancy (Pastuty et al, 2018; Hernawati and Kartika, 2018). A study conducted in Mali has met energy, protein, fat and fiber requirements of malnourished pregnant women by providing RUTF (Bechman et al, 2015). The RUTF contents included beans, millet, barley koji (containing a-amylase and other ingredients).

Large amount of marine products available in Indonesia, such as eel. Eel could be found easily in the Sukabumi Districts and could be a source of animal protein which rich in amino acids and fats that are good for health (Nafsiyah et al, 2018). Eel is a food source that has a high nutrient content (Widyasari et al, 2014). This study conducted in the beach area of Sukabumi District, which had eel as a local food. Eel flour could be used to make eel cookies to increase food intake and improve nutritional status in pregnant women with CED (Fahmi et al, 2010; Giango, 2016).

The basic ingredients of the eel cookies was flour of eel bone as a source of protein and fat and corn flour as a source of carbohydrates (Istinganah et al, 2016). Aside from being a source of carbohydrates, the corn flour also has a high provitamin A and fiber that can be used as ingredient for making cookies (Hardiyanti et al, 2016). Eel cookies were expected to be an alternative supplementary food which could be used in the RUTF program for pregnant women with CED. This study aimed to analyze the efficacy of eel cookies on improving nutritional status (MUAC) in pregnant women with CED risk.

## METHOD

The design of this study was experimental with a pre-post test group. This study was a pilot study and had received ethical clearance from the Ethics Committee of Medicine Faculty of Padjadjaran University No.106/UN6.C.10/ PN.2017.

The research was conducted for 30 days in Ciletuh Geopark, Sukabumi District, which included 3 subdistricts, Ciemas Subdistrict, Tamanjaya Subdistrict and Ciracap Subdistrict. The inclusion criteria were pregnant women with 13-24 weeks of gestation; pregnant women with MUAC less than 23.5 cm; willing to participate in the study for 30 days. The exclusion criteria included pregnant women with infectious diseases and metabolic disorders such as tuberculosis, malaria, diabetes mellitus based on the physician's diagnosis and multiple pregnancies. The subject who were not eating the cookies as recommended, moving out from the Subdistricts, as well as ill and hospitalized were considered dropping out of the study.

Sampling is done by simple random sampling with total sample of 36 pregnant women, which divided into 2 groups. The intervention group who received eel cookies

and the control group who received cookies without eel whose formula was made by the research team. The control group did not receive cookies from the Ministry of Health, because the energy content was not equivalent to eel cookies.

The nutritional content of eel cookies per 100 grams was 505 calories of energy, 34.96 grams of fat, and 15.7 grams of protein. The cookies without eel contain 500 calories of energy, 39 grams of fat, and 9.4 grams of protein. Eel cookies and cookies without eel had undergone several testing, including quality testing, proximate testing, metal contamination and microbiology testing at the Indo Genetech Saraswanti Laboratory and had fulfilled SNI 2973-2011. Both cookies were given 100 grams daily for 30 days to the pregnant women in each group.

The independent variable of the study was eel cookies, and the dependent variables include the nutritional status and CED risk of the subjects while the confounding variables were age, food intake and gestational age. The data was collected at the beginning and end of the study. At the beginning, anthropometric measurements, such as bodyheight, bodyweight and MUAC as well as medical check up by midwives at the local health center were performed in both groups.

The food intake was measured using simple 24-hour recall method which was carried out by the nutritionist from the local health center. The assessment results were analyzed using Nutrisurvey 2007. The compliance in eating the cookies monitored by 6 cadres every day using a monitoring form. Each cadres monitored 6 subjects. The average consumption of the cookies in both groups was 20 pieces/day or approximately 90% of the intended ration. At the end of the study, bodyweight and MUAC measurement, as well as assessment of nutritional intake were done by local health center staff.

Univariate analysis was performed to assess the characteristics of the subjects in both groups. Analysis of homogeneity or equality of both groups for the categorical data was using Chi square test, while the numerical data was using unpaired t-test (if the data were normally distributed) or Mann-Whitney test (if the data were not normally distributed). Bivariate analysis was carried out to determine the effect of eel cookies and cookies without eel consumption to MUAC changes in pregnant women. Differential test for the MUAC changes between groups was performed using the t test after the data normality test. Additionally, analysis to determine effectiveness of eel cookies and cookies without eel in increasing MUAC in pregnant women with CED was also carried out.

## RESULTS AND DISCUSSION

Table 1 showed that the age, education, occupation and gestational age of the subjects in the intervention and control groups were homogenous (p> 0.05).

**Table 1. Respondents' Characteristics**

| Characteristics | Intervention (n =18) | Control (n =18) | p value |
|---|---|---|---|
| **Age** | | | |
| < 20 y.o. | 6 | 10 | 0,917* |
| 21- 35 y.o. | 11 | 7 | |
| >35 y.o. | 1 | 1 | |
| **Education** | | | |
| Elementary school | 6 | 5 | 0,233** |
| Middle School | 7 | 9 | |
| High School | 4 | 4 | |
| College/ University | 1 | 0 | |
| **Occupation** | | | |
| Employed | 1 | | 0,387** |
| Unemployed | 17 | 18 | |
| **Gestational Age** | | | |
| 13 – 16 weeks | 9 | 2 | |
| 17 – 20 weeks | 5 | 2 | 0,301* |
| 21 – 24 weeks | 4 | 14 | |

*T-Test

Analysis of energy intake unable to show a significant difference of energy intake at the end of the intervention. The energy intake in both groups were homogeneous. Energy intake from both cookies showed no significant difference (p> 0.05). The mean difference in improvement of energy intake at the beginning and end of the intervention in both groups showed a significant difference (p = 0.035). The mean difference in improvement of energy intake in the intervention group was higher than in the control group, which were 9.3 and -2.22 respectively. These results indicate that the energy intake from the cookies at the end of the intervention is related to the daily energy intake ratio of pregnant women.

**Table 2. Comparison of Energy Intake in Intervention and Control Group**

| Energy (%) | Group | | |
|---|---|---|---|
| | Intervention | Control | p value |
| Pre | | | |
| Mean± (SD) | 50,5 ± (9,2) | 54,22 ± (18,2) | 0,446* |
| Post | | | |
| Mean± (SD) | 59,89 ± (15,5) | 56,44 ± (17,5) | 0,536* |
| p value | 0,000** | 0,000** | |
| Mean difference± (SD) | 9,3 ± (13,7) | -2,22 ± (17,7) | 0,035* |

*Paired T-test

Protein intake in both groups were homogeneous. Difference in protein intake from the cookies at the end of the intervention in both groups was insignificant (p> 0.05). The mean difference in protein intake at the beginning and end of the intervention in both groups also did not show a significant difference (p = 0.692). This proves that the intake of protein from the cookies was not related and did not have significance with the daily protein intake of pregnant women.

**Table 3. Comparison of Protein Intake in Intervention and Control Group**

| Protein (%) | Intervention | Control | P value |
|---|---|---|---|
| Pre | | | |
| Mean ± ( SD) | 84,17±(36,61) | 94,94 ±(56,05) | 0,449* |
| Post | | | |
| Mean ± ( SD) | 79,89 (35,16) | 78,50± (27,2) | 0,895 * |
| p value | 0,619** | 0,185** | |
| Mean difference± (SD) | -4,28 ±( 35,82) | -16,44±(50,48) | 0,692* |

*T-Test **Paired T-Test

Bodyweight changes in both groups were not significant (p>0.05). However, the mean increase of bodyweight in intervention group was higher than the control group, 4.5kg and 4.14kg respectively. The mean difference in bodyweight changes at the beginning and end of the intervention in both groups also indicate insignificant difference (p = 0.673).

**Table 4. Comparison of Bodyweight Changes in Intervention and Control Group**

| BW (Kg) | Group | | |
|---|---|---|---|
| | Intervention | Control | p value |
| Pre | | | |
| Mean±(SD) | 44 ± (5,5) | 44,16 ± (5,6) | 0,976* |
| Median | 43,5 | 44,5 | |
| Range | 34 – 53 | 34 - 56 | |
| Post | | | |
| Mean±(SD) | 48,5 ± (4,6) | 48,3 ± (6,8) | 0,955* |
| Median | 47,5 | 49,7 | |
| Range | 40,7 – 56 | 36 – 60,4 | |
| p value | 0,000** | 0,000** | |
| Mean difference±(SD) | 3,9 ± (1,5) | 4 ± (1,6) | 0,673*** |
| Median | 3 | 4 | |
| Range | 0 – 6,2 | 0 - 7 | |

*T test **Paired T-test *** Mann-Whitney Test

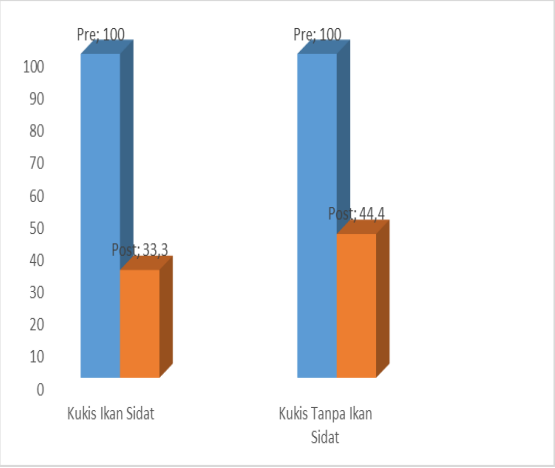
MUAC changes in both groups were not significant. (p>0.05). The mean difference of MUAC at the beginning and end of the intervention in both groups also showed insignificant difference (p=0.569).

**Table 5. Comparison of MUAC Changes in Intervention and Control Groups**

| MUAC (cm) | Group | | |
|---|---|---|---|
| | **Intervention** | **Control** | **p value** |
| **Pre** | | | |
| **Mean±(SD)** | 21,88 ± (1,17) | 21,73 ± (1,6) | 0,601*** |
| **Median** | 22 | 22 | |
| **Range** | 19 – 23 | 20 - 23 | |
| **Post** | | | |
| **Mean±(SD)** | 23,2 ± (1,3) | 23,3,3 ± (1,7) | 0,751* |
| **Median** | 23,7 | 23,5 | |
| **Range** | 20 – 26 | 20 - 28 | |
| **p value** | 0,000* | 0,000** | |
| **Mean Difference± (SD)** | 1,3 ± (1) | 1,6 ± (1,2) | 0,569** |
| **Median** | 1 | 1,7 | |
| **Range** | 0 – 3,3 | - 5 | |

*Paired t test *** *Mann Whitney*

Reduction of CED risk in pregnant women who received eel cookies was higher compared to pregnant women who received cookies without eel. Lower CED risk in intervention group was seen, which was 33.3 % compared to 44.4% in control group.




**Picture 1. CED Risk Prevalence Graph Before and After Intervention**

The prevalence of CED risk reduction in pregnant women who consumed eel cookies was higher than those who received cookies without eel. The efficacy value of giving eel cookies to increase BW and MUAC was calculated by the following formula:

$$\% \text{ Efficacy} = \frac{RR - 1.0}{RR} \times 100\% = \frac{1,3 - 1}{1,3} \times 100\% = 53\%$$

The effectiveness value is the success rate of the intervention, in this intervention was giving eel cookies. The efficacy value in both groups was 53%. In the intervention group 66.7% of pregnant women who received eel cookies were not at risk of CED, while in the control group there were 55.6% who did not have CED risk. The effectiveness value calculated by:

- % Effectiveness = % Efficacy x %pregnant women who did not have CED risk in each group
- % Effectiveness of intervention group was 53% x 66,7% = 35%.
- % Effectiveness of control group was 53% x 55,6% = 29,4%.

Although there were no significant differences statistically in bodyweight and MUAC changes in both groups, giving eel cookies could reduce CED risk in pregnant women by 35%, while giving cookies without eel reduce 29.4% of CED risk.

**Subject Characteristics**

Some of the subjects' age in this study were under 20 years. Pregnancy at a young age had a substantial risk for CED development compared to pregnancy at over 20 years of age. This was in accordance with a research conducted by Kusparlina who stated that one of the factors which influence CED risk was pregnancy before 20 years of age (Kusparlina, 2016).

The occupation and activity of the pregnant women determined the adequate amount of nutritional intake. In this study, almost all of the subjects were housewives (99%) with moderate physical activities which requires greater energy compared to people who had mild activity. Women with moderate activity, along with her pregnancy could increase the risk of CED. It was consistent with the results in Kartikasari's research which showed that the incidence of CED among housewives was 5.55 times higher (Kartikasari and Mustika, 2013).

As the gestation age, the appetite of pregnant women is improving. Thus, the RUTF intervention in the form of eel cookies was expected to have a considerable effect on the pregnant women's health. Trimester 2 and trimester 3 pregnancy required adequate nutrition for adaption to metabolic changes that occur during pregnancy (Fried et al, 2017).

The energy intake requirements in pregnancy was utilized for maternal and fetal metabolism, as well as fetal growth (Most et al, 2019). The requirements depend on the body size of the pregnant women, physical activity category and physiological requirements in each trimester (Most et al, 2019). Increased needs due to metabolic changes required a balance intake of macro and micronutrient which fulfilled the nutrient adequacy ratio to maintain the balance of hormonal changes that occur during pregnancy (Godfrey et al, 2017).

**Energy and Protein Intake**

Nutritional intake during pregnancy was strongly affected by pregnancy hormones, fetal development and increased maternal activity. Pregnancy was a condition which was prone to malnutrition. Balanced nutrition depends on eating habits and the amount of food consumed to support fetal growth, development, and health.

Additional energy from the cookies provided were 500 kcal per 100 grams which were important to fulfil daily calories requirements by 25% and were expected to compensate a 15% increase in metabolism during pregnancy to support metabolism and physiology during pregnancy. The results of this study indicate that there was an increase in energy intake in pregnant women with CED risk after receiving cookies in both groups.

Eel had a dense nutrient content, including micro nutrients such as zinc to improve immunity and appetite

as well as contribute positively to energy intake changes. The increased daily energy intake in pregnant women was not statistically significant because each group was given similar calorie intake. The difference was also insignificant for increasing protein intake in both groups. Therefore, it could be concluded that supplementary food for pregnant women with energy amount of 500 kcal could increase energy intake by 25% of the total daily requirements. These results were in line with WHO recommendations and guidelines for supplementary food in CED women, that balanced energy food could improve daily food intake of pregnant women (Kemenkes, 2015; WHO, 2016).

**Bodyweight and MUAC Changes**

The results of this study indicated that pregnant women after receiving RUTF for 30 days in the form of eel cookies were not significantly different in changing bodyweight from the women who received cookies without eel. The average increase of body weight in the intervention group was 3.9 kg, while the control group was 4 kg. The changes of bodyweight in this study were higher than in the research conducted by Amerta, which increase bodyweight of pregnant women approximately 4.48 kg after receiving RUTF for 3 months (Amareta, 2016). It means that giving eel cookies for one month can increase weight gain of 3.9 kg, while the Ministry of Health's cookies for 3 months only increase bodyweight by 4.48 kg.

There was also insignificant difference in MUAC changes between two groups in this study. The mean increase of MUAC in the intervention group was 1.3 cm, while the control group was 1.6 cm. In one month of intervention, the mean MUAC in the intervention group increased to 23.2 cm, while in the control group increased to 23.3 cm. MUAC changes in the control group was greater than the intervention group. However, the effectiveness of eel cookies in reducing CED risk were higher (35%) than the cookies without eel (29.4%).

Inoptimal weight gain and MUAC changes in this study were caused by several factors, such as the limited time of the intervention; the range of minimum and maximum body weight of pregnant women in the intervention group was lower than in the control group. Eel cookies and cookies without eel had similar energy and fat content, only protein content which was different. Researchers did not use sandwich cookies from the Ministry of Health because the energy content is only 270 kcal, with 6 grams of protein and 12 grams of fat, far below the nutritional content of the eel cookies.

The results of this study showed that supplementary food in the form of eel cookies and cookies without eel was able to increase daily food intake which was characterized by increased bodyweight and MUAC of the pregnant women. The increase in MUAC was from the fat content in the cookies, which was 30% in the 100 grams of both cookies. The fat content, such as omega 3 and 6 in eel was very high. Omega 6 and omega 3 as well as polyunsaturated fatty acids were very important for fetal development as a key element of cell membranes and essentials for new tissues formation. Omega 3 and omega 6 could not be synthesized in human body, therefore we need a marine food source which contain high omega 3 and 6 (Swanson et al, 2012). EPA and DHA supplementation during pregnancy will improve fetal development (Ramakrishnan et al, 2010; Swanson, 2012).

Maternal nutritional guidelines always emphasize on diet including adequate calorie and protein intake, but recently fatty acids had also been considered important (Ramakrishnan et al, 2010). Nutritional deficiencies in pregnant women were caused by inadequate energy intake including protein, essential fatty acids (especially

omega 3 fatty acids), iron, folate, and other micronutrients during pregnancy.

The results of a systematic review showed that the quality of maternal food intake during pregnancy had a positive association with fetal development (Borge et al, 2017). The association between maternal and fetal nutrition was complex, and influenced by many factors such as biological, socioeconomic, and demographic as well as population variations (Abu-Saad and Fraser, 2010). Understanding the relationship between maternal and fetal nutrition could provide a basis for nutritional intervention development which led to birth outcomes and long-term quality of life improvements, while reducing the maternal and fetal mortality, morbidity, as well as health costs (Abu-Saad and Fraser, 2010). This opinion is supported by the Cochrane study which identified balanced protein energy supplementation during pregnancy that could significantly improve fetal birth weight and length (Ota et al, 2015).

RUTF development in the form of eel cookies could be used by the Ministry of Health as an interventional program to address pregnant women with the risk of CED, because in one month, this intervention had been proven to increase bodyweight and MUAC of the pregnant women. The pregnant women who were malnourished had a high risk of giving birth to babies with low birth weight (Gebre et al, 2018). The limitation of this study was the intervention which only carried out for 30 days in a small number of samples because it was a pilot study.

## CONCLUSION

Eel cookies is more effective than cookies without eel, although the results of statistical analysis did not show significant difference in bodyweight and MUAC between intervention and control groups.

Eel cookies could be an alternative of RUTF for pregnant women with CED risk. Sukabumi District is expected to provide eel cookies as RUTF for pregnant women with CED because they were made of local food source which were widely available locally.

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