

## Household food security and diet quality with chronic energy deficiency among preconception women

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### ABSTRACT

**Background:** Chronic energy deficiency (CED) that occurs at risk preconception women during pregnancy increased low birth weight (LBW) in infants. Household food security and diet quality are factors that cause CED. Therefore, this study aims to determine the relationship between household food security and diet quality with CED preconception women.

**Materials and Methods:** We used a cross-sectional study design. The subject of 70 preconception women aged 16-35 years registered in the religious affairs office in Sumowono and Pringapus Subdistrict were selected by consecutive sampling method. Weight and height were measured to assess body mass index to determine CED. Household food security was measured using the Household Food Security Scale Module (HFSSM). Food intake data were obtained using the Semi-Quantitative Food Frequency Questionnaire (SQ-FFQ) and DQI-I (Diet Quality Index-International) to measure diet quality. Bivariate analyses were tested using Rank Spearman and Pearson Product Moment.

**Results:** The prevalence of subjects with CED risk was 48.6% and subjects with CED was 15.7%. 38.6% of subjects married at the age of 16-20 years, 75.1% of subjects had low household food security and 80% of subjects had low diet quality. There was no significant relationship between household food security and diet quality with CED, namely ( $p = 0.537$ ) and ( $p = 0.711$ ). The components of diet quality, namely variation, adequacy, moderation and balance also did not show a significant relationship with CED, respectively with p-value ( $p = 0.711$ ), ( $p = 0.523$ ), ( $p = 0.412$ ), ( $p = 0.604$ )

**Conclusions:** There was no correlation between household food security and CED, also no correlation between diet quality and CED.

**Key Words:** CED; Diet quality; food security; Preconception woman

### BACKGROUND

The preconception period is the period before pregnancy. Preconception women are women of reproductive age, who will have to be ready to become mothers. The preconception period needs different nutritional support compared to the previous period. The nutritional status of pregnant women is determined by the period before pregnancy, thus the poor nutritional status of preconception women will have an impact on the pregnancy. Preconception women are also defined as women of reproductive age who are also prone to CED.<sup>1</sup>

Chronic energy deficiency (CED) in women is defined as a condition when a person experiences a

prolonged or chronic lack of calories and protein. CED is characterized by a mid-upper arm circumference (MUAC) of  $<23.5$  cm.<sup>2</sup> Another indicator in defining CED is body mass index (BMI) of  $<18.5$  kg/m<sup>2</sup>.<sup>3</sup> Based on the results of Basic Health Research (Riskesdas) 2013, the prevalence of pregnant women aged 15-49 years who suffer from CED was 24.3%, while the prevalence of women of reproductive age who were not pregnant was 20.8%.<sup>4</sup> A preceding research stated that the prevalence of CED in pregnant women in Semarang District was 10.28%.<sup>5</sup> Another study conducted by Sumarmi also stated that the prevalence of CED among future brides in 4 sub-districts of Probolinggo District was 27.3%.<sup>6</sup>

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The impact of the incidence of CED among pregnant women in Indonesia includes the high rate of infant mortality (IMR) due to low birth weight (LBW) where the prevalence of LBW reached 10.2% in 2013.<sup>7</sup> Other impacts that can arise due to CED are bleeding, abnormal weight gain in pregnant women, and infectious diseases. Pregnant women with CED have a high risk of miscarriage, abortion, stillbirth, congenital defects, anemia in the baby, and die in the womb (Asphyxia intrapartum).<sup>8</sup>

The quality and quantity of diet are some of the factors that cause CED in preconception women. The quality of the diet is an important index to determine the intake of macro and micro-nutrients as well as dietary patterns that may affect the risk of diet-related diseases. According to researches that have been conducted in developing countries such as Indonesia and India, it is known that the quality of diet will affect the nutritional status of women of reproductive age (WRA) including brides.<sup>9</sup> Other studies have shown that a poor quality diet before pregnancy will affect the nutritional status of pregnant women which may lead to low birth weight (LBW) in children.<sup>10</sup>

The quality of one's diet is determined by the food security of the household, the better household food security, the better its diet quality. Food insecurity in WRA often results in the consumption of food that is not following their needs. This can cause a lack of energy, protein, and micronutrients which will affect the nutritional status of women of childbearing age, namely chronic energy deficiency (CED).<sup>11,12</sup>

Sumowono and Pringapus subdistricts are areas with a fairly high prevalence of infant mortality rate (IMR) and maternal mortality rate (MMR). Based on the Health Profile of Semarang District in 2016, there were 5 cases of MMR within 2011-2016. Meanwhile, during the same period, 70 and 49 cases of IMR were recorded in Sumowono and Pringapus districts respectively.<sup>13</sup> One of the risk factors of low birth weight (LBW) and also a major risk factor in infant mortality is CED during pregnancy.<sup>14</sup> The number of CED cases in Sumowono and Pringapus districts occurred due to the intake of protein and energy of their people which was relatively low compared to people in other areas in Central Java.<sup>15</sup> Therefore, this study aims to examine the relationship between household food security and

diet quality with chronic energy deficiency (CED) in preconception women.

## MATERIALS AND METHODS

This study was conducted between March-April 2018 in the Office of Religious Affairs (*Kantor Urusan Agama/KUA*) of Sumowono and Pringapus sub-districts, Semarang District. This is a cross-sectional study within the scope of Public Health Science. This study has been granted a permit by the Health Research Ethics Commission of the Faculty of Medicine, Universitas Diponegoro - Central Public Hospital Dr. Kariadi Semarang with No. 480 / EC / FK-RSDK / VII / 2018.

The minimum sample size was calculated using a correlative analytic formula and the 70 study participants were selected through the consecutive sampling method. The sample inclusion criteria include preconception women registered in the Office of Religious Affairs Sumowono and Pringapus sub-districts, aged 16-35 years, never and not currently pregnant (at the time of the data collection), and willing to fill in their information and sign a statement of willingness as research study participants.

The independent variables in this study were household food security and diet quality, while the dependent variable was chronic energy deficiency (CED). The cut-off point of CED is Mid-Upper Arm Circumference (MUAC) of <23.5 cm and has a BMI of <18.5 kg / m<sup>2</sup>. The collected data in this study were study participants' general data, anthropometric data, household food security, and diet quality.

Household food security is a condition when people have the right to have physical and economic access at any time to obtain sufficient food to meet their needs for a productive and healthy life. The household food security was measured using the Household Food Security Scale Module (HFSSM) on study participants who live with no children aged under 18 years. Each of the questions from the HFSSM was assigned a 1 score if the study participants answered frequently or occasionally and a 0 score for never. Food security is categorized into 4 categories, namely high food security with 0 scores, moderate food security with a score of 1-2, low food security with a score of 3-5, and very low (food insecurity) with a score of 6-10.<sup>16,17</sup>

Diet quality is an assessment of food consumption that consists of 4 categories, namely variation, sufficiency, moderation, and overall balance based on dietary guidelines using the Diet Quality Index International (DQI-I) form. The total score of the DQI-I varies between 0 as the lowest score and 100 as the highest score. Diet quality is rated low if the score is  $\leq 60$  and is rated high if the score is  $> 60$ .<sup>18</sup> Data on the diet quality was collected through food intake interviews using the Semi-Quantitative Food Frequency (SQ-FFQ) form during the last month. Food photo books are used to minimize bias in intake data collection.

Data processing and analysis were carried by a computer program. Univariate analysis was

performed to describe the characteristics of the subject. The bivariate analysis started with a normality test with the Kolmogorov-Smirnov test. Furthermore, bivariate analysis was carried out to determine the correlation between the independent and dependent variables with the Rank-Spearman and Pearson Product Moment tests.

## RESULTS

### Subject Characteristics

The participants' characteristics consist of data on age, education, occupation, nutritional status, household food security, and diet quality.

**Table 1. Subjects characteristics**

Characteristics	n	%
<b>Age</b>		
Adolescents (16-20 years old)	27	38.6
Adult (21-35 years old)	43	61.4
<b>Educational Level</b>		
Elementary School	8	11.4
Junior High School	23	32.9
Senior High School	29	41.4
Bachelor	10	14.3
<b>Occupation</b>		
Employment	45	64.3
Unemployment	25	35.7
<b>Chronic Energy Deficiency (CED)</b>		
CED (BMI $< 18.5\text{kg/m}^2$ MUAC $< 23.5$ cm)	11	15.7
Normal (BMI $\geq 18.5\text{kg/m}^2$ MUAC $< 23.5$ cm)	59	84.3
<b>Risk of Chronic Energy Deficiency</b>		
Risk of CED (MUAC $< 23.5$ cm)	34	48.6
Normal (MUAC $\geq 23.5$ cm)	36	51.4
<b>Household Food Security</b>		
High Food Security	14	17.1
Medium Food Security	2	2.4
Low Food Security	53	75.1
Very low (Food Insecurity)	1	1.4
<b>Diet Quality</b>		
Low (score $\leq 60$ )	56	80
High (score $> 60$ )	14	20

A total of 38.6% of the study participants aged 16-20 years old, within the youth category. Most of the participants were junior and senior high school

level, only 14.3% of the participants had an education up to diploma or bachelor's degree. The nutritional status based on BMI indicated that 11

participants (15.7%) suffered from CED and the other 84.3% of participants were normal. The MUAC measurement showed that 48.6% of participants were at risk of CED and another 51.4% of the participants were normal. A total of 53 participants (75.1%) were in the low food security category. Most of the participants (80%) also had poor diet quality, and only 14 participants (20%) had good diet quality.

Table 2 describes the minimum, maximum, average, and median values of age, BMI, MUAC, household food security score, and diet quality score. The youngest study participant was 16 years

old. The average BMI was 21.46 kg/m<sup>2</sup>, which was normal. However, there was a participant who had a BMI score of 15.6 kg/m<sup>2</sup> which was classified as CED. On the other hand, there was a study participant who had a BMI score of 32.8 kg/m<sup>2</sup> which was classified as over-nutrition. The average MUAC score was 23.9 cm which was normal, but some study participants' MUAC were less than 23.5 cm. They were classified as at risk of CED. The median score of household food security was 3, which showed that most of the participants had low household food security. The average score of diet quality was 51.77, which was classified as low dietary quality.

**Table 2. Minimum, maximum, average, and median values of age, BMI, MUAC, household food security score, and diet quality score**

Variable	Minimum	Maximum	Mean±DS/Median
Age (years)	16	29	21±3.4 <sup>b</sup>
BMI (kg/m <sup>2</sup> )	15.6	32.8	21.45±3.23 <sup>b</sup>
MUAC (cm)	17	30.7	23.8±2.83 <sup>b</sup>
Household Food Security (score)	0	8	3 <sup>a</sup>
Diet Quality (score)	28	75	52±11 <sup>b</sup>

<sup>a</sup> Median <sup>b</sup> Mean (Deviation Standard)

### Household Food Security

Table 3 showed that 72.9% of the participants were worried about not being able to buy food before they get another income and were only able to buy food to survive. A total of 57.1% of participants were unable to consume a balanced diet because they had no money. There were 21.4% of the participants who consciously reduced their eating portions due to financial constraints. Furthermore, there were 14.3% of the participants ate less than usual. Meanwhile, 5.7% of the participants were unable to buy food when they got hungry. A total of 17.1% of the participants lost their weight due to financial constraints to buy food, and 7.1% of the participants experienced not eating any food for the whole day because they did not have enough money to buy food.

### Diet Quality

The diet quality consists of four aspects, i.e., variety, adequacy, moderation, and overall balance. Table 4 shows that the median score of the variation of the participants was 17 out of a maximum score

of 20, which means that the participants were already consuming a variety of foods including overall variance and variety of protein. The minimum score (0) was given if a participant did not consume any fruit and vegetable. Moderation scores showed that the average consumption of total fat was 36%, which was relatively high compared to the recommendation of DQI-I, which is less than 30% energy needs. Additionally, the average score of saturated fat consumption was 16.9%, which was relatively high. It was also higher than the recommendation (less than 10%). The adequacy aspect, shown in table 5, consists of some components, i.e., vegetable, fruit, staple foods, fiber intake, protein intake, iron intake, calcium intake, and vitamin C intake. The results of this study showed that the consumption of vegetable, iron, and calcium groups was low, which lead to the low quality of the overall diet. On the other hand, the intake of staple food, protein, and vitamin C was adequate.

**Table 3. Components of the HFSSM Questionnaire**

Statements	Responses	n	%
<b>Household Level</b>			
Worried about not being able to buy food before getting next income	S, K T	51 19	72.9 27.1
Only buying food to survive and unable to stock on food	S, K T	51 19	72.9 27.1
Unable to consume a balanced diet	S, K T	40 30	57.1 42.9
<b>Individual Level</b>			
Having the experience to reduce an eating portion or skip meal time due to having not enough money to buy food	S, K T	15 55	21.4 78.6
Having the experience to eat less than you usually consumed due to having not enough money to buy food	S, K T	10 60	14.3 85.7
Feeling hungry, but do not have enough money to buy food	S, K T	4 66	5.7 94.3
Having an experience of weight loss due to having not enough money to buy food	S, K T	12 58	17.1 82.9
Having an experience to not eat all day long due to having not enough money to buy food	S, K T	5 65	7.1 92.9

S= happens often, K=sometimes happens, T= never happen

**Table 4. Value of Minimum, Maximum, and Mean Diet Quality Subjects**

Variable	Minimum	Maximum	Mean <sup>a</sup> ±DS/Median <sup>b</sup>
<b>Variety (score)</b>	4	20	17 <sup>a</sup>
Overall group food variety	1	5	4 <sup>a</sup>
Within-group variety for Protein sources	1	6	6 <sup>a</sup>
<b>Adequacy (score)</b>	11	38	22±6,3 <sup>b</sup>
Vegetable group (servings/day)	0	4	0,5 <sup>a</sup>
Fruit Group (servings/day)	0	12	1,2 <sup>a</sup>
Grain Group (servings/day)	0.1	7.3	3.65±1.5 <sup>b</sup>
Fiber intake (gr/day)	2	60.1	12.35 <sup>a</sup>
Protein Intake (gr/day)	7.5	20	13.25±2.9 <sup>b</sup>
Iron Intake (mg/day)	1.7	32.8	9.5 <sup>a</sup>
Calcium Intake (mg/day)	41.1	1505.6	415.4 <sup>a</sup>
vitamin C Intake (mg/day)	5.8	139.3	112.05 <sup>a</sup>
<b>Moderation (score)</b>	3	24	12 <sup>a</sup>
Total Fat (% total energy/day)	16.2	59	36±8.59 <sup>b</sup>
Saturated Fat (% total energy/day)	3.6	37	16.9 <sup>a</sup>
Cholesterol (mg/day)	26	921.9	240 <sup>a</sup>
Natrium (mg/day)	94.5	4565.6	559.3 <sup>a</sup>
Empty Calory Food (gr/day)	1	41	14±9.3 <sup>b</sup>
<b>Overall Balance (skor)</b>	0	6	0.0 <sup>a</sup>
Macronutrient Ratio (KH:P:L)	0	6	0.8 <sup>a</sup>
Fatty Acid Ratio (PUFA:MUFA:SFA)	0	2	0.0 <sup>a</sup>

An assessment by moderation category was used to evaluate food intake that indicated a link to chronic diseases and might need to be restricted, i.e. fats, saturated fats, cholesterol, sodium, and low-nutrient foods. This study showed that the moderation score was low, which means that the food intake of the participants was still not appropriate.

Table 6 shows the total consumption of fats, saturated fats, and junk food which then contributing to the score of the diet quality. According to the balanced nutritional guidelines, the intake of cholesterol and sodium of the participants was relatively good.

The last category was the balance category consisting of macronutrient balance and fatty acid ratio. The balance category evaluated the overall diet in terms of the proportion of energy sources and fatty acid composition. Tables 5 and 6 show that most participants consumed foods high in fat and enough for protein which led to the low intake of carbohydrates. Moreover, the intake of saturated fatty acid (SFA) and monounsaturated fatty acid (MUFA) were high (>10%). The recommendation stated that the intake of MUFA should be higher compared to the intake of PUFA.

**Table 5. Description of Adequacy in Diet Quality**

Variable	components	n	%
<b>Adequacy</b>			
Vegetable Group	Good ( $\geq 3$ -5 servings/day)	2	2.9%
	Adequate ( $< 3$ -1.5 servings/day)	9	12.9%
	Less ( $< 1.5$ servings/day)	59	84.3%
Fruit Group	Good ( $\geq 2$ -3 servings/day)	22	31.4%
	adequate ( $< 2$ -1 servings/day)	26	37.1%
	Less ( $< 1$ servings/day)	22	31.4%
Grain Group	Good ( $\geq 3$ -5 servings/day)	50	71.4%
	Adequate ( $< 3$ -1.5 servings/day)	17	24.3%
	Less ( $< 1.5$ servings/day)	3	4.3%
Fiber Intake	Good ( $\geq 20$ -30 gram/day)	14	20%
	Adequate ( $< 20$ -10 gram/day)	31	44.3%
	Less ( $< 10$ gram/day)	25	35.7%
Protein intake	Good ( $\geq 15\%$ energi/day)	21	30%
	Adequate ( $< 15$ -7.5 energy/day)	49	70%
Iron intake	Good ( $\geq 100\%$ RDA mg/day)	3	4.3%
	Adequate ( $< 100\%$ -50%RDA/day)	18	25.7%
	Less ( $< 50\%$ RDA/day)	49	70%
Calcium Intake	Good ( $\geq 100\%$ RDA mg/day)	2	2.9%
	Adequate ( $< 100\%$ -50%RDA/day)	22	31.4%
	Less ( $< 50\%$ RDA/day)	46	65.7%
Vitamin C intake	Good ( $\geq 100\%$ RDA mg/day)	45	64.3%
	Adequate ( $< 100\%$ -50%RDA/day)	11	15.7%
	Less ( $< 50\%$ RDA/day)	14	20%
Carbohydrate Intake	Excessive ( $> 100\%$ carbohydrate need/day)	27	38.6%
	Adequate (80-100% ( $> 100\%$ carbohydrate need/day)	8	11.4%
	Less ( $< 80\%$ ( $> 100\%$ carbohydrate need/day)	35	50%
Energy intake	Excessive ( $> 100\%$ energy need/day)	27	38.5%
	Adequate (80-100% energy need/day)	18	25.7%
	Less ( $< 80\%$ energy need/day)	25	35.7%

**Table 6. Description Moderation in Diet Quality**

Variable	Components	n	%
<b>Moderation</b>			
Total Fat	Good ( $\leq 30\%$ total energy/day)	17	24.3%
	excessive ( $>30\%$ total energy/day)	53	75.7%
Saturated Fat	Good ( $\leq 10\%$ total energy/day)	10	14.3%
	excessive ( $>10\%$ total energy/day)	60	85.7%
Cholesterol	Good ( $\leq 300$ mg/day)	44	62.9%
	excessive ( $>300$ mg/day)	26	37.1%
Natrium	Good ( $\leq 2400$ mg/day)	66	94.3%
	excessive ( $>2400$ mg/day)	4	5.7%
Empty Calory Foods	Good ( $\leq 10\%$ total energy/day)	22	31.4%
	excessive ( $>10\%$ total energy/day)	48	68.6%

**Relations between Household Food Security and Diet Quality with CED**

Bivariate analysis was conducted to investigate the relationship between household food security and the quality of diet with CED in the study participants. Table 7 shows no significant link ( $p=0.537$ ) between household food security and chronic energy deficiency.

**Table 7. Relations between Household Food Security and Diet Quality with CED**

Variable	CED	
	<i>p</i>	<i>r</i>
Household Food Security	0.537 <sup>b</sup>	0.075
Diet Quality	0.711 <sup>a</sup>	0.045

<sup>a</sup> Pearson <sup>b</sup> Rank Spearman

**DISCUSSION****Study Participant Characteristics**

This study consisted of 38.6% of adolescents (16-20) years. Marriage under the age of 20 years also occurred in Palestine where the prevalence of married women under the age of 18 was 41.4% while in India it was 44.5%.<sup>19,20</sup> Marriage under the age of 20 years is an important risk factor of adolescent pregnancy, where a pregnant young mother and suffers from CED would have a higher risk of perinatal death and give birth to low birth weight (LBW) babies.<sup>21</sup> Education was one of the underlying factors of early marriage in Indonesia.<sup>22</sup> Most of the participants were only graduated from junior and high school. Also, some of the participants only graduated from elementary school.

The prevalence of participants who were at risk of CED based on MUAC measurement was still high (48.6%). However, this prevalence was lower (15.7%) when assessed based on BMI measurement. The higher prevalence of CED based on MUAC measurement in this study was also reported by a preceding study conducted among brides in

Probolinggo, which was only 27.3%, and a study conducted in Gorontalo, which was only 28.3%.<sup>6,23</sup> Meanwhile, the prevalence of CED in this study was lower compared to a study conducted in India which reported a prevalence of CED among preconception women of 32.1%.<sup>21</sup> We also found that 14.3% of the participants were over nutrition, which means that there was a double burden of malnutrition in this study.

**Household Food Security**

75.1% of the study participants in this study had low food security and 1.4% had food insecurity. The prevalence of low food security observed in this study is higher compared to the prevalence of food security among adult women in Malaysia which was only 43.5%.<sup>24</sup> The high prevalence of low food security may be affected by culture and habits among villagers who prioritize the food sufficiency of children. Besides children, working adults with an important role in the household, like fathers, become the main prioritize to get first and more food compared to other family members.<sup>25</sup>

The statement in the HFSSM questionnaire that contributed the highest score is the statement at the household level. A total of 72.9% of the participants were worried they could not buy food before they get another income and could only buy enough food to survive and not being able to stock up on food. Furthermore, 57.1% of the participants could not buy balanced food. This is due to 64.3% of the participants were working but only get low income as factory workers (regional minimum wage) in Semarang District. The other 35.7% of participants were unemployed thus dependent on their parents. The economy is the underlying factor for household food security. Low – middle-income households tend to have low food security. While high-income households often spend more on healthy food.<sup>26</sup>

Low income in a household and the number of family members that live in it will affect the household food security.<sup>27</sup> Low-income households with many dependent members lead to insufficient intake of each family member due to limited access to food. This condition was shown in the statement at the individual level where 21.4% of participants have experienced reducing of skipping a meal due to financial constraint. A total of 14.3% of participants have experienced eating less than usual and 5.7% of participants have experienced hunger due to financial constraints which led them to not be able to purchase food.

### Diet Quality

Results show that the average score of diet quality among study participants was low. A total of 80% of the participants had a low-quality diet and the other 20% had high diet quality. The low-quality diet among participants was affected by the discrepancy between the nutrient intake and the recommendation.

The quality of diet consists of four categories which are variation, sufficiency, moderation, and overall balance. The variation evaluates the variation of the overall food and overall protein of the participants. Results show that in general, the participants consume varied food. Insufficiency, moderation, and overall balance categories, the results show a low mean which led to a low score of diet quality. Another study in Spain reported a similar finding, where female adolescents in the said study were found to consume varied food, but the other categories (sufficiency, moderation, and

overall balance) contributed a low score to the total diet quality score.<sup>28</sup>

The sufficiency of vegetables, iron, and calcium in participants recorded a low mean. The average vegetable intake was only 0.5 portions/day compared to the recommended 3-5 portions/day. Similarly, a study in Spain also showed that the average vegetable and fruit intake among female adolescents was low.<sup>28</sup> Iron and calcium are important minerals needed during pregnancy. Most of the participants consumed iron and calcium-rich food which are not following the recommendation. A preceding study on pre-pregnancy women in Bogor supports this finding. The said study found that the iron and calcium intake pre-pregnancy among women was low.<sup>29</sup> Low intake of vegetable, fruit, and other micronutrients like iron and calcium can cause low diet quality among preconception women.<sup>30</sup>

The DQI-I score shows an imbalance of total fat, total saturated fat, and low-nutrients food compare to the requirement. Based on the DQI-I, the recommended consumption of total fat per day is <30% total energy/day, saturated fat is <10% total energy/day and low-nutrients food is <10% total energy/day. However, most of the participants still consumed high-fat and low-nutrient food like sugar, which contributes a low score to their diet quality score. A high intake of total and saturated fat resulted from the high consumption of fried food.

A low score was also found in the overall balance category. The high intake of fat among participants hinders the balance of other macronutrient intakes. Very few of the participants consumed total fat less than 30% of the total energy/day. This has an impact on the low intake of carbohydrates and protein. Results show that the consumption of carbohydrates and protein among the participants was relatively low compared to the recommendation even though many of the participants consumed sufficient protein. The high intake of fat increases the total energy intake which then affects the nutritional status.<sup>31</sup>

This study also reported an imbalance of fatty acids. The average intake of SFA was higher than PUFA and MUFA. This finding is in line with the findings in Iran which showed that the high intake of SFA was higher than PUFA and MUFA in female adolescents. This may be caused by the shift in the diet pattern where adolescents tend to consume

more high-energy foods like fast food and snack.<sup>32</sup> Fast food has become an easy and cheap option even though it contributes to excessive energy intake.

### **Relations between Household Food Security and Diet Quality with CED**

Based on the test, household food security is not significantly correlated to CED among preconception women ( $p=0.536$ ). Very limited studies evaluated household food security of preconception women using the HFSSM questionnaire. This study is supported by studies conducted in Bangladesh among pregnant women and in Kenya among women of reproductive age between 15-49 years which found no significant relations between household food security with nutritional status by BMI measurement.<sup>33,34</sup> Yet, the results of these studies contradicted the findings of a study conducted in Ethiopia which found a significant status between household food security and nutritional status by BMI measurement.<sup>35</sup>

In this study, household food security did not indicate low energy and protein intake. This can be seen from the high (and sometimes excessive) intake of energy and protein among the participants which was 64.2%. The high energy intake was acquired from sugar and fat intake and low fiber which tend to be low in micronutrients. Thus, the CED rate was not high as the participants were close to being over nutrient.

On the other hand, diet patterns in society also went through a shift where most households with low food security only paid attention to quantity and not the quality of the food. For example, by accessing fried food and low intake of vegetables and fruit. A study in Kenya backed this finding. It reported a shift in diet patterns in the household with low food security. Fried food was chosen because it is cheap and easy to consume compared to vegetables and fruit even though fried food is high in energy and is unhealthy.<sup>34,36</sup> Statements from most of the participants portray this by stating that they cannot consume a balanced diet due to financial constraints. Also, access to fried food is easier, as most of the participants work as factory workers where access to buy food was limited. A limited break time is a reason that the participants consumed an unhealthy diet that in prolonged time will cause overnutrition.<sup>37</sup>

Very limited studies evaluated the diet quality of preconception women using the DQI-I questionnaire. The overall diet quality of the participants in this study did not show a significant correlation with CED ( $p=0.711$ ). This finding is supported by findings of other studies conducted in the USA among female adolescents which explains the quality diet of female adolescents did not have a significant relationship with their nutritional status based on BMI.<sup>38</sup> However, this finding contradicts a preceding study that reported a significant relationship between diet quality and BMI before pregnancy among pregnant women.<sup>1</sup> Another direct factor that may cause CED in preconception women is infection. During infection or another sickness, we tend to lose appetite thus lead to malnutrition. If it continues for a prolonged time, it can cause CED.<sup>39,40</sup>

This disagreement may happen because CED in preconception women is not only affected by household food security and diet quality. Energy and protein intake plays an important role in the incidence of CED among preconception women. A low protein and energy intake for a prolonged time can cause CED.<sup>23</sup> In this study, most of the participants had sufficient energy intake, moreover, 38.5% of the participants had excessive energy intake. Looking at the sufficiency of staple food, the average consumption of staple food of a participant was 3.65 portions/day and is categorized as sufficient. Also, the protein intake of the participants was categorized as sufficient and good, thus it can be concluded that by quantity the intake of the participants was adequate.

This study differs from the Central Java Individual Food Consumption Survey in 2014 which stated that women who live in the village tend to have low consumption of energy and protein thus causing malnutrition. However, in this study, the participants had high energy high-fat diets thus tend to be over nutrition. This is supported by the result that shows 14.35% of the participants had over nutrition. Diets that tend to be over nutritious is a low vegetable and fruit yet high fat intake.<sup>15,28</sup>

Diet quality is influenced by household food security, where a family with high food security will have a good diet quality.<sup>12,41</sup> A low household food security caused most of the participants in this study to consume cheap and easily accessed food like fried food. It was shown by the high intake of fat among

the participants in the moderation category which was more than 30% of total energy. A low moderation score will affect the overall balance score where most of the participants had a high intake of fat and impair the balance of other macronutrients. A high intake of fat will contribute to excessive energy thus cause a build-up of fat on the adipose tissue and plays an important role in the incidence of overnutrition.<sup>42</sup>

## CONCLUSIONS

A total of 48.1% of participants were at risk of CED, but only 15% of preconception women were categorized as CED. The household food security of the participants was mostly low (75.1%). Most of the participants (80%) had low-quality diets where the mean diet quality was 51.77. there was no significant correlation between household food security and diet quality with CED.

## REFERENCES

1. Shin D, Lee KW, Song WO. Pre-Pregnancy Weight Status Is Associated with Diet Quality and Nutritional Biomarkers during Pregnancy. *Nutrients*. 2016 Mar 11;8(3):1–12.
2. Stephanie P, Kartika SKA. Gambaran Kejadian Kurang Energi Kronik dan Pola Makan Wanita Usia Subur di Desa Pesinggahan Kecamatan Klungkung Bali 2014. *E-Jurnal Medika Udayana*. 2016 May 31;5(6):1–6.
3. Das S, Bose K. Body Mass Index, and Chronic Energy Deficiency among Adult Santals of Purulia District, West Bengal, India. *Journal of Human Sciences*. 2010 Jul 25;7(2):488–503.
4. Kementerian Kesehatan RI. Riset Kesehatan Dasar 2013 (RISKESDAS 2013). Indonesia: Kementerian Kesehatan Republik Indonesia; 2013.
5. Budiono I. Pengembangan Model Indeks Pembangunan Gizi. *KEMAS: Jurnal Kesehatan Masyarakat*. 2013 Jan 3;8(2):113–20.
6. Putri SI, Sumarmi S. Perbandingan Konsumsi Zat Gizi, Status Gizi, dan Kadar Hemoglobin Pengantin Wanita di Wilayah Pantai dan Pertanian Kabupaten Probolinggo. *Media Gizi Indonesia*. 2012 Jan;9(1):1–6.
7. Kementerian Kesehatan Republik Indonesia. Pusat Data dan Informasi Kementrian Kesehatan RI. Kementerian Kesehatan Republik Indonesia; 2014.
8. Rahmi L. Faktor-Faktor yang Berhubungan dengan Kekurangan Energi Kronik (KEK) pada Ibu Hamil di Puskesmas Belimbing Padang Tahun 2016. *Jurnal Kesehatan Medika Sainatika*. 2017 Jun 12;8(1):35–46.
9. Arimond M, Elin L, Wiesmann D, Joseph M, Carriquiry A. Dietary Diversity as a Measure of Women's Diet Quality in Resource-Poor Areas: Results from Rural Bangladesh Site. *Food and Nutrition Technical Assistance*. 2008;58.
10. Potdar RD, Sahariah SA, Gandhi M, Kehoe SH, Brown N, Sane H, et al. Improving women's diet quality preconceptionally and during gestation: effects on birth weight and prevalence of low birth weight--a randomized controlled efficacy trial in India (Mumbai Maternal Nutrition Project). *Am J Clin Nutr*. 2014 Nov;100(5):1257–68.
11. Na M, Mehra S, Christian P, Ali H, Shaikh S, Shamim AA, et al. Maternal Dietary Diversity Decreases with Household Food Insecurity in Rural Bangladesh: A Longitudinal Analysis. *J Nutr*. 2016 Oct;146(10):2109–16.
12. Abraham S, Miruts G, Shumye A. Magnitude of chronic energy deficiency and its associated factors among women of reproductive age in the Kunama population, Tigray, Ethiopia, in 2014. *BMC Nutrition*. 2015 Jun 22;1(1):12.
13. Kementerian Kesehatan Republik Indonesia. Profil Kesehatan Provinsi Jawa Tengah Tahun 2016. Kementerian Kesehatan Republik Indonesia; 2016.
14. Kementerian Kesehatan Republik Indonesia. Profil Kesehatan Kabupaten Semarang 2014. Kementerian Kesehatan Republik Indonesia; 2014.
15. Santoso B, Sulistiowati E, Fajarwati T, Pambudi J. Survei Konsumsi Makanan Individu Provinsi Jawa Tengah 2014. Semarang: Badan Penelitian dan Pengembangan; 2014.
16. Usfar AA, Fahmida U, Februhartanty J. Household food security status measured by the US-Household Food Security/Hunger Survey Module (US-FSSM) is in line with coping strategy indicators found in urban and rural Indonesia. *Asia Pac J Clin Nutr*. 2007;16(2):368–74.
17. Adereti DT, Fasina OO. Gender analysis of food security status of rural households in Ondo

- State, Nigeria. *Russ Agricult Sci.* 2017 Jul 1;43(4):353–60.
18. Guerrero MLP, Pérez-Rodríguez F. Diet Quality Indices for Nutrition Assessment: Types and Applications. In: *Functional Food - Improve Health through Adequate Food* [Internet]. IntechOpen; 2017 [cited 2020 Nov 16]. Available from: <https://www.intechopen.com/books/functional-food-improve-health-through-adequate-food/diet-quality-indices-for-nutrition-assessment-types-and-applications>
  19. Ghayeb FA, Rusli A M, Ismail I M, Ghayeb NF, Al Rifai A. Prevalence of Early Marriage among Women in Rural Palestinian Community: A Cross-Sectional Study. *International Medical Journal.* 2015 Oct 3;22(4):291–4.
  20. Raj A, Saggurti N, Balaiah D, Silverman JG. Prevalence of Child Marriage and its Impact on the Fertility and Fertility Control Behaviors of Young Women in India. *Lancet.* 2009 May 30;373(9678):1883–9.
  21. Islam A, Islam N, Bharati P, Aik S, Hossain G. Socio-economic and demographic factors influencing nutritional status among early childbearing young mothers in Bangladesh. *BMC Women's Health.* 2016 26;16(1):58.
  22. Rumble L, Peterman A, Irdiana N, Triyana M, Minnick E. An empirical exploration of female child marriage determinants in Indonesia. *BMC Public Health.* 2018 Mar 27;18(1):407.
  23. Hubu N, Nuryani N, Hano YH. Pengetahuan, Asupan Energy dan Zat Gizi Berhubungan dengan Kekurangan Energy Kronis pada Wanita Prakonsepsi. *GJPH.* 2018 Apr 19;1(1):015.
  24. Atiqah AN, Norazmir M, Anuar MK, Fahmi MM, Norazlanshah H. Food security status: it's association with inflammatory marker and lipid profile among young adult. [Internet]. undefined. 2015 [cited 2020 Nov 16]. Available from: /paper/Food-security-status%3A-it%27s-association-with-marker-Atiqah-Norazmir/557339a0f893c6e1e813a700a3ad236a335e5b50
  25. Cordeiro LS, Wilde PE, Semu H, Levinson FJ. Household food security is inversely associated with undernutrition among adolescents from Kilosa, Tanzania. *J Nutr.* 2012 Sep;142(9):1741–7.
  26. Hackett M, Melgar-Quinonez H, Taylor CA, Alvarez Uribe MC. Factors associated with the household food security of participants of the MANA food supplement program in Colombia. *Arch Latinoam Nutr.* 2010 Mar;60(1):42–7.
  27. Ahmed UI, Ying L, Bashir MK, Abid M, Zulfiqar F. Status and determinants of small farming households' food security and role of market access in enhancing food security in rural Pakistan. *PLoS One.* 2017;12(10):e0185466.
  28. Mariscal-Arcas M, Romaguera D, Rivas A, Feriche B, Pons A, Tur JA, et al. Diet quality of young people in southern Spain evaluated by a Mediterranean adaptation of the Diet Quality Index-International (DQI-I). *Br J Nutr.* 2007 Dec;98(6):1267–73.
  29. Madanijah S, Briawan D, Rimbawan R, Zulaikhah Z, Andarwulan N, Nuraida L, et al. Nutritional status of pre-pregnant and pregnant women residing in Bogor district, Indonesia: a cross-sectional dietary and nutrient intake study. *Br J Nutr.* 2016;116 Suppl 1:S57–66.
  30. Shamim AA, Mashreky SR, Ferdous T, Tegenfeldt K, Roy S, Rahman AKMF, et al. Pregnant Women Diet Quality and Its Sociodemographic Determinants in Southwestern Bangladesh. *Food Nutr Bull.* 2016 Mar;37(1):14–26.
  31. Austin GL, Ogden LG, Hill JO. Trends in carbohydrate, fat, and protein intakes and association with energy intake in normal-weight, overweight, and obese individuals: 1971–2006. *Am J Clin Nutr.* 2011 Apr;93(4):836–43.
  32. Mohseni-Takaloo S, Mirmiran P, Hosseini-Esfahani F, Azizi F. Dietary Fat Intake and Its Relationship with Serum Lipid Profiles in Tehranian Adolescents. *JFNR.* 2014 Jun 16;2(6):330–4.
  33. Mridha MK, Matias SL, Arnold CD, Dewey KG. Factors associated with nutritional status and dietary practices of Bangladeshi adolescents in early pregnancy. *Ann N Y Acad Sci.* 2018 Feb 18;1416:66–76.
  34. Keino S, Plasqui G, van den Borne B. Household food insecurity access: a predictor of overweight and underweight among Kenyan

- women. *Agriculture & Food Security*. 2014 Jan 28;3(1):2.
35. Abdu J, Kahssay M, Gebremedhin M. Household Food Insecurity, Underweight Status, and Associated Characteristics among Women of Reproductive Age Group in Assayita District, Afar Regional State, Ethiopia [Internet]. Vol. 2018, *Journal of Environmental and Public Health*. Hindawi; 2018 [cited 2020 Nov 16]. p. e7659204. Available from: <https://www.hindawi.com/journals/jep/2018/7659204/>
36. Gulliford MC, Mahabir D, Rocke B. Food insecurity, food choices, and body mass index in adults: nutrition transition in Trinidad and Tobago. *Int J Epidemiol*. 2003 Aug;32(4):508–16.
37. Nobrega S, Champagne N, Abreu M, Goldstein-Gelb M, Montano M, Lopez I, et al. Obesity/Overweight and the Role of Working Conditions: A Qualitative, Participatory Investigation. *Health Promot Pract*. 2016 Jan;17(1):127–36.
38. Feskanich D, Rockett HRH, Colditz GA. Modifying the Healthy Eating Index to assess diet quality in children and adolescents. *J Am Diet Assoc*. 2004 Sep;104(9):1375–83.
39. Dobner J, Kaser S. Body mass index and the risk of infection - from underweight to obesity. *Clin Microbiol Infect*. 2018 Jan;24(1):24–8.
40. Katona P, Katona-Apte J. The Interaction between Nutrition and Infection. *CLIN INFECT DIS*. 2008 May 15;46(10):1582–8.
41. Leung CW, Epel ES, Ritchie LD, Crawford PB, Laraia BA. Food Insecurity Is Inversely Associated with Diet Quality of Lower-Income Adults. *Journal of the Academy of Nutrition and Dietetics*. 2014 Dec;114(12):1943-1953.e2.
42. Coelho DF, Pereira-Lancha LO, Chaves DS, Diwan D, Ferraz R, Campos-Ferraz PL, et al. Effect of high-fat diets on body composition, lipid metabolism and insulin sensitivity, and the role of exercise on these parameters. *Brazilian Journal of Medical and Biological Research*. 2011 Oct;44(10):966–72.