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Nutritional Content Identification of Local-Based Foods for Pregnant Mothers' Nutritional Needs

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A B S T R A C T

Pregnant women with chronic energy deficiency (CED) are likely to have an increased risk of fetal death (stillbirths), premature birth, congenital disabilities, low birth weight infants (LBW), and infant mortality. CED also contributes to approximately 40% of stunting incidents in Indonesia. This study aimed to identify the nutritional content of local-based food pregnant women consume. This research was carried out in 3 stages; first, a descriptive approach to analyze the nutritional content of local foods. Second, a quasi-experiment was conducted to see the effect of local food consumption. Third, a qualitative approach to explore food consumption patterns was also be conducted. The results showed that the type of local Acehnese was wet food containing high energy, water, minerals, protein, fat and carbohydrates. This food can be used as an alternative for pregnant women to support their nutritional requirements. The present study also found a significant change in mid-upper arm circumference and weight gain of pregnant women after consuming wet food. The staple foods often consumed are rice, cassava and Indomie instant noodle because they are accessible and affordable for pregnant women and their families. The Acehnese local wet food can be used as complementary food for pregnant women. Inappropriate consumption patterns can increase the risk of nutritional deficiencies among pregnant women, which will have short-term and long-term consequences on health.

Kata kunci:

KEK
Ibu
Kehamilan
nutrisi

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A B S T R A K

Ibu hamil dengan kekurangan energi kronis (KEK) cenderung memiliki peningkatan risiko kematian janin (lahir mati), kelahiran prematur, cacat bawaan, bayi berat lahir rendah (BBLR), kematian bayi. KEK juga berkontribusi terhadap sekitar 40% kejadian stunting di Indonesia. Penelitian ini bertujuan untuk mengidentifikasi kandungan gizi pangan berbasis lokal yang dikonsumsi ibu hamil. Penelitian ini dilakukan dalam 3 tahap; pertama, pendekatan deskriptif untuk menganalisis kandungan gizi pangan lokal. Kedua, kuasi eksperimen dilakukan untuk melihat pengaruh konsumsi pangan lokal. Ketiga, pendekatan kualitatif untuk menggali pola konsumsi pangan juga dilakukan. Hasil penelitian menunjukkan bahwa jenis makanan lokal Aceh adalah makanan basah yang mengandung energi tinggi, air, mineral, protein, lemak dan karbohidrat. Makanan ini dapat dijadikan sebagai alternatif ibu hamil dalam menunjang kebutuhan gizinya. Penelitian ini juga menemukan perubahan signifikan pada lingkar lengan atas dan penambahan berat badan ibu hamil setelah mengonsumsi makanan basah. Secara keseluruhan, makanan pokok yang sering dikonsumsi adalah nasi, singkong dan mie instan Indomie karena makanan ini mudah didapat dan terjangkau oleh ibu hamil dan keluarganya.

Makanan basah khas Aceh ini bisa dijadikan makanan pendamping ibu hamil. Pola konsumsi yang tidak tepat dapat meningkatkan risiko kekurangan gizi pada ibu hamil yang akan berdampak jangka pendek dan jangka panjang terhadap kesehatan

INTRODUCTION

Nutrition is the main determinant of the quality of Human Resources. Pregnant women are the group most at risk for malnutrition as additional energy and essential nutrients are needed during this period (Bryson, dkk, 2021). Pregnant women in low-middle income countries, including Indonesia, are likely to have poor nutrition intake, which might cause wasting, anaemia, and chronic energy deficiency (CED). The latter is more prevalent in pregnant women due to lack of food intake, while the nutrient demands increase. In Indonesia, CED during pregnancy contributed to more than 40% of stunting in children (Kemenkes, 2018). In 2017, the Indonesian Ministry of Health reported that childbearing age women are at risk of CED (10.70%), increasing risk among pregnant women (14.80%)(Kemenkes, 2018).

The problem of pregnant women with CED is the focus of attention and one of the performance indicators of the Ministry of Health program because it can lead to stillbirths, premature births, birth defects, low birth weight (LBW) and neonatal deaths (Okube, dkk, 2016). The prevalence of CED in pregnant women (15-49 years) is relatively high, reaching 24.2% in 2018 (Kemenkes, 2018).

Aceh Province is one of the regions that contributed to CED for pregnant women, amounting to 18.70% (Dinkes Aceh, 2019). Nagan Raya Regency is a very strategic area located in the western part of Aceh Province. This regency has abundant natural wealth but has not been able to guarantee the nutritional status of the local community, such as the case of CED in pregnant women who are at risk of giving birth to lose generation/stunting. The annual nutrition status assessment report of Nagan Raya Regency in 2019 revealed 18.9% CED in pregnant women, and this problem was associated with increased stunting rates in this area within the last three years (Dinkes Aceh, 2019). Although the government has provided health budgets to the villages listed in the Minister of Village Regulation No. PDTT. 19 of 2017, the prevalence of CED among pregnant women this region remains high.

Energy requirements increase by 300 kcal/day during pregnancy in the second and third trimesters. Meeting the nutrient needs is critical as it can adversely affect pregnancy outcomes (Chakona G, dan Shacleton, 2019). A recommended dietary pattern should include staple foods, side dishes, and vegetables in the menu, and the quantities should also be fulfilled according to daily needs. Dietary consumption in pregnancy, including carbohydrates, protein, and vegetable intake, is associated with newborn babies' birth weight.

In order to support the nutrient needs, pregnant women can choose local foods as the main sources of their food intake as it is much easier to access (Rahayu dan Sagita, 2019). Local food is a product from an area made traditionally in manufacturing using simple equipment (De Benoist, Mclean, and Cogswel, 2008). However, local foods in Aceh have not been widely known by Acehnese people. Therefore, providing information regarding the nutritional content of local foods is essential for pregnant women deciding to choose foods.

This study aims to identify the nutritional content of local foods consumed by pregnant women by linking dietary needs during pregnancy. Revealing the nutrient compositions of local food might help women choose good quality foods (Hasanah, Febrianti, and Minsarnawati, 2013). Hence, they may be able to arrange their daily menu based on their nutritional needs.

METHODS

This research is quantitative research with an experimental design approach, in which the experimental research design was used, namely The Posttest Cases Control Group Design because there was a group that was given local food interventions and a control group, the control group was not given treatment but measurements were still taken. Furthermore, this research was carried out in Aceh Nagan Raya Regency for local food and then given to pregnant women from March to April 2022.

This research was carried out in two stages; first, we analyzed the nutritional contents of local food, including energy, water, mineral, fat, protein, and carbohydrate contents, using a proximate test. Second, a quasi-experiment was conducted to examine the effect of local food consumption on the nutritional status of the women, determined by mid-upper arm circumference (MUAC). Upper arm circumference indicates nutritional status and describes the state of food consumption, especially energy and protein consumption in the long term. This measurement can be used to detect energy deficiency in pregnant women, as when it occures, the mother can give birth to babies with low birth weight. The upper arm circumference is measured using a ribbon. Measurements were made on the right or left arm of the pregnant women.

The study participants were 180 pregnant women, divided into three groups, the Wet Food Group consisted (30 controls and 30 interventions), the Semi-Wet Food Group (30 controls and 30 interventions), and the Dry Food Group (30 controls and 30 interventions). Research data collection was carried out using purposive sampling method. The control group have received no local foods. Prior to data collection, the study participants were asked to give their consents of participate.

Regarding the data collection, the intervention group consumed local food for one month, and we measured their intake using non-consecutive 2 x 24 hours food recall to determine consumption patterns. We also explore the food consumption patterns of pregnant women using a food frequency questionnaire. A dependent t-test was performed to examine the changes (delta) after the treatment in the intervention groups. Pregnant women who were given the treatment had signed a research informed consent. This

study has received authority permission from the Public Health Office of Nagan Raya (441/234/2021).

RESULTS AND DISCUSSION

The study performed proximate test to evaluate the nutrient composition in the food, including energy, water, mineral, fat, protein, and carbohydrate compositions, which are essential for human body. Nutrients play a role in providing energy, growth processes, tissue repair, regulation, and maintenance of physiological and biochemical processes in the body. Table 1 shows the results of the proximate content analysis.

Wajeb is a local-based dry food group containing high energy content; it is made from the combination of glutinous rice, sugar and coconut milk. In addition, the local-based food containing high protein and fat content was *Bu tho*. This food is made from a combination of rice, salt and cooking oil. This food can be made by drying the cooked rice before frying them. Hence, the frying process increases the fat content in this food by 2.01 g.

Among the semi-wet local-based foods, *Leumpeng* is made from glutinous rice, sago and mixed with coconut milk and brown sugar had the highest energy content, while *Apam* has the highest protein content. This food is made from glutinous rice flour and mixed with coconut milk starch and brown sugar. In addition, the high fat composition of semi-wet local-based foods was found in *Boh Rom-Rom*, as this food is made from rice and sprinkling of freshly grated coconut. The grated-coconut contains high fat composition.

Lupis made from glutinous rice, a mixture of coconut milk and brown sugar has the highest energy content among the wet local-based foods. Moreover, *Bongkol,* made of glutinous rice and a combination of coconut milk and sugar, has the highest protein content. This food is processed through steaming with a shorter time; thus, the protein content can be maintained. Meanwhile, wet food with high-fat content is found in *Kanji* because its basic ingredients are coconut milk starch, various fruits, spices and broth.

The need for energy-dense foods and macronutrient-sourced foods is increased during pregnancy to support metabolic and physiological changes and foetal growth (Arimond, Vitta, Moursi, and Dewey, 2018). Energy functions to maintain a wide range of body functions, such as circulation and protein synthesis. Protein is the main component of all body cells that plays essential roles, including acting as enzymes, membrane operators and hormones. In addition, the body needs sufficient energy intake to perform physical activity and support body metabolism. For the foetus, energy from the mother will be used for growth and development and the labour process. The amount of energy needed to give birth is relatively high, approximately 80,000 kcal, which can be accumulated when the mothers consume added 300 kcal a day during pregnancy (Xiong, Huang, at all, 2021). In the first trimester, the caloric needs increase at least 2,000 kcal/day, increased by 3,000 kcal/day in the second and third trimesters adjusting the maternal condition changes, such as increased blood volume, uterine growth, readiness for lactation in the mammary glands, and foetal and placental growth (Rao, Yajnik, at all, 2021).

Protein intake during pregnancy is vital for foetal growth and embryogenesis, supporting normal born babies. Lack of protein intake during pregnancy may result in impaired foetal development and low birth weight (LBW). Moreover, poor energy and protein intake can reduce the core of DNA and RNA and disrupt the fatty acid profile, negatively affecting the transfer of nutrients from the mother to the foetus. This mechanism also reduces brain size due to changes in protein structure, growth factor concentration and neurotransmitter production (Okubo, Sasaki, at all, 2012).

Table 1
Nutritional Content of Local Aceh Food

No	Type of food	Serving size (g)	Nutrient content per 100 g of food					
			Energy (Kcal)	Water (g)	Mineral (g)	Protein (g)	Fat (g)	Carbohydrate (g)
A	Dry Food							
1	*Kue Karah*	20	66	0.9	0.10	1.1	1.6	9.3
2	*Kue Sapit*	15	56	0.9	0.12	0.9	2.5	7.2
3	*Bungong Kaye*	20	64	1	0.17	1.1	1.4	8.6
4	*Bu Tho*	20	68	0.7	0.09	2.0	2.9	9.6
5	*Wajeb*	25	76	1.5	0.19	1.2	2	9.8
B	Semi-wet food							
1	*Timphan*	20	41	0.7	0.11	0.7	1.9	9.3
2	*Apam*	15	50	0.7	0.17	0.9	1.4	8.6
3	*Boeh Rom-rom*	30	61	0.2	0.20	0.9	1.9	8.6
4	*Leumpeung*	40	61	0.6	0.15	0.7	1.7	8.9
5	*Kue Ade*	60	71	0.7	0.18	0.9	1.5	23.5
C	Wet food							
1	*Lupis*	65	157	59.7	1.07	2.4	0.1	36.6
2	*Kolak*	150	85	118.2	0.66	1.2	0.2	19.7
3	*Serabi*	150	110	123.2	0.36	1.9	0.9	23.7
4	*Bongkol*	100	111	73.3	0.16	4.5	1.1	20.9
5	*Kanji*	100	142	67.7	1.10	3.3	3.3	24.6

Protein quality can be evaluated by evaluating the ratio of amino acids contained in the protein. A food containing multiple essential amino acids for human needs is considered a high-quality protein food. During the first trimester, the need for protein is 61 g, which increases to 70 g in the second trimester, and 100 g in the third trimester. The increased need for protein was because the growth and development of the foetus are getting faster during the

second and third trimesters, especially for the development of the brain.

Fat has a significant role to provide metabolic energy, foetal growth in the womb requires unsaturated fatty acids *Docosahexaenoic Acid* (DHA) and *Arachidonic Acid* (AA). AA and DHA are beneficial for the growth and development of the foetus in the womb (Muthayya, 2009). Hormonal imbalance or poor absorption of the mother's body during pregnancy causes the transfer of fat to the foetus to be disturbed, and the foetus's need for fat becomes less and it consequently influences the foetal growth (Gomez, Field at all, 2015).

The dependent t-test result on dry food showed a significant change in maternal MUAC from the first to the second measurements (22.70 cm vs 23.20 cm; p<0.001). In semi-wet food, it was found that the maternal MUAC was significantly increased from the first to second (23.10 cm vs 23.60 cm; p<0.001). Similarly, maternal MUAC rose considerably from the first to second measurement in the wet food group (22.40 cm vs 23.90 cm; p<0.001).

Table 2
Results of two groups

Type of food	Intervention group				Control group			
	Pre- Test		Post-test		Post Test		Post Test	
	MUAC	Weight	MUAC	Weight	MUAC	Weight	MUAC	Weight
Dry food								
a. Mean	22.70	73	23.20	75.40	22.10	63.50	22.20	64.10
b. P-Value	≤0.001	≤0.001	≤0.001	≤0.001	0.40	0.51	0.40	0.51
Semi-wet food								
a. Mean	23.10	62.80	23.60	65.10	23.10	62.80	23.60	65.10
b. P-Value	≤0.001	≤0.001	≤0.001	≤0.001	0.50	0.20	0.50	0.20
Wet food								
a. Mean	22.40	66.90	23.90	71.20	22.40	66.90	23.90	71.20
b. P-Value	≤0.001	≤0.001	≤0.001	≤0.001	0.80	0.65	0.80	0.65

DISCUSSION

Acehnese local food as snacks can be categorized into three types, they are dry food, semi-wet ood, and wet food. By analyzing the nutritional content of those traditiona food, it was found that the food can increase the mothers' MUAC in pregnant women (*p-value* < 0.05). Consequently, this traditional food can be consume as snacks for pregnant women. This food can also increase energy; as a matter of fact, energy needs that must be fulfille at snack time are 20% of energy needs for one day. Snacking time can be divided into two times: 10% for morning energy needs and 10% for afternoon energy needs.

Based on the table 2 above, it can be seen that Acenese local food contributes to the average increase of MUAC up to 22% for dry food, 21.7% or semi-wet food, and 23% for wet food. Hence, Acehnese local food can fulfil pregnant women's nutrition and this can be progressed to be a program of Supplementary Food Provision (PMT) based on local food ingredients.

Nutritional needs during pregnancy are increased due to demands for supporting the growth and development of the foetus and preparing for breastfeeding (Kavle, Mehanna, at all, 2018). The mother should fulfil the amount and type of food following dietary allowance recommendations of balanced nutrition (Torlesse, Benedict, at all, 2020). Pregnant women need more nutrients than non-pregnant women, and all nutrients can be fulfilled by consuming various foods and being balanced in quantity and proportion. The foetus receives nutrients from the food consumed by the mother and is also taken from the reserves of nutrients stored in the mother's body (Chyne, Meshram, at all, 2017).

Malnutrition during pregnancy may have negative consequences for themselves and their offspring; thus, the pregnant women group needs special attention by providing adequate foods (Siekmans, Roche, at all, 2017). Several types of supplementary food can be given to pregnant women, including local-based complementary foods. The Regulation of the Minister of Health Number 51 of 2016 concerning Nutritional Supplementation Product Standards recommends that all pregnant women with CED should receive additional energy-dense food in the form of biscuits (Chakrabarti, Kishore, at all, 2019).

In this study, we initially found was that most pregnant women had poor knowledge about nutrition in pregnancy. It is primarily due to a lack of information and education regarding nutrition during pregnancy and the potential use of additional local-based foods, which the mother can easily access in their living areas. The previous study showed that some local foods had low nutrient compositions. Table 3 shows the nutritional adequacy rate for pregnant women according to gestational age (Anono, Ochola, at all, 2018).

The growth of the foetus affects the need for additional protein during pregnancy. In the 2nd trimester, the mothers need six grams of protein per day, and the number increases to be 10 grams per day in the 3rd trimester. The protein needs can primarily be obtained from animal sources, such as lean meat, fish, eggs, milk. In addition, other food such as tofu, *tempeh*, and nuts also contain high protein. Protein plays significant roles in supporting new tissue formation of the placenta and foetus, cell growth and differentiation, formation of blood reserves and preparation for breastfeeding (Dafiu, Maryani, and Estiwidani, 2017).

The nutritional needs of pregnant women might be different from one to another, which are determined by age, weight, height, parities, and gestational age. Several studies have found that weight gain is associated with gestational age. The higher the gestational age, the greater the weight gain becomes. Table 4 shows studies the association of weight gain and gestational age (Ambikapathi, Passareli, at all, 2021).

A study conducted by Ghosh-Jerath reported multiple strategies to promote nutritional content in vulnerable pregnant women groups, including promoting the nutritional content of local food, providing education, information and communication about nutritional values of the local foods and how to prepare dietary menus for pregnant women. The study found that supplementary

feeding programs and community food distribution systems in the communities can complement existing nutrition interventions in order to improve women's nutritional status (Ghost-Jerath, Kapoor, at all, 2021).

The present study investigated food consumption patterns of pregnant women showed that rice, cassava, and *Indomie* instant noodle are the staple foods that the mother often consumes as these foods are easy to get and affordable. Thus, the mothers and their families routinely consume these staple foods. The study also showed a lack of variation of the staple foods consumed by pregnant women, increasing the risk of imbalance nutrition between the needs and reserves of energy sources during pregnancy. Moreover, pregnant women also rarely consume a variety of meat, including free-range chicken, beef, mutton, *Sito* shrimp, lobster shrimp, free-range chicken eggs, and blood clams, all of which are the major proteins source. The reasons were that these foods are relatively expensive and sometimes the mothers uncomfortable or nauseous after consuming these foods.

The vegetable-based side dish that pregnant women often consume is *tempe* and tofu because these foods are always available in the market. On the other hand, some pregnant women rarely consume boiled peanuts, fried beans, green beans due to availability reasons. For example, boiled peanuts can only be consumed when relatives give them. Fried peanuts and green beans are usually needed at particular periods and can only be obtained from traditional markets. Our study found that ferns and cassava leaves are the local vegetables that pregnant women uptake as the abundant sources to get these foods. The mothers do not have to buy them. Other vegetables that are accessible are eggplant and papaya. However, the mothers consume these foods less because these foods may cause skin allergies or itching. The bitter taste of papaya caused pregnant women to dislike this fruit. The other reason that could inhibit mothers from uptake vegetables is that the fruit is expensive, which is unaffordable for the majority of pregnant women. Meanwhile, low availability in the village tends to affect the fruit consumption of pregnant women. Some fruits such as bananas, rambutan, guava, water guava, langsat, are seasonal fruit that the mothers rarely consume, although they like these fruits and the price are probably cheaper than non-local fruit.

Furthermore, the study found that most pregnant women had low energy intake. This situation is probably caused by insufficient availability of family food, such as rice and fruits, many dependents in the houses, lack of income, and poor attention to family nutrition. Similarly, the protein intake of pregnant women shows insufficient due to limited consumption of protein from various sources, low purchasing power, high school fees for children and household as additional expenses and low awareness of family nutrition. A study by Sumalika found that nutrient intake was less than 50% of the recommended needs. This was due to low level of education, poverty, and limited access to food (Menon, Mcdonald an Chakrabarti, 2016).

Inappropriate consumption patterns cause malnutrition in pregnant women, which will have an impact in the short and long term on maternal health. Insufficient energy in pregnant women will cause the energy reserves in the body to be used. Suppose this situation continues for a long time, it will decrease energy for work productivity, leading to poor nutritional status. As a result, maternal weight loss and poor nutritional status could adversely affect the foetal development.

There are several periods when human rapid growth occurs, including during foetal development, childhood, adolescence and adulthood. The need for protein increases during these periods because the protein can also be used as energy when the energy intake was insufficient. Pregnant women physiologically need protein because this nutrient supports the form of foetal body tissue and optimal growth of the foetus in the womb. A previous study found that low energy and other nutrients intake increased the risk of having low birth weight babies. Low birth weight was associated with the incidence of stunting 1.81 times higher than babies with normal birth weight (Longvah, Khutsoh, at all 2017).

Table 3
Nutritional Adequacy Rate for pregnant women according to gestational age

No	Nutrients	Gestational Age	Nutritional needs
1	Energy	Trimester I	180 kcal
		Trimester II and III	300 kcal
2	Protein	Trimester I, II and III	17 gr
3	Vitamin A	Trimester I, II and III	300 micrograms RE
4	Vitamin B1	Trimester I, II and III	0.40 mg
5	Niacin	Trimester I, II and III	4 mg
6	Vitamin B6	Trimester I, II and III	0.40 mg
7	Vitamin B12	Trimester I, II and III	0.20 microgram
8	Folic acid	Trimester I, II and III	200 micrograms
9	Vitamin C	Trimester I, II and III	10 mg/day
10	Iodine	Trimester I, II and III	50 micrograms
11	Iron	Trimester I	9 mg
		Trimester II	13 mg
12	Zinc	Trimester I	
		Trimester II	
		Trimester III	
13	Calcium		150 mg

The addition of protein during pregnancy depends on fetus' rate of growth. The need for protein in the second trimester is less than 6 grams/day and has increased in the third trimester to 10 grams/day. Protein needs can be obtained from vegetable or animal sources. Animal sources such as lean meat, fish, eggs, milk. Meanwhile, vegetable

sources such as tofu, *tempeh*, and nuts. The function of protein is to form new tissue for both placenta and fetus, cell growth and differentiation, formation of blood reserves and preparation for breastfeeding (Setiyowati and Ulvie, 2019) .

Every pregnant woman has different nutritional needs during pregnancy. The nutritional needs of pregnant women are in accordance with the mother's age, mother's weight, mother's height, the frequency of pregnancies, the age of fetus/baby. Several studies have found that gestational age follows weight gain. The following is a study of weight gain by length (gestational age) (Xiong, Huang, at all, 2021)

Table 3
Nutritional Adequacy Rate for pregnant women according to gestational age

Study	Weight gain (Kg ± SD)	Length of Pregnancy (weeks)	Total Weight Gain (Kg)
Hyten *et al.,* (1976)	11.15 ± 3.34	10-38	13.00
Taggart *et al.,* (1961)	11.00	10-38	12.80
Emerson *et al.,* (1972)	9.20	10-2=38	9.20
Pipe *et al.,* (1979)	10.40	10-14 to 36-38	12.00
Campbell *et al.,* (1986)	9.20	20-38	13.80
Forsu *et al.,* (1985)	13.6 ± 3.00	Before pregnancy until delivery time	13.60

This research emphasizes that there is a strategy to promote nutritional content in vulnerable groups such as pregnant women, namely promoting the nutritional content of local food, education, information, and communication about nutritional values and how to prepare menus for nutritional needs, and supplementary feeding programs and community food distribution systems (Arimond, Vita, at all, 2018). These communities have the potential to complement ongoing nutrition interventions and improve women's nutritional status.

LIMITATIONS OF THE STUDY

The limitation is that this study only focused on studying local food in Aceh Barat. Future research is suggested to study larger areas of food research.

CONCLUSIONS AND SUGGESTIONS

This study concluded that the local Acehnese wet food could be additional foods for pregnant women. However, inappropriate consumption patterns can lead to nutritional deficiencies in pregnant women, affecting pregnant women's health in the short and long term.

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ETHICAL CONSIDERATIONS

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Conflict of Interest Statement

The authors declare no conflict of interest.

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