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Maternal palmitic acid intake, palmitic acid levels in maternal blood and cord blood with infant body composition

Asupan asam palmitat ibu, kadar asam almitat di darah ibu dan tali pusat dengan komposisi tubuh bayi

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Abstract

The fat intake of pregnant mothers, especially palmitic acid, which is one of the main components of palm oil, may affect the weight and fat mass of newborns. This study aimed to analyze the relationship between maternal palmitic acid intake and palmitic acid levels in maternal and cord blood with birth weight and infant fat mass. This study uses secondary data using a cross-sectional design, which is part of the main study of the BSEA and IPB University. The research was conducted from May to October 2018 at the Tanah Sareal Health Center and North Bogor Health Center. A total of 142 pregnant women were selected based on a single pregnancy and Hb level of >9 mg/dL. Exclusion criteria were the presence of congenital abnormalities or undergoing therapy for a particular disease. Data analysis was performed using the Pearson/Spearman correlation test. The results of the study showed no association between maternal palmitic acid intake and birth weight or infant fat mass (p> 0,05). Two approximate significant indicators were palmitic acid level in maternal blood with birth weight (p= 0,089), as well as palmitic acid level in cord blood with infant fat mass (p= 0,053). In conclusion, maternal palmitic acid intake and palmitic acid levels in maternal and cord blood did not affect birth weight or infant fat mass.
Keywords: Birth weight, infant fat mass, palmitic acid

Abstrak

Pemakaian minyak goreng yang digunakan sehari-hari biasanya berasal dari minyak sawit. Asupan lemak ibu hamil terutama asam palmitat sebagai kandungan utama minyak sawit, kemungkinan dapat mempengaruhi berat badan dan massa lemak bayi baru lahir. Penelitian bertujuan untuk menganalisis hubungan asupan asam palmitat ibu, kadar asam palmitat darah ibu dan tali pusat dengan berat lahir dan massa lemak bayi. Penelitian menggunakan desain studi *cross sectional* yang merupakan bagian dari penelitian utama dari BSEA dan IPB University, dan menggunakan data sekunder. Penelitian telah dilakukan pada bulan Mei-Oktober 2018 di Puskesmas Tanah Sareal dan Puskesmas Bogor Utara. Sebanyak 142 ibu hamil telah terpilih sesuai dengan kriteria inklusi kehamilan tunggal, Hb>9 mg/dL. Kriteria eksklusi yaitu adanya kelainan kongenital atau sedang menjalani terapi penyakit tertentu. Analisis data menggunakan uji Korelasi Pearson atau Rank Spearman. Hasil penelitian menunjukkan bahwa tidak terdapat hubungan antara asupan asam palmitat ibu dengan berat lahir dan massa lemak bayi (p> 0,05). Dua indikator yang mendekati signifikan yaitu kadar asam palmitat darah ibu dengan berat lahir (p= 0,089), juga kadar asam palmitat tali pusat dengan massa lemak bayi (p= 0,053). Kesimpulan, asupan asam palmitat ibu, juga kadar asam palmitat di darah ibu dan tali pusat tidak mempengaruhi berat lahir dan massa lemak bayi.
Kata Kunci: Asam palmitat, berat lahir, massa lemak bayi

Introduction

Fetal growth directly depends on the availability of nutritional intake from the mother and the placental capacity. A mother's nutritional status affects both birth weight and infant growth and development (Christian et al., 2015; King, 2016). Childhood obesity is predicted to occur at birth through deposition of infant fat mass (Moore et al., 2020). Excessive neonatal adiposity during childhood contributes to the future occurrence of inflammatory diseases (O'Donovan et al., 2016).

Palm oil is a source of fat and is widely used in everyday cooking. The survey results of SUSENAS (2022) show that the Indonesian population's consumption participation rate for cooking oil (palm oil and sunflower oil) is 89,21%. Therefore, cooking oil is widely used in daily food processing. Palmitic acid is the main ingredient of palm oil (Hariyadi, 2014). The results of the latest research also show that palmitic acid intake is the highest intake of saturated fatty acids during pregnancy, with the percentage of consumption reaching 63,94% compared with other saturated fatty acids (Halimah et al., 2022).

Saturated fatty acids are the most abundant fat components. However, the effects of saturated fatty acids on neonatal adiposity have not been consistent and remain limited. Several studies have reported that an excessive intake of saturated fatty acids can cause metabolic diseases and obesity (Mennitti et al. 2015). In contrast, other studies have shown that saturated fatty acid intake was positively correlated with total cholesterol in early pregnancy, but no positive relationship was found in late pregnancy (Geraghty et al., 2016). The role of saturated fatty acid intake in pregnant women remains a concern because increasing saturated fatty acid intake and saturated fatty acid levels in the blood can increase the saturated fatty acid content in breast milk (Siziba et al., 2020).

Research by Padial-Jaudenes et al. (2020) on animals during the first 60 days of pregnancy showed that mothers who consumed palm oil had offspring with the highest average birth weight compared with mothers who consumed olive oil and sunflower oil. Consumption of palm oil by pregnant women, the main ingredient of which is palmitic acid, should receive attention because of its relationship with birth weight and infant fat mass, which are related to the birth process and infant health in the future. Maternal high-fat diets have also been associated with changes in the offspring, including increased body weight, hyperleptinemia, and hypercholesterolemia (Gawlinska et al., 2020). This study is also important because maternal and fetal fatty acid profiles can influence fetal growth during pregnancy. Excess saturated fatty acids, trans-fatty acids, and erucic acid are associated with low intrauterine growth (Cinelli et al., 2018). Therefore, this study focused on analyzing the relationship between maternal palmitic acid intake, palmitic acid levels in maternal blood and cord blood, birth weight, and infant fat mass.

Methods

This research used a cross-sectional study was conducted between May and December 2018 at the Tanah Sareal Community Health Center and North Bogor Community Health Center, Bogor City, Indonesia. Pregnant women were selected using consecutive sampling. A total of 142 pregnant women who met the criteria participated in the main study on maternal PUFA intake and infant health conducted by IPB University and BSEA. The inclusion criteria for this study were pregnant women aged 18–45 years, gestational age 32–40 weeks, single pregnancy Hb level > 9 mg/dL, and complete data. The exclusion criteria were congenital abnormalities and long-term therapy or treatment (diabetes mellitus, cancer, hyperlipidemia, and use of corticosteroids).

A total of 142 pregnant women were recruited, but only 100 had complete data until the end of the main research analysis. Data on maternal palmitic acid, energy, protein, fat, and carbohydrate intake were available for 142 subjects. Complete maternal characteristic data were available for 142 subjects. Data on palmitic acid levels in maternal blood were only available for 125 subjects; data were missing for the remainder (17 subjects) because maternal blood samples were not available. Data on birth weight and infant fat mass were only available for 104 subjects; the remaining data were missing (38 subjects) due to withdrawal (7 subjects), giving birth to another hospital (4 subjects), or loss of follow-up (27 subjects). Data on the palmitic acid level in cord blood were only available for 100 subjects; the remaining data were missing (42 subjects) due to cord blood hemolysis (4 subjects), withdrawal (7 subjects), giving birth to another hospital (4 subjects), or loss of follow-up (27 subjects).

The data included maternal characteristics (age, maternal education, maternal occupation, family income, body mass index (BMI) before pregnancy, upper arm circumference (LiLA), and gestational weight gain (GWG)), obtained from the main research. Data on intake and adequacy levels (energy, protein, fat, and carbohydrates), as well as maternal palmitic acid intake, were collected through two 24-hour food recall questionnaires. Palmitic acid content in food was obtained from the Indonesian Food Fatty Acid Content Database (Sulaiman et al., 2015), Food Nutrient Database Australia (FSANZ, 2013), and Standard Tables of Food Composition in Japan (MECSST of Japan, 2015).

Blood samples were collected from the cubital vein at as much as 5 cm at 36–40 weeks of gestation. Fatty acid content was determined using the Folch method and analyzed using the gas chromatography flame ionization detector (GC-FID) method. Cord blood vein samples were collected after delivery, stored in EDTA tubes, and centrifuged for 12 h. Red blood cells were collected and stored in labeled plastic containers at −80°C. Fatty acids in red blood cells were extracted and analyzed using the Folch Method. Fatty acid profiles were measured using a Gas Chromatography-Flame Ionization Detector (GC-FID) at the DKI Jakarta Regional Health Laboratory. Home visits were carried out between days 5 and 14 after delivery to collect data on the birth history and skin folds of the infant. Birth weight was recorded through medical birth records. The triceps, subscapular, and thigh skinfolds of the infant were measured directly at the subject's home using a body caliper.

The infant fat mass was calculated using the equation described by Aris et al. (2013).

$$FM = -0{,}022+(0{,}307*W)-(0{,}077*G)-(0{,}019*GA) + (0{,}028*SSF)$$

Information:
FM : Fat Mass (kg)
GA : Gestational Age (weeks)
G : Gender (1=male; 0=female)
SSF : Subscapular Skin Fold (mm)
W : Birth Weight (kg)

Data analysis was performed using the Pearson correlation test, or if the data were not normally distributed, the Spearman rank correlation test was used at a 95% CI. This analysis aimed to prove the hypothesis of a relationship between maternal palmitic acid intake, palmitic acid levels in maternal blood and cord blood, birth weight, and infant fat mass.

Result and Discussion

Maternal Characteristics

As many as 47,9% of pregnant women were between the ages of 20 and 29 years and 45,8% were between the ages of 30 and 39 years. The recommended age range for mothers to give birth to babies is between 20 and 30 years to avoid risks (Gossett et al., 2013). As mothers age, they have more experience caring for their babies (Fall et al., 2015). The relationship between maternal age and birth weight has been inconsistent (Cedars, 2015; Fayed et al., 2017; Wang et al., 2017). This is because it does not yet reflect trends in birth weight and maternal age; however, younger mothers have a lower risk of pregnancy complications (Summers et al., 2018). The risk of LBW increases in younger age groups due to low socioeconomic status (Ganchimeg et al., 2014).

Maternal education is an important indicator of infant growth and development. Most subjects had a history of high school/equivalent education (47,9%) and elementary school/equivalent (26,1%). This means that the subject had been studied for at least 12 years. However, at this age, you are still very young and may not have sufficient knowledge about pregnancy. Makoka et al. (2015) revealed a correlation between better maternal education and a lower risk of stunting in children. Maternal schooling has been proposed as a solution to prevent stunting in Malawi, Tanzania, and Zimbabwe. There are several reasons for the importance of maternal education in the prevention of stunting. Higher education helps mothers make better choices when caring for their children (Bhutta et al., 2013). Higher education allows for better access to food and the ability to detect illnesses and seek better medical care (Makoka et al. 2015).

Table 1. Maternal characteristics (n= 142)

Maternal Characteristics	n	%
Age		
<20 year	2	1,4
20-29 year	68	47,9
30-39 year	65	45,8
40-49 year	7	4,9
Mean ± SD (year)	29,4 ± 6,1	
Maternal Education		
Not Studying	1	0,7
Elementary School/equivalent (≤6 years)	37	26,1
Junior High School/equivalent (7-9 years)	24	16,9
Senior High School/equivalent (10-12 years)	68	47,9
Diploma/Bachelor (>12 years)	12	8,5
Maternal Occupation		
Housewife	113	79,6
Businesswoman	9	6,3
Office Employee	5	3,5
Factory Employee	3	2,1
Others	12	8,5
Family Income/month		
Below The Minimum Wage (< 3,599,400)	109	76,8
Above The Minimum Wage (≥ 3,599,400)	33	23,2
Mean ± SD (Rupiah)	2.901.690,1 ± 1.572.859,7	
BMI Before Pregnancy		
Underweight (<18,5 kg/m2)	7	6,7
Normal (18,5-24,9 kg/m2)	74	71,2
Overweight (≥25 kg/m2)	23	22,1
Mean ± SD (kg/m^2)	22,8 ± 3,7	
Upper Arm Circumference (LiLA)		
<23,5 cm	11	7,7
≥23,5 cm	131	92,3
Mean ± SD (cm)	26,9 ± 2,8	
Gestational Weight Gain		
<5 kg	15	10,6
5-8,9 kg	27	19
9-11,5 kg	43	30,3
>11,5 kg	57	40,1
Mean ± SD (kg)	10,9 ± 4,7	

Most of the mothers were housewife (79,6%). This means that mothers perform more activities at home, so that the emotional bond between the mother and baby will usually develop stronger. Working mothers tend to meet their nutritional needs according to recommendations because of their income (Nayak et al., 2017). The family income of most subjects (76,8%) was still below the Bogor minimum wage (<3,599,400). The family income of most of the participants obtained from their husbands' work is also said to be low. Family income is a benchmark for spending on food and non-food needs. Family income from pregnant women's food consumption directly influences the growth and development of babies in the womb.

Children from families with a high economic status have better nutritional status. The BMI before pregnancy was normal for most mothers (54,2%). LBW infants tend to be born to malnourished mothers. LBW infants are more susceptible to stunting. During critical periods, the organ systems of the human body are plastic and sensitive to the environment. This mostly occurs in the womb; however, the brain, liver, and immune system remain plastic after birth. A mother who experiences malnutrition during pregnancy sends a signal to her fetus that the external environment may be harsh. The fetus responds to this signal by reducing body size and changing metabolism for survival after birth. In addition, increases in lauric acid, myristic acid, palmitic acid, and total saturated fatty acids occurred in obese mothers (Yustiyani et al., 2021)

Monitoring the nutritional status of pregnant women is carried out by monitoring weight gain during pregnancy (GWG) and measuring the upper arm circumference (MUAC). Almost all pregnant women have a normal upper arm circumference (≥ 23,5 cm), namely 92,3%. A low upper arm circumference is associated with the incidence of LBW (Wang et al., 2020). However, the gestational weight gain of most pregnant women is still below the recommended value of 43%. The mother's weight gain in the first and second trimesters affects the body length of the newborn. In the second trimester, the growth of fetal bones is better than the growth and development of the brain. In the third trimester, fetal tissue growth accounts for 60% of weight gain (Lumbers et al., 2014). Pregnant women's weight gain that exceeds recommendations causes an increase in palmitic acid levels of 0,09 SD for every 1 SD increase in gestational weight gain (Vidacovic et al., 2015).

Maternal Intake

The intake and adequacy levels of pregnant women still experienced a deficit in energy, protein, and carbohydrate intake (Table 2).

Table 2. Maternal intake and adequacy level (n=142)

Energy and Nutrients	Intake	Adequacy Level
Energy (kcal)	2096 ± 728	84 ± 29
Carbohydrates (g)	235 ± 94	60 ± 24
Fat (g)	84,2 ± 40,4	130,5 ± 64,2
Protein (g)	69,2 ± 26,5	78,4 ± 31,5

Only fat intake was considered sufficient, because the adequacy level was above 100%. According to the Recommended Dietary Allowance (RDA), pregnant women's energy consumption should be 2175 kcal/day. Low energy and nutrient intake were suspected because data collection was performed at the end of the third trimester. Pregnant women may be advised to reduce their food portions if the mother's weight is considered sufficient or excessive to prevent the baby from being born large (Nurulfuadi, 2018; Al Rahmad, 2023).

Pregnancy inevitably increases the mother's need for energy and nutrient intake to meet the nutritional needs of the mother and baby. If the mother's energy and nutrient intake are deficient, it can disrupt the baby's development, resulting in a risk of diseases in the future, including type II diabetes, hypertension, and cardiovascular disease (Myles et al., 2017). Other studies have also shown a positive relationship between neonatal length, energy intake, and protein intake (Gala et al., 2016). Deficit protein intake is also influenced by the belief that mothers who have just given birth should not consume "fishy" food so that birth scars heal more quickly (Yustiyani et al., 2021).

The sources of carbohydrates consumed by all subjects were mainly white rice, instant noodles, wet noodles, or potatoes. Only a few subjects consumed brown rice as a carbohydrate source. The sources of vegetable protein that are often consumed include tempeh, tofu, oncom, peanuts, and soybeans. In addition, animal proteins that are often consumed include chicken liver, nuggets, sausages, chicken, fish, and beef. Even though the subjects' energy, protein, and carbohydrate intakes are still in deficit and must be increased, the choice of food consumed must still be considered. If pregnant women avoid foods that contain high levels of added sugar, such as sweet drinks or snacks, this can contribute to lower infant adiposity (Chen et al., 2017). All participants used palm oil to cook their daily meals. The average intake of palm oil is 26,28 g per person. According to Nahrowi (2015), palm oil is one source of essential fatty acids that is widely consumed by the public. This is because palm oil is relatively inexpensive and easy to obtain.

Palmitic Acid Status

Bonakdar et al. (2019) emphasized that fat intake is not only important at the beginning and end of pregnancy, but also throughout pregnancy. Fatty acids, including palmitic acid, play an important role in infant growth and the development of the central nervous system.

Food processing greatly influences the palmitic acid content of food. This causes the diversity of palmitic acid content in food, making it very difficult to determine the exact palmitic acid intake. In term babies, 13–15% of their body fat consists of palmitic acid, and as much as 45–50% comes from endogenous fetal synthesis (Innis, 2016). Palmitic acid is the most dominant type of saturated fatty acid because it is generally found in animal and human tissues. Palmitic acid intake in pregnant women is the highest intake of saturated fatty acids compared to other saturated fatty acids, at 63,94% (Halimah et al., 2021).

Table 3 showed that the average palmitic acid intake of the subjects was 12,56 g/day. In addition, the average palmitic acid levels in maternal and cord blood were 24,51 g and 19,61 g, respectively. Interestingly, compared with saturated fatty acids, placental plasma membrane binding has a strong preference for long-chain unsaturated fatty acids (LCPUFA), such as arachidonic acid, docosahexaenoic acid, and eicosapentaenoic acid (Duttoray et al., 2020). The human body also synthesizes saturated fatty acids via de novo synthesis, the main products of which are palmitic and stearic acids (Chauvan-Gautam et al. 2018).

Table 3. Palmitic acid status in the maternal intake, maternal blood, and cord blood

Palmitic Acid	n	Value
Palmitic Acid Intake (g/day)	142	12,56 ± 6,07
Palmitic Acid Level in Maternal Blood (g/100 g)	125	24,51 ± 11,96
Palmitic Acid in Cord Blood (g/100 g)	100	19,61 ± 15,63

Table 4 shows that the ten foodstuffs consumed by pregnant women were the highest source of palmitic acid intake. Food ingredients include palm oil, peanuts, instant noodles, cheese, ice cream, avocado, chicken liver, nuggets, coconut milk, grated coconut, and yogurt. Food ingredients that are the highest source of palmitic acid intake come from palm oil (10,77 g/100 g food), peanuts (0,37 g/100 g food), and instant noodles (0,31 g/100 g food). These three food ingredients are derived from vegetable products. Meanwhile, food sources with the lowest palmitic acid intake were nuggets (0,14 g/100 g food), coconut milk grated coconut (0,095 g/100 g food), and yogurt (0,078 g/100 g food).

Table 4. Food consumption and palmitic acid intake in pregnant women

Foodstuffs	Consumption Quantity (g)	Palmitic Acid Intake (g)
Palm Oil	26,28	10,77
Peanuts	0,90	0,37
Instant Noodle	0,75	0,31
Cheese	0,63	0,26
Ice Cream	0,41	0,17
Avocado	0,36	0,15
Chicken's Liver	0,36	0,15
Nuggets	0,34	0,14
Coconut Milk & Grated Coconut	0,23	0,095
Yogurt	0,19	0,078

The food source for palmitic acid intake can be said to be easy to obtain, and the price is relatively cheap, so it is often consumed by subjects. The quality of the fatty acid composition of the diet improved, which was characterized by a decrease in the intake of saturated fatty acids and an increase in the intake of polyunsaturated fatty acids. The results of this study support the epidemiological findings of a reduced risk of cardiovascular disease with the consumption of vegetable protein (Satija et al., 2018).

Pregnant women must pay attention to the intake of saturated fats, particularly those from animal foods. The cooking process must also be considered because many foods are cooked by deep-frying. This cooking method also contributes to an increase in the incidence of degenerative diseases owing to the repeated use of palm oil. This results in the oxidation, hydrolysis, and polymerization of unsaturated fatty acids, leading to the formation of ketones, aldehydes, and polymer compounds (Mulyati et al., 2015). According to Pipoyan et al. (2021), there is an association between trans fatty acid intake and the risk of coronary artery disease and other adverse health effects has been proven. However, many food companies still use them because trans fatty acids are easy to use, cheap to produce, and last for a long time. Trans-fatty acids provide the desired taste and texture of foods. Therefore, dietary recommendations should focus on limiting trans fatty acid intake.

Infant Body Composition

Birth weight is an important indicator of the health status of newborns (Kiserud et al. 2018). Birth weight alone cannot indicate an infant's body composition, but along with the infant's fat mass, it can be a better predictor of future chronic diseases (Kabaran et al., 2015; Pereira-da-Silva et al., 2015). The average birth weight of all the subjects in this study was normal (≥2500 g). Damen et al. (2021) found that the average maternal intake of total fat, saturated fat, and unsaturated fat during pregnancy is related to the newborn's body fat percentage, especially in the second trimester. In line with the findings of Crume et al. (2016), there was a positive relationship between maternal saturated fat intake and neonatal fat mass.

Table 5. Infant body composition

Variable	n	Value
Birth Weight (g)	104	3188 ± 346
Normal (%)	104	99
LBW (%)	104	1
Fat Mass (g)	104	370 ± 168
Normal (%)	104	51
Low (%)	104	49

A study in Singapore showed that medium-chain fatty acids (MCFA) are associated with smaller skinfold thickness in babies (Chia et al., 2020). This occurs because MCFA prevent fat accumulation in adipose tissue by increasing the intrinsic respiratory capacity of mitochondria (Montgomery et al., 2013). This is also in line with prenatal sugar intake, and prenatal/postnatal saturated fat intake is associated with adiposity in offspring (Murrin et al., 2013). The relationship between maternal palmitic acid intake, birth weight, and infant fat mass has not yet been proven because there is still a lack of research examining this matter. The mechanism underlying the relationship between maternal fatty acid intake and infant size has not been fully elucidated. However, if pregnant women lack fatty acid intake, it will hurt birth weight, birth length, and gestational age because the infant's development depends on the mother's supply of essential fatty acids (Smits et al., 2013).

Relationship Between Palmitic Acid Intake and Palmitic Acid Levels With Infant Body Composition

The relationship between palmitic acid intake and palmitic acid levels in maternal and cord blood with birth weight and infant fat mass is shown in Table 6. The results of this study showed that there was no relationship between palmitic acid intake and birth weight or infant fat mass. Apart from that, it was also found that there was no relationship between palmitic acid levels in maternal blood and cord blood with birth weight or infant fat mass. Meher et al. (2016) found that high levels of saturated fatty acids in maternal erythrocytes were found in mothers who gave birth to LBW babies. It is also associated with inadequate transfer of fatty acids through the placenta, thereby contributing to the inadequate growth of the baby. Another study found that an increase in total saturated fatty acids, palmitic acid, stearic acid, and behenic acid in cord blood was associated with lower infant adiposity. In contrast, increased levels of maternal caproic acid, capric acid, and lauric acid are associated with higher infant adiposity (Yustiyani et al., 2021). Yammine et al. (2018) reported that palmitoleic acid and palmitic acid, as biomarkers of endogenous lipogenesis, were positively correlated with body mass index, especially in women.

Although the results of this study are not significantly related, it should be noted that the two indicators are close to significant (approaching p=0,05), namely, the relationship between palmitic acid level in maternal blood and birth weight, as well as the relationship between palmitic acid level in cord blood and infant fat mass. This means that it is very likely that the mother's blood palmitic acid levels can influence birth weight (p=0,089), and it is also very likely that the palmitic acid level in cord blood can influence infant fat mass (p = 0,053). Palmitic acid is also a part of the mother's total energy intake, which influences the increase in the infant's fat mass. This is by research by Crume et al. (2016), who found that infant fat mass at birth is influenced by the source of the mother's macronutrient intake. However, the effect is small (for example, a 100 kcal increase in maternal saturated fatty acid intake is associated with an increase in infant fat mass of 11,1 grams or 4% at birth). Therefore, nutritional interventions during pregnancy have the potential to reduce neonatal adiposity without causing undesirable effects on the neonatal body size or muscle mass.

Yustiyani et al. (2021) showed that there is a correlation between saturated fatty acid levels in cord blood and infant adiposity. The lauric acid level in the cord blood was positively correlated with the triceps skinfold. In addition, myristic acid levels in the cord blood were positively correlated with the percentages of subscapular, thigh skinfold, and fat mass. Based on the results of this study, it can be said that pregnant women do not need to limit their intake of palmitic acid, including the use of palm oil. However, it is necessary to pay attention to the processing of palm oil so as not to increase trans fatty acids, which have detrimental health effects.

Table 6. Relationship between palmitic acid intake and palmitic acid levels with infant body composition

Variable	Birth Weight			Fat Mass		
	n	r	p-value	n	r	p-value
Palmitic Acid Intake	103	0,118	0,234	103	0,142	0,152
Palmitic Acid Level in Maternal Blood	102	0,169	0,089	102	0,067	0,506
Palmitic Acid Level in Cord Blood	100	-0,059	0,560	100	-0,194	0,053

Research results regarding the relationship between saturated fatty acids, especially palmitic acid, and birth weight and infant fat mass are still rare and inconsistent. Therefore, further research needs to be conducted on pregnant women. Approximately 90% of a baby's body fat at birth comes from fat stores during the last ten weeks of pregnancy. The maternal circulation of free fatty acids regulates the provision of fat to the fetus (Pantham et al., 2014; Pantham et al., 2015). The most abundant fatty acid in breast milk is oleic acid, which accounts for approximately 33% of the total fatty acids, followed by palmitic acid, which accounts for approximately 26% (Khor et al., 2021). At birth, 45–50% of full-term infant fat mass is palmitic acid, most of which comes from endogenous synthesis in the fetus. Palmitic acid is often considered a triglyceride component of adipose tissue, but it is also abundant in fat membranes. More recent research has emphasized that palmitic acid is a major metabolic fuel and structural membrane component of lipids, with an important role in protein palmitoylation and palmitoylation signal molecules (Innis, 2015).

Palmitic acid plays an important role in the growth and development of infants. Other research states that saturated fatty acids allow an increase in the transfer of saturated fatty acids from mothers to SGA (small gestational age) babies. This contributes to changes in placental metabolism, which disrupt placental nutrient transport and result in reduced infant growth (Cinelli et al., 2018). Although the results of this study are not significant, research on the effects of palmitic acid on birth weight and infant fat mass should be conducted. It is worth remembering that several previous studies have revealed the role of palmitic acid, which is also related to a baby's health.

Conclusion

There was no significant relationship between palmitic acid intake and palmitic acid levels in maternal blood and cord blood with birth weight or infant fat mass. However, the two indicators were close to significant: the relationship between palmitic acid level in maternal blood and birth weight, and the relationship between palmitic acid level in cord blood and infant fat mass.

There is a need for nutritional education for expectant mothers and pregnant women regarding the importance of maintaining their intake of saturated fatty acids, especially from animal foods. Further research is needed to ensure that the two indicators are close to significant in this study. Further research should be conducted from the first to the last trimester of pregnancy to obtain more comprehensive conclusions.

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