



## The relationship between the ratio of omega-6 and omega-3 consumption with caesarean section

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### ABSTRAK

**Latar Belakang:** Banyak penelitian yang menjelaskan bahwa konsumsi Omega-3 dan Omega-6 selama kehamilan mempengaruhi metode persalinan. Omega-3 dan Omega-6 berhubungan dengan inflamasi dan mempengaruhi kontraksi uterus selama kehamilan di trimester pertama dan ketiga. Prevalensi operasi caesar di 154 negara mencapai 21,1% sedangkan di Puskesmas Bendosari cukup tinggi, mencapai 43%. Caesarean section beresiko terjadinya komplikasi selama dan setelah kelahiran serta meningkatkan biaya persalinan..

**Tujuan:** Tujuan dari penelitian ini adalah untuk menentukan hubungan antara rasio asupan omega-6: omega-3 dan kejadian operasi caesar pada ibu pasca melahirkan di wilayah Puskesmas Bendosari.

**Metode:** Ini adalah studi observasional dengan pendekatan cross sectional. Subjek penelitian terdiri dari 66 ibu pasca melahirkan yang memenuhi kriteria inklusi dan eksklusi, dan dipilih menggunakan metode purposive sampling. Data asupan omega-3 dan omega-6 selama periode kehamilan trimester ke-2 hingga ke-3 diperoleh melalui wawancara menggunakan formulir Semi Quantitative Food Frequency (SQ\_FFQ). Hubungan antara asupan omega-3 dan operasi caesar dianalisis dengan uji Chi-Square ( $P < 0,05$ ), sedangkan uji Fisher's exact digunakan untuk menganalisis hubungan antara rasio asupan omega-6 dan omega-3 ( $P < 0,05$ ).

**Hasil:** Terdapat hubungan antara asupan omega-3 dan rasio antara asupan omega-6: omega-3 dengan operasi Caesar with  $P$ -value 0.03. Ibu yang mengonsumsi omega-3 tinggi memiliki rasio prevalensi 3,6 kali lebih tinggi untuk melahirkan normal dibandingkan dengan ibu yang mengonsumsi omega-3 rendah. Selain itu, ibu yang memiliki rasio yang cukup antara omega-6: omega-3 dalam diet mereka memiliki rasio prevalensi 9 kali lebih tinggi untuk melahirkan normal dibandingkan dengan ibu yang memiliki rasio tinggi antara omega-6: omega-3 dalam diet selama kehamilan. Ibu hamil disarankan mengonsumsi tinggi omega-3 dan cukup rasio omega-6:omega-3 selama kehamilan.

**Kesimpulan:** Ibu yang mengonsumsi omega-3 tinggi memiliki rasio prevalensi 3,6 kali lebih tinggi untuk melahirkan normal dibandingkan dengan ibu yang mengonsumsi omega-3 rendah. Selain itu, ibu yang memiliki rasio yang cukup antara omega-6: omega-3 dalam diet mereka memiliki rasio prevalensi 9 kali lebih tinggi untuk melahirkan normal dibandingkan dengan ibu yang memiliki rasio tinggi antara omega-6: omega-3 dalam diet selama kehamilan.

**KATA KUNCI:** omega-3; omega-6; operasi caesar



## ABSTRACT

**Background:** Many of research explained that Omega-3 and Omega-6 consumption during pregnancy affect delivery method. Omega-3 and omega-5 affect uterus contraction. The prevalence of caesarean section in 154 countries were 21.1%, and 43% in Primary health care. Caesarean section has a risk to get complication during and after parturition also could increase maternity cost.

**Objectives:** The aim of study was to determine the relationship between ratio omega-6: omega-3 intake and the incidence of cesarean section in postpartum mothers in the Bendosari Primary Health Care area.

**Methods:** This was observational study with cross sectional approach. The subjects of the study were 66 postpartum mothers who met the inclusion and exclusion criteria and were selected using the purposive sampling method. Data of omega-3 and omega-6 intake during the 2-3rd semester tri pregnancy period were obtained by interview method using the Semi Quantitative Food Frequency (SQ\_FFQ) form. The relationship between omega-3 intake and caesarean section was analyzed with the Chi-Square test ( $P < 0,05$ ), while Fisher's exact test was used to analyzed the relationship between intake ratio of omega-6 and omega-3 ( $P < 0,05$ ).

**Results:** There was a relationship between omega-3 intake and ratio between omega-6: omega-3 intake with caesarean section with P-value 0.03. The mother who consume high omega-3 had prevalence ratio 3,6 times higher to have normal delivery compared than mother who had low consumption of omega-3. Moreover, mother who had sufficient ratio of omega 6: omega 3 in their diet had prevalence ratio 9 times higher to have normal delivery compared with mother who had high ratio of omega 6: omega 3 in the diet during pregnancy. Pregnant women suggests to consume high omega-3 and sufficient ratio omega-6:omega-3 to prevent risk of caesarean section

**Conclusions:** The mother who consume high omega-3 had prevalence ratio 3,6 times higher to have normal delivery compared than mother who had low consumption of omega-3. Moreover, mother who had sufficient ratio of omega 6: omega 3 in their diet had prevalence ratio 9 times higher to have normal delivery compared with mother who had high ratio of omega 6: omega 3 in the diet during pregnancy

**KEYWORD:** caesarean section; omega-3; omega-6

Article info:

Article submitted on February 2, 2024

Articles revised on May 27, 2024

Articles received on June 19, 2024

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## INTRODUCTION

Pregnancy is the process of the meeting of the egg cell and sperm cell resulting in fertilization. The normal duration of pregnancy is 280 days (40 weeks or 9 months and 7 days) (1). The number of post-term births worldwide ranges from 4-19%, while the prevalence of post-term births in Indonesia is 10% of total birth whereas, the over 42 weeks of gestation is at risk of reduced amniotic fluid level and often requires caesarean delivery (2).

In addition to post-term pregnancy, there is also preterm birth which according to World Health Organization (3) is defined when delivery occurs between 28 weeks and less than 37 weeks of gestation. The prevalence rate of preterm birth in

Indonesia was over 15% and ranks fifth among the highest number of preterm births in the world (3). Moreover, the data from Indonesia Basic Health Research (4) stated that the prevalence of preterm birth in Indonesia is 29.5% of the total birth and it was the fifth highest number of preterm births in the world (5).

According to RISKESDAS (3), the incidence of preterm birth in Sukoharjo Regency, Central Java was 16.59% in 2018. Meanwhile, 43% of babies were born by caesarean section in January 2022 in Bendosari Health care. From the same reference, also mentioned that the prevalence of caesarean section in Indonesia has increased over the years, which has almost doubled from

9.8% in 2013 to 17.6% in 2018. A cohort study conducted in France explained that 61% of pregnant women who give birth by caesarean section were associated with premature cases such as ruptured membranes at gestational age of 24 to 34 weeks (6).

Various studies show that polyunsaturated fatty acids (PUFA), particularly omega-3 and omega-6 are associated with parturition (7). Omega-3 PUFA supplementation from fish oil during last trimester of pregnancy significantly reduce the risk of preterm birth and caesarean delivery by up to 33% in women (8). This study supported by Smuts et al.,(9) that reported increase of length of pregnancy by up to 6 days after supplementation of DHA in pregnant women during third trimester of pregnancy. In-vitro provide the evidence that omega-3 PUFA DHA inhibits the synthesis PGE<sub>2</sub>, one of isomers of Prostaglandin type-2 that can stimulate contractions in amnion cells (10). On the other hand, a clinical study reported that increased intake of omega-6 PUFA Linoleic acid (LA) during pregnancy increases the circulation of prostaglandin type-2 production in mothers and fetuses during childbirth, which can increase the risk of preterm birth in sheep (11). Prostaglandin type-2 can stimulate contractions by increasing the concentration of oxytocin receptor (OXTR) in the uterus, decidua and ovaries in human and animal studies, so that consuming omega-6 might good in late gestation rather than in early gestation (12,13). This theory supported by a study in Korea that showed a high intake of omega-6 during pregnancy has negative relationship with length of labour, thereby increasing the risk of caesarean delivery in the Korean population (14).

Numerous studies shown that omega-3 and omega-6 affect the duration of labour, foetal weight and associated with improvement of severity of preeclampsia. A review-metanalysis study states that omega-3 supplementation effective to prevent preeclampsia in mother with low risk factors (15). However, consuming high level of omega-3 can increase fetal weight which is also a risk of caesarean section (7). Experimental studies in animals such as mice have shown that omega-3 supplementation during pregnancy can increase cellular protein related with communication between cells in the uterine

muscle, thereby potential to increase contraction during labour (16).

Based on the statement above, it is known that low intake of omega-3 during pregnancy is potential to increase the risk of preterm birth. However, omega-6 and omega-3 are fatty acid that can increase contractions through different mechanism at the end of gestation, therefore balance ratio between omega-6 and omega-3 needed to improve contraction during parturition. The high level of caesarean section in Bendosari primary care might correlated with ratio omega-6 and omega-3 intake, however the study about this has not been conducted yet, therefore this study aim was to investigate the relationship between ratio of omega-6 and omega-3 intake with caesarean section in Bendosari Primary Health Care.

The study is necessary due the high caesarean section has not only short-term impact such as infection and bleeding but also caused long term impact such as increased risk of uterine rupture, ectopic pregnancy, abnormal placental placement. In addition, caesarean section is also affect economic and National Health Insurance. According to BPJS (17) reported that the the number of caesarean section case was increased and BPJS payment for caesarean section was enhanced significantly from Rp 42.6 trilliun in 2014 to 108,7 trilliun in 2019. This means that the high rate of caesarean section potential to used much more government money compared than normal delivery. Therefore, knowing about the relationship between ratio omega-6 and omega-3 with caesarean section might give solution to reducing the high rate of caesarean section and reducing government health expanded related with caesarean section. Currently, no one study confirmed the relationship between omega-3 and omega-3 consumption with caesarean section in postpartum women in Indonesia. Therefore, this study will give information for pregnant women and healthcare workers related potential diet to prevent caesarean section during last trimester of pregnancy.

## **MATERIALS AND METHODS**

The research carried out in Bendosari Primary Health Care area. This was observational study with cross-sectional approach. The

purposive sample was used to get the research sample, while the size of sampling was calculated with Solvin formulation with the proportion of caesarean section based on Basic Health Research in year 2018 which was 17.6%, while the d score was 0.10. The 66 postpartum women who met the inclusion criteria such as postpartum women with maximum age of babies were 3 months, not born her baby through caesarean section at their own will, not have headfirst position of baby, did not have short birth intervals before current pregnancy, without concurrent disease such as cancer, HIV and infection that make women deliver their baby with caesarean section were used in this study. The semi quantitative Food Frequency Questionnaire (Semi quantitative FFQ) was used as an instrument to investigate the omega-3 and omega-6 food consumed. Market survey and direct interview using 3 day food-recall questionnaire in 20 samples were conducted as reference tools to collect data of omega-3 and omega-6 source food that often consumed by people in Bendosari area. From market survey and recall 24 hours found that the number of omega-3 sourced was 60, while the number of omega-6 food sources was 69 food. Then FFQ semiquantitative questionnaire has reviewed by expert review. Nutrisurvey application was used

to count omega-3 and omega-6 consumption. Intake of omega-3 categorized as less if the consumption was less than 90% Indonesian dietary allowance (AKG), and sufficient if the intake between 90-90% AKG and high if the consumption  $\geq 119\%$  AKG (18). Meanwhile, the Ratio of omega-6: omega-3 was categorized as sufficient if the ratio  $\geq 1 < 9$  and high if the ratio  $\geq 9$  (19). Pearson chi square was used to investigate the relationship between omega-3 intake with caesarean section, while the relationship between ratio intake of omega-6 and omega-3 with caesarean section was analysed with fisher's exact with significance  $P < 0.05$ . Prevalence ratio was calculated based on Tamhane et al., (20). The Statistic Package (SPSS) version 25 was used to analysed the data. The number of ethical clearance was 4287/B.2/KEPK-FKUMS/2022.

## RESULTS AND DISCUSSIONS

### Characteristic respondent

The data of characteristic of respondent were length of gestation, age, education, salary, job, omega-3 and omega-6 intake. Detail characteristic of respondents could be seen in **Table 1**, while the mean of omega-3, omega-6 intake and ratio omega-6:omega-3 consumption was shown in **Table 2**.

**Table 1. Characteristic respondent**

Variable	Frequency (n)	Percentage (%)
Length of Gestation		
<37 weeks	5	7.6
37-40 weeks	56	84.8
>40 weeks	5	7.6
Delivery Method		
Normal	37	56.1
Caesar	29	43.9
Age		
No risk (20-35 yo)	49	74.2
risk < 20 y.o and >35 y.o)	17	25.8
Education		
Basic (Elementary – junior high school)	22	33.3
High (Senior high school-collage)	44	66.7
Job		
Working	21	31.8
Not working	45	68.2
Salary		
Less than minimum wage of Sukoharjo (< Rp. 2.100.000)	49	74.2
More than minimum wage of Sukoharjo ( $\geq$ Rp 2.100.000)	17	25.8
* minimum wage of Sukoharjo is according to Central agency statistic on Sukoharjo year 2023		

Variable	Frequency (n)	Percentage (%)
Omega-3 Intake		
Less	16	24.2
Sufficient	27	40.9
High	23	34.8
Omega-6 Intake		
Sufficient	15	22.7
High	51	77.3

Most of the respondent's age were 19 until 49 years old postpartum women with earnings less than minimum wage in Sukoharjo. The number of women who had normal delivery was 56.1%, while the number of women who got caesarean section was 43.1%. Moreover, only 5% of respondents had a length of pregnancy of less than 37 weeks and more than 40 weeks (21). The research shown that more than 70% of respondents consume high amount of omoga-6 compared that Indonesian Dietary allowance (AKG), while only 34.8% postpartum woman consumed high omega-3 that over than AKG.

The characteristic of the respondent's data shows that more than a half respondent was consumed higher amount of omega-6, while only

40.9% respondents ate sufficient amount of omega-3. However, low consumption or co-supplementation with omega-3 decreased level of inflammatory indicators, whereas, increased of inflammatory indicator might lead to increase preterm birth in pregnant women ( 22; 23). Omega-6 source mainly from nuts, while the highest source of omega-3 are fish. Statistics data from the ministry of marine and Fisheries shown that the consumption of fish by Indonesian population is generally low at only 22.37 kg per capita per year (24). Rahmawaty et al., (25) mentioned that price is one of the main barrier to consumption fish in Australia and the same reason potential occurs in Bendorari Sukoharjo.

**Table 2. The omega-3, omega-6 and ratio omega-6:omega3 consumption**

Consumption	Minimum (mg/day)	Maximum (mg/day)	95% CI		Median (mg/day)	Mean±SEM (mg/day)
			Lower Bound	Upper Bound		
Omega-3	876	3164	1459.64	1714.60	1478.500	1587.12±63.83
Omega-6	9900	58060	22847.99	27791.19	24890.00	25319.69±1237.64
Omega-6:omega-3	5	40	15.32	19.14	15.500	17.23±0.96

The **Table 2** shows that the mean consumption of omega -3 was 2.11 mg/ day, while the omega-6 was 2.77 mg/day. The average consumption of omega-3 already fulfilled omega-3 recommendation for pregnant women, whereas daily adequate intake of omega-3 based on Trumbo et al., (26). Furthermore, median daily intake pregnant woman in Urban area Jakarta was 0.82 gr/day, while in this study mentioned that the median of daily intake of omega-3 in postpartum woman was 1.5 gram/ day (27) and the average of omega-3 consumption of pregnant women at trimester 3 in Puskesmas Cadasari Padeglang was 1.2 gr/day , which indicated that the pregnant women in Bendorari might consumed higher omega-3 compared than pregnant women in

Urban Jakarta and puskesmas Cadasari Padeglang.

The study mentioned that the average daily intake of omega-6 was 25 gr/day. The result of study was lower compared than daily intake of pregnant women in third trimester in 4,61 gram, while Indonesia Recommendation of omega-6 consumption for pregnant woman (AKG) was 14 gr/day (28). Furthermore, the ratio of omega-6 :omega-3 was 17 gr/day which higher compared Rocha et al., (19) which mentioned that recommendation of omega-6:omega-3 intake was 9:1 and higher intake of the ratio of omega-6 :omega-3 increased risk to get postpartum depression after childbirth.

### The relationship between omega-3 consumption with caesarean section

The number of postpartum women who ate high omega-3 during pregnancy and had normal delivery was 3 times higher compared that

the women who ate high omega-3 and had caesarean section delivery. The detail of relationship between omega-3 consumption with incidence of caesarean section have shown in **Table 3**.

**Table 3. Correlation of micronutrient intake with incidence of protozoa infection**

Omega-3 Intake	Delivery method				Total	p-value	PR
	Normal		Caesarean section				
	n	%	n	%			
Less	8	21.6	8	27.6	16	0.03	3.6
Sufficient	11	29.7	16	55.2	27		
High	18	48.6	5	17.2	23		
<b>Total</b>	<b>37</b>	<b>56.1</b>	<b>29</b>	<b>43.9</b>	<b>66</b>	<b>100</b>	

Intake of omega-3 has a correlation with incidence of caesarean section with P-value: 0.03. Table 3 indicates that 48% of postpartum women with a higher intake of omega-3 had normal delivery, while only 5% of them had caesarean section. Furthermore, based on Prevalence ratio test, the mothers with higher intake of omega-3 have 3,6 times higher risk to have normal delivery. This study in line with Review study conducted by Cetin et al., (29) showed significant reduction in early preterm birth and preterm birth in the Germany pregnant women group with low level of omega-3 supply in blood. In addition, review study conducted by Akerele and Cheema (30) also mentioned that omega-3 improves maternal and neonatal health outcomes by modifying gestation length which necessary for uterine contraction and prevent caesarean section. Omega-3 have the highest effect to increase membrane fluidity, therefore it potential to influence function and composition where many protein signalling abundance. Thus, omega-3 increases redistribution and translocation the protein cellular such as Cav-1, Cx-43 which potential to increase contraction during labour through enhance communication between cell ( 31;32). Furthermore, another study provide evidence that omega-3 EPA and DHA binding with PPAR  $\alpha$  then decreases mRNA expression of IL-1  $\beta$  and TNF  $\alpha$  suggesting that omega-3 can control inflammatory

cytokine that could play a role in the pathophysiological mechanism behind dysfunction labour in maternal obesity (33).

### The relationship between ratio omega 6 and omega-3 (omega-6: omega 3) consumption with Incidence of Caesarean Section.

Table 4 shows the correlation between ratio omega-6 and omega-3 intake with caesarean section in Bendosari primary health care. There was same frequency of respondents that consumed over ratio of omega-6 and omega-3 and deliver her baby with normal method and caesarean section.

From **Table 4** illustrated that the number of mothers who consumed sufficient amount of omega-6 : omega3 and delivered her baby with normal method were 13% higher compared than the mother who ate sufficient amount of omega-6:omega3 and had caesarean section. The current study showed that there was a correlation between the omega-6 : omega-3 intake with caesarean section with P value = 0.03. Prevalence ratio analysis mentioned that mothers who have sufficient amount of omega-6 : omega-3 intake have 9 times higher prevalence ratio to have normal delivery compared that mothers who ate over omega-6 : omega-3.

**Table 4. The correlation between ratio omega-6 and omega-3 intake with caesarean section**

Ratio (omega-6:omega3) intake	Delivery Method				Frequency (n)		p-value	PR
	Normal		Caesarean section		n	%		
	n	%	n	%				
Sufficient	9	13.6	1	1,5	10			
High	28	42.2	28	42.4	56		0.03	
<b>Total</b>	<b>37</b>	<b>56.1</b>	<b>29</b>	<b>43.9</b>	<b>66</b>	<b>100</b>		

The characteristic of the respondent's data shows that more than a half respondent was consumed higher amount of omega-6, while only 40.9% respondents ate sufficient amount of omega-3. Omega-6 source mainly from nuts, while the highest source of omega-3 are fish. Statistics data from the ministry of marine and Fisheries shown that the consumption of fish by Indonesian population is generally low at only 22.37 kg per capita per year (24). Studies suggests that omega-3 and omega-6 compete to use desaturase and elongate enzymes to add carbon or double carbon chains to their structure, thus affecting the amounts of omega-3 derivatives such as eicosapentaenoic acid (EPA), alpha linolenic acid (ALA) and Docosahexaenoic acid (DHA) also omega-6 derivatives such as AA in cell membranes (25). The proportion of fatty acids in the diet affects PUFA composition in the cell membrane, and this will correlate with the level of prostaglandins synthesised since the precursors for prostaglandin type 2 (AA) compete for the same enzyme systems for metabolism (34). A study explained that decreased production of prostaglandin type-2 in cultured decidual cells that had been preincubated with DHA and EPA, and that these fatty acids might inhibit myometrial contraction and decrease the incidence of preterm birth (35). Therefore, the different composition of omega-6 and omega-3 a might be associated with plasma prostaglandin type-2 production and might contribute to method of parturition.

Based on Prevalence ratio test, the mothers with higher intake of omega-3 have 3,6 times higher risk to have normal delivery. This finding is consistent with s review study conducted by Serra et al., (36) that mentioned that omega-3 supplementation, especially DHA can increase gestational length and prevent preterm birth by up

10%. The same review study also suggests that omega-3 supplementation can reduce the risk of preeclampsia by up to 13%. Clinical trials in pregnant women and meta-analysis study have also shown that adequate omega-3 consumption can reduce the risk of prolonged labour (37). This is in line with a study conducted by Mustikaningrum (16) that stated a high omega-3 diet during pregnancy improves the protein expression CX-43 and Cav-1 which could help contraction by enhancing communication between cell in the myometrium during labour in obese pregnant rat, thus could potential prevent caesarean section.

This result supported by many studies that omega-3 play an important role as anti-inflammation molecules that can prevent rupture in placenta particularly in mid and early trimester, thus indicate that omega-3 could prevent preterm birth (7). A Study also suggests that omega-, particularly DHA and ALA affect membrane permeability cells by enhance permeability cell membranes in myometrium that lead to increase intracellular signalling from cellular proteins such as connexin, MAPK and PKC which can stimulate contractions during labour, then potentially reduce the incidence of caesarean section (38).

Furthermore, omega-6 also needed during labour, whereas, sufficient amount of omega-6 especially arachidonic acid (AA) have an important role to activate cyclooxygenase (COX-2) enzyme that help to produce prostaglandin type-2, a hormone that increase myometrium contraction in the human and animal study (35,39 ). This theory supported by Elmes et al., (40) that proved the evidence that consumption of Linoleic acid (LA) omega-6 in late pregnancy can enhance placental Prostaglandin production in ewes and may thus increase risk of preterm birth. The same

theory potential happen in human. Omega-6 consumption also help to increase myometrium contraction during parturition in ewes. Amira et al., (41) explained that a high ratio omega-6: omega-3 significantly increased the level of AA in the plasma and potentially increased the risk of preterm birth. Therefore, the consumption of omega-6 and omega-3 ratio should be sufficient to support normal delivery or to prevent caesarean section.

This study figure out that high omega-3 consumption and sufficient amount of ratio between omega-3 and omega-6 are important to prevent dysfunctional labour that lead to caesarean section. Omega-3 play an important role as antiinflammation and have the highest effect on fluidity membrane, so that it could help abundance of protein cellular that play a pivotal role in contraction and prevent from caesarean section. However, the bigger sample of study needed for future study to figure the effect of omega-3 on caesarean section more accurate. Furthermore, this study yet analyse the number of omega-3 and omega-6 diet in pregnant women plasma that more accurate to see the omega-3 actual consumption. Moreover, cellular study of omega-3 effect in uterus will needed for future study to see the effect of omega-3 in caesarean section.

#### CONCLUSIONS AND RECOMMENDATIONS

There was a correlation between omega-3 consumption, also omega-6: omega-3 consumption with incidence of caesarean section in Bendosari Primary Health Care area with P-value < 0,05. The mother who ate sufficient amount omega-6: omega-3 intake has 9 times higher prevalence for normal delivery compared that mother who ate over number of omega-6: omega-3. Despite of the number of omega-6 and omega-3 consumption, the type of omega-3 especially DHA, EPA ALA and omega-6 particularly LA and AA affects myometrium contraction, so further study could investigate the potential relationship between type of omega-3 and omega-6 PUFA with delivery method. In addition, further research is needed to investigate the relationship between omega-3 and omega-6 consumption and the incidence of preterm birth and preeclampsia

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