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Evaluation of Maternal Polyunsaturated Fatty Acid Status and Its Association with Birth Outcomes

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Abstract

The present study examines the potential role of the Maternal Polyunsaturated Fatty Acid profile in fetal growth by investigating the association between maternal concentrations of these fatty acids in the gestation stage and birth outcome measures (birth weight, birth length, and head circumference at birth). The study covered (255) women with a mean age of 29.22 ± 5.29 years. Half of them had a Bachelor's degree or higher, and most of them were unemployed. The author used a questionnaire for data collection. The level of fatty acids was not correlated with pregnancy outcomes such as weight, height, and head circumference. A significant positive correlation between total MUFAs and gestational age was established. There was a positive correlation between the level of total n-3 PUFA and gestational weight gain. There was also a positive correlation between nutritional knowledge and the amount of fish consumed during pregnancy. However, no correlation was found between the consumption of fish and pregnancy outcomes. This study has demonstrated preliminary results regarding the level of polyunsaturated fatty acids in pregnant women and pregnancy outcomes that can help evaluate the current or future pregnancy preventative programs when planning reproductive health programs.

Keywords: Maternal, Polyunsaturated Fatty Acid, Birth Outcomes.

Introduction

Of the twenty or so fatty acids, only two cannot be formed by the body - omega-6 and omega-3 fatty acids as they must be absorbed from the mother to the fetus through the placenta. Omega-6 fatty acids can be found in many sources, such as vegetable oil, processed foods, as well as various condiments, e.g. salad dressing. One teaspoon of corn oil can fulfill the daily omega-6 requirement. However, most people consume around 10 to 20 times more than the required daily intake. On the other hand, the intake of omega-3 fatty acids is suboptimal. One of the richest naturally occurring dietary sources of omega-3 fatty acids are fish oil supplements, fish, and vegetable oils like flaxseed (57% omega-3 fatty acids content), canola (11% omega-3 fatty acids), and soybean (8% omega-3 fatty acids content). These fatty acids compete for the enzyme system cyclooxygenase (Greenberg et al., 2008).

There are two types of essential fatty acids (EFAs): Omega-3 fatty acids (*n*-3 FAs) and omega-6 fatty acids (*n*-6 FAs). Both types originate from lipids ingested in the diet because they cannot be synthesized naturally in the body (Meyer et al., 2003). While *n*-6 FAs are abundant in foods, including cereal grains, processed foods, meat, milk, eggs, and some vegetable oils, *n*-3 FAs are found in a significant quantity in a few seeds and nuts, as well as in fish oil only.

Maternal fish consumption during pregnancy has been suggested to affect pregnancy and birth outcomes (Heppe et al., 2011). Clinical research has shown that DHA intake during pregnancy improves visual and motor skills (Innis, 2007). Maternal intake of at least 200 mg DHA per day throughout gestation is recommended to support a healthy pregnancy to prevent maternal depletion of DHA and to meet the increased fetal demands of 67 mg DHA per day during the third trimester, which is considered a period of rapid fetal growth (European Food Safety Authority, 2010; U.S. Department of Health and Human Services, 2016).

Omega-3 fatty acids with shorter chains "α-linolenic acid (ALA)" are an important component of diets as they are naturally found in many plants that are commonly consumed. They do not deliver the health benefits that EPA and DHA provide, although it is likely for the body to transform ALA to EPA and DHA by elongase and desaturase enzymes. The study proposes that only a minor amount can be created in the body through this method (Akerele and Cheema, 2016)**.** For example, Chiu et al. (2008) suggested that only ~2 to 10% of ALA is converted to EPA or DHA. Other studies concluded that less amount is converted (about 7% for EPA), but only (0.013%) for DHA (Goyens et al., 2005)**.** Another study found an ALA conversion of only 0.3% for EPA and <0.01% for DHA (Hussein et al., 2005). Maternal nutrition plans have always emphasized that a diet should include sufficient caloric and protein requirements. Currently, fatty acid importance is being recognized (Orr et al., 2013) because EPA and DHA supplementation during pregnancy has been linked with multiple benefits for the infant. During pregnancy, the placenta transfers nutrients, including DHA, from the mother to the fetus (Le Donne et al., 2016).

There is a correlation between the amount of omega 3 fatty acid consumed by the mother and the levels of omega-3 fatty acid in the fetus (Dunstan et al., 2008). The dietary guidelines of the 2010 U.S. Department of Health and Human Services (2016) recommend that pregnant or breastfeeding women should "consume 8 to 12 ounces of seafood per week from a variety of seafood types"**.** This is equivalent to 300–900 mg EPA+DHA per day. During the third trimester, large amounts of DHA accumulate in fetal tissue.

The two most permeated fetal areas include the retina and brain, which correlate with regular eyesight and brain function (Mozurkewich & Klemens, 2012)**.** EPA and DHA supplementation during pregnancy has been linked with longer gestation and their increased concentrations in fetal tissues (Le Donne et al., 2016). However, prematurity is the cause of various infant illnesses and can lead to death (Ahmed & Tseng, 2013).

Several studies were conducted to investigate EPA and DHA intake during pregnancy and its association with longer gestation. Results indicate that EPA and DHA supplementation during pregnancy delayed delivery to term or closer to term. On the contrary, supplementation does not correlate with a delayed delivery to the point of being post-term (Heppe et al., 2011)**.**

Olsen and Secher (2002) reported that low consumption of fish was a strong risk factor for preterm delivery and low birth weight. Women who do not consume a sufficient amount of fish or its products can consume small amounts of n-3 fatty acids provided as fish oil supplements to provide protection against preterm delivery and low birth weight. Studies reporting dietary intake of n-3 fatty acids in pregnant women in Saudi Arabia are limited.

A retrospective study was carried out on 300 women during their postpartum period. An incomplete intake of the daily requirement of the different food groups was observed among Saudi women. The meat group was inadequately taken by more than four-fifths of Saudi women, 50% of them increased their chicken intake during the postpartum period and only 24% of them increased their intake of red meat and fish prepared in a unique Saudi Arabian way such as Mazby and Mandy (Hafez & Yakout, 2010)**.** In another study, AL-Numair et al. (2005) reported that the food consumption pattern providing n-3 FAs differs by location and that coastal residents consume as twice as much n-3 FAs as internal residents. Thus, nutrition education intervention among internal residents is needed to increase the consumption of n-3 FAs.

A prospective cohort study was conducted from early pregnancy onwards in the Netherlands. It assessed the associations of first-trimester seafood, such as lean-fish, fatty-fish, and shellfish consumption with fetal growth characteristics in the second and third trimesters. The findings suggested that low fish intake, consumption of lean-fish, fatty-fish, or shellfish in the first trimester is not associated with fetal growth or the risks of neonatal complications (Gaillard et al., 2014).

The current body of evidence suggests that the early life environment quality of the fetus can affect the probability of future disease risk. The present study concludes the same finding. Moreover, some studies of the literature explain the relationship between the profile of plasma fatty acid in pregnant women and their association with pregnancy outcomes in Saudi Arabia.

Materials and Methods

***Study Area*:** The study covers healthy pregnant women from the Department of Obstetrics and Gynecology at King Abdul Aziz Hospital, Al-Ahsa.

Inclusion criteria:

- Participants included in the study are pregnant women aged 20-40.
- Delivering at term (total gestation >= 37 weeks).
- They have no obstetrical or medical complications.

Exclusion criteria:

- Pregnant women with medical difficulties, such as multiple gestation.
- Chronic hypertension.
- Type I or type II diabetes mellitus, alcohol or drug abuse, seizure disorder, preeclampsia, renal or liver disease, gestational diabetes, and anemia are excluded from the study.

Study Design: *A hospital-based, cross-sectional study design is employed. A survey is used to measure the level of polyunsaturated fatty acids omega-3 for pregnant women at the end of the ninth month of pregnancy. Blood samples are collected immediately after birth at King Abdul Aziz Hospital in Al-Ahsa and compared to pregnancy outcomes**.***

Sample Size*: The study includes a randomized sample of pregnant women with medical appointments at King Abdul Aziz Hospital in Al-Ahsa for 6 months. They have the following conditions: They were aged 20-40 years. They are 255 women who did not suffer from any health problems from October 2017 to March 2018.*

Sampling Technique:

The study surveys (outpatient clinics, maternity rooms, lab, patient rooms) of King Abdul Aziz Hospital in Al Ahsa, Saudi Arabia.

- It includes a random sample of pregnant women attending the King Abdul Aziz Hospital in Al-Ahsa for 3 months, which are subject to the following conditions:

1)The age ranges 20-40 years.

2)They are at the end of the ninth month of pregnancy.

3) The size of the sample is 255 women.

4) They do not suffer from any health problems.

5)Blood samples are collected immediately after birth and compared to the results of pregnancy.

- Medical history was taken, the physical examination was done, and basic laboratory tests were drawn.

- Data were collected through a face-to-face interview and a structured questionnaire. The questionnaire includes information about socio-demographic characteristics. The obstetrical history of the participants was obtained, including a history of spontaneous or therapeutic abortions, stillbirths, and low birth weight babies. Pregnant women were administered with a food frequency questionnaire (FFQ) at delivery to estimate the frequency of consumption of foods rich in omega-3 fatty acids modified from (Reaburn et al., 1979; Chee et al., 1996). They should specify the regularity of each food consumed. The questionnaire was pre-tested on 5% of the sample size among hospital attendees who were not included in the study a week before the actual data collection. Moreover, appropriate changes were made according to the feedback received.
- At delivery, (5mL) blood was collected from the subjects into (EDTA) tubes. All blood samples were immediately centrifuged at 3000rpm for 15min to separate the plasma and erythrocytes. The samples were stored at -80 degrees celsius until further analysis.
- Baby length, head circumference, birth weight, and chest circumference were recorded. A digital measuring scale was used to record birth weight with an accuracy of 10gm, and a portable infantometer was used to measure the length which was measured to the nearest 0.1cm. Moreover, a fiberglass measuring tape was used to measure the head. It was placed around the head just above the eyebrows anteriorly, around the most prominent bulge posteriorly, and around the lower chest (Health Resources and Services Administration, 2000).
- Gas chromatography was used to analyze LCPUFA from the plasma samples as described by (Ren et al., 2013).
- Measurements were performed by trained nurses in a hospital clinical setting.

Data Collection methods, instruments, and measurements

1. **Dietary assessments:** Data were collected through a face-to-face interviewer-administered structured questionnaire. The questionnaire includes information about socio-demographic characteristics. The obstetrical history of the participants was obtained, including a history of spontaneous or therapeutic abortions, stillbirths, and low birth weight babies. Pregnant women were administered with an FFQ at delivery to estimate the frequency of consumption of foods rich in omega-3 fatty acids modified. They all had to specify the regularity of each food consumed. The questionnaire was pretested on 5% of the sample size among hospital attendees who were not included in the study a week before the actual data collection. Additionally, appropriate changes were made according to the feedback received.
2. **Sample collection and processing:** At delivery, (5mL) blood was collected from the subjects into (EDTA) tubes. All blood samples were immediately centrifuged at 3000rpm for 15min to separate the plasma and erythrocytes. The Plasma was stored at -80°C until further analysis.

- **Fetal growth measures:** Baby length, head circumference, and birth weight were recorded. A digital measuring scale was used to record birth weight with an accuracy of 10gm, and a portable infantometer was used to measure the length which was measured to the nearest 0.1cm. Moreover, a fiberglass measuring tape was used to measure the head and chest circumference. It was placed around the head just above the eyebrows anteriorly, around the most prominent bulge posteriorly, and around the lower chest.

3. **Measuring the level of fatty acids in plasma blood:** Blood samples were collected for women in the case of fasting. The author separated 10 ml of red blood cells from the plasma using the centrifuge and analyzed fatty acids of plasma. Fatty acids were separated using GC gas chromatography (Brantsæter et al., 2012).

Data Analysis: Data were entered into Excel file then exported to PASW statistics 17 (SPSS), Inc., Chicago, IL, USA) version 21 statistical packages for analysis with a p-value <0.05 that was considered as statistically significant. To study the relationship between the level of fatty acids, many non-saturation of blood and birth outcomes of the newborn (head circumference, weight, height, and gestation) were considered. The multiple linear regression was estimated. The study variables, such as age, height, BMI, level of education, number of births, and food intake from omega-3 were identified (Lee et al., 2018).

Results

1- Socio-demographic characteristics

Table (1) illustrates the socio-demographic characteristics of the participating parents. For example, the mean age of mothers was 5.29±29.22. They were mainly unemployed (79.6%) and had a university or postgraduate (51%). On the contrary, secondary education was the highest attained educational level of the fathers, rating (54.5%). The monthly income of most participants was SR 6,000-10,000 rating (42.7%).

Table 1. Socio-demographic characteristics (n= 255)

Socio-demographic characteristics	**Mother n%**	**Father n%**
Age (years) (M± SD)	5.29±29.22	-
Employment status		
Employed	52(20.4)	246 (96.5)
Unemployed	203 (79.6)	9 (3.5)
Educational level		
Illiterate	3 (1.2)	0
Primary	8 (3.1)	7(2.8)
Intermediate	25(9.8)	20 (7.8)
Secondary	89 (34.9)	139 (54.5)
University or postgraduate	130 (51.0)	89(34.9)
Monthly income		
Less than SR 3,000	9(3.6)	
SR 3,000-6,000	60 (23.5)	
SR 6,000-10,000	109 (42.7)	
More than SR 10,000	77(30.7)	

2- Nutritional awareness of omega-3

The participants' nutritional awareness of omega-3 was measured by posing some questions on the awareness of omega-3, as well as its resources, and importance to the proper embryonic development. Their awareness rated 4.65±11.56. The items of "Omega-3 reduces the chances of low-birth-weight infants" and "Omega-3 protects the suckling mother from postpartum depression" were ranked first among the "no" respondents and rated (67.8%). Their responses to "pregnant women should eat 2–3 meals of fatty fish per week" and "Omega-3 motivates the optimum development of the child's eyesight" were rated (66.7%) and (63.9%), respectively (Table 2).

Table 2. Nutritional awareness of omega-3 (n= 255)

Items	Frequency		
	Yes n%	**No n%**	**Neutral n%**
1. Have you ever heard about omega-3?	145 (56.9)	13 (5.1)	97 (38.0)
2. Fatty fish, e.g. (sardines, mullet, salmon, tuna, shrimp, oysters, squid, and crab) are high in Omega-3.	107 (42.0)	23 (9.0)	125 (49.0)
3. Omega-3 is key in the proper brain development and mental abilities of the child.	54 (21.2)	50 (19.6)	151 (59.2)
4. Omega-3 protects the suckling mother from postpartum depression.	23 (9.1)	59 (23.1)	173 (67.8)
5. Omega-3 motivates the optimum development of the child's eyesight.	36 (14.1)	56 (22.0)	163 (63.9)
6. Omega-3 reduces the chances of low-birth-weight infants.	26 (10.2)	56 (22.0)	173 (67.8)
7. Pregnant women should eat 2–3 meals of fatty fish per week.	40 (15.7)	45 (17.6)	170 (66.7)
(M± SD)	4.65±11.56		
High awareness	154 (51.7)		
Moderate awareness	61 (23.9)		
Low awareness	40 (60.4)		

Table 3. Anthropometric measurements of infants (n= 255)

Anthropometric measurements (M± SD)	
Weight (kg)	1.93±3.25
Height (cm)	3.01±50.70
Head circumference (cm)	1.92±34.10
Length of pregnancy (weeks)	1.27±38.85
Length of pregnancy(days)	2.15±1.76
Date of delivery n%	
<37 weeks	**33(12.9)**
≥ 37 weeks	**222(87.1)**
Gender n%	
Females	**127(49.8)**
Males	**128(50.2)**

3 Anthropometric measurements of infants

Table (3) shows the anthropometric measurements of infants, including the length of pregnancy, weight, height, head circumference, and gender. They were equal for both males and females. The mean weight was 1.93±3.25 kg, the height was 3.01±50.70 cm, and the head circumference was 1.92±34.10 cm. The date of delivery (<37 weeks) was rated (12.9%).

4 The fatty acid blood level

After injection with gas chromatography, 17 cases were excluded (7 cases were not prepared accurately at the extraction stage, 5 cases have low acids, and 5 cases were injected incorrectly). Accordingly, the total sample comprises 238 cases.

Table (4) shows the mean fatty acid blood level among the participants. They were divided into saturated fatty acids (SFA), monounsaturated fatty acids (MUFA), and n-6/ n-3 polyunsaturated fatty acids (PUFA). The means of SFA, MUFA, and n-6 / n-3 PUFA were (4.37±26.86 mg/ml), (3.10±25.35 mg/ml), (4.52±22.41 mg/ml), and (0.63±1.34), respectively.

Table 4. The mean fatty acid blood level (n= 238)

Fatty Acid Blood Level (mg/ml) (M± SD)	
SFA	
C12:0	0.13±0.03
C14:0	0.35±0.77
C16:0	3.44±20.83
C18:0	1.26±4.72
C20:0	0.40±0.38
C22:0	0.18±0.08
Total SFA	4.37±26.86
MUFA	
C12:1	0.83±2.37
C14:1	0.14±0.34
C16:1	0.81±2.11
C18:1 n-9	3.66±16.77
C22:1 n-9	1.43±4.06
Total MUFA	3.10±25.35
n-6 PUFA	
C18:2 n-6	3.40±16.38
C20:2 n-6	0.18±0.88
C20:3 n-6	0.45±1.41
C20:4 n-6	1.35±4.52
Total n-6	4.52±22.41
n-3 PUFA	
C18:3 n-3	0.65±0.64
C22:6 n-3	0.48±0.69
Total n-3	0.63±1.34
n6/n3	12.53±19.75

5 The correlation between fatty acids and pregnancy outcomes

Pearson test was adopted to study the correlation between the fatty acid blood level, pregnancy outcomes, and nutritional awareness among the participants. The results showed no correlation between having fatty acids (n-3 PUFA, n-6 PUFA, MUFA, and SFA), and the weight, height, and head circumference of the infant (appendix 13). However, there was a statistically significant positive correlation ($r=0.129$, $P<0.05$) between having MUFA and the length of pregnancy.

Discussion

1. Socio-demographic characteristics

The mean age of the participants was (5.29±29.22) which matches many previous studies on the ratio of having omega-3-rich fish and the effect on pregnancy outcomes (Mirsanjari et al., 2012; Leventakou et al., 2014; Lee et al., 2018). Although most of the participants had a university or postgraduate (51%), only (20.4%) were employed. Only (38.2%) of Saudi women are employed (Ministry of Labor and Social Development, 2016). The monthly income of most participants was SR 6,000-10,000 rating (42.7%). This ratio is less than the results of the national survey, which showed that the monthly salary of the Saudi family in the Eastern Province is SR 16,605 (General Authority for Statistics, 2018).

2. Nutritional awareness of omega-3

The results showed that about two-fifths (38%) of the participants have not heard about omega-3, and half of the participants do not know about the sources of n-3. While (21.2%) of the participants were aware that "Omega-3 is key in the proper brain development and mental abilities of the child", (63.9%) did not know that "Omega-3 motivates the optimum development of the child's eyesight and retina". These findings did not match the results of the studies on pregnant women's knowledge regarding the importance of long-chain omega-3 polyunsaturated fatty acids (LC n-3 PUFA). Sinikovic et al. (2009) surveyed a hundred and ninety pregnant women and reported that (56%) of the participants were aware of the importance of omega-3 for the baby's brain development and (30%) demonstrated knowledge of its other benefits. On the contrary, (14%) could not recall the importance of this fatty acid. Lim et al. (2018) surveyed (88) pregnant women and showed that while (84.3%) of the participants declared knowledge of the importance of having omega-3 and omega-6 for the development of the brain and retina of the fetus, (5.7%) knew nothing about this issue. The results showed that (67.8%) of the participants did not know that "Omega-3 protects the suckling mother from postpartum depression" and "Omega-3 reduces the chances of low-birth-weight infants". Coletta et al. (2010) recommended having the supplements of omega-3 to reduce premature births because it affects the length of pregnancy and premature births.

No agreement was concluded regarding the prevention of maternal depression. Therefore, further studies should be conducted. Sinikovic et al. (2009) reported that (55%) of the participants were aware of issues regarding risks and benefits of eating fish during pregnancy, while (20%) of women answered ‘not sure’ and (25%) reported they were not aware at all. This finding contradicts our study that (66.7%) of the participants did not know that a pregnant woman should eat 2–3 meals of fatty fish per week. Coletta et al. (2010) recommended that a pregnant woman should eat 2–3 meals of fish and seafood weekly.

In general, the results showed that the low, moderate, and high awareness of n-3 rated (60.4%), (23.9%), and (15.7%), respectively. Therefore, (7.1%) of the participants had n-3 supplements only. This finding disagrees with the results of Lim et al. (2018) that showed that (63.6%) demonstrated good knowledge and (31.8%) showed moderate knowledge. Because (58%) of the participants were employed, they have better access to the Internet, books, and journals to obtain information and exchange experience.

Nutritional awareness generally related to many factors, such as economic status and educational level. Mirsanjari et al. (2012) investigated the relationship between nutritional knowledge, healthy attitude, and practice during pregnancy. They showed that the high nutritional knowledge of the participants was largely related to the choice of healthy food (dinner and lunch), drinks, infrequent snacks, and consumption of vitamin and mineral supplements. These findings show that high knowledge motivates having better healthy food, especially fruit, vegetables, and unsaturated fat. Awareness of healthy food habits is raised by having new information that may cause a change of attitudes and improves nutritional behavior (O'Brien & Davies, 2007; Verbeke, 2008).

3. Anthropometric measurements of infants

The results showed that the mean weight, height, and head circumference were in the normal range of Saudi society. They were compared with the national development curves (El-Mouzan et al., 2007). These findings match those of Le Donne et al. (2016) who investigated the effect of fish oil on pregnancy outcomes among (114) women in Italy. Moreover, the date of delivery (<37 weeks) was rated (12.9%). No data were obtained about premature births (before 34 weeks) as illustrated (Imhoff-Kunsch et al., 2012).

4. The fatty acid blood level

The results showed that the means of SFA, MUFA, and n-6 / n-3 PUFA were (4.37±26.86 mg/ml), (3.10±25.35 mg/ml), (4.52±22.41 mg/ml), and (0.63±1.34), respectively. This finding contradicts the results of Lee et al. (2018) that surveyed (1407) pregnant women in South Korea. They reported that the means of SFA, MUFA, and n-6 PUFA rated (9.99±14.78), (11.15±16.60), and (6.34±10.73), respectively. Omega-3 was (1.45±1.47). The contradicting findings may be discussed in terms of the different geographical locations, food habits, or different measurements of fatty acid blood levels.

Similarly, the level of omega-3 was close to the findings of Meher et al. (2016) that examined (111) pregnant women whose fatty acid level was measured through blood and umbilical cord and reported that SFA, MUFA, n-6 / n-3 PUFA were (3.09±34.55), (2.40±18.29), (5.01±38.78), and (0.67±1.90), respectively. The agreement with this study may be due to the small sample, although the study was conducted in India, which is a coastal country and uses fish as a food. However, n-3 was lower than n-6.

5. The correlation between fatty acids and pregnancy outcomes

The results showed no correlation between PUFA (e.g. n-3) and pregnancy outcomes, such as weight, height, and head circumference of the infant. This result matches the findings of similar studies, including Rogers et al. (2004) in the United Kingdom, Muthayya et al. (2009) in India, and Lee et al. (2018) in South Korea. This finding may be due to the relatively low n-3 having by the participants. For example, the means of having fatty fish (the source of n-3) was 14.25 gm/month in comparison to (3-4 gm/day) in India, (32.8 gm/day) in the United Kingdom, and (1.45 gm/day) in South Korea. It may also result from having n-3/n-6 foods (competition for enzymes in metabolic pathways). Reviewing the nutritional pattern of the participants whose fatty fish and n-3 supplements are low and consumption of vegetable oils, especially corn and sunflower is high (61.6%). They also have snacks, bakeries, and foods rich in n-6 PUFA. Thus, the level of n-6 is high, which affects transferring α-Linolenic acid into EPA and DHA. This finding is supported by Stark et al. (2008) that reported that n-6 and n-3 rated (22.41%) and (1.34%), respectively. In South Korea, n-3 and n-6 rated (1.47%) and (10.73%), respectively.

Some studies reported a positive correlation between n-3 and the weight of infants. For example, Olsen and Secher (2002) reported that pregnant women had (15.8 gm/day) of fatty fish and (161 mg/day) of n-3 capsules. Carlson et al. (2013) showed that the participants had (600 mg/day) of DHA capsules. Therefore, it is important to define the dosage of n-3 to n-6.

There was a statistically significant positive correlation at the level of ($P<0.05$) between having a total of MUFA and length of pregnancy because ($r=0.129$). Accordingly, the higher the level of MUFA is, the longer pregnancy becomes. This finding matches Cinelli et al. (2018), although he did not conclude any statistically significant relations.

Conclusion

Maternal Polyunsaturated Fatty Acid may have potentially beneficial effects on the birth outcomes. Further studies are needed to determine the significance of this finding.

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