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RESEARCH PAPER

Fish Consumption and Knowledge of Chemical Pollutants Among a Sample of New Mothers in Tripoli, Libya

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استهلاك الأسماك والمعرفة بالملوثات الكيميائية لدى عينة من الأمهات الجدد في طرابلس ، ليبيا

ثريا احمد ابوحليقة و حورية مسعود معمر

ABSTRACT. Fish and fish products are important sources of nutritional elements, especially iodine and unsaturated fatty acids (omega-3). These are essential for pregnant women and their embryos during a pregnancy period. However, women and their embryos may be exposed to chemical pollutants when they consume fish. Therefore, this study aimed to assess the consumption pattern of fish during pre-pregnancy, pregnancy and post-pregnancy periods, and explore the awareness on the chemical pollutants in fish among the women who recently gave birth in Tripoli city, Libya. This study targeted 370 women randomly in Tripoli city and collected data through a face to face questionnaire. The questionnaire consisted of three parts: characteristics of new mothers; consumption of fish, crustaceans, mollusks and canned fish; and knowledge on the importance and risks of eating fish and fish products. The results showed that eating fish, crustaceans, and mollusks once a month was the highest proportion in the three periods with a percentage of 38, 38 and 41%, respectively. Sardine, sea bream and mackerel were the most fish common consumed by new mothers during the three periods. More than half of the mothers did not change the pattern of their consumption of fish, crustaceans and/or mollusks during pregnancy as compared to the pre-pregnancy period and after the birth of their children as compared to the pregnancy period. The canned tuna was the most canned fish consumed by respondents (93%). More than half of mothers realized that eating fish is important for health in general and for pregnant women with a percentage of 58 and 59%, respectively. The results of this study showed that there was a great need to raise the awareness of new mothers about chemical pollutants in fish. Furthermore, effective programs should be adopted by the competent authorities to educate mothers about what types and amounts of fish they should consume during pregnancy and the types that should be avoided.

KEYWORDS: Pregnancy; Mothers; Environmental pollutants; Libya; Seafood

الملخص: تعتبر الأسماك والمنتجات السمكية من المصادر الهامة للعناصر الغذائية، وخاصة اليود والأحماض الدهنية غير المشبعة (أوميغا ٣). التي تعتبر ضرورية للنساء الحوامل وأجنتهن خلال فترة الحمل. ومع ذلك، قد تتعرض النساء وأجنتهن للملوثات الكيميائية عندما يستهلكن الأسماك. لذلك، تهدف هذه الدراسة إلى تقييم نمط استهلاك الأسماك خلال فترات ما قبل الحمل والحمل وما بعد الحمل، واستكشاف الوعي حول الملوثات الكيميائية في الأسماك بين النساء اللائي ولدن مؤخراً في مدينة طرابلس، ليبيا. استهدفت هذه الدراسة ٣٧٠ امرأة بشكل عشوائي في مدينة طرابلس وجمعت البيانات من خلال استبيان وجهاً لوجه. يتكون الاستبيان من ثلاثة أجزاء: خصائص الأمهات الجدد؛ استهلاك الأسماك والقشريات والرخويات والأسماك المعلبة؛ والمعرفة بأهمية ومخاطر تناول الأسماك والمنتجات السمكية. أظهرت النتائج أن تناول الأسماك والقشريات والرخويات مرة واحدة في الشهر كان أعلى نسبة في الفترات الثلاث بنسبة ٣٨ و ٣٨ و ٤١ ٪ على التوالي. كانت أسماك السردين والوراتة والماكريل أكثر الأسماك التي تستهلكها الأمهات الجدد خلال الفترات الثلاث. لم تغير أكثر من نصف الأمهات نمط استهلاكهن للأسماك والقشريات و / أو الرخويات أثناء الحمل مقارنةً بفترة ما قبل الحمل وبعد ولادة أطفالهن مقارنةً بفترة الحمل. كانت أسماك التونة المعلبة أكثر الأسماك المعلبة التي تستهلكها الامهات (٩٣٪). أدرك أكثر من نصف الأمهات أن تناول السمك مهم للصحة بشكل عام وللحوامل بنسبة ٥٨ و ٥٩٪ على التوالي. أظهرت نتائج هذه الدراسة أن هناك حاجة كبيرة لرفع وعي الأمهات الجدد بالملوثات الكيميائية في الأسماك. علاوة على ذلك، ينبغي اعتماد برامج فعالة من قبل السلطات المختصة لتثقيف الأمهات بشأن أنواع وكميات الأسماك التي يجب أن يستهلكنها أثناء الحمل والأنواع التي ينبغي تجنبها.

Introduction

The presence of fish in the diet is very important because it is a source of proteins, vitamins, minerals and unsaturated essential fatty acids, especially omega-3 fatty acids. Omega-3 fatty acids have activity against cancer and prevent heart disease and atherosclerosis (Abuhlega and Hassan, 2017). The amount of poly-unsaturated fatty acids consumed during pregnancy is associated with the reduced preterm delivery, low risk of under development within the womb, and high blood pressure during pregnancy (Dovydaitis, 2008). Omega-3 fatty acids also play an important role in the growth of the embryos, especially docosahexaenoic acid, which is an important component of the neural and retinal membranes and accumulates in the brain during pregnancy and the postpartum period (Cetin and Koletzko, 2018).

On the other side, fish may be a source of various

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Table 1. Characteristics of the responding mothers

Characteristics of the sample	Number	Percentage
Age		
<18	1	0.30
18-22	37	10.0
23-27	98	26.5
28-32	101	27.3
33-37	80	21.6
38-42	46	12.4
> 42	7	1.90
Educational level		
Uneducated	3	.8
Basic Education	35	9.5
Secondary Education	91	24.6
University Education	237	64.0
MA / PhD	4	1.1
Most recent pregnancy was the first		
Yes	95	25.7
No	275	74.3
Type of baby feeding		
Breastfeeding	175	47.3
Bottlefeeding	65	17.6
Breastfeeding and bottlefeeding together	130	35.1
The period of time after the last birth		
‹ a month	44	11.9
› a month-two months	38	10.3
› two months-3 months	26	7.0
› 3 months-4 months	19	5.1
› 4 months-5 months	22	6.0
› 5 months-6 months	54	14.6
› 6 months-12 months	167	45.1

chemical pollutants that can cause harmful effects on human health especially pregnant women and their embryos. The chemical pollutants include persistent organic pollutants, including mercury, polychlorinated biphenyls and dioxins (Costa, 2007; MDH, 2012; and Jacobs Jr et al., 2014). Mercury is mainly found in the organic form methylmercury (MeHg).

The MeHg can have neurotoxic effects if ingested in sufficient quantities and accumulated in fish from contaminated aquatic environments (Balshaw et al., 2007 and Strain, 2014). It is a strong neurotoxin that is known to impair infant neuronal growth (Strain, 2014). Fetal exposure is associated with maternal exposure (Dariush Mozaffarian and Rimm, 2006). The fetus is susceptible to the toxic effects of mercury because of its possible transmission from the placenta (Taylor et al. 2018). It was found that mothers who highly consume fish during pregnancy may be exposed to MeHg, which may negatively affect the development of the fetal brain (Strain, 2014). In the 1950s, children developed neurodevelopmental abnormalities, because their mothers ate highly contaminated fish containing 10-30 ppm of MeHg caught from industrially polluted Minimata Bay, Japan (Dariush Mozaffarian and Rimm, 2006). Environmental pollution is the main source of mercury in aquatic organisms and its concentration in fish tissues depends on the type and age of fish (Dariush Mozaffarian and Rimm, 2006).

The tissues of large and long-lived predatory fish such as swordfish, and shark contained higher concentrations of MeHg while small and short-lived fish such as shellfish, salmon contained lower concentrations (Dariush Mozaffarian and Rimm, 2006). Many studies have been conducted to evaluate the mercury level in fish and aquatic environments in Libya. Banana et al. (2016) found that the fish at Farwa lagoon is heavily contaminated with Hg2+ and Hg2+ concentrations exceeded the levels provided by international standards (0.34-3.13 µg/g). Similarly, Al-Asadi (2018) found that the concentration of total mercury in fish muscle ranged from 0.176 and 3.586 µg/g as a result of industrial wastes of the chlorine-alkali plant at Abo-Kamash area, west of Libya.

The State of Libya is located on the southern shore of the Mediterranean with a coastline of about 2000 km. Tripoli is the most important city overlooking it and its population gets fish from local fishing as well as from imported fish. The estimated per capita fish consumption in Libya 21.4 kg/year (Abuhlega and Hassan, 2020).

Several countries have provided guidance regarding the types of fish that a pregnant woman should consume during pregnancy and the types that should be avoided, ensuring that the fetus gets omega-3 fatty acids and harmful effects of mercury element on the neurodevelopment of the fetus can be avoided (Verger et al., 2007; Oken & Bellinger, 2008 Taylor et al., 2018 and EPA & FDA, 2019). The EPA and FDA advised women and young children as followed: (i) Do not eat shark, swordfish, king mackerel, or tilefish, because they contain high levels of mercury, (ii) Eat up to 12 ounces (2 average meals) a week of a variety of fish and shellfish that contains lower mercury, such as shrimp, canned light tuna, salmon, pollock, and catfish (AEP and FAO, 2019).

Pregnant women need to raise awareness and guidance on fish consumption in terms of increased fish intake and reduced exposure to MeHg (Connelly et al., 2013). However, intensive recommendations confirming that fish are a source of MeHg and it is contributed to the reluctance of pregnant women to eat fish despite their high nutritional value. Therefore, awareness of the risks and benefits of fish consumption should be raised using different communications with the pregnant women and should advise them to help choosing the safer fish based on scientific evidence (Starling et al., 2015). It was mentioned that pregnant women reduced fish consumption including tuna, dark meat fish, and white meat

Table 2. Number times of eating fish, crustaceans and/or mollusks of new mothers in pre-pregnancy, pregnancy and post-pregnancy periods

Number of times of fish eaten	Periods		
	Pre-pregnancy % (n)*	pregnancy % (n)*	Post-pregnancy % (n)*
None	27.0 (100)	28.4 (105)	27.3 (101)
Once/month	38.4 (142)	38.1 (141)	40.5 (150)
Twice/month	18.6 (69)	17.3 (64)	16.5 (61)
Once/week	5.4 (20)	5.4 (20)	5.7 (21)
Twice/week	7.6 (28)	7.8 (29)	7.6 (28)
3-6 times/week	1.6 (6)	1.4 (5)	1.6 (6)
Daily	0.3 (1)	0.5 (2)	0.0 (0)
Do not know	1.1 (4)	1.1 (4)	0.8 (3)

*numbers of new mothers

Table 3. Types of fish eaten by new mothers in pre-pregnancy, pregnancy and post-pregnancy periods before, during, and after pregnancy

Conmen name	Periods		
	Pre-pregnancy % (n)*	pregnancy % (n)*	Post-pregnancy % (n)*
Shrimp	12.5	11.4	12.72
Seafood	13.2	12.5	12.72
Cuttlefish	16.1	14.0	16.36
Octopus	7.5	7.0	6.90
Mackerel	37.1	37.6	37.45
Sea bream	51.8	52.4	52
Red mullet	9.6	9.2	9.81
Red porgy	10	10.3	9.81
Sardine	72.1	73.1	72.36
Grouper	11.9	12.5	12
Sepia	0.0	0.0	5.09

Table 4. Changes in the amount of fish, crustaceans and/or mollusks meals eaten by new mothers during pregnancy compared to pre-pregnancy

Statement	Percentage Respondents (n)*
Did not eat fish before and during pregnancy	25.1 (93)
Ate a lot more fish	2.4 (9)
Ate a little more fish	1.4 (5)
Ate the same amount of fish	66.2 (245)
Ate a little less fish	1.9 (7)
Ate a lot less fish	1.4 (5)
stopped eating fish	1.6 (6)

*numbers of new mothers

fish after the dissemination of federal recommendations (Oken et al., 2003).

As a result of the lack of previous studies on the pattern of consumption of fish and fishery products by new mothers in Tripoli, Libya, and the mothers' cultural level on the health benefits of fish and fishery products, needs to be explored. In addition, very negligible study was available on how to avoid their risks. Therefore, the objectives of the study were: (i) To assess the pattern of fish consumption (pre-pregnancy, pregnancy, and post-pregnancy); (ii) To determine the most important factors affecting this pattern; and (iii) To explore the knowledge of chemical pollutants in fish among the new mothers in Tripoli, Libya.

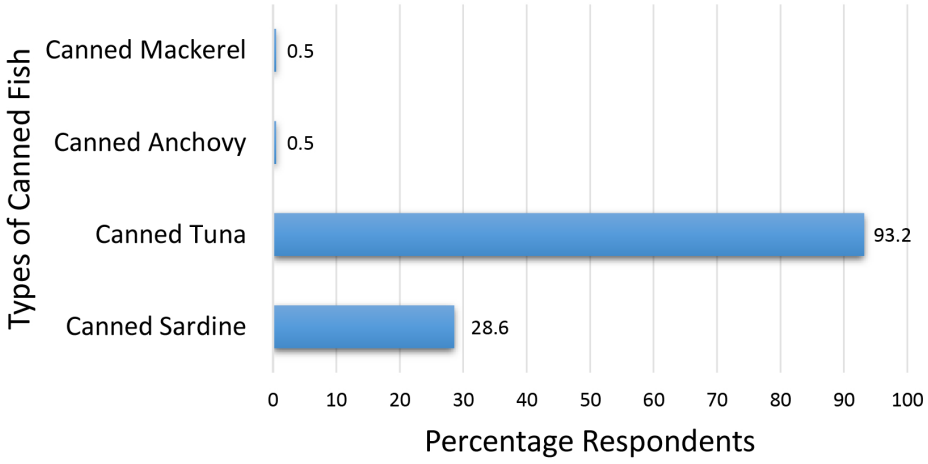

Figure 1. Types of canned fish consumed by new mothers

Table 5. Changes in the amount of fish, crustaceans and/or mollusks meals eaten by new mothers after pregnancy compared with the pregnancy period

Statement	Percentage Respondents (n)*
Did not eat fish during and after pregnancy	23.5 (87)
Ate a lot more fish	1.9 (7)
Ate a little more fish	2.2 (8)
Ate the same amount of fish	65.6 (243)
Ate a little less fish	2.2 (8)
Ate a lot less fish	2.2 (8)
Stopped eating fish	2.4 (9)

*numbers of new mothers

Table 6. The number of times of eaten of canned tuna fish, whether in the form of sandwiches, pizza, salad, pasta or others by new mothers in pre-pregnancy, pregnancy and after pregnancy

Number of times of eating canned tuna	Periods		
	Pre-pregnancy % (n)*	pregnancy % (n)*	Post-pregnancy % (n)*
None	6.2 (23)	7.6 (28)	7.3 (27)
Once/ month	9.5 (35)	9.5 (35)	9.2 (34)
Twice/ month	5.4 (20)	5.4 (20)	5.1 (19)
Once/ week	12.2 (45)	11.6 (43)	11.9 (44)
Twice/ week	18.1 (67)	17.8 (66)	18.4 (68)
3-6 times/ week	30.5 (113)	30.0 (111)	29.2 (108)
Daily	17.8 (66)	17.6 (65)	18.1 (67)
Do not know	0.3 (1)	.5 (2)	.8 (3)

*numbers of new mothers

Methodology

Data Collection

The face to face questionnaire was designed based on a study conducted by Connelly et al. (2013) and it was presented to the new mother in the Arabic language. The observational cross-section study targeted 370 new mothers at public hospitals, public health centers, and private clinics across the five municipalities in the city of Tripoli (Suk Alguma, Tripoli Center, Abusleem, Hai Al Andulas, and Tajoura). The researcher explained to the women targetted in this study and assured that the confidentiality of women's responses will be maintained. Then, they were asked for their voluntary participation in this study. Women who exceeded more than 12 months after giving birth, were excluded from this study to ensure accurate answers. The survey was conducted between February and November (2018). The questionnaire consisted of three parts: Part 1: Characteristics of a new mothers sample (5 questions); Part 2: Consumption of fish, crustaceans, mollusks and canned fish (6 questions), and Part 3: Knowledge about importance and risks of eating fish and fish products (5 questions). The new mothers were interviewed within 20 minutes.

Data Analysis

Data collected from the survey were coded and filled in an excel table (Microsoft Office Excel 2016). Then, data were entered into SPSS (Statistical Package for Social Sciences, version 22) and were subjected to descriptive analyses. Fisher's exact test was used to verify possible associations between the education level of new mothers and fish consumption patterns, canned fish consumption patterns, and new mothers' knowledge of fish. The significance of difference was tested with the 5% level of the confidence interval.

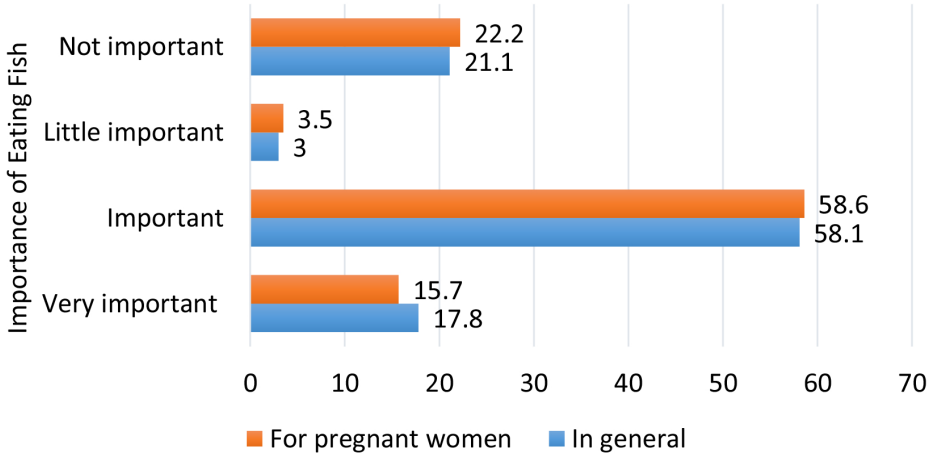

Figure 2. Knowledge of the importance of eating fish for health in general and for pregnant women

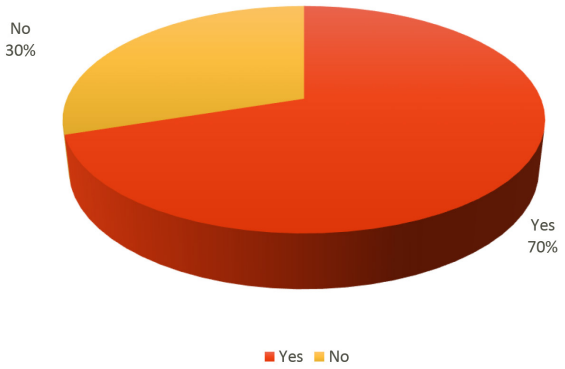

Figure 3. Received information about the types and quantity of fish that should be eaten to maintain the health of the mother and her baby by new mothers

Questionnaire Validity and Reliability

A pilot study carried out by presenting the questionnaire forms to 25 women and filled to ensure the validity and reliability of the questionnaire. These respondents were not included in the final data collection for this study. After the pre-testing, some questions were reformulated, as some respondents encountered difficulties with some of the questions in the questionnaire.

Results

Characteristics of the New Mothers

Table 1 shows the characteristics of the sample of new mothers. The age of the sample ranged from <18 to > 42 and the age of 28-32 represented the highest age category of respondents (27.3%). The majority of respondents (64.1%) had received a university education. For the majority of women (74.3%), their most recent childbirth was not their first pregnancy. Breast feeding was the most common method used by mothers, followed by breast feeding and bottle feeding together, and then bottle-feeding with a percentage of 47%, 35%, and 18%, respectively. Table 1 also shows that the period of time after the last birth of the mothers when the interview was conducted. The duration ranged from a month to 6 months and 12 months. The time period (6-12 months) represented the highest percentage of mothers, while (3-4 months) was the lowest percentage.

Consumption of Fish, Crustaceans, and Mollusks in Pre-pregnancy, Pregnancy, and Post-pregnancy Periods

Table 2 shows the frequency of eating fish, crustaceans and/or mollusks in pre-pregnancy, pregnancy, and post-pregnancy periods by new mothers. The results show that eating fish, crustaceans, and mollusks once a month was the highest eating rate in three periods before, during and after pregnancy with a 38, 38 and 41%, respectively. The percentages of new mothers who eat fish, crustaceans, and mollusks once/week or twice/week before, during and after pregnancy were 13, 13 and 13 %, respectively. The results of the statistical analysis (Fisher's exact test) revealed that no significant association between the three periods of eating fish before (p=0.41), during (p=0.51) and after pregnancy (p=0.71) and education level. Table 3 displays the various fish that were eaten by new mothers. Sardine, sea bream and mackerel were the most common fish types that were eaten by new mothers before, during, and after pregnancy.

The results of this study showed that more than half of the sample (66%) did not change their consumption

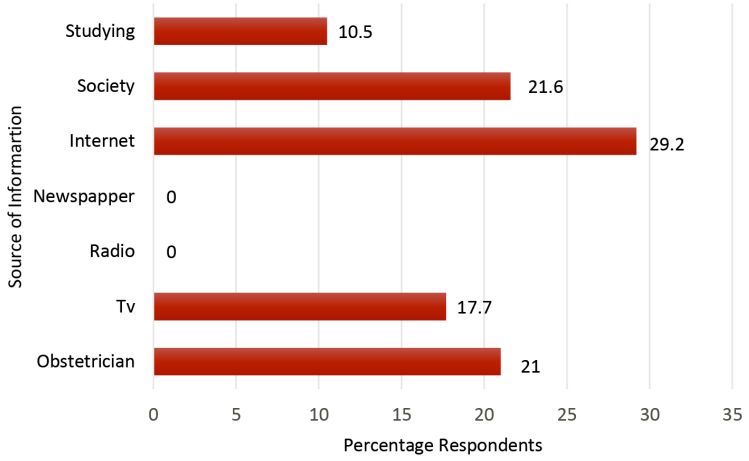

Figure 4. Main information source of the new mothers on the types and quantity of fish that should be eaten to maintain the health of the mother and her baby

Table 7. Knowledge of new mothers about chemical pollutants in fish

Statements	Strongly agree	Agree	Neutral	Strongly disagree	Disagree
Some chemical contaminants from eating fish build up in my body over time (generally true).	3.8	28.9	44.1	4.6	18.6
Older fish generally have more chemical contaminants in them than younger fish (generally true).	4.0	27.6	47.8	3.8	16.8
Most of the mercury is found in the fat of fish (generally false).	4.3	27.2	49.7	3.8	15.0
Amount of chemical contaminants in predatory fish is higher than that of herbivorous fish (generally true).	3.2	27.6	49.2	15.4	4.6
I know predatory fish and herbivorous fish.	14.1	24.3	4.3	3.0	54.3
Smaller fish generally have more chemical contaminants in them than larger fish (generally false).	1.9	10.3	51.3	26.8	9.7
Children's health can be harmed more than adults' health by chemical contaminants in fish (generally true).	7.0	28.2	46.1	15.2	3.5

pattern of fish, crustaceans and/or mollusks during pregnancy compared to the pre-pregnancy period (Table 4). By the Fisher exact test, no significant association was found between the change in the amount of fish, crustaceans and/or mollusks meals consumed during pregnancy as compared to pre-pregnancy and the education level of new mothers (p=0.062). Similarly, Table 5 shows that more than half of the sample (66%) did not change the pattern of their fish, crustaceans and/or mollusks intakes after the birth of their children as compared with the pregnancy period.

Using the Fisher's exact test, it was observed that there was no significant association between change in the amount of fish eaten after birth as compared with the pregnancy period and the education level of new mothers (p=0.077).

Consumption of Canned Fish Pre-pregnant, Pregnancy and Post-pregnancy

Types of canned fish consumed by new mothers are illustrated in Figure 1. The results showed that canned tuna was the most common canned fish consumed by respondents (93%) followed by a canned sardine, anchovy, and mackerel with a percentage of 29, 0.5 and 0.5%, respectively. The frequency of canned tuna fish consumption in the form of sandwiches, pizza, salad, pasta or others during pre-pregnancy, pregnancy and post-pregnancy periods is shown in Table 6. The results revealed that a high percentage of new mothers ate canned tuna 3-6 times a week with a percentage of 31, 30 and 29% followed by twice a week with the percentages of 18% and then daily with percentages of 18% before, during and after pregnancy, respectively. There was a significant association between frequency of canned fish-eating in three periods before (p=0.001), during (p=0.006) and after (p=0.00001) pregnancy and new mothers' education level.

New Mothers' Knowledge on the Benefits and Risks of Fish Consumption

Results in Figure 4 shows that 29% of the mothers reported that the internet was the main source that provided them with information about importance of eating fish for their health and their babys' health followed by society (22%), obstetrician (21%), TV (18%) and personal study (11%). The mothers did not receive any information about eating fish from newspapers and radio.

New mothers were tested to explore their knowledge about chemical pollutants in fish through eight statements as shown in Table 7 (four generally true, two generally false, and one for self-assessment of knowledge of the mothers). Slightly less than a third of the mothers agreed with statements that some chemical contaminants from eating fish build up in their body over time. Older fish generally have more chemical contaminants than younger fish. The amount of chemical contaminants in predatory fish is higher than that of herbivorous fish and children's health can be harmed more than adult's health by chemical contaminants in fish with percentage of 33, 32, 31 and 35%, respectively. While the percentage of new mothers who disagree with generally false statements (i.e. most of the mercury is found in the fat of fish and, smaller fish generally have more chemical contaminants in them than larger fish) was 19 and 37%, respectively. More than half of new mothers (57%) disagreed with the statement that "I know predatory fish and herbivorous fish". The statistical analysis revealed that there was a significant association between some statements and education level of new mothers that were some chemical contaminants from eating fish build

up in my body over time (generally true) (p=0.00001), older fish generally have more chemical contaminants in them than younger fish (generally true) (p=0.017), smaller fish generally have more chemical contaminants in them than larger fish (generally false) (p=0.009) and children's health can be harmed more than adults' health by chemical contaminants in fish (generally true) (p=0.0035). While no significant association was found between other statements and education level of new mothers that included most of the mercury is found in the fat of fish (generally false) (p=0.10), amount of chemical contaminants in predatory fish is higher than that of herbivorous fish (generally true) (p=0.82), "I know predatory fish and herbivorous fish" (p=0.061).

Discussion

Characteristics of the New Mothers

It is worthy to focus on two important points. The educational level of the majority of respondents was university level, which indicated the possibility of success of any educational program before and during pregnancy if offerred by competent authorities. Breastfeeding was the most common way of feeding a baby among respondents, which indicated the importance of what the mother eating for her child's health. Breastfeeding is the best source of infant nutrition. However, it may also be a source of environmental pollutants (Björnberg et al. 2005).

Consumption of Fish, Crustaceans, and Mollusks during Pre-pregnancy, Pregnancy, and Post-pregnancy Periods

The results showed that less than a quarter of new mothers ate fish once/week or twice/week before, during and after pregnancy. While a lower percentage ate fish 3-6 times/week in the three periods. The percentage was lower in this study as compared to Anderson et al. (2004). They observed nearly 10% of the women consumed two or more fish meals per week. Slightly better results were obtained in this study as compared to Godala et al. (2012), when 1/3 of pregnant women consumed fish several times a week. From the point of view of nutritionists, pregnant women should consume three to four oil-rich fish meals a week (Simopoulos et al., 1999). The type and quantity of fatty acids and chemical pollutants varied in fish and shellfish (Guldner et al., 2007). The new mothers in this study did not consume fish predatory species, which are prevented by many countries and agencies that include shark, swordfish, marlin, orange rough and escolar (Taylor et al., 2018).

More than 65% of new mothers did not change the pattern of their intake of fish, crustaceans and/or mollusks during pregnancy as compared to the pre-pregnancy period and after the birth of their children as compared with the pregnancy period. This reflects that they did not receive an effective program to increase their knowledge on the importance of eating fish. In a similar study conducted by Connelly et al. (2013), it was found that 29.4% of women did not change the pattern of fish consumption during pregnancy as compared to before pregnancy and also 43.9% did not change the pattern of fish consumption after pregnancy as compared to pregnancy.

Consumption of Canned Fish during Pre-pregnancy, Pregnancy and Post-pregnancy Periods

In the recent decades, Libyan society has been characterized by the consumption of canned tuna. Hosseini et al. (2015) reported that countries including Libya, the United States of America, Portugal, Saudi Arabia, Turkey, and Iran consumed canned fish regularly. The majority of the new mothers ate canned tuna, while a low proportion of them ate canned sardines, anchovies and mackerel. Similarly, Abuhlega and Hassan (2017) found that canned tuna was the highest consumption by pupils/students for both males and females with a percentage of 78% and 81%, respectively. Also, Abuhlega and Hassan (2020) found that canned tuna was the most consumed canned fish by respondents with a percentage of 94.4%. The highest percentage of new mothers ate canned tuna 3-6 times a week. There was a significant association between the number of times of eating canned tuna fish and the level of education of new mothers. It is very important to mention there is a need to raise the awareness level of mothers about the importance of eating canned sardine, anchovies and mackerel due to their high nutritious value as a source of omega-3 and as well as these types of fish are not a source of mercury. This is due to their high nutritious value as a source of omega-3 and as well as these types of fish are not a source of mercury. Sardine, anchovy and mackerel fish are considered the best choice for pregnant women as guided by FDA (2017).

New Mothers' Knowledge on the Benefits and Risks of Fish Consumption

Many countries provide detailed advice to pregnant women about the types of fish that should be reduced during pregnancy and those that should be avoided completely. This advice varies from country to country. The advice mainly focuses on the content of mercury in fish in order to maintain the health of the pregnant woman and the health of her fetus (Taylor et al., 2018). It is worthy to mention that there are no programs in the State of Libya at present for advising for pregnant women. Similarly, Guneri et al. (2017) reported that pregnant women didn't receive education about food safety. However, a high percentage of new mothers (74 and 76%) realized that eating fish is important for health in general and for pregnant women. There was a significant association between the education level of new

mothers and the importance of fish in general and for pregnant women. The result is in the line of Musaiger and, Al Rumaidh (2005), who found that 76% of individuals disagreed with a statement that eating pregnant women of fish is harmful. Despite no significant association was found between agreeing with this belief and education level.

The Internet was the main source of getting information on the types and quantity of fish that should be eatten by pregnant women, followed by society, obstetrician, TV, and studying. The internet and society information may not be correct and accurate. Therefore, the obstetrician should play a role in raising the awareness of pregnant women. Bloomingdale et al. (2010) concluded that the advice of obstetricians could affect pregnant women and make them eating more fish. It is worthy to mention that although 70% of new mothers reported that they received information about eating fish, and their knowledge of chemical pollutants in fish was low. The knowledge of new mothers on chemical pollutants in fish varied. Slightly less than a third of the mothers knew that some chemical contaminants from eating fish build up in my body over time; older fish generally have more chemical contaminants in them than younger fish, amount of chemical contaminants in predatory fish is higher than that of herbivorous fish and children's health can be harmed more than adult's health by chemical contaminants in fish. On the contrary, Anderson et al. (2004) found that most women (71%) were aware of mercury's toxicity to the development of a child. This study is in line with a related study conducted by Gliori et al. (2006), who found that roughly one-third of women were aware that older fish and predatory fish have the highest levels of mercury. There was a significant association between the level of education of new mothers and four statements: (i) some chemical contaminants from eating fish build up in my body over time (generally true), (ii) older fish generally have more chemical contaminants in them than younger fish (generally true), (iii) smaller fish generally have more chemical contaminants in them than larger fish (generally false) and (iv) children's health can be harmed more than adults' health by chemical contaminants in fish (generally true). The education level was strongly related to the knowledge of fish chemical contaminants (Connelly et al., 2013). The results of this study showed that there is a great need to raise women awareness through an integrated program supported by the government sector, private sector, and occupational organizations in the country.

Conclusion

Based on the findings of this study and for the purpose of raising the level of safe consumption of fish by pregnant women, it is recommended the following: (i) Adopting programs to educate mothers by the competent authorities through provision special publications and distributing them in maternity centers and clinics as well as by programs in the available media such television to increase amount and number of times of eating safe fish in a week; (ii)The role of obstetrician should include advising mothers about what they should eat particularly fish consumption ; (iii) Replicate similar surveys regularly, at least every five years; (iv) Use this study as a reference to monitor behavioral changes in fish consumption habits by mothers; (v) More comprehensive studies on the role of fish in the diet and the actual quantity of consumption by mothers at the country level should be conducted rather than on annual fish statistics that do not provide sufficient indication.

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