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Libyan Women's Knowledge and Practices of Fish Safety

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ABSTRACT

Fish and fish products are important sources of essential nutrients for the body, and nutritionists recommend eating seafood twice a week. Therefore, to achieve the benefits of fish and fish products, the safety of fish should be considered from catching to the consumer table. The study evaluated fish safety knowledge and practices in a random sample of 344 women in Tripoli City, Libya. The survey was carried out by the self-administered questionnaire prepared for this purpose. The questionnaire consisted of four parts; the first part: questions about fish safety knowledge; the second part: questions about fish safety practices during purchasing; the third part: questions about fish safety practices at home; the fourth part: personal information. The mean knowledge score was 10.97±2.49 out of a total score of 15, the mean score of practices during purchasing was 23.2±4.10 out of a total score of 32, and the mean score of practices at home was 55.8± 6.32 out of a total score of 88. Age, marital status, employment and educational level had no significant effect on knowledge and practices (P>0.05). The study concluded that effective programs should be adopted to educate women to raise their awareness level of fish safety.

Keywords: Fish safety, Knowledge, Practices, Home, Women, Libya.

INTRODUCTION

Due to the increase in people's awareness of the high nutritional value of fish in recent years, their consumption of fish and its products has increased (Feng *et al*., 2009). Thus, the fish industry responds to that increase in fish consumption (Conte *et al*., 2014). The Libyan state has a long coast on the Mediterranean Sea, with a length of about 2000 km, and therefore it is an important source of fish and fish products. The Libyan total fisheries production was 32276 metric tons in 2018 (The World Bank, 2022). Also, the Libyan state imports some types of fish and their products from abroad (Abuhlega & Hassan, 2020). The per capita fish consumption in Libya has grown from 9.0 kg in 1961 to 21.4 kg in 2016 and 2017 (Food and Agriculture Organization, 2018b and Abuhlega & Hassan, 2020).

The quality of fish rapidly deteriorates due to a combination of natural factors that include the chemical composition such as the high moisture content, nonprotein nitrogenous compounds, and unsaturated fatty acids (Hassan & Abuhlega, 2016). Fish contains a high amount of free amino acids that are metabolized by bacteria, producing ammonia, biogenic amines, organic acids, ketones, and sulfur compounds. Also, fatty fish contain a high amount of lipids which degrades by bacteria resulting in rancid odors. Saltwater fish and some freshwater fish contain trimethylamine oxide compound that is reduced by bacteria to trimethylamine, which is responsible for fishy off odors. Furthermore, fish contains a low level of iron, and thus that helps the growth of some types of bacteria that produce siderophores that bind iron

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(Doyle, 2007). As well as the growth of microorganisms in three main parts, the skin surface, gills, and the gastrointestinal tract. Moreover, endogenous enzymes work and cause various changes. Such factors make fish subject to various natural, microbial, and chemical changes (Hassan & Abuhlega, 2016). Fish safety is a concern source due to factors including contamination of the fish environment and poor hygiene during fishing and onboard, handling, and distribution (Novoslavskij *et al*, 2016). Therefore, good hygienic practices and temperature control from fishing to consumption are keys to fish safety (Food and Agriculture Organization, 2018a).

Despite the scientific and technical progression in food production and controlling and regulating food safety through the development of different laws, regulations, and standards between countries (Langiano *et al*., 2012; Wongprawmas & Canavari, 2017), foodborne diseases still represent a burden on public health and the economy of countries (Langiano *et al*., 2012). Because of the global concern about food safety issues, scientists and researchers conducted domestic studies to evaluate the level of knowledge and practices of food safety (Mol *et al.,* 2018).

One of the consumers' basic rights is to have safe food (Wahyuni *et al*., 2018). However, consumers have also a role to achieve the safety of food. Their role is to apply proper handling techniques, from purchase to preparation. Whatever the procedures followed to maintain food safety are strong and effective, they will be of no value if they are not completed by applying food safety rules by the consumer from the time the food commodity is purchased to its preparation to eat at home (Hicks, 2016).

Consumer knowledge of fish safety facts is the basis to avoid the incidence of foodborne diseases. However, there are almost no previous studies on women's Knowledge and practices of fish safety in Libya. Therefore, this study aims to identify the knowledge of fish safety and evaluate fish safety practices in purchasing, storing, and preparing at home among women's sample in Tripoli City, Libya.

Research Methodology

Questionnaire and Data Collection

The self-administration questionnaire was designed by the author and presented to the women in the Arabic language. The questionnaire was pretested by four food sciences and technology experts to ensure the collection of relevant information and to ensure a uniform understanding of the questions. As well as a pilot study was carried out by presenting the questionnaire forms to 23 women and filled to ensure the validity and reliability of the questionnaire. Their responses were not included in the final data for this study and some questions were modified to facilitate their understanding.

Because food preparation in the state of Libya typically is a task to be conducted by females in the household. Therefore, 344 women were selected randomly in Tripoli City, Libya in the period between October 2020 and March 2021. The questionnaire forms gave serial numbers to facilitate return to it when necessary. The questionnaire collected information on a wide range of fish safety knowledge and practices for purchasing, storing, and preparing at home. Demographic information regarding women's age, marital status, education level, and employment was collected at the end of the questionnaire.

Calculations

Answers were graded by assigning 1 point for the right answer and 0 points for the wrong answer given to the questions on food safety knowledge. Scores regarding food safety knowledge range from 0 to 15. Where a score of 0 means that the participant did not correctly answer any question and a score of 15 means that the participant correctly answered all the questions. The cut-off points for scores regarded as poor for food safety knowledge is 9 (≤9) out of 15 while 10 (≥10) out of 15 is regarded as good food safety knowledge. Answers to the questions on food safety practices were graded as follows: 'almost never', 1 point, 'sometimes', 2 points, and 'often'. 3 points and 'always', 4 points. Scores regarding food safety practices vary from 8 to 32 and 19 to 76 during purchasing and at home, respectively. Where a score of 8

and 19 means that the participant almost never does all the practices listed in the questionnaire during purchasing and at home, respectively. while a score of 32 and 76 means that the participant always does all the practices listed in the questionnaire during purchasing and at home, respectively. The cut-off point for scores regarded as low for food safety practice during purchasing is 20 (≤20) out of 32 while 21 (≥21) out of 32 is regarded as a high food safety practice. The cut-off points for scores regarded as low for food safety practice at home is 49 (≤ 49) out of 76 while 50 (≥50) out of 76 is regarded as a high food safety practice.

Statistical methods

The statistical analyses were carried out using SPSS (Statistical Package for Social Sciences), version 22. Descriptive statistics were conducted to determine the means, percentages, standard deviations, and frequencies. The Chi-square test (X^2) was used to determine the association between variables of sample characteristics and food safety knowledge and also between variables of sample characteristics and food safety practices of the participants. A significance level of $p \leq 0.05$ was used to establish significance.

Results and discussion

Since the consumers are part of the food chain and come at the end of it, their responsibility is to follow appropriate handling practices, from purchase to home storage and preparation, regardless of the regulations, laws, and inspection procedures established (Redmond & Griffith, 2010; Hicks, 2016). This study was conducted to assess the knowledge of fish safety and evaluate fish safety practices at purchasing, storing, and preparing at home among a sample of women in Tripoli City, Libya.

Demographic information of women who responded to the study is shown in Table 1. The age of the sample ranged from 18 to > 55 y and the age of 18-35 y represented the highest age category of participants (55.2%). The results of the study were similar to that of Abuhlega & Al turki (2020) in which the age category of participants, 18-35 y was the highest percentage (70.7%). Half of the sample was single. On the contrary in a study conducted by Abuhlega & Abduljalil (2022). The number of single participants was higher (54.8%). More than half of the sample (57.3%) were employees. A similar result was obtained by Abuhlega & Al Turki (2022) where 53.4% of participants were employees. The majority of participants (68.3%) had received a university education. This result is in line with a related study conducted by Abuhlega & Maamar (2020) where the educational level of the majority of participants (64.0%) was university level. Therefore, the prevalence of education among women in Libya helps the responsible authorities to set up effective programs that raise awareness in the community.

Table 1: Demographic characteristics of the women's sample (N=344).

Characteristic	Numbers	Percentage of the sample (%)
Age group (y)		
18-35	190	55.2
36-55	128	37.2
> 55	26	7.6
Marital status		
Single	172	50.0
Married	172	50.0
Employment		
Employee	197	57.3
Does not work	147	42.7
Educational level		
Less than university	84	24.4
University education	235	68.3
M.Sc. and Ph.D.	25	7.3

Knowledge is defined as the capacity to acquire, retain and use information (Ibrahim, 1995). Figure 1. illustrates the fish safety knowledge levels of the women sample. The majority of participants (74.7%) had a good level of fish safety knowledge with scores ranging between 10-15 and 25.3% of them had a poor level of fish safety knowledge with scores ranging between 0-9. The result was lower than that obtained by a study that targeted

knowledge assessment of food safety among Libyan women (Abuhlega & Al Turki, 2022). Where 95.4% of them had a good level. The mean of the fish safety knowledge scores of the participants was calculated to be 10.97±2.49 which falls in the scores range of good (10-15). The mean reflects the need to raise the level of some knowledge points. A similar finding was obtained from a Libyan study that evaluated the knowledge of secondary school students about food safety (Abuhlega, 2020).

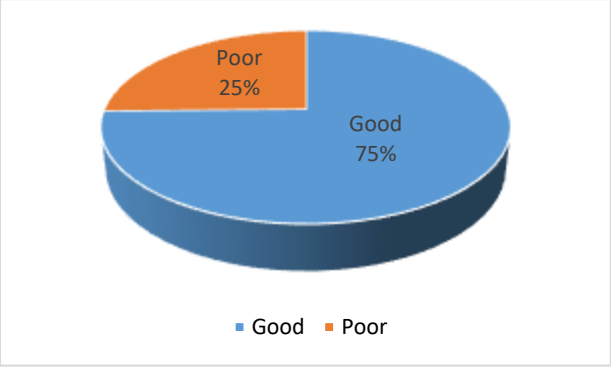

Figure1: Food safety knowledge level among women's sample (N=344).

Table 2 reports the results of knowledge of fish safety. Approximately 90% of participants knew that fish spoils by bacteria, enzymes, and heat. In a study conducted by Abuhlega & Hassan (2020), 47% and 38% of the participants knew that bacteria/germs and heat affect the quality of fish, respectively whilst 5.9% of the participants were not aware of all factors that spoil fish. A high percentage of the participants (94.8 %) were aware that when the fish spoils, the external appearance changes significantly, especially the eyes, gills, and meat. At the same time, there is a change in the smell from the smell of the fresh sea to the smell of spoiled fish. Abuhlega & Hassan (2020) reported that the majority of Libyan participants did not know all the quality characteristics of fish and 17.6% were not familiar with all of them. Over 79 % of participants gave the right answer to the question that the fish in the market is fresh, frozen, or thawed. In Libya, the fish retailers do not declare if the frozen fish was thawed. Therefore, the consumers think they are fresh. The thawed fish should be labeled "previously frozen." (Hicks, 2016). About 93% of participants realized that fish should be exhibited to the market in the refrigerator or on a thick layer of melted ice. A lower result was obtained by Fawzi & Shama (2009) where only 72.6% of women working at Alexandria University knew that fresh fish should be displayed on ice. The majority of the participants (89.2%) were knowledgeable that contaminated fish can cause food poisoning due to bacteria or chemical contaminants. On the contrary, in a Libyan study (Abuhlega & Al turki, 2022), the percentage of correct answers to a similar question was lower (83.2%). Awareness of food safety, education, and encouragement of its rules must be emphasized among citizens because most outbreaks of foodborne diseases occur at home, in restaurants, and/or at social events (Stratev *et al*., 2017). Over eighty-three percent (83.7 %) were aware that the responsibility for poisoning by fish lies on the producer, retailer, restaurant employee, or consumer per se. To keep the quality of fish the body temperature should be rapidly reduced to 0 °C (Gökoğlu & Yerlikaya, 2015). A large percentage of the sample (85.2%) gave the correct answer that the fish is placed after purchase in the coldest part of the refrigerator and at a temperature close to 0 °C as much as possible. To avoid the bacterial hazards of raw fish juices, the raw juices should be prevented from dripping on cooked foods since they will not be exposed to any further treatment to destroy the bacteria (Hicks, 2016). Cross-contamination occurs when harmful germs from raw foods or contaminated surfaces are passed onto the food. More than three-quarters of the participants (75.6%) were aware that fish juice dropping on food that has not been and will not be cooked should be avoided. Fish should be thawed under hygienic conditions; their contamination should be avoided. During defrosting, the temperature of the fish should not exceed 5℃ (Goulding, 2016). More than two-thirds (67.4%) of the participants knew that the best way of defrosting fish is to place it in the refrigerator overnight. Fish and shellfish should be cooked thoroughly until it turns from a translucent appearance and opaque (Hicks, 2016). Less than half of the sample (44.2%) realized that for safety, the fish should be cooked until it reaches an internal temperature of 60 °C to 63 °C for 15

seconds. Partial cooking and later completing the cooking should be avoided because it creates conditions suitable for microbial growth (Hicks, 2016). Approximately 72% of the sample knew that fish should be cooked at the same time and not intermittently (Cooking partially and completing cooking later). Almost half of the participants (51.2%) realized that at the buffet, the fish should be served hot from heaters that maintain the temperature inside the fish at 60 °C or higher. Unlike, street-cooked food handlers in Ghana (82.6%) were aware that cooked meals should stay hot before serving which was higher than that obtained in this study (Tuglo, *et al*., 2021). About 63% of participants were knowledgeable that tuna, sharks, and large predatory fish could be contaminated with heavy metals such as mercury. In a previous Libyan study, only 3.2% and 27.6% of women strongly agreed and agreed, respectively on a similar question " Amount of chemical contaminants in predatory fish is higher than that of herbivorous fish" (Abuhlega & Maamar, 2020). Histamine was known as a cause of food poisoning in the forties (Abuhlega & Ali, 2022). Histamine is formed as temperatures rise during storage and no production of histamine occurs in fishes at 0˚C (Bulula, *et al*., 2017). A low percentage of the sample (47.7%) answered correctly that histamine poisoning in fish is caused by the growth of certain types of bacteria as a result of insufficient cooling. Fish with high-fat content could be exposed to oxidation which leads to objectionable flavors and odors (Johnston, 1994). More than half of the sample (57.5%) knew that the fatty fish should be frozen at home for no more than 3 months. The association between women's characteristics and food safety knowledge level was examined by using X^2 chi-square test. There is no statistically significant association between food safety knowledge scores and age, marital status, employment, and educational level ($p>0.05$), Table 3. On contrary, in a study conducted by Abuhlega & Al turki (2022), there was a significant association between food safety knowledge scores of Libyan women and the demographic characteristics considered in the study ($p<0.05$) except for educational level ($p>0.05$).

Table 2: Fish safety knowledge among Libyan women (N =344).

Question	Correct Answer N(%)	Incorrect Answer N(%)	Do not Know N(%)	No response N(%)
Fish spoils by bacteria, enzymes and heat.	309(89.8)	5(1.4)	26(7.6)	4(1.2)
When the fish spoils, the external appearance changes significantly, especially the eyes, gills, and meat. At the same time, there is a change in the smell from the smell of the fresh sea to the smell of spoiled fish.	326(94.8)	6(1.7)	12(3.5)	0(0.0)
The fish in the market is fresh, frozen or thawed.	275(79.9)	20(5.8)	47(13.7)	2(0.6)
Fish should be exhibited to the market in the refrigerator or on a thick layer of melted ice.	319(92.7)	14(4.1)	7(2.0)	4(1.2)
Contaminated fish can cause food poisoning due to bacteria or chemical contaminants.	307(89.2)	8(2.3)	24(7.0)	5(1.5)
The responsibility for poisoning by fish lies on the producer, retailer, restaurant employee, or consumer per se.	288(83.7)	12(3.5)	44(12.8)	0(0.0)
The fish is placed after purchase in the coldest part of the refrigerator and at a	293(85.2)	14(4.0)	35(10.2)	2(0.6)

temperature close to 0°C as much as possible.				
Fish juice dropping on food that has not been and will not be cooked should be avoided.	260(75.6)	5(1.4)	78(22.7)	1(0.3)
The best way of defrosting fish is to place it in the refrigerator overnight.	232(67.4)	66(19.2)	46(13.4)	0(0.0)
For safety, the fish should be cooked until it reaches an internal temperature of 60°C to 63°C for 15 seconds.	152(44.2)	38(11.0)	151(43.9)	3(0.9)
Fish should be cooked at the same time and not intermittently (the partial cooking that is completed later).	249(72.4)	54(15.7)	40(11.6)	1(0.3)
When serving at the buffet, the fish should be served hot from heaters that maintain the temperature inside the fish at 60°C or higher.	176(51.2)	51(14.8)	108(31.4)	9(2.6)
Tuna, sharks, and large predatory fish could be contaminated with heavy metals such as mercury.	216(62.8)	14(4.1)	112(32.5)	2(0.6)
Histamine poisoning in fish is caused by the growth of certain types of bacteria as a result of insufficient cooling.	164(47.7)	13(3.8)	159(46.2)	8(2.3)
Fatty fish should be frozen at home for no more than 3 months.	198(57.5)	85(24.7)	57(16.6)	4(1.2)

Table 3: The association between demographic characteristics of the women's sample and fish safety knowledge level (N =344).

Variables	Knowledge Level		P- value
	Good	Poor	
Age group (y)			
18- 35	143 (41.6)	47 (13.7)	0.9013
36- 55	94(27.3)	34(9.9)	
> 55	20 (5.8)	6(1.7)	
Marital status			
Single	124(36.0)	48(14.0)	0.2643
Married	133(38.7)	39(11.3)	
Employment			
Employee	145(42.1)	52(15.1)	0.5851
Does not work	112(32.6)	35(10.2)	
Educational level			
Less than university	57(16.6)	27(7.8)	0.1024
University education	178(51.7)	57(16.6)	
M.Sc. and Ph.D.	22(6.4)	3(0.9)	

Practice is regarded as the application of rules and knowledge that leads to action (Ibrahim, 1995). In this study, 269 (78.2%) of 344 women reported that they purchase fish from the market. Figure 2. illustrates the fish safety practices levels during purchasing among women sample. The majority of participants (78.1%) had a high level of fish safety practices with a score ranging between 21-32 and 21.9% of them had a low level of fish safety practices scored between 8-20. The mean of the

food safety practices scores of the participants was calculated to be 23.2±4.10 which falls in the scores range of high (21-32). On the contrary, in Libya, the mean practices score of consumers during purchasing score was 71.6±10.97 which was lower than the obtained result in this study (Abuhlega & Abduljalil, 2022).

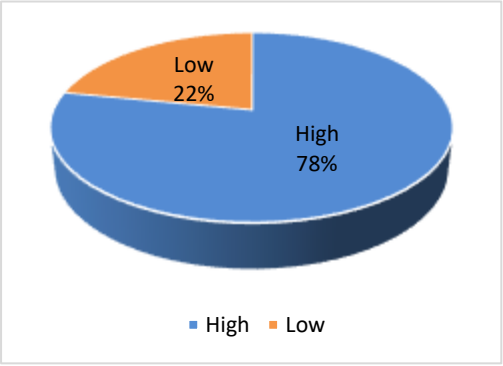

Figure 2: Food safety practices level during purchasing among women's sample (N=269).

Table 4 reveals the results of the food safety practices of the women's sample. Consumers should buy seafood from reputable sellers and avoid street vendors (Hicks, 2016). Fish purchased from unknown sources may be contaminated and cause foodborne diseases (Medeiros *et al*., 2001). About 41% of participants reported that they "always" ask the seller about the source of the fish. The majority of participants (71.7%) indicated that they "always" buy fish from a place where suitable and adequate refrigeration for the fish exists. All fresh seafood should be held as near to 0°C as possible, which is maintained by refrigeration and/or ice. (Hicks, 2016). Less than a third of women working at Alexandria University (27.8%) Purchased iced fresh fish (Fawzi & Shama, 2009). Also, a lower percentage of Turkish consumers (52.3%) reported that they always or usually when shopping, pay attention to whether the fish is chilled (Mol *et al*., 2018). More than half of the participants (57.6%) mentioned that they "always" buy fish just before they leave the market (the last thing they buy and leave). Buying fish on the last shopping trip maintains the quality and safety of the fish (Hicks, 2016). In Arabia Saudi, 73.6% of mothers were aware that the best time to purchase frozen food when shopping at the end of the shopping time (Ayaz *et al*., 2018). A similar result was obtained in Australia, where 58.3% of the participants bought raw meat before leaving the market (Jay *et al*., 1999). Also, In Turkey, a similar result was obtained by Mol et al. (2018), where 52.8% of participants stated that they always buy fish just before leaving the market. The raw juices from seafood should not drip on other foods, especially those that will be eaten without further cooking (Hicks, 2016). Approximately 76.0% of participants indicated that they "always" carry fish separated from other foods upon purchase. Less than one-third of the sample (27.1%) reported that when they buy fish, they "always" ask the retailer to eviscerate the fish. In Turkey, the majority of participants (57%) stated that they usually or always ask the fish retailer to eviscerate fish which was higher than that obtained in this study (Mol *et al*., 2018). Fish should not be exposed to ambient temperature from the moment of fishing until cooking. A low percentage of participants (19.0%) mentioned that they "always" use an insulated box with ice or other cold sources to move the fish home in hot weather. Also, a very low of them (7.8%) indicated that they "always" buy fish that has been pre-cut or sliced. In Turkey, the percentage was higher, 27.5% of consumers always buy previously sliced (Mol *et al.,* 2018). About 71.0% of the sample reported that they "always" check the expiration date if the fish is in packs. A lower percentage was obtained in a study carried out in Turkey, where 58.2% reported that they always checked the expiry dates of packaged foods. Using an X^2 chi-square test, the association was insignificant ($P > 0.05$) between the sample characteristics considered in this study and the practices' scores during purchasing, table 5. On the contrary, in Libya, the age of participants influenced practices of food safety during purchasing. While similarly, marital status and educational level did not influence food safety practices (Abuhlega & Abduljalil, 2022).

Table 4: Fish safety practices among Libyan women during purchasing (N=269) (If you purchase fish, please answer the questions, if not move to the next part).

Practices	Almost never N (%)	Sometimes N (%)	Often N (%)	Always N (%)	No response N (%)
I ask the seller about the source of the fish.	37(13.7)	54(20.1)	65(24.2)	110(40.9)	3(1.1)
I buy fish from a place where suitable and adequate refrigeration for the fish exists.	9(3.3)	9(3.3)	54(20.1)	193(71.7)	4(1.5)
I buy fish just before I leave the market (the last thing I buy and leave).	20(7.4)	18(6.7)	74(27.5)	155(57.6)	2(0.7)
I carry fish separated from other foods upon purchase.	15(5.6)	11(4.1)	34(12.6)	203(75.5)	6(2.2)
When I buy fish, I ask the retailer to eviscerate the fish.	83(30.9)	57(21.2)	54(20.1)	73(27.1)	2(0.7)
I use an insulated box with ice or other cold sources to move the fish home in hot weather.	112(41.6)	45(16.7)	56(20.8)	51(19.0)	5(1.9)
I buy fish that has been pre-cut or sliced.	102(37.9)	100(37.2)	40(14.9)	21(7.8)	6(2.2)
I check the expiration date if the fish is in packs.	22(8.2)	18(6.7)	34(12.6)	192(71.4)	3(1.1)

Table 5: The association between demographic characteristics of the women's sample and fish safety practices during purchasing (N =269).

Variables	Knowledge Level		P- value
	High N(%)	Low N(%)	
Age group (y)			
18- 35	118(43.9)	29(10.8)	0.5027
36- 55	75 (27.9)	26(9.6)	
> 55	17(6.3)	4(1.5)	
Marital status			
Single	105(39.0)	26(9.7)	0.4205
Married	105(39.0)	33(12.3)	
Type of employment			
Employee	122(45.4)	39(14.5)	0.2677
Does not work	88 (32.7)	20(7.4)	
Educational level			
Less than university	52(19.3)	12 (4.5)	0.6212
University education	146(54.3)	42 (15.6)	
M.Sc. and Ph.D.	12(4.5)	5(1.8)	

The home environment mainly contributes to foodborne disease incidence (Langiano *et al*., 2012). Figure 3. shows the fish safety practices levels at home of the women sample. The majority of participants (292\84.9 %) have a high level of fish safety practices with a score ranging between 50-76 and 52\15.1 % of them have a low level of fish safety practices scored between 19-49. The mean of the food safety practices at home scores of the

participants was calculated to be 55.8 ± 6.32 which falls in the scores range of high (50-76).

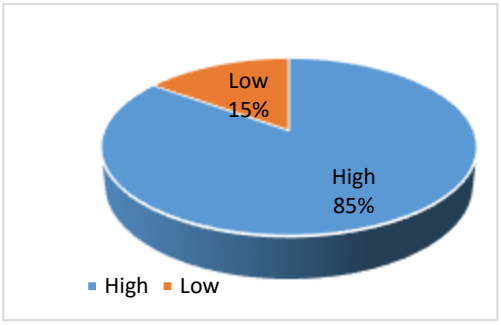

Figure 3: Food safety practices level at home among women's sample (N=344).

Table 6: Fish safety practices at home among Libyan women (N= 344).

Practices	**Almost never N (%)**	**Sometimes N (%)**	**Often N (%)**	**Always N (%)**	**No response N (%)**
Fish safety practices at the storage					
I put the fish in the fridge or freezer within two hours of purchase.	77(22.4)	62(18.0)	78(22.7)	124(36.0)	3(0.9)
I wrap the fish or keep it in a closed container when I store it in the refrigerator or freezer.	41(11.9)	23(6.7)	53(15.4)	223(64.8)	4(1.2)
I put fish and other foods in the same place in the fridge or freezer.	54(15.7)	59(17.2)	32(9.3)	191(55.5)	8(2.3)
I store fish on shelves in the refrigerator or freezer under ready-to-eat foods.	246(71.5)	28(8.1)	40(11.6)	27(7.8)	3(0.9)
I refreeze fish that thawing outside of the refrigerator	16(4.7)	26(7.5)	62(18.0)	237(68.9)	3(0.9)
I write the date on the package of the fish I put in the freezer.	183(53.2)	62(18.0)	48(13.9)	47(13.7)	4(1.2)
Fish safety practices at the preparation					
I prepare fish on clean surfaces with clean utensils and bowls.	21(6.1)	1(0.3)	21(6.1)	299(86.9)	2(0.6)
I wash my hands with warm water and soap for 20 seconds before preparing the fish.	43(12.5)	34(9.9)	81(23.5)	183(53.2)	3(0.9)
I leave the fish on the counter when I intend to cook it on the same day for more than two hours.	40(11.6)	45(13.1)	51(14.8)	203(59.0)	5(1..5)
I do not leave the cooked fish at room temperature and then reheat it when serving.	153(44.5)	80(23.2)	63(18.3)	44(12.8)	4(1.2)
I clean the surfaces after preparing the fish at the end of the day.	229(66.6)	9(2.6)	4(1.2)	96(27.9)	6(1.7)
I use a wooden cutting board for fish.	131(38.1)	71(20.6)	26(7.6)	112(32.5)	4(1.2)
I use the same utensils for raw and cooked fish.	43(12.5)	30(8.7)	25(7.3)	239(69.5)	7(2.0)

I wash cutting boards and utensils in hot water and soap after cutting raw fish.	17(4.9)	3(0.9)	36(10.4)	283(82.3)	5(1.5)
I wash my hands with warm water and soap for 20 seconds while preparing fish before touching surfaces or other raw or cooked foodstuffs.	18(5.2)	16(4.7)	54(15.7)	254(73.8)	2(0.6)
I wash my hands with warm water and soap for 20 seconds after I finish preparing the fish.	13(3.8)	13(3.8)	29(8.4)	285(82.8)	4(1.2)
I taste raw fish and during cooking.	11(3.2)	14(4.1)	15(4.3)	302(87.8)	2(0.6)
I put the fish after cooking on a plate that I previously used for raw fish and did not clean it.	19(5.5)	5(1.5)	14(4.1)	298(86.6)	8(2.3)
I carry the fish when going out on a picnic using the cooled container with ice or other cold source and place the container in the shade when possible and keep the lid closed as long as I can.	48(13.9)	37(10.8)	67(19.5)	181(52.6)	11(3.2)
I heat leftover cooked fish to an internal temperature of 74°C.	186(54.1)	61(17.7)	54(15.7)	22(6.4)	21(6.1)

Although, the mean food safety practices score, 55.8 ± 6.32 indicates a high level, however, the results of the study show that a high percentage of the participants "always" do not do some practices related to fish safety. Many foods brought into the home are frequently contaminated (Redmond & Griffith, 2010). The preparation of food in a clean kitchen especially the cleanness of surfaces and equipment prevents cross-contamination or the transfer of disease-causing microorganisms to food (Byrd-Bredbenner *et al*., 2013; Hicks, 2016). Consumers should change their improper food practice that is inconsistent with safe food storage and preparation practices to prevent foodborne disease risks (Losasso, *et al*., 2012). For fish safety practices at storage, a low percentage of participants (36.0%) reported that they "always" put the fish in the refrigerator or freezer within two hours of purchase. In a similar study, the percentage of Saudi women who reported that when refrigerated or frozen foods were purchased, they always first go back home to store them in the refrigerator or freezer was higher than that obtained in this study which was 82.4% (Arfaoui *et al*., 2021). Fish should wrap in moisture-proof paper or plastic wrap, placed in a heavy plastic bag, or stored in an air-tight, rigid container until ready for cooking (Hicks, 2016). About 65% of the participants mentioned that they "always" wrap the fish or keep it in a closed container when they store it in the refrigerator or freezer. More than half of the participants (55.5%) stated that they "always" put fish and other foods in the same place in the fridge or freezer. In Turkey, the percentage was higher than that obtained in this study where 37.5% of participants mentioned that they never put fish and other foods on the same shelf in the fridge or freezer (Mol *et al*., 2018). More than half of the sample (52.2%) gave correct answers to a similar question "Raw chicken, fish, and red meat are not placed in the same place in the refrigerator" (Abuhlega *et al.,* 2020). The raw juices from seafood should not drip on other foods, especially those that will be eaten without further cooking. Bacteria in the raw juices can cause cooked foods to spoil, and since these foods are already cooked, there won't be any chance for the bacteria to be destroyed

(Hicks, 2016). A very low percentage of participants (7.8%) indicated that they "always" store fish on shelves in the refrigerator or freezer under ready-to-eat foods. In a Saudi study, a similar result was obtained where 8.3% of women stated that they "always" store raw meat or poultry on the bottom shelf of the refrigerator (Arfaoui *et al*., 2021). Approximately 69% of participants reported that they "always" refreeze fish that thawed outside of the refrigerator. In Saudi Arabia, 4% of women reported that they always refreeze thawed frozen food (Arfaoui *et al*., 2021). To store the frozen fish, a label with contents, amount, and date should be done (Hicks, 2016). A very low percentage of participants (13.7%) mentioned that they "always" write the date on the package of the fish they put in the freezer. For fish safety practices in preparation, the food preparation area in the kitchen that will touch food should be clean (Hicks, 2016). Approximately 87% of participants mentioned that they "always" prepare fish on clean surfaces with clean utensils and bowls. To ensure the fish's safety during preparation, hands should always be washed with soap and warm water for at least 20 seconds before starting to prepare fish, during preparing fish before touching surfaces or other raw or cooked foodstuffs, and after finishing preparing the fish (Hicks, 2016). More than half of the participants (53.2%) reported that they "always" wash their hands with warm water and soap for 20 seconds before preparing the fish. A higher percentage (88.5%) of women working at Alexandria University reported that they washed their hands before food preparation (Fawzi & Shama, 2009). A lower percentage of Turkish participants (27.6%) mentioned that they are washing their hands for 20 s or more (Mol *et al*., 2018). More than half of the participants (59%) stated that they "always" leave the fish on the counter when they intend to cook it on the same day for more than two hours. In a similar study in Turkey, 56.8% of consumers' samples do not leave raw seafood on the counter until cooking, which was higher than the result obtained in this study (Mol *et al*., 2018). Fish after cooking should be immediately refrigerated or frozen if prepared to later use. (Hicks, 2016). Only 12.8% of the participants indicated that they "always" leave the cooked fish at room temperature and then reheat it when serving. In a similar study conducted in Lebanon, 51.7% of married women reported that after they have cooked a meal they "always" store any leftovers in a cool place within two hours (El Haddad *et al*., 2020). Less than one-third of participants (27.9%) reported they "always" clean the surfaces after preparing the fish at the end of the day. On the contrary, a higher percentage of Saudi women (84.5%) stated that they always wash utensils and equipment after each use (Arfaoui *et al.,* 2021). About one-third of participants (32.5%) mentioned that they "always" use a wooden cutting board for fish. In a similar study in Turkey, 55.8% of the consumers sample do not use a wooden cutting board which was higher than the result obtained in this study (Mol *et al.,* 2018). Roughly 82% of participants indicated that they "always" wash cutting boards and utensils in hot water and soap after cutting raw fish. Similarly, 84.5% of Saudi women stated that they always wash utensils and equipment after each use (Arfaoui *et al.,* 2021). The majority of participants (73.8%) reported they "always" wash their hands with warm water and soap for 20 seconds while preparing fish before touching surfaces or other raw or cooked foodstuffs. Approximately, 83% of participants mentioned that they "always" wash their hands with warm water and soap for 20 seconds after they finish preparing the fish. A study in Slovenia reported that 57.1% of participants washed their hands properly with soap and warm water, although a significant number (33.9%) washed their hands with water only or did not wash it at all (1.6%). (Jevsnik, *et al*., 2008). Food of animal origin including fish should not be tasted when it's raw or during cooking (Hicks, 2016). A high percentage of participants (87.8%) stated that they "always" taste raw fish during cooking. Because of the hazard of tasting raw fish and cooking for women's health, it is very important to focus on this wrong practice and explain how dangerous is when adopting any awareness program. It is necessary to separate between raw and cooked food, because of the possibility that raw foods, especially meat, poultry, and seafood, and their juices, contain dangerous pathogens that can be transmitted to other foods during food

preparation and storage (World Health Organization, 2020). Approximately, 70% of participants stated that they "always" use the same utensils for raw and cooked fish. In a study conducted in the United States of America, nine in ten consumers mentioned that they use different plates for raw and cooked meat, which was higher than obtained in this study (American Dietetic Association, 2011). In Lebanon, the comparable question was addressed to women where 66.7% of them reported that they always use separate utensils and cutting boards when preparing raw and cooked food (El Haddad *et al*., 2020). During a picnic or traveling with food, keep all perishables in a cooler with ice or freeze-pack inserts until serving time (Hicks, 2016). Roughly half of the participants (52.6%) reported that they "always" carry the fish when going out on a picnic using the cooled container with ice or other cold source and place the container in the shade when possible and keep the lid closed as long as they can. A very low percentage of participants (6.4%) reported that they "always" heat leftover cooked fish to an internal temperature of 74 °C. In a similar question, Saudi women (39.5%) reported that they always adequately reheat leftover foods. The association between Libyan women's sample characteristics and the level of fish safety practices at home is shown in Table 7. Using an X^2 chi-square test, there was no significant association between all variables considered in this study and food safety practices ($p>0.05$).

Table 7: The association between demographic characteristics of the women's sample and fish safety practices at home (N =344).

Variables	Knowledge Level		P- value
	High N(%)	Low N(%)	
Age group (y)			
18- 35	163 (47.4)	27 (7.8)	0 .8655
36- 55	107 (31.1)	21 (6.1)	
> 55	22 (6.4)	4 (1.2)	
Marital status			
Single	151 (43.9)	21(6.1)	.01323
Married	141 (41.0)	31 (9.0)	
Type of employment			
Employee	166 (48.3)	31 (9.0)	0.7103
Does not work	126 (36.6)	21 (6.1)	
Educational level			
Less than university	68 (19.8)	16(4.7)	0.4871
University education	203 (59.0)	32 (9.3)	
M.Sc. and Ph.D.	21 (6.1)	4 (1.1)	

Conclusion

In conclusion, it seems that the sample of women in this study had good and high levels of knowledge and practices related to fish safety, respectively. However, there was a weakness in some important knowledge and practice points of fish safety that need improvement through the educational courses. The outcome of this study reveals that age, marital status, employment, and educational level had not a significant effect on the women's knowledge and practices related to fish safety. Also, the study shows that the prevalence of education among women in Libya helps the responsible authorities to set up effective programs to raise awareness in the community. These programs may include distributing brochures and posters in fish shops and markets to explain how to safely deal with fish during purchase and at home.

Also, awareness campaigns about fish safety through websites and pages on the Internet and on television. Lastly, conducting more comprehensive studies to assess the level of fish safety awareness among women in the whole country.

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معرفة وممارسات سلامة الأسماك بين النساء الليبيات

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ملخص

تعتبر الأسماك ومنتجاتها مصادر مهمة للعناصر الغذائية الأساسية للجسم، ويوصي خبراء التغذية بتناول الأغذية البحرية مرتين في الأسبوع. لذلك، لتحقيق فوائد الأسماك والمنتجات السمكية، يجب مراعاة سلامة الأسماك من الصيد إلى مائدة المستهلك. قيمت الدراسة المعرفة والممارسات المتعلقة بسلامة الأسماك في عينة عشوائية من 344 امرأة في مدينة طرابلس، ليبيا. تم إجراء المسح من خلال استبيان تم إعداده لهذا الغرض. يتكون الاستبيان من أربعة أجزاء؛ الجزء الأول: أسئلة حول المعرفة بسلامة الأسماك؛ الجزء الثاني: أسئلة حول ممارسات سلامة الأسماك أثناء الشراء؛ الجزء الثالث: أسئلة حول ممارسات سلامة الأسماك في المنزل؛ الجزء الرابع: المعلومات الشخصية. كان متوسط درجة المعرفة 10.97 ± 2.49 من إجمالي الدرجة 15، وكان متوسط درجة الممارسات أثناء الشراء 23.2 ± 4.10 من إجمالي الدرجة 32، وكان متوسط درجة الممارسات في المنزل 55.8 ± 6.32 من إجمالي الدرجة 88. لم يكن للعمر والحالة الاجتماعية والعمل والمستوى التعليمي تأثير معنوي على المعرفة والممارسات ($P>0.05$). خلصت الدراسة إلى ضرورة اعتماد برامج فعالة لتثقيف النساء لرفع مستوى وعيهن بسلامة الأسماك.

الكلمات الدالة: سلامة الأسماك، المعرفة، الممارسات، المنزل، المرأة، ليبيا.