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The awareness of thyroid disorders and an iodine-rich diet among a sample of the population in some western cities of Libya

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ABSTRACT

The deficiency of iodine in a diet is a global health issue. Therefore, this study aimed to assess the awareness of thyroid disorders and explore iodine-related dietary knowledge and practices among a sample of the population in some cities in western Libya. A cross-sectional survey was carried out among 425 individuals in the population, of whom 265 were healthy and 160 had thyroid disorders. The sample consisted of 72.0% females and 28.0% males. More than a quarter of the sample (26.6%) were between the ages of 38 and 47. The data were analyzed by SPSS. The findings revealed that only 37.9%, 43.8%, and 46.9% of the respondents knew that thyroid dysfunction causes brain damage, iodine is the main cause of thyroid problems, and thyroid disorders are genetic, respectively. As well, almost one-third of respondents (33.0%) expected that the mothers' thyroid problems would cause harm to the fetus. Only 14.6% of respondents realized that the function of the thyroid gland is important for metabolism. The findings also revealed that only 33.4% of respondents knew the main dietary sources of iodine. As well, only 23.5% of respondents ate seafood two or three times a week. Very few of the respondents (8.90%) used iodized salt. The study indicated that there is a need to raise awareness of thyroid disorders and their relationship with food among the population in western Libya. Therefore, effective and continuous programs from responsible authorities are essential.

الوعي باضطرابات الغدة الدرقية والنظام الغذائي الغني باليود لدى عينة من السكان في بعض مدن غرب ليبيا

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الكلمات المفتاحية:
المعرفة
اضطراب الغدة الدرقية
اليود
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الملخص

يعد نقص اليود في النظام الغذائي مشكلة صحية عالمية. لذلك، هدفت هذه الدراسة إلى تقييم الوعي باضطرابات الغدة الدرقية واستكشاف المعرفة والممارسات الغذائية المتعلقة باليود لدى عينة من السكان في بعض مدن غرب ليبيا. تم إجراء مسح مقطعي على 425 فردامن السكان، من بينهم 265 أصحاء و160 مرضى يعانون من اضطرابات الغدة الدرقية. تكونت العينة من 72.0٪ إناث و28.0٪ ذكور. كانت أعمار أكثر من ربع العينة (26.6%) تتراوح بين 38 و47 عامًا. تم تحليل البيانات باستخدام الحزمة الإحصائية للعلوم الاجتماعية (SPSS). كشفت النتائج أن 37.9٪ و43.8٪ و46.9٪ فقط من المستجيبين يعرفون أن ضعف الغدة الدرقية يسبب تلفاً في الدماغ، واليود هو السبب الرئيسي لمشاكل الغدة الدرقية، والغدة الدرقية تكون وراثية، على التوالي. كذلك توقع تقريبا ثلث العينة (33.0%) أن مشاكل الغدة الدرقية تسبب للأم ضررا بالجنين. أدرك 14.6٪ فقط من المشاركين في الدراسة أن وظيفة الغدة الدرقية مهمة لعملية التمثيل الغذائي. وكشفت النتائج أيضا أن 33.4 ٪ فقط من المشاركين في الدراسة يعرفون المصادر الغذائية الرئيسية لليود. كذلك 23.5٪ فقط من العينة

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يتناولون الأغذية البحرية من 2 الى 3 مرات في الأسبوع. عدد قليل جدا من العينة (8.90%) استخدموا الملح المدعم باليود. خلصت الدراسة إلى أن هناك حاجة لرفع مستوى المعرفة باضطرابات الغدة الدرقية وعلاقتها بالغذاء بين السكان في غرب ليبيا. لذلك، فإن البرامج التوعوية الفعالة والمستمرة من السلطات المسؤولة ضرورية.

1. Introduction

The availability of iodine in the diet is crucial for human life. Iodine is an essential component in the formation of thyroid hormones; it represents 65% and 59% of the weight of thyroxine (T4) and triiodothyronine (T3), respectively. The thyroid hormones T4 and T3 control many important biochemical reactions in the body, such as protein synthesis and enzymatic activities [1,2,3]. Moreover, insufficient iodine intake, below the recommended daily amount, significantly raises the risk of iodine deficiency (ID), particularly leading to goiter and impaired cognitive development in children [4, 5,6]. In addition, ID in a pregnant woman's diet may cause poor production of thyroid hormones and thus mental retardation of the fetus [7].

There are many sources of iodine, including food, iodized salt, and dietary supplements [8,9,10]. The iodine amount in food is varied; some foods are rich sources of iodine, such as seaweed, seafood, milk, and milk products, as well as eggs and egg products [11]. Though fish and crustaceans, fish products, seaweeds, and sea vegetables are the richest food sources of iodine [12,13].

Al Shahrani et al. [14] reported that the prevalence of different types of thyroid diseases in the Arab world ranged between 6.18% and 47.34%. Also, Mohammed and Asmeil [15] measured the thyroid hormone for both genders and different age groups in 515 serum samples collected from EL-Beyda City, Libya; they found that thyroid dysfunction was 24%, including hypothyroidism and hyperthyroidism.

ID is a global health problem of the individual's diet for nearly a billion people [16,17], and about one-third of people in the world suffer from ID [18]. In Ethiopia, 39.9% of children suffer from ID [19,20].

Libya is located on the southern coast of the Mediterranean, with a coast of 1,770 km long [21]. Tripoli and Sabratha are among the most important coastal cities, while Gharyan is a city on the mountain in northwestern Libya, 80 km south of Tripoli [22]. In Libyan water, the fishermen caught a high quality and quantity of fish, about 153 species of Osteiochtyes and 58 species of Chondrochtyes [23,24], whereas the mean consumption of fish is 21.4 kg/year [25].

It is necessary to understand the importance of a balanced diet among individuals in society that contains fish and fish products, as well as the role they play in providing enough iodine to the body. Therefore, different countries are interested in raising knowledge by preparing awareness programs, especially through television, to encourage consumers to increase the number of meals and quantity of fish consumed per week by explaining its nutritional value and methods of preparation [25]. In addition, raising awareness of the importance of iodine intake in the community is an important component of preventive health care to reduce the prevalence of thyroid disorders [6]. Further, fortification of salt with iodine and its availability in the local market within the reach of consumers is the ideal option. It was found that iodized salt is the optimal, effective, and proven method for the prevention of diseases caused by ID [7]. Therefore, many researchers focused on the awareness of people in some countries of iodine intake, such as Latvia [26], South Africa [27], and Ethiopia [28,29,30,31,32).

The dietary supply of certain micronutrients, such as iodine, is limited in many areas of the world, including central Europe and most of Asia and Africa [33]. It is worth noting that thyroid gland disorders were recorded in some coastal countries, such as the Gaza Strip in Palestine [34]. Almost no previous studies focused on the awareness of the importance of iodine in dietary meals among a population in Libya, and according to information obtained from the archives or documents of patients of some Tripoli hospitals and statements of competent doctors, there are increased thyroid gland disorders, especially hypothyroidism, among adults and children. Consequently, the purpose of this study is to explore consumers' knowledge of thyroid diseases and their relationship to their diet.

2. Materials and Methods

2.1.Study Design and Data Collection

The present study targeted 425 Libyan citizens in Tripoli City (Bin Al-Nafees Hospital of Diabetes and Endocrinology, El-Zawia Street Hospital, and Pediatric Department in Tripoli Medical Center), Sabratah City (National Cancer Institute), and Gharyan City (private clinics "Al-Farouk Clinic, Dar Al-Shifa, Al-Rahma, and Al-Safa," a public dispensary "Awlad Bin Yaqoub Clinic," and the combined clinic, Gharyan). The study was conducted between 2018 and 2021. The survey was carried out randomly in various places in the three cities. The respondents were 265 healthy individuals (HIs) and 160 patients with thyroid disorders (PTDs). The respondents to this study were fully informed about the nature of the study, and they voluntarily consented to filling out the questionnaire. No identities were documented on the questionnaires, and all the respondents' personal information was kept confidential.

The face-to-face questionnaire was designed by the authors. It consists of three parts: Part 1: 5 questions for the demographic characteristics of a population sample (gender, age, education level, income, and marital status); Part 2: 8 questions for knowledge of thyroid disorders; and Part 3: 6 questions for iodine-related dietary knowledge and practices. The questionnaire was pretested by two experts in the field of fish science and technology, and almost all the recommended observations were taken to verify the validity and confidence of the questions included in the questionnaire. Also, 10 questionnaires were initially distributed to a random sample of people to determine 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. Furthermore, the questions were linguistically simplified to be clearer. Finally, the questionnaire questions were subjected to Cronbach's alpha test to measure reliability.

2.2.Data Analysis

The study data collected were coded and filled in an Excel table (Microsoft Office Excel 2016). Then, the data were entered into the Statistical Package for Social Sciences (SPSS), version 23, and subjected to descriptive analyses. The chi-square test of independence ($\chi 2$) was used to determine the association between variables of sample characteristics and thyroid disorders knowledge and iodine-related dietary knowledge and practices among respondents. Also, the chi-square test of independence ($\chi 2$) was used to determine the differences in responses to the questions among the three groups (Tripoli City, Sabratah City, and Gharyan City), as well as a t-test between two groups (HIs and PTDs). A significance level of $p \leq 0.05$ was used to establish significance.

3- Results

The demographic characteristics of the respondents are listed in Table 1. Of the 425 respondents, 265(62.4 %) were females and 160 (37.6.0%) were males. More than a quarter of the sample (113/26.6%) were between the ages of 38 and 47. The percentage distribution of the respondents in the three cities (Tripoli, Sabratah, and Gharyan) was varied. The highest percentage of respondents (180/42.4%) were from Sabratah City. Regarding the level of education, 146 (34.4%) received a college education or more, while 28 (6.6%) were uneducated. The majority of the respondents (304 /71.5%) earned a medium income. The number of married in this study (287/67.5%) was higher than single.

Knowledge of thyroid disorders among respondents is shown in Table 2 and Figures 1 and 2. The percentage of respondents who knew that the thyroid gland is an endocrine gland ranged from 26.2% to 82.5%

in the three cities, and the highest percentage (82.5%) was of PTDs from Tripoli City. The results of the chi-square test ($\chi 2$) show a high significant difference (P = 0.000) among the three cities. A higher percentage of respondents, between 66.7% and 97.5%, realized that the thyroid gland plays an important role in the body, and the highest percentage (97.5%) was of the PTDs from Tripoli City. The results of the chi-square test ($\chi 2$) showed a high significant difference (P = 0.000) among the three cities. Regarding the question, does thyroid dysfunction cause brain damage? the range of respondents who knew the response was between 21.4% and 61.7%, and the highest percentage (61.7%) was of PTDs from Sabratah City. The results of the chi-square test ($\chi 2$) showed a high significant difference (P = 0.001) among the three cities. Approximately 79% of

Table 1: Demographic characteristics of the respondents (N = 425)

Demographic characteristics	Tripoli (N= 124)		Sabratah (N= 180)		Gharyan (N= 121)	
	HIs* (N= 84) N(%)	PTDs** (N= 40) N(%)	HIs* (N= 120) N(%)	PTDs** (N= 60) N(%)	HIs* (N= 61) N(%)	PTDs** (N= 60) N(%)
Gender						
Male	29(34.5)	1(2.5)	72(60.0)	10(16.7)	2(3.3)	5(8.3)
Female	55(65.5)	39(97.5)	48(40.0)	50(83.3)	59(96.7)	55(91.7)
Age						
18-27	32(38.1)	3(7.5)	42(35.0)	8(13.3)	0(0.0)	4(6.7)
28-37	14(16.7)	5(12.5)	40(33.3)	15(25)	12(19.7)	17(28.3)
38-47	20(23.8)	14(35.0)	24(20.0)	12(20.0)	29(47.5)	14(23.3)
48-57	8(9.5)	15(37.5)	10(8.3)	18(30.0)	16(26.2)	12(20.0)
58-67	8(9.5)	2(5.0)	4(3.3)	6(10.0)	2(3.3)	11(18.3)
> 67	2(2.4)	1(2.5)	0(0.0)	1(1.7)	2(3.3)	2(3.3)
Education level						
Illiterate	1(1.2)	1(2.5)	8(6.7)	12(20.0)	0(0.0)	6(10.0)
Less than college	32(38.1)	24(60.0)	68(56.7)	27(45.0)	61(100)	39(65.0)
college	44(52.4)	12(30.0)	32(26.7)	19(31.7)	0(0.0)	14(23.3)
More than college***	7(8.3)	3(7.5)	12(10)	2(3.3)	0(0.0)	1(1.7)
Income						
Low	8(10.0)	15(37.5)	24(20.0)	9(15.0)	4(6.6)	12(20.0)
Medium	66(78.6)	24(60.0)	76(63.3)	38(63.3)	55(90.2)	45(75.0)
High	10(11.9)	1(2.5)	20(16.7)	13(21.7)	2(3.3)	3(5.0)
Social status						
Married	47(56.0)	29(72.5)	60(50.0)	48(80.0)	53(86.9)	50(83.3)
Single	37(44.0)	11(27.5)	60(50.0)	12(20.0)	8(13.1)	10(16.7)

*Healthy Individuals, **Patients with Thyroid Disorder, *** M.Sc. and Ph.D.

the HIs in Gharyan City were aware that iodine is the main cause of thyroid problems. While only 26.7% of PTDs from Sabratah City were aware of the response to the previous question. The results of the chi-square test ($\chi 2$) showed a high significant difference (P = 0.000) among the three cities. The percentage of respondents who knew that thyroid disorders are genetic ranged from 38.1% to 70.5% and the highest percentage (70.5%) was of HIs from Gharyan City. The results of the chi-square test ($\chi 2$) showed a high significant difference (p = 0.000) among the three cities. More than 41% of HIs in Sabratah City expect that the mother's thyroid problems cause harm to the fetus, while only 23.3% of PTDs in Gharyan City expect the previous statement. The results of the chi-square test ($\chi 2$) showed a significant difference (P = 0.039) among the three cities. By comparing HIs and PTDs, the results show no significant differences ($p \geq 0.05$) in the responses to these questions except for knowing that the mother's thyroid problems will cause harm to the fetus, $p \leq 0.05$ (Table 3).

The majority of respondents of PTDs (ranging from 55% to 90%) considered that women are the most likely to suffer from thyroid disorders (Figure 1), and the highest percentage (90%) was in Tripoli City. Also, the percentage of respondents of HIs who realized that women are the most likely to suffer from thyroid disorders ranged between 58.3% and 65.6%, with the lowest percentage in Sabratah City. At the same time, there is a convergence in the percentage between Tripoli and Gharyan. The results of the chi-square test ($\chi 2$) showed a high significant difference (p = 0.000) between the three cities. However, no significant difference was shown between PTDs and HIs in answering the previous question (t-test, P = 0.434).

Table 2: Knowledge of thyroid disorders among respondents. Available options include: Yes (1); No (2); Don't know (3) (N = 425)

Questions	Tripoli (N= 124)						Sabratah (N= 180)						Gharyan (N = 121)					
	HIs* (N = 84) (%)			PTDs** (N= 40) (%)			HIs* (N= 120) (%)			PTDs** (N= 60) (%)			HIs* (N= 61) (%)			PTDs** (N = 60) (%)		
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Is the thyroid gland an endocrine gland?	72.6	7.1	20.2	82.5	7.5	10.0	45.0	13.3	41.7	50.0	6.7	43.3	26.2	3.3	70.5	40.0	5.0	55.0
Does the thyroid gland play an important role in the body?	91.7	1.2	7.1	97.5	0.0	2.5	66.7	3.3	30.0	70.0	1.7	28.3	90.2	3.3	6.6	85.0	0.0	15.0
Does thyroid dysfunction cause brain damage?	21.4	25.0	53.6	37.5	30.0	32.5	40.0	18.3	41.7	61.7	16.7	21.7	23.0	45.9	31.1	38.3	16.7	45.0
Is iodine the main cause of thyroid problems?	38.1	17.9	44.0	67.5	7.5	25.0	35.0	15.0	50.0	26.7	36.7	36.7	78.7	0.0	21.3	41.7	6.7	51.7
Are thyroid disorders genetic?	38.1	21.4	40.5	47.5	27.5	25.0	45.0	35.0	20.0	40.0	51.7	8.3	70.5	6.6	23.0	55.0	16.7	28.3
Do you expect that the mother's thyroid problems will cause harm to the fetus?	35.7	17.9	46.4	35.0	15.0	50.0	41.7	16.7	41.7	30.0	46.7	23.3	29.5	27.9	42.6	23.3	20.0	56.7

*Healthy Individuals; **Patients with Thyroid Disorder

The right answer on the role of the thyroid gland in the human body is all above, where Figure (2) shows that the percentage of respondents who correctly answered ranged from 16.7% to 29.8% and 10% to 41.7% for HIs and PTDs, respectively. The lowest percentage was in Tripoli City. The noteworthy result was that the percentage of people who did not know anything about thyroid gland functions among PTDs was 22.5%, 30%, and 40% in Tripoli, Sabratah, and Gharyan, respectively. The least knowledgeable respondents in this study about the role of the thyroid gland were among the HIs (43.3%) in Sabratah City. The results of the chi-square test ($\chi 2$) showed a high significant difference (p = 0.000) among the three cities. No significant difference was shown between PTDs and HIs in their knowledge about the functions of the thyroid gland (t-test, P = 0.533).

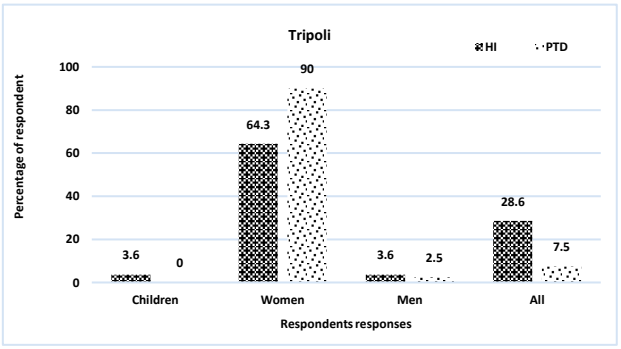
The knowledge and practices of iodine-related dietary among

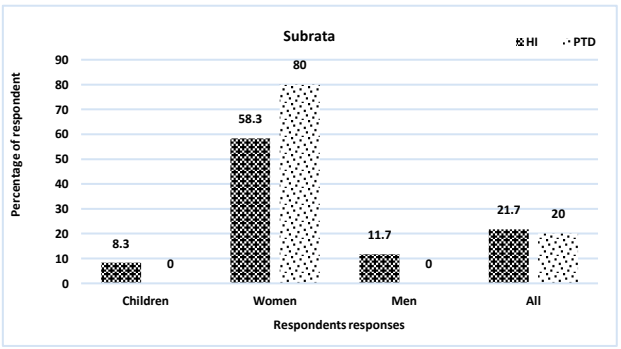
respondents are depicted in Table 4. The percentage of respondents who knew that several diseases affecting humans are related to food ranged from 53.3% to 86.9% in the three cities. The highest percentage (86.9%) was among HIs in Gharyan City. The results of the chi-square test ($\chi 2$) showed a high significant difference ($p = 0.000$) among the three cities. Also, the t-test showed a high significant difference between PTDs and HIs ($P = 0.000$).

A percentage ranging from 30.0% to 75.0% of respondents realized that seafood is the main source of iodine. The highest percentage (75.0%) was from PTDs in Tripoli City. A lower percentage of respondents knew that egg and dairy products are the main sources of iodine, ranging from 0.0% to 2.5% and 0.0% to 6.7%, respectively. Using the chi-square test ($\chi 2$), there is a high significant difference among the cities ($P = 0.000$); however, there was no significant difference between PTDs and HIs (t-test, $P = 0.154$).

When respondents were asked about how many times they ate seafood, 14.3% to 31.7% of them reported that they ate seafood 2 to 3 times a week. It is worth noting that the highest percentage of respondents who ate seafood were HIs, whether weekly, two to three times a week, or monthly, at 26.2%, 31.7%, and 32.1%, respectively. The statistical results showed a high significant difference among the three cities ($\chi 2$, $P = 0.002$), while there was no significant difference between PTDs and HIs (t-test, $P = 0.122$).

The results show that the highest percentage of respondents from all cities prefer chicken, whether HIs or PTDs, except HIs from Sabratah City, who prefer seafood (41.7%), while the lowest percentage of respondents (3.3%) who prefer seafood were HIs from Gharyan City. Using the chi-square test ($\chi 2$), there was a high significant difference in meat preference among the three cities ($P = 0.000$), and the t-test showed a high significant difference between PTDs and HIs (t-test, $P = 0.000$).





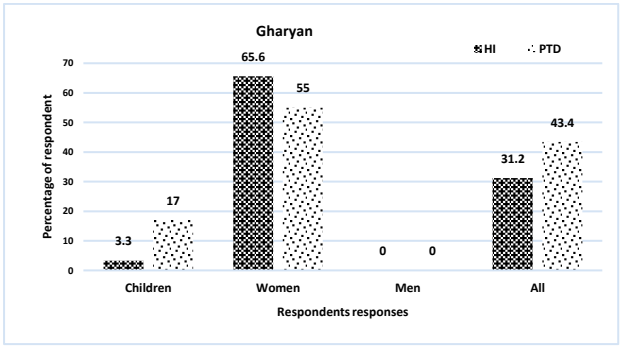
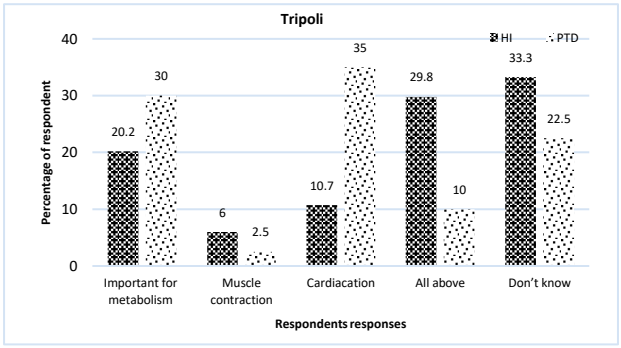
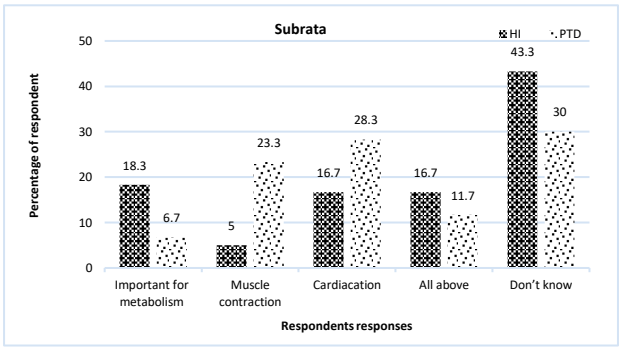


Figure 1: Responses of respondents on which category of people are most likely to suffer from thyroid disorders (N = 425)





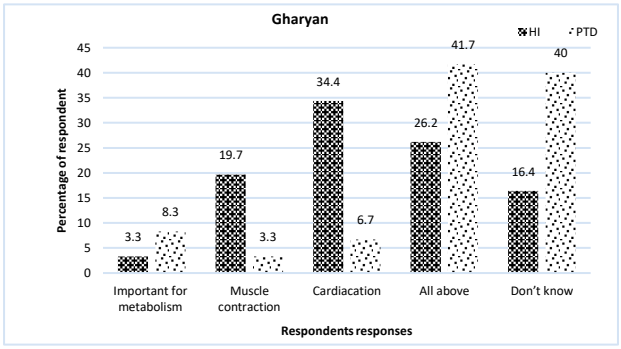


Figure 2: Responses of respondents on what is the role of the thyroid gland in the human body? (N = 425)

Table 3: Knowledge of thyroid disorders of HIs and PTDs. Available options include: Yes (1); No (2); Don't know (3) (N = 425)

Questions	HIs*(N =265) (%)			PTDs**(N=160) (%)			Sig. (t-test)
	1	2	3	1	2	3	
Is the thyroid gland an endocrine gland?	7	9.4	37.4	48.5	5.9	45.6	0.283
Does the thyroid gland play an important role in the body?	79.6	2.3	18.1	81.2	0.6	18.2	0.342
Does thyroid dysfunction cause brain damage?	32.8	25.3	41.9	46.5	18.2	35.3	0.225
Is iodine the main cause of thyroid problems?	46.4	12.5	41.1	39.4	17.4	43.2	0.101
Are thyroid disorders genetic?	45.7	26.8	27.5	48.8	30.3	20.9	0.109
Do you expect that the mother's thyroid problems will cause harm to the fetus?	36.6	18.5	44.9	27.1	28.8	44.1	0.016***

*Healthy Individuals, **Patients with Thyroid Disorder, *** significant difference ($P \leq 0.05$)

Table 4: Frequency (%) of responses to iodine-related dietary knowledge and practice questions among respondents (N = 425)

Questions	Tripoli (n = 124)		Sabratah (n = 180)		Gharyan (n = 121)	
	*HIs (N= 84) N(%)	**PTDs (N= 40) N(%)	*HIs (N= 120) N(%)	**PTDs (N= 60) N(%)	*HIs (N= 61) N(%)	**PTDs (N= 60) N(%)
Are several diseases affecting humans related to food?						
Yes	68(81.0)	34(85.0)	90(75.0)	32(53.3)	53(86.9)	37(61.7)
No	4(4.8)	2(5.0)	16(13.3)	10(16.7)	2(3.3)	3(5.0)
Sometimes	12(14.3)	4(10.0)	14(11.7)	18(30.0)	6(9.8)	20(33.3)
Which food is the main source of iodine?						
Cereals	3(3.6)	1(2.5)	12(10.0)	1(1.7)	12(19.7)	7(11.7)
Seafood	42(50)	30(75.0)	54(45.0)	40(66.7)	24(39.3)	18(30.0)
Eggs	1(1.2)	1(2.5)	2(1.7)	0(0.0)	0(0.0)	1(1.7)
Dairy products	1(1.2)	0(0.0)	4(3.3)	4(6.7)	0(0.0)	1(1.7)
Fruit	0(0.0)	0(0.0)	10(8.3)	1(1.7)	0(0.0)	1(1.7)
Vegetable	5(6.0)	0(0.0)	2(1.7)	2(3.3)	0(0.0)	3 (5.0)
All	32(38.1)	8(20.0)	36(30.0)	12(20.0)	25(41.0)	29(48.3)
How many times do you eat seafood?						
1/weekly	22(26.2)	7(17.5)	26(21.7)	11(18.3)	10(16.4)	9(15.0)
2-3/weekly	12(14.3)	9(22.5)	38(31.7)	15(25)	13(21.3)	13(21.7)
1/monthly	27(32.1)	11(27.5)	22(18.3)	17(28.3)	8(13.1)	17(28.3)
Rarely	19(22.6)	11(27.5)	20(16.7)	12(20.0)	26(42.6)	18(30)
Never	4(4.8)	2(5.0)	14(11.7)	5(8.3)	4(6.6)	3(5.0)
Which type of meat do you prefer?						
Chicken	34(40.5)	20(50.0)	34(28.3)	31(51.7)	41(67.2)	29(48.3)
Red meat	22(26.2)	9(22.5)	36(30.0)	20(33.3)	14(23.0)	17(28.3)
Seafood	24(28.6)	11(27.5)	50(41.7)	9(15.0)	2(3.3)	12(20.0)
Don't eat meat	4(4.8)	0(0.0)	0(0.0)	0(0.0)	4(6.6)	2(3.3)
Is your seafood mostly canned tuna or sardine?						
Yes	28(33.3)	9(22.5)	50(41.7)	38(63.3)	49(80.3)	41(68.3)
No	24(28.6)	15(37.5)	54(45.0)	18(30.0)	2(3.3)	8(13.3)
Sometimes	32(38.1)	16(40.0)	16(13.3)	4(6.7)	10(16.4)	11(18.3)
Which type of salt do you use?						
Without iodine	69(82.1)	37(92.5)	96(80.0)	47(78.3)	54(88.5)	54(90.0)
Iodized salt	3(3.6)	1(2.5)	18(15.0)	13(21.7)	5(8.2)	4(6.7)
Don't know	12(14.3)	2(5.0)	6(5.0)	0(0.0)	2(3.3)	2(3.3)

*Healthy Individuals, **Patients with Thyroid Disorder

More than half of the sample (50.6%) mentioned that their seafood was mostly canned tuna or sardine, where the highest percentage (80.3%) was of HIs from Gharyan City. The statistical results showed a high significant difference ($\chi 2$, P = 0.001) among the three cities, while there was no significant difference between PTDs and HIs (t-test, P = 0.882).

A high percentage of respondents, ranging from 78.3% to 92.5%, reported consuming salt without iodine. In contrast, the percentage of the respondents who used iodized salt was very low, but the highest percentage used iodized salt was from Sabratah City (15.0% and 21.7% of HIs and PTDs, respectively). The results showed a high significant difference ($\chi 2$, P = 0.000) among the three cities and between PTDs and HIs (t-test, P = 0.000).

Table 5 presents the association between certain demographic characteristics, including gender, age, education level, income, and social status of the respondents, and the knowledge of thyroid disorders and iodine-related dietary knowledge and practices. The results indicate that education level, income, and social status were the most associated demographic characteristics ($p \leq 0.05$) in the respondents' answers to the different questions in this study.

Table 5. The association between demographic characteristics of the sample and thyroid disorders knowledge and iodine-related dietary knowledge and practices among respondents (N =425)

Questions	Sex	Age	Education level	Income	Social status
Is the thyroid gland an endocrine gland?	0.502 [a]	0.159 [a]	0.000 [c]	0.663 [a]	0.018 [b]
Does the thyroid gland play an important role in the body?	0.007 [c]	0.019 [b]	0.000 [c]	0.213 [a]	0.033 [b]
Does thyroid dysfunction cause brain damage?	0.801 [a]	0.079 [a]	0.585 [a]	0.012 [b]	0.828 [a]
Is iodine the main cause of thyroid problems?	0.090 [a]	0.133 [a]	0.024 [b]	0.005 [c]	0.524 [a]
Are thyroid disorders genetic?	0.036 [b]	0.001 [c]	0.001 [c]	0.084 [a]	0.138 [a]
Do you expect that the mother's thyroid problems will cause harm to the fetus?	0.582 [a]	0.156 [a]	0.351 [a]	0.033 [b]	0.130 [a]
which category of people are most likely to suffer from thyroid disorders	0.000 [c]	0.455 [a]	0.732 [a]	0.033 [b]	0.017 [b]
What is the role of the thyroid gland in the human body?	0.133 [a]	0.002 [c]	0.007 [c]	0.265 [a]	0.023 [b]
Are several diseases affecting humans related to food?	0.136 [a]	0.082 [a]	0.000 [c]	0.460 [a]	0.000 [c]
Which food is the main source of iodine?	0.398 [a]	0.009 [c]	0.002 [c]	0.009 [c]	0.010 [c]
How many times do you eat seafood?	0.606 [a]	0.001 [c]	0.092 [a]	0.000 [c]	0.281 [a]
Which type of meat do you prefer?	0.000 [c]	0.349 [a]	0.270 [a]	0.613 [a]	0.124 [a]
Is your seafood mostly canned tuna or sardine?	0.338 [a]	0.189 [a]	0.089 [a]	0.000 [c]	0.147 [a]
Which type of salt do you use?	0.004 [c]	0.599 [a]	0.084 [a]	0.024 [b]	0.612 [a]

[a] Non-significant, [b] Significant, [c] High significant)

4- Discussion

Raising awareness about thyroid disorders and their relationship to iodine, as well as the importance of consuming iodine-rich food, is very important to avoid health problems that result from its deficiency. The study aimed to assess the knowledge of the population in some cities in Libya, including Tripoli, Sabratah, and Gharyan, about some important facts about thyroid disorders and an iodine-rich diet.

Almost half of the sample (51.4 %) is aware that the thyroid gland is an endocrine gland. Unlike in the previous Saudi Arabia study, where the percentage of adult residents (77.9%) who knew the previous fact was higher [35]. Even though a high percentage of the sample (80.2%) knew that the thyroid gland plays an important role in the body, less than half of respondents (37.9%) realized that thyroid dysfunction causes brain damage. Similarly, in a previous study in Saudi Arabia, 43.6% of the sample knew that thyroid dysfunction causes brain damage [35]. Except for HIs in Gharyan city and PTDs in Tripoli city, the results indicated poor knowledge of the importance of iodine among respondents: "Is iodine the main cause of thyroid problems?". Importantly, 40.7% of the sample were uninformed. In line with a previous study in South Africa, 76% to 94.9% of respondents in 10 provinces replied that they did not know which gland in the body needs

iodine to produce hormones [27]. In contrast, in Ethiopia, 62.7% and 55.1% of adolescent girls are aware of the benefits of iodine and its importance in preventing goiter, respectively [36]. Approximately half of the respondents (46.9%) knew that thyroid disorders are genetic; Thus perhaps this reflects their lack of interest in iodine-rich food. A lack of iodine and poor nutrition were listed in Saudi Arabia as risk factors [37]. In contrast, a low percentage of patients with primary hypothyroidism in India (31%) and Saudi Arabia (19.3%) answered a similar question correctly: is hyperthyroidism a genetic disease? [38,39]. About 33% of respondents expected that the mother's thyroid problems would cause harm to the fetus. Milk iodine concentration is positively correlated with iodine intake [40]. The mammary gland regulates and concentrates iodine levels in human milk to reach 20–50 times that of plasma (40,41). A lower percentage of Indian women (5.0%) in a similar study knew that there is a risk for the fetus due to the untreated thyroid disorder of the mother [42]. More than half of respondents (66.1%) considered that women are the most likely to suffer from thyroid disorders. According to the Libyan hospital databases of Sabratah (National Cancer Institute), Elzawia Street, Pediatric Department, Tripoli Medical Center, and Murzok, the most patients with hypothyroidism were women [14,43]; this also agrees with several reports of Arab countries such as Kuwait [44], Egypt [45], Iraq [46], Saudi Arabia [47], and Palestine [34]. Furthermore, many studies have been carried out on women with thyroid disorders, especially pregnant women and adolescent girls, such as in Belgium, Tunisia, India, Australia, the Czech Republic, and Ethiopia [31,48,49,50,51,52].

The respondents' knowledge of gland functions was poor, so only 14.6% realized that the function of the thyroid gland is important for metabolism, and the percentage of those who did not know the function of the thyroid gland was fairly large. This led to increased hypothyroidism and don't care about food-rich iodine, and the majority of them preferred chicken and red meat, and may be due to low monthly income compared with the price of seafood. The thyroid gland impacts several organs due to the importance of its functions; so, Gabrielson et al. [53] suggested that will treat sexual dysfunction of males and females by regulating thyroid hormones soon, and there is related among the thyroid gland, iodine, and breast cancer [54].

About 60% of all deaths and 43% of the global burden of disease are caused by nutrition-related diseases [18]. About 74% of respondents thought that several diseases affecting humans are related to food. Along the same line, 77.2% of residents in Saudi Arabia were aware that a well-balanced diet is essential to prevent thyroid diseases [55]. Despite 48.9%% of respondents in this study knew that seafood is the main source of iodine. However, only 33.4% of them knew the main dietary sources of iodine. Unlike in South Africa, only 5.46% of the adult population knew that seafood is the main source of iodine, while 80.0% of them were uninformed [27]. The WHO [18] recommended consuming fish and shellfish around twice a week. A low percentage of respondents (23.5%) reported that they eat seafood 2-3 times a week. Likewise, Abuhlega and Hassan [25] found that only 27% of the population in Tripoli City consumes seafood 1-2 times a week. Only 25.4% of the sample prefer eating seafood. This reflects the low percentage of respondents who consume seafood 2–3 times a week. During the last decades, a major change occurred in the consumption pattern of Libyan families, especially at breakfast, as the demand for consumption of canned tuna and sardines increased [25,56,57]. More than half of the sample in this study (50.6%) reported they rely on canned tuna and sardine as seafood sources. Unlike Abuhlega and Hassan [25], who reported that 94.7% of the population in Tripoli City consumed canned fish. Eighty-four percent of respondents said that they consume salt without iodine. Along the same line, 68.0% of young adults in China did not use iodized salt or were unsure whether the type of salt they consumed at home was iodized [58]. Therefore, efforts must be made to encourage the population to consume iodized salt. Many researchers were interested in raising awareness of iodized salt in countries such as South Africa [59], Latvia [26], Tunisia [60], Ethiopia [28,29,30,32], Armenia [61], Bangladesh [62], and Ghana [63], in addition to iodine-rich foods [64,65,66] or iodine supplements [51,67,68]. A previous Turkish study confirmed the role of awareness in improving dietary practices, where the prevalence of iodized salt consumption was 54.5%; after the 3-month education program, it increased to 62.4% [69]. Also, Meinhardt et al. [70] recommended using KIO3-enriched salt for cooking to increase the iodine intake. Since the education level and income had a significant association with many points of thyroid disorders knowledge and iodine-related dietary knowledge and practices among respondents, competent authorities should pay attention to the education and income levels of citizens and control the prices of fish and fish products.

Finally, the results show that the percentage of questions related to knowledge of thyroid disorders that the respondents answered correctly by 50% or more was 37.5% (3 questions). Also, the percent of questions about iodine-related dietary knowledge and practice questions among respondents that were correctly and properly answered by 50% or more didn't exceed 33.3% (2 questions). These results reflect the need for awareness campaigns about thyroid disorders and iodine-related dietary knowledge and practices.

5- Conclusion

The results of this study show poor knowledge about thyroid disorders as well as knowledge and practices related to an iodine-rich diet. Therefore, effective and continuous programs are required to improve knowledge of thyroid disorders and their relationship with food among the population in Western Libya. Raising the level of awareness includes developing plans by public entities such as the Ministry of Health in partnership with civil society institutions such as associations of food and nutrition targeting different groups, especially women, including distributing brochures in dispensaries, hospitals, and pharmacies explaining thyroid disorders and their relationship to iodine, as well as the importance of consuming iodine-rich food such as fish and fish products and iodized salt. Addressing the topic of food-related diseases, especially thyroid diseases, in television and radio programs and the official websites and pages on the internet of responsible public entities. The government, through the Ministry of Economy, should adopt a strategy to control the prices of fish and fish products to make them accessible to everyone. Holding ongoing workshops and seminars to shed light on food-related diseases and clarify the importance of adopting a preventive policy by the government to prevent their occurrence. In addition, additional comprehensive studies should be conducted to clarify the role of dietary iodine among PTDs in the entire country. The study's limitation is selecting some cities from western Libya. Therefore, in future studies, more cities should be targeted to expand the survey and obtain comprehensive information for the entire country.

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