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Thyroid Disorders and Iodine Intake in Adult Females Attending Diabetes and Endocrine Center at Buraidah in Saudi Arabia

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Abstract
Introduction: Iodine is a crucial dietary component as it cannot be stored in the human body. It is naturally present in certain foods like seafood and can also be artificially added, such as in iodized salt. The World Health Organization (WHO) recommends a daily iodine intake of 150 µg for adults.
Objective: This study aims to examine variations in dietary iodine consumption among adult females with thyroid disorders who are receiving care at the Diabetes and Endocrine Center in Buraidah, Saudi Arabia.
Methods:A cross-sectional study. This study had 331 female participants diagnosed with thyroid disorders (18-60 years old) were chosen randomly from Diabetes and Endocrine Center at Buraidah. Demographic questionnaire and I-FFQ were distributed online among the sample. All data were entered and analyzed through SPSS program version 26. The iodine intake is distributed into insufficient (≤99 µg/day), adequate (100-199 µg/day), above requirements (200-299 µg/day), and excessive (≥300 µg/day) groups.
Results and Conclusion: The average age of participants was 40.79 years, and their mean iodine intake was 216.47 µg/day. The main contributor to iodine intake was iodized salt, which accounted for 100.32 µg/day. Mean iodine intake varied among thyroid disorders: 210.65 µg/day in hypothyroidism, 244.98 µg/day in hyperthyroidism, 269.82 µg/day in thyroid nodules, and 195.37 µg/day in thyroid tumors. There were no statistically significant differences in iodine intake across the various thyroid conditions ($p<0.05$). The population should be educated about the adverse health effects of increased daily iodine intake exceeding daily iodine requirement (100-199µg/d) especially among thyroid disorders' population. Future cohort studies should be conducted to further understand the effects of different iodine intake on possible alterations in thyroid function during different life stages. Future studies should be conducted to reach a new recommendation for iodized salt intake among thyroid disorders' population to reduce further health complications.
KEYWORDS: Iodine, UIC, iodine concentration, thyroid disorders, thyroid diseases.

INTRODUCTION

The thyroid gland, the largest endocrine organ in the human body, is situated in the front of the neck. It plays a key role in regulating the basal metabolic rate by secreting thyroid hormones. Abnormal secretion of these hormones can lead to a variety of thyroid disorders, which are among the most common medical conditions globally, particularly in populations residing in iodine-deficient regions—accounting for nearly one-third of the world's population. The leading cause of thyroid disorders is iodine deficiency (1–4). While short-term fluctuations in iodine intake typically do not disrupt thyroid hormone regulation, chronic excess or deficiency can disturb thyroid hormone balance, governed by the hypothalamus-pituitary-thyroid axis, and result in thyroid-related conditions (5). If left untreated, these disorders may significantly impact quality of life due to associated complications (1–4).

In Saudi Arabia, thyroid disorders are prevalent across various age groups, especially among those living in high-altitude regions (4). However, recent data on dietary iodine intake, particularly among Saudi females or women diagnosed with thyroid disorders, is lacking. To address this gap, this study explores dietary iodine consumption in women with thyroid disorders who are attending the Diabetes and Endocrine Center in Buraidah, Saudi Arabia. The findings aim to provide insights that could assist health authorities in refining policies to prevent iodine deficiency and mitigate complications associated with thyroid disorders.

1.1. Research Question

How does dietary iodine intake vary among adult females with thyroid disorders?

1.2. Research Hypothesis

The null hypothesis for this study is as follows:
There is no significant variation in adequate dietary iodine intake (100–199 µg/day) among adult females diagnosed with thyroid disorders attending the Diabetes and Endocrine Center in Buraidah, Saudi Arabia.

1.3. Research Objective

To examine the differences in dietary iodine intake among adult females with thyroid disorders receiving care at the Diabetes and Endocrine Center in Buraidah, Saudi Arabia.

REVIEW OF LITERATURE

2.1 Definition of Iodine

Iodine is an essential micronutrient, acting as a bioactive compound with antioxidant and anti-inflammatory properties. It is a critical dietary element since it cannot be stored in the body. Its primary role is to aid in the production of thyroid hormones, which are vital for metabolic processes (6,7).

2.2 Sources of Iodine

Iodine is obtained predominantly through iodized salt, followed by fortified dairy products like milk and yogurt, and seafood, including codfish, salmon, and tuna. Smaller amounts are found in eggs, vegetables, nuts, and grains. Certain medications, such as radiological contrast agents, iodine-based disinfectants, and amiodarone, also serve as iodine sources, delivering varying concentrations per dose (7).

2.3 Iodine Concentration in Foods

The iodine content in food varies significantly based on factors such as soil iodine levels, fortification practices, and food preparation methods. The U.S. Department of Agriculture (USDA) and Food and Drug Administration (FDA) databases provide an iodine composition guide for commonly consumed foods based on portion size.

Table 1 summarizes iodine concentrations in various food items derived from these databases (9).

Food	Iodine Content (µg/g)	Food	Iodine Content (µg/g)
Yogurt (170 ml)	87	Chicken (100 g)	2
Milk (250 ml)	85	Bread (36 g)	1
Cheese (40 g)	15	Fresh juice (250 ml)	1
Whitefish (100 g)	37	Fruits and vegetables (75 g)	2
Redfish (100 g)	24	Nuts (30 g)	0.2
Shellfish (100 g)	17	Iodized table salt (5 g)	70
Eggs; boiled (63 g)	26		

2.4 Recommended Daily Iodine Intake

The Institute of Medicine suggests a daily intake of 150 µg for individuals aged 14 and older, with higher requirements for pregnant (220 µg) and lactating women (290 µg). For children aged 6 to 13, 120 µg per day is recommended. The World Health Organization (WHO) offers similar guidance, recommending 150 µg for those aged 12 and above and 250 µg for pregnant and breastfeeding women. Excessive iodine intake (above 1100 µg/day for adults) or insufficient intake (below 50 µg/day) can disrupt thyroid hormone production, potentially causing hypothyroidism or hyperthyroidism, with significant health consequences (6,7,9–11).

2.5 Evaluating Iodine Consumption

Epidemiological standards classify iodine deficiency severity as follows: severe (<20 µg/day), moderate (20–49 µg/day), mild (50–99 µg/day), and adequate (100–199 µg/day). Intake levels exceeding daily requirements (200–299 µg/day) or surpassing 300 µg/day may lead to negative health effects, particularly concerning thyroid function (10,12,13).

2.6 Prevalence of Iodine Intake and Thyroid Disorders

Thyroid disorders significantly impact long-term health if untreated. Hyperthyroidism and thyrotoxicosis are linked to cardiovascular risks and osteoporosis, while hypothyroidism is associated with dyslipidemia and atherosclerosis (14). Thyroid nodules, increasingly prevalent, may lead to thyroid cancer, with iodine levels influencing cancer risk. For example, iodine deficiency is a known risk factor for follicular thyroid cancer, while excessive intake can increase papillary thyroid cancer risk (15–17).

Globally, iodine deficiency affects approximately 25 countries. WHO estimates 740 million cases of goiter worldwide, with significant deficiencies reported in African (39.3%) and European (43.9%) children in 2012 (18,19).

In the United States, iodine intake is generally sufficient, though some groups, such as women of reproductive age, remain at risk for deficiency (9). China's implementation of iodized salt programs reduced severe iodine deficiency to mild levels, but excessive intake has since emerged as a public health concern, contributing to thyroid dysfunction (20–22). Similarly, South Korea reports high thyroid cancer rates influenced by dietary and genetic factors, with average iodine intake exceeding 750 µg/day among females and 950 µg/day among males (5,23).

In Saudi Arabia, a study in the western region revealed severe iodine deficiency among both healthy individuals and hypothyroidism patients, potentially due to only 70% of households using iodized salt—a figure below WHO's recommendations (3,4,11).

METHODOLOGY

3.1 Study Design

This research utilized a cross-sectional design to achieve its objectives.

3.2 Study Location

The investigation took place in Buraidah, located in the Al-Qassim Region of the Kingdom of Saudi Arabia. The Diabetes and Endocrine Center in Buraidah served as the primary study site. Notably, this region is classified as an area with low iodine exposure.

3.3 Sampling

3.3.1 Sample Size

The study targeted females diagnosed with thyroid disorders who visited the Diabetes and Endocrine Center in Buraidah between October 2021 and March 2022. Following the application of exclusion criteria, 1,572 eligible females were identified. A sample size of 309 participants was determined using a 95% confidence level. A total of 350 responses were received, and after excluding pregnant or lactating women and those with chronic diseases or nutritional supplement use, the final sample size comprised 331 females aged between 18 and 60 years with thyroid disorders and no other health issues.

3.3.2 Inclusion Criteria

- Females aged 18–60 years.
- Diagnosed with thyroid disorders.
- Regularly visiting the Diabetes and Endocrine Center in Buraidah for at least six months.

3.3.3 Exclusion Criteria

- Individuals outside the age range (children and elderly).
- Males.
- Pregnant or lactating females.
- Those with chronic illnesses or on nutritional supplements.

3.4 Sampling Process

A random sampling method was adopted to ensure equal opportunity for selection among eligible participants. Women diagnosed with thyroid disorders and who attended the Diabetes and Endocrine Center for six months between October 2021 and March 2022 were considered. Participants were provided with consent forms, a demographic questionnaire, and an Iodine Food Frequency Questionnaire (I-FFQ). These forms were distributed via an online platform (Google Forms). After reaching approximately 800 patients, a response rate of 44% (350 participants) was achieved. Responses were screened to eliminate duplicates and ensure adherence to the exclusion criteria.

3.5 Data Collection Tools

3.5.1 Demographic Questionnaire

A custom-designed demographic survey was used to gather participant information, including personal details, medical history, and use of nutritional supplements (see Appendix A).

3.5.2 Iodine Food Frequency Questionnaire (I-FFQ)

The semi-quantitative I-FFQ was adapted and validated from research conducted in Saudi Arabia (11) and Australia (24). It incorporated 13 iodine-rich food items, with serving sizes standardized based on Food Standards Agency 2014 guidelines (25). The I-FFQ served as a straightforward tool to measure both frequency and quantity of iodine intake (see Appendix B).

3.5.3 Data Entry

Data from the demographic questionnaire were directly entered into SPSS software (version 26). Body weight and height measurements were used to compute BMI using Excel, and BMI values were categorized into five groups as per WHO standards. Iodine intake calculations followed specific frequency multipliers for each consumption level (e.g., "don't like" = 0, "once-daily" = 1, etc.). The total daily iodine intake, expressed in µg/day, was calculated by summing contributions from all I-FFQ items. Two subtotals were also derived: iodine intake from iodized salt and from other dietary sources. Categories of iodine intake were classified as insufficient (<99 µg/day), adequate (100–199 µg/day), above requirements (200–299 µg/day), or excessive (≥300 µg/day). Data from I-FFQ were compiled in Excel and subsequently transferred to SPSS for analysis.

3.6 Statistical Analysis

Data analysis was conducted using SPSS software (version 26). Descriptive statistics were employed to summarize demographic data. Chi-square tests were used to assess the relationship between iodine intake levels and thyroid disorders, with significance defined as $p < 0.05$. Additionally, Analysis of Variance (ANOVA) was utilized to test the study hypotheses and address the research question. Assumptions of normality and variance homogeneity were met for all analyses. Statistical significance was established at $p < 0.05$.

3.7 Ethical Considerations

Ethical guidelines were rigorously followed during the study:

- Approval was secured from the Research Ethics Committee of Hail University (approval number H-2022-065) and the Diabetes and Endocrine Center in Buraidah, as well as the Regional Research Ethics Committee of Al-Qassim Region (approval number 607-43-1096) (see Appendices C and D).
- Informed consent was obtained from participants, who were made aware of their right to withdraw at any time.
- Confidentiality of participant data was maintained throughout the study.
- All participant records were securely stored and protected at every stage of the research process.

RESULTS

4.1. Descriptive Analysis of Sample's Characteristics

The study collected data through a demographic questionnaire and the I-FFQ, encompassing a sample size of 331 women aged 18 to 60 years. The average age of participants was 40.79 ± 10.77 years. Notably, participants' mean usual weight was recorded as 69.79 ± 14.48 kg, which was lower than their current average weight of 74.18 ± 15.73 kg, indicating weight gain. The mean Body Mass Index (BMI) across the sample was 29.58 ± 6.13 kg/m², classifying the group as overweight overall. Among the participants, 42.9% (N=142) were categorized as obese, 32.6% (N=108) as overweight, 22.4% (N=74) as having a normal BMI, and 2.1% (N=7) as underweight. The average daily dietary iodine intake was 216.47 ± 129.40 µg, exceeding the daily recommended amount for adults.

Table 1 Characteristics of the study sample

Characteristics	Mean ± SD	Minimum	Maximum
Age (years)	40.79 ± 10.77	18	60
Current Weight (kg)	74.18 ± 15.73	39	135
Usual Weight (kg)	69.79 ± 14.48	37	136
Height (cm)	158.37 ± 6.50	140	186
BMI (kg/m^2)	29.58 ± 6.13	16.65	53.28
Total Dietary Iodine Intake (µg/d)	216.47 ± 129.40	24.75	793.79
Total Dietary Intake of Iodine without Iodized salt (µg/d)	116.15±93.2	3	568.13
Total Dietary Intake of Iodine from Iodized salt (µg/d)	100.32±85.47	0	342

BMI, body mass index; SD, standard division; µg/d, microgram per day.

Table 3 outlines the health characteristics of the participants. Nearly half of the participants (48%, N=158) had a family history of thyroid disorders. Hypothyroidism was the most common type (78.2%), followed by hyperthyroidism (12.1%), thyroid tumors (5.4%), and thyroid nodules (4.2%). Following a diagnosis of thyroid disorders, 58.6% (N=194) of participants reported weight gain, 32% (N=106) reported no change, and 9.4% (N=31) experienced weight loss.

Table 2Health status of the study sample

Characteristics	Frequency	%
Diagnostic Type of Thyroid Disorders		
Hypothyroidism	259	78.2
Hyperthyroidism	40	12.1
Thyroid-Nodules	14	4.2
Thyroid-Tumors	18	5.4
Weight Change Since Diagnosis		
Decreased	31	9.4
Increased	194	58.6
No Change	106	32.0

4.2. Results of Total Daily Iodine Intake

Table 4 highlights the total daily iodine intake and the primary sources of dietary iodine for participants. The leading contributors were iodized salt, milk, and yogurt, providing mean intakes of 100.32 µg/d, 40.1 µg/d, and 31.14 µg/d, respectively. Although chicken, bread, fruits, and vegetables were frequently consumed, they contributed minimal iodine content (97.89%, 95.77%, and 93.35%, respectively).

Table 3 Total daily iodine intake and habitual iodine consumption from dietary sources

Dietary Sources	Mean ± SD (µg/d)	Frequency	%
Yogurt (170 ml)	31.14 ± 42.48	228	68.88
Milk (250 ml)	40.1 ± 58.85	216	65.26
Cheese (40g)	13.37 ± 15.62	299	90.33
Whitefish (100g)	4.38 ± 8.78	240	72.51
Redfish; Sardine, tuna, or salmon (100 g)	2.8 ± 5.22	217	65.56
Shellfish; Shrimps, oysters (100 g)	0.59 ± 1.12	153	46.22
Eggs; boiled or fried (63 g)	14.49±19.84	301	90.94
Chicken (100 g)	1.85±1.26	324	97.89
Bread (36 g)	1.36±1.04	317	95.77
Fresh juice (250 ml)	0.39±0.67	197	59.52
Fruits and vegetables (75 g)	5.59±5.78	309	93.35
Nuts (30 g)	0.09±0.13	211	63.75
Iodized table salt (5g)	100.32±85.47	278	83.99

SD, standard division; µg/d, microgram per day.

As shown in Table 5, 14.8% of participants consumed iodine at insufficient levels (<99 µg/d), while 51.1% had inadequate iodine intake when iodized salt was excluded. This insufficiency increased further when iodine intake was calculated from iodized salt alone. The proportion of participants with adequate iodine intake (100-199 µg/d) was (37.5%) in total dietary intake of Iodine. Excessive iodine consumption (≥300 µg/d) was observed in 5.7% of participants from iodized salt and in 4.5% from other sources, with 23.6% of participants exceeding the recommended daily intake from all sources combined.

Table 4 Total dietary intake of iodine from non-iodized salt sources and iodized salt

Dietary Iodine Intake	Frequency	%
Total Dietary Intake of Iodine		
Insufficient	49	14.8
Adequate	124	37.5
Above Requirements	80	24.2
Excessive	78	23.6
Total Dietary Intake of Iodine without Iodized salt		
Insufficient	169	51.1
Adequate	111	33.5
Above Requirements	36	10.9
Excessive	15	4.5
Total Dietary Intake of Iodine from Iodized salt		
Insufficient	242	73.1
Adequate	70	21.1
Excessive	19	5.7

4.3. Total Dietary Intake of Iodine Differences AmongThyroid Disorders

A Chi-square test and one-way ANOVA test were utilized to explore the relationship between total dietary iodine intake and thyroid disorder types.

Table 6 details iodine intake distribution among different thyroid conditions. Among participants with hypothyroidism, 97 consumed adequate iodine, 66 consumed above requirements, 58 had excessive intake, and 38 consumed insufficient iodine. For hyperthyroidism, the respective numbers were 14, 13, 8, and 5. Regarding thyroid nodules, 4 participants had adequate and excessive iodine intake, while 3 participants consumed iodine at above-requirement and insufficient levels. In the thyroid tumors group, half of the participants had adequate iodine intake.

The statistical analysis revealed no significant association between total dietary iodine intake and the type of thyroid disorder (P=0.862), with significance set at a p-value <0.05.

Table 5 Distribution of total dietary intake of iodine by diagnostic type of thyroid disorders

Diagnostic Type of Thyroid Disorders	Total Dietary Intake of Iodine					Chi-square value	P-value
	Insufficient	Adequate	Above Requirements	Excessive	Total		
Hypothyroidism	38	97	66	58	259	4.673	0.862
Hyperthyroidism	5	14	8	13	40		
Thyroid-Nodules	3	4	3	4	14		
Thyroid-Tumors	3	9	3	3	18		

Categorical variables using the Chi-square test
$P < 0.05$ is considered as a significant difference

The average iodine intake was highest among participants with thyroid nodules (269.82 µg/d), classified as above-requirement intake (200-299 µg/d), and lowest among participants with thyroid tumors (195.37 µg/d), considered adequate intake (100-199 µg/d). Participants with hyperthyroidism and hypothyroidism showed mean intakes of 244.98 µg/d and 210.65 µg/d, respectively, both above the recommended levels.The ANOVA test further confirmed that differences in dietary iodine intake (100-199 µg/d) among women with varying thyroid disorders were not statistically significant (P=0.149).

Table 6 Statistical comparison of total dietary intake of iodine among the sample with the diagnostic type of thyroid disorders (Mean and SD)

Diagnostic Type of Thyroid Disorders	Total Iodine Intake (µg/L)	Sum of Squares	Mean Square	F	P-value
Hypothyroidism N= 259	210.65± 121.47	89140.133	29713.378	1.787	0.149
Hyperthyroidism N= 40	244.98± 140.35				
Thyroid-Nodules N= 14	269.82± 195.73				
Thyroid-Tumors N= 18	195.37± 146.17				

Multiple sets of data using one-way ANOVA
$P < 0.05$ was considered a significant difference
SD, standard division; N, number; µg/d, microgram per day; F, for statistic test; ANOVA, analysis of variance.

In conclusion, the statistical findings support the null hypothesis, indicating no significant differences in adequate dietary iodine intake among women diagnosed with thyroid disorders at the Diabetes and Endocrine Center in Buraidah, Saudi Arabia.

5.1. Research Discussion

The variability in daily iodine intake across populations, particularly among individuals with thyroid disorders, remains a topic of debate. While some studies have reported differences in total iodine consumption, others have found no significant variation. This study aimed to investigate dietary iodine intake in adult females diagnosed with thyroid disorders attending the Diabetes and Endocrine Center in Buraidah, Saudi Arabia.

A total of 331 participants, aged between 18 and 60 years, were included in this research. The majority (42.9%) had a BMI within the range of 30–34.9 kg/m², classifying them as obese. Urinary iodine concentration (UIC) is a widely used method for assessing iodine nutrition status because over 90% of iodine is excreted in urine, reflecting recent intake. However, UIC alone may not provide an accurate measure of long-term iodine

consumption or deficiency (2, 23, 24). This study employed an iodine-specific food frequency questionnaire (I-FFQ), validated using UIC, to estimate usual iodine intake rather than short-term fluctuations. Iodine intake ranged from 24.75 µg/day to 793.79 µg/day, with a mean intake of 216.47 µg/day, aligning with findings from a Chinese study where thyroid disorder patients had a median UIC of 233.20 µg/L (2). Similarly, in another Chinese study comparing iodine intake across two regions, UIC averaged 244 µg/L in Shandong and 159 µg/L in Tianjin, with differences attributed to the iodine content in drinking water (21).

In contrast, a Norwegian study reported a lower mean iodine intake of 121 µg/day based on FFQ data (6). A study from Saudi Arabia's western region also found a lower iodine intake of 102.86 µg/day, though this excluded iodized salt (4). Iodine content in water has a significant influence on intake, as demonstrated in a Chinese study examining three villages with varying water iodine levels. UIC means were 126.6, 221.2, and 421.3 µg/L, depending on iodine sufficiency, with the middle group resembling this study's results (22). Meanwhile, a Korean case-control study recorded higher dietary iodine intakes: 551 µg/day overall, 554 µg/day for controls, and 458.8 µg/day for thyroid disorder cases, largely due to Korea's high seaweed consumption (23).

In this study, the most frequently consumed foods were chicken (97.89%), bread (95.77%), fruits and vegetables (93.35%), eggs (90.94%), and cheese (90.33%), while the least consumed were shellfish (46.22%), fresh juice (59.52%), and nuts (63.75%). A study in Saudi Arabia's western region similarly highlighted bread, yogurt, milk, chicken, fruits, vegetables, and eggs as the most consumed iodine-rich foods, though fish and shellfish were less frequently eaten (11).

Iodized salt usage in this study was 83.99%, higher than the reported usage in other Saudi studies—73% (4) and 60.9% (11). Family history of thyroid disorders was reported by 48% of participants, consistent with findings from the eastern region of Saudi Arabia (40%) (3). The distribution of thyroid disorders was hypothyroidism (78.2%), hyperthyroidism (12.1%), thyroid tumors (5.4%), and thyroid nodules (4.2%). These findings partially align with another Saudi study where hypothyroidism was 68.9%, thyroid nodules 11.3%, hyperthyroidism 9.9%, and thyroid tumors 0.7% (3). In comparison, a Chinese study reported a different distribution: hyperthyroidism (26.3%), papillary thyroid cancer (21.3%), benign nodules (18.2%), and Hashimoto's thyroiditis (11%) (2).

Statistical analysis revealed no significant difference in iodine intake adequacy (100–199 µg/day) among participants with thyroid disorders. This finding is consistent with a Saudi study and a Korean study, both of which observed no significant differences in iodine consumption between thyroid disorder groups (11, 23). However, in a Chinese study, UIC varied significantly across thyroid conditions, such as hyperthyroidism (278 µg/L), Hashimoto's thyroiditis (305 µg/L), papillary thyroid cancer (284 µg/L), and benign nodules (280 µg/L) (2). This suggests that while excessive or insufficient iodine intake may influence thyroid disorders, the underlying mechanisms remain unclear (2).

5.2. Research Limitations

- The findings cannot be generalized to other groups, such as males, pregnant or lactating women, or individuals with chronic diseases, as the sample was selected based on specific criteria.
- The cross-sectional study design limits the ability to infer causality regarding the relationship between iodine intake and thyroid disorders.
- There is potential for measurement error in estimating iodine intake due to reliance on self-reported data from the I-FFQ.
- The study lacked funding for laboratory tests and advanced equipment.

6.1. Conclusion

Prolonged iodine excess or deficiency can disrupt thyroid hormone regulation and contribute to various thyroid disorders. Iodine is primarily obtained from seafood, dairy products, and iodized salt.

This study investigated dietary iodine intake among adult females diagnosed with thyroid disorders who attended the Diabetes and Endocrine Center in Buraidah, Saudi Arabia. The participants (N=331) were aged 18–60 years, with the majority falling within the obesity BMI range (30–34.9 kg/m²). The mean iodine intake was 216.47 µg/day, exceeding daily requirements, with iodized salt (100.32 µg/day) being the primary source. Hypothyroidism was the most common thyroid disorder (78.2%). No significant differences in iodine intake were observed across thyroid disorder types.

6.2. Recommendations

Based on the research results, the researcher came up with the following recommendations:

- Public education campaigns should raise awareness of the health risks associated with inadequate or excessive iodine intake, as recommended by the WHO (100–199 µg/day).
- Future studies should focus on male participants within similar age groups.
- Laboratory-based assessments should quantify actual iodine intake and evaluate its effects on thyroid function.
- Additional research is needed to explore the impact of iodine intake on thyroid health across different life stages, as variations in intake may lead to subtle changes in thyroid function.
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Appendix A

Demographic Data

المشاركة في البحث امر تطوعي، وان قررت عدم المشاركة فلن يترتب عليه اية عقوبة او خسارة لمنفعة تستحقها بسبب اخر، كما ان لك الحق بالانسحاب من البحث في أي مرحلة من مراحله دون ان تتعرض لخسارة او فوات منفعة تستحقها لاي سبب، سيتم ابلاغك بجميع المعلومات التي قد تستجد خلال مدة اجراء البحث مما قد يؤثر بطريقة معقولة على رغبتك في الاستمرار بالمشاركة في هذا البحث	
Name:	الاسم:
Age:	العمر:
Sex: ○ Male ○ Female	الجنس: ○ ذكر ○ أنثى
Marital : status ○ Single ○ Married ○ Divorced ○ Widowed	الحالة الاجتماعية: ○ عزباء ○ متزوجة ○ مطلقة ○ أرملة
Monthly Household Income ○ SR 10,000> ○ SR 20,000-15,000 ○ SR 20,000 – 15,000> ○ SR 20,000 < ○ I prefer not to answer	ما هو دخل أسرتك الشهري؟ ○ 1000 ريال سعودي أو أقل ○ > 10000-15000 ريال سعودي ○ > 15000-20000 ريال سعودي ○ أكثر من 20000 ريال سعودي ○ أفضل عدم الإجابة
Current weight: ……kg Usual wight …… kg Height: ……cm	الوزن الحالي ……كجم الوزن المعتاد ..... كجم الطول .....سم
Weight change since diagnosis: ○ No change ○ Increased ○ Decreased	مدى تغير وزن الجسم منذ التشخيص ○ لا يوجد تغير ○ ازداد الوزن ○ نقصان الوزن
Is there a family history of any thyroid disorders? ○ Yes ○ No	هل يوجد تاريخ عائلي (أحد افراد الاسرة) للإصابة بأمراض او اضطرابات الغده الدرقية؟ ○ نعم ○ لا
Are you pregnant? ○ Yes ○ No	هل أنتِ حامل؟ ○ نعم ○ لا
Are you lactating? ○ Yes ○ No	هل أنتِ مرضع؟ ○ نعم ○ لا
Are you taking any dietary supplement? ○ Yes ○ No	هل تتناولين أي مكمل غذائي (فيتامينات أو معادن)؟ ○ نعم ○ لا

Appendix B

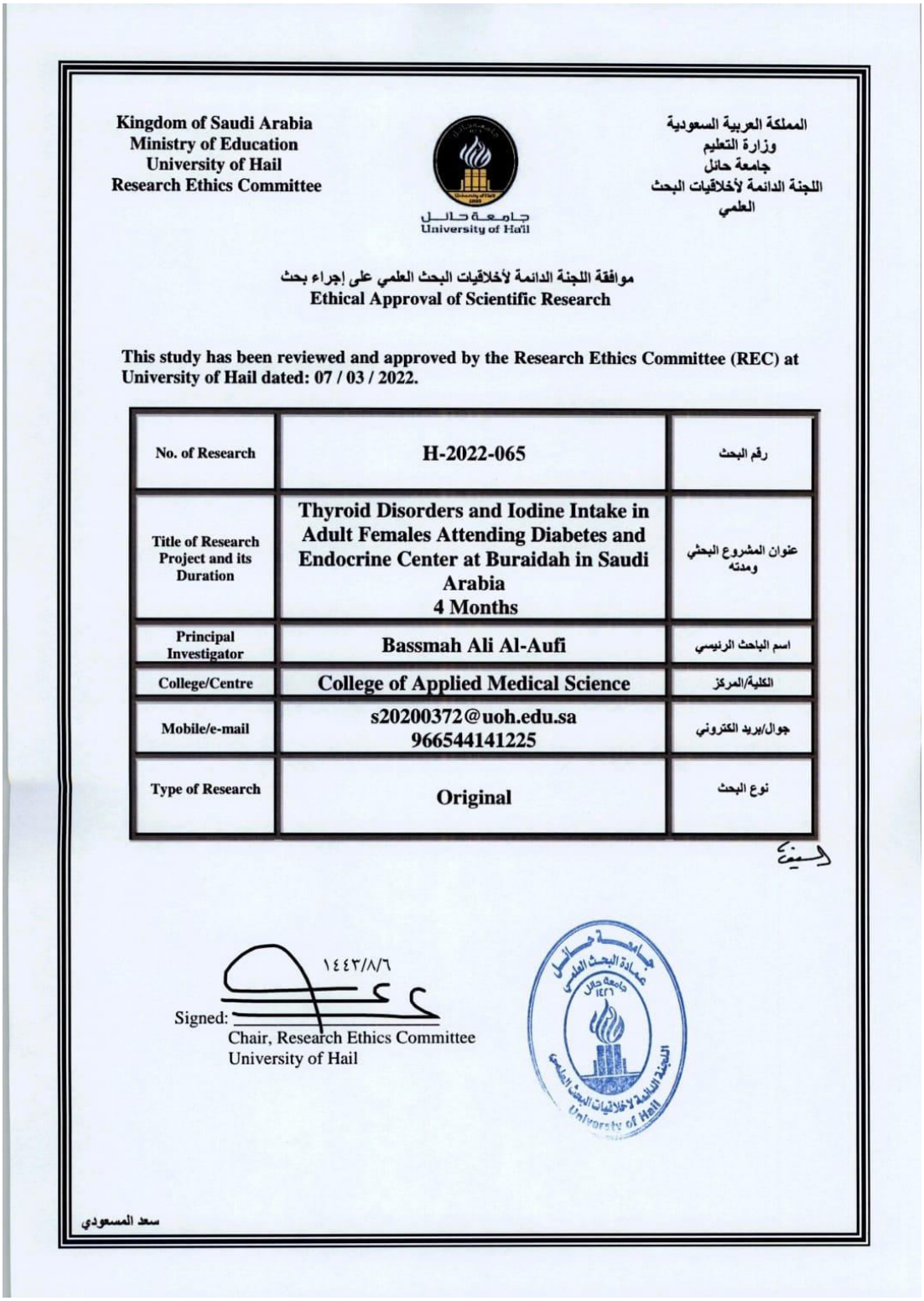
IodineFoodFrequencyQuestionnaire

Typeoffood(servingsize)	Frequency ofservings									
	Don't Li	Per day				Per week			Permonth	
		Once	2-3	4-5	6+	Once	2-4	5-6	Once	1-3
Yogurt(1cupor200ml)										
Milk(1cupor250ml)										
Cheese(Allvarieties;2slicesprocessed,or40g=2tablespoonsgrated=2wedgesofcheese)										
Whitefish(1mediumfilletor100g)										
Redfish;Sardine,tuna,orsalmon(1mediumfilletor100g)										
Shellfish;Shrimps,oysters(100g)										
Eggs;boiledorfried(1 mediumor63g)										
Chicken(100g)										
Bread(36g,1sliceor½mediumbreadrollor½mediumbun)										
Freshjuice(1cupor250ml)										
Fruitsandvegetables(1mediumor75g)										
Nuts(30g)										
Iodized table salt (1 small spoon or 5g)										

استبانةتكرارتناولاليود من الغذاء

نوع الطعام (حجم الحصة)	معدل تكرار الحصص									
	لا أتناوله	في اليوم				في الأسبوع			في الشهر	
		مرة واحدة	3-2	5-4	6+	مرة واحدة	4-2	6-5	مرة واحدة	3-1
زبادي (1 كوب أو 200 مل)										
حليب (1 كوب أو 250 مل)										
الجبن (جميع الأصناف؛ 2 شريحتين معالجة، أو 40جم = 2 ملاعق كبيرة المبشور = 2 مثلثين من الجبن)										
السمك الأبيض (1 فيليه متوسط أو 100 جم)										
سمك أحمر; السردين أو التونة أو السلمون (1 فيليه متوسط أو 100 جم)										
ثمار البحر أو الجمبري أوالمحار (100 جم)										
البيض؛ مسلوقة أو مقلية (1 متوسط أو 63 جم)										
الدجاج (100 جم)										
الخبز (36 جم، شريحة واحدة أو لفافة خبز متوسطة أو كعكة متوسطة)										
عصير طازج (1 كوب أو 250 مل)										
الفواكه والخضروات (1 متوسطة أو 75 غرام)										
المكسرات (30 غرام)										
ملح الطعام المدعم باليود (ملعقة صغيرة أو 5 جرام)										

Appendix C



Kingdom of Saudi Arabia
Ministry of Education
University of Hail
Research Ethics Committee

المملكة العربية السعودية
وزارة التعليم
جامعة حائل
اللجنة الدائمة لأخلاقيات البحث العلمي

جامعة حائل
University of Hail

موافقة اللجنة الدائمة لأخلاقيات البحث العلمي على إجراء بحث
Ethical Approval of Scientific Research

This study has been reviewed and approved by the Research Ethics Committee (REC) at University of Hail dated: 07 / 03 / 2022.

No. of Research	H-2022-065	رقم البحث
Title of Research Project and its Duration	Thyroid Disorders and Iodine Intake in Adult Females Attending Diabetes and Endocrine Center at Buraidah in Saudi Arabia 4 Months	عنوان المشروع البحثي ومدته
Principal Investigator	Bassmah Ali Al-Aufi	اسم الباحث الرئيسي
College/Centre	College of Applied Medical Science	الكلية/المركز
Mobile/e-mail	s20200372@uoh.edu.sa 966544141225	جوال/بريد الكتروني
Type of Research	Original	نوع البحث

١٤٤٣/٨/٦

Signed:
Chair, Research Ethics Committee
University of Hail

سعد المسعودي

Appendix D

KINGDOM OF SAUDI ARABIA
MINISTRY OF HEALTH
GENERAL DIRECTORATE OF HEALTH AFFAIRS
AL-QASSEM REGION

وزارة الصحة
Ministry Of Health

المملكة العربية السعودية
وزارة الصحة
المديرية العامة للشئون الصحية بمنطقة القصيم

الرقم : ٩٦-٦-٤٢-٦٠٧ التاريخ : ١٤٤٢/٨/١٢ المشفوعات :
الموضوع :

Wednesday, March 16, 2022

To:	**Bassmah Ali AlAufi,** Principal Investigator بسمة العوفي Master's student, Department of Clinical Nutrition, College of Applied Science (CAS), Hail University (HU), Kingdom of Saudi Arabia (KSA)
Supervisor:	**Dr. Nagat Elzein Eltoum,** Assistant professor, CAS, HU, KSA
From:	**Regional Research Ethics Committee**, Registered at National Committee of Bio & Med. Ethics (NCBE) Registration No. H-04-Q-001
Research title:	**"Thyroid Disorders and Iodine Intake in Adult Females Attending Diabetes and Endocrine Center at Buraidah in Saudi Arabia"**
Study Setting:	**Diabetes and Endocrine Center, Buraydah, Qassim**
Study design:	**A cross-sectional study**
Revision type:	**☑ Expedited ☒ Exemption ☒ Full Board**

Decision: **Approval, for:** **☑ Implementation** **☒ Publication**

Dear P.I,
We are pleased to inform you that the local research ethics committee had approved your research proposal. Your efforts to meet the criteria requested by NCBE are highly appreciated

Upon receiving this approval, you may commence your field work at your convenience.

- You should be responsible for upholding the confidentiality of participants' data.
- This approval is for study implementation **ONLY**. In case of publication, kindly submit a new request specifying the name of the periodical with a copy of the study report.
- Kindly, update us on your project advancement every 6 months. On completion of your project, kindly send us a summary of the project final report.
- Finally, be aware that this approval embraces no financial, or any other, obligations or responsibilities on Saudi Ministry of Health or its health affiliates.

Note: Any corrections and/or alterations of this certificate will make it invalid.

For queries, please call Dr. Abdullah Al Saigul at telephone No. 00966163693429 ext. 101, and e-mail: irb-qassim@moh.gov.sa or qassim_ethcom@yahoo.com

Best regards,

Dr. Abdullah M. Al Saigul

Chairman, Regional Research
Ethics Committee - Qassim Province
16-03-2022

www.qh.gov.sa بريدة – ص.ب ٢٢٩٥ هاتف : ٣٢٣١٧١٨ – ٣٢٣٥٥٠٦ تلكس : ٣٠١٢٩٩ فاكس : ٣٢٣١١٥٨

١/٢