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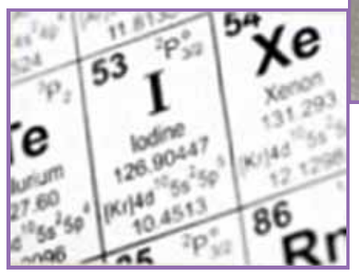
Ministry of Health
Public Health Directorate

ICCIDD

Prevalence and Risk Factors of Iodine Deficiency

Among School Children (6-12) years in Kingdom of Bahrain



Prepared by:

Dr. Ayoub Al-Jawaldeh
Regional Advisor, Nutrition WHO
Regional Office for the Eastern
Mediteranean Region EMRO

Dr. Nadia Gharib
Chief / Nutrition Section

Dr. Izzaldin Sharief
Regional Coordinator,
International Council for the Control
of Iodine Deficiency Disorders - ICCIDD
GN-EMR & Gulf

Dr. Saniya Al Salehi
Head / Nutrition Clinics Unit

Mrs. Mariam Al Amer
Head / Children and Adolescent Unit

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Nutrition Section

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Dr. Nadia Gharib
Chief, Nutrition Section
Public Health Directorate
Ministry of Health

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نقص اليود لدى اطفال السن المدرسي (٦-١٢ سنة) وعوامل الاصابة بها في مملكة البحرين

إن مملكة البحرين في سعيها الدائم لرفع المستوى الصحي لأفراد المجتمع كافة باعتباره أساسا لتنمية ومحورها فإنها تعمل على متابعة تنفيذ قرار المنظمة الصحة العالمية المتعلقة بالتغذية الصحية وفي ذلك وضعت الخطط والاستراتيجيات الصحية ودأبت على وضع آليات تنفيذها ومتابعتها .

إن البحرين ومن خلال وزارة الصحة قد بذلت جهودا ملحوظة تخص متابعة توصيات المنظمة من اجل التخلص من اضطرابات نقص اليود بشكل دائم كون اليود من المغذيات المهمة وسبب أساسي للتخلف الذهني وتأخر التحصيل الدراسي وتضخم الغدة الدرقية، وقصر القامة، وتأخر في النطق، ومشاكل في السمع، وشلل، وإيضاحا لإجهاض ووفاة الأجنة لدى النساء الحوامل. وكل ما سبق من المشاكل من الممكن منعه من خلال غذاء صحي متكامل غني باليود.

ومن أهم التدابير التي وضعتها المملكة هي البرامج التثقيفية للمجتمع بأهمية عنصر اليود والمخاطر التي تنتج عن نقص اليود، وتنمية السلوكيات الايجابية للمواطنين المتعلقة بتناول الأغذية التي تحتوي على عنصر اليود الغذائي، والمتابعة المستمرة عن طريق

المسوحات لمعرفة مدى انتشار اضطرابات نقص اليود في المملكة والمراقبة للملح المتواجد في الأسواق المحلية.
أن المسح الميداني الذي أقيم في مملكة البحرين في عام ٢٠٠٢ توصل إلى أن مملكة البحرين تصنف من البلدان التي لا يمثل فيها نقص اليود مشكلة صحية عامة حيث ان تضخم الغدة الدرقية حوالي ١,٧٪ وان معدل نسبة اليود في البول ٢١٣ ميكروجرام في الليتر إلا أننا ومن منطلق حرصنا على حماية مجتمعنا قمنا بالمسح الثاني للتأكيد على خلو البحرين من اضطرابات نقص اليود. وذلك إتباعا لما جاء في توصيات منظمة الصحة العالمية والتي تنص على ضرورة الاستمرار في مراقبة وتقييم الوضع خصوصاً عند صغار السن والمتمثلين بطلبة المدارس الفئة العمرية من ٦-١٢ سنة. وخلال عام ٢٠١٢ قام قسم التغذية بإدارة الصحة العامة وبالتعاون مع المجلس الدولي لاضطرابات نقص اليود وبشكل متوافق مع بروتوكول منظمة الصحة العالمية تم دراسة أهم المؤشرات المعتمدة لتقييم نقص اليود وذلك بقياس معدل نسبة اليود في البول ونسبة تضخم الغدة الدرقية والكشف عن معدل استهلاك الملح المدعم باليود ومدى تماشي نسبة اليود بالملح المتوفر في الأسواق ومقارنتها بالمعايير الدولية. ومن هذا المسح الذي شمل ١٠٥١ طالب وطالبة (٦-١٢ سنة) تبين إن نسبة انتشار تضخم الغدة الدرقية لا يتجاوز ٢٪ وهذا اقل بكثير من المستوى المعتمد من منظمة الصحة العالمية لتشخيص اضطرابات نقص اليود (اقل من ٥٪) بينما معدل اليود في البول حوالي ٢٤٩ ميكرومول في اللتر والذي يتجاوز ما تعتبره المنظمة المستوى الكافي وهوان يكون بين ١٠٠-١٩٩ ميكروجرام في اللتر.

وهذه المؤشرات تشير بدلالة قطعية بان اضطرابات نقص اليود لا تعد مشكلة صحية عامة في مملكة البحرين.

ولكن معدل نسبة اليود في البول يشير إلى ارتفاع في استهلاك اليود ومن المحتمل إن استمرارية ذلك قد يؤدي إلى المشاكل الأخرى المرتبطة بزيادة الاستهلاك وليس النقص.

للمحافظة الدائمة على وضع مملكة البحرين الخالي من اضطرابات نقص اليود يجب الاستمرارية في الترصد والمتابعة والمراقبة من خلال المسوح الوطنية وأيضا التأكيد على برامج التوعية المجتمعية باستخدام جميع الوسائل المتاحة ووضع وتنفيذ الاستراتيجيات للتقليل من استهلاك الملح من ضمن الخطط المستهدفة لتقليل نسبة الخطورة من الأمراض غير السارية مع التأكيد على تناول الملح المدعم باليود ومن الجدير من الذكر بان الجهات الصحية المعنية في وزارة الصحة قد بدأت فعليا بتنفيذ ذلك.

Summary

Background: In many developing countries, children are at high risk of both goiter and iron deficiency anemia. In Bahrain, In a survey conducted in 2000 out of 1600 children examined, only 26 (1.7%) were found to have goiter; 121 out of 749 (16.5%) children tested had low urinary iodine levels. Overall prevalence of IDD was slightly lower for boys (15.8%) compared to girls (16.5%), in spite of the distribution of iodized salt.

Objectives: The aim of this study was to demonstrate the prevalence of goiter, median urinary iodine concentration (UIC) in school-aged children (6–12 years), and to estimate salt iodine content at the household level in Bahrain.

Design: A cluster sampling with probability proportional to size (PPS) was carried out to select 900 schoolchildren from 30 schools (approximately 30 students from each) chosen randomly in five different governorates in Bahrain.

Methods: One thousand and fifty one schoolchildren (6-12 years) were studied (48.7% males, 51.3% females) and data were collected on sociodemographic, dietary habits, and parameters such as height and weight. The indicators used in this study to assess for IDD were recommended by the WHO/UNICEF/ICCIDD. Goiter was assessed clinically by the standard palpation technique. The urinary iodine excretion level was analyzed by the wet digestion method using ammonium persulphate. Salt samples consumed at the household level were collected and tested by using the titration method.

Results: Total goiter Rate (TGR) (≥1 grade) was 2.1 per cent. Grade 1 was 1.8% and Grade 2 (visible goitre) was 0.28%. The median urinary iodine excretion level was 247 µg/l (normal range: 100-199µg/l), only three students had a value less than 50 µg/l. In 59.27% of the students the urine iodine levels above requirements (200-299 µg/l), and 17.69 % of the students had excessive urine iodine levels (≥ 300 µg/l). However, the rate of iodine deficiency was reduced significantly in 2012 (1.75 %) compared to that in 2000 (16.5%). The rate of household use of iodized salt was 37.57 per cent. 65% and 61% of students daily consumed bread and rice, respectively; Whereas dairy products (milk, cheese, yogurt) were the next greatest food sources of salt for another 52.4% of the children; and 45% students consumed seafood at least 1-2 times /week.

Conclusion: TGR of 2.1% indicates that Bahrain Goiter prevalence in the studied governorates was low and IDD is not a public health problem. Median urinary iodine level (247µg/l) was above the threshold level of the recommended level of 100–200µg/l. Interpreting these two indicators of the present study together, it may be concluded that absence of endemic goiter in The Kingdom of Bahrain according to WHO criteria1,6,7. Adequately iodized salt consumption at the household level (63.6 %) is fair enough. However, the UIC reflects excessive iodine intake may put the population at risk of adverse health consequences like iodine-induced hyperthyroidism and autoimmune thyroid diseases. Establishing surveillance and monitoring systems will protect the population and help in guiding the implementation of Universal Salt Iodization (USI) in the country. Intensified information, education and communication activities along with continuous monitoring are required to sustain the elimination of IDD in the country.

Introduction

Iodine deficiency is the single greatest cause of preventable mental retardation in the world today1. Due to lack of iodine in their diets, 1.6 billion people worldwide are at risk of diminished mental and physical capacities. Iodine deficiency disorders(IDD)also cause poor eye–hand coordination, deaf–mutism, dwarfism, facial and physical deformity, partial paralysis, cretinism, neurological damage, goiter, and lassitude. The chances of miscarriage, stillbirth or prematurity rise significantly if a pregnant woman is deficient in iodine. Each child in mildly iodine-deficient areas may forfeit as many as 10–15 IQ points2-4.

In developing countries about 38 million newborns every year remain unprotected from the lifelong consequences of brain damage associated with IDD5. A recent study estimated that 266 million school-age children and two billion of the general population worldwide have insufficient iodine intake6.

In the Middle East and North Africa region the situation of IDD control varies considerably between countries. Only the Islamic Republic of Iran and Tunisia have achieved IDD control goals7. Iraq, Afghanistan and Pakistan were classified as suffering from severe IDD while Morocco, Sudan and the Kingdom of Saudi Arabia (KSA) were considered as suffering from moderate IDD problems7,8.

In Bahrain a national cross-sectional epidemiological survey for studying iodine status was conducted among Bahraini schoolchildren aged 8–10 years in 20009. Only 1.7% were found to have goiter (0.1% grade 2, 1.6% grade 1). Nationally the proportion of the population with urinary iodine concentration (UIC) less than 100µg/L was16.5%children (boys 15.8%, girls 16.5%).Most of these were from Jidhafs, Northern and Hamad Town regions. The Central region of Bahrain had the lowest UIC and the highest percentage (35%) of subjects with a UIC < 100 µg/L9.The IDD control program using the Universal Salt Iodization (USI)strategy started in 199410 and the Bahraini Standards, Metrology and Quality recommend that iodine content of salt must be 20–40 mg/kg in all food salt according to Standardization Organization for GCC11. Since the national survey in 2000, no follow up survey or monitoring system has taken place to assess the iodine nutrition status in the population at a national level.

Our study aimed to identify the prevalence of iodine deficiency among schoolchildren in Bahrain by measuring the UIC and by clinical assessment of the goiter rate, and studying the factors affecting the prevalence of iodine deficiency.

Subjects and Methods

Subjects

After obtaining permission from the headmaster, schoolchildren aged 6-12 years were asked to participate. Some days before the actual investigation, the schoolchildren received written information on the project, a questionnaire on sex, age and dietary habits and an informed consent form. Consent had to be given by the parents for all the children.

Height and weight were measured. Urine samples were collected. Assessment of thyroid size by inspection and palpation was done. In case of abnormality in the clinical examination of the thyroid, the parents of the children received a written note directed to the family physician describing the abnormal results of the examination. At each evaluation, interviews on lifestyle and health related issues, such as the use of iodized salt at home are conducted.

Sample Size

The sample size was based on previous calculations of the prevalence of goiter and urinary iodine levels in areas bordering the study zone (Bah IDD Study 2000)[9], assuming an α error of 0.05 and a β error of 0.20. The total number of children studied was1051, giving a sample size error less than 0.5% for the prevalence of both goiter and urinary iodine levels.

Sampling was carried out in different stages to guarantee representatively of the whole geographic area; governorates (n =5) and children (n = 1051) were selected as the sampling units.

The study was carried out in state schools. Education in Bahrain is universal, compulsory, and free for the all age groups studied; thereby ensuring that selection of a school unit was fully representative of the entire population.

Data Collection

The following data were obtained from all children:

1) Presence of goiter according to the criteria recommended by the joint WHO/UNICEF/ICCIDD[12,13] (Grade 0, thyroid not palpable; Grade 1, thyroid palpable but not visibly enlarged; Grade 2, goiter palpable and a swelling in the neck that is clearly visible when the neck in a normal position);

2) Standardized weight and height[14] from which the body mass index was calculated [weight (kilograms)/height (meters)^2]; and

3) Evaluation of usual food consumption by means of a previously validated questionnaire (FFQ)[15,16]; and

4) All the study children were asked to bring about 20g of salt which were routinely being consumed in their respective families. The concentration of iodine in the salt samples collected from each household and those purchased from retail outlets was determined using the standard iodometric titration procedure recommended by the ICCIDD[13].

The parents and teachers were informed of the characteristics of the survey and the questionnaire, which, after completion at home, was sent to the investigators.

Anthropometric Measurements

Anthropometric measurements for weight and height were performed according the recommendations of Gibson (1990)[17] and WHO[14]. Weight and height was measured using electronic weighing scales (SECA, Hamburg, Germany). All electronic scales were calibrated for accuracy. The schoolchildren were barefoot with minimum clothing and stood in the center of the scale with the body weight evenly distributed between both feet. Then the subject was asked to look straight ahead, still and relaxed. The weight was measured to the nearest 0.1 kg. Height measurement was measured to the nearest 0.1 cm. Body mass index (BMI) (body weight [kg]/height [m^2]) was then calculated.

Assessment of Frequency of Iodine Intake

Usual dietary intake was assessed with a daily intake item, food frequency questionnaire administered to the children. The food frequency questionnaire was an adapted version of previously validated and developed for school children nutrition assessment survey in Bahrain[15,18]. The questionnaire included dairy, sea food, Meat and meat products, bread, Nuts, chips, crisps, fruits and juices, items the main dietary contributors to iodine intake[19]. Additionally, the type of salt consumed data was collected using a structured questionnaire.

Sampling Method

Proportionate to Population Size (PPS) sampling technique was used to determine the required number of children from classes as recommended by the WHO for iodine nutrition surveys (600 to 900)12. We aimed to obtain a sample of 900 children for this study.

We followed multistage cluster sampling methodology for selecting the study population. Children were selected from schools representing 5governorates of Bahrain.1051 students were selected from 30cluster schools chosen at random as follows:

a) A list showing names of all government boys and girls primary schools, the number of students in each school and the cumulative number of students was prepared from Ministry of Education (see appendix 1).
b) The cumulative enrolment of students in all of the schools was 61679 for year 2012. This was divided by 30(no of schools) to obtain the cluster interval k level (K=1699).
c) A random starting point between 1 and 1699 was produced using electronic random number table. The first cluster school was the one in which the corresponding cumulative number contained the random digit.
d) The class interval value was added to the random digit value in point (c) and the second cluster school was the next school in which the corresponding cumulative number contained the resulting summed value.
e) The following clusters were identified by keeping adding the cluster interval to the total summed value which identified the previous cluster.
f) The 30 schools were randomly selected from the list of schools of the target age group in each governorate and then one class was randomly selected in each of the selected schools.
g) All children interviewed in each cluster school were also chosen for the purpose of the Urine Iodine Study (100%).

On the day of survey, from the sampling frame of all children between 6-10 years old of the selected school, 900 children were selected following simple random sampling technique for inclusion in the study. There was no attrition of sampled students. No sample student refused to participate. Thus a

total of 1051 school child were included in the study to overcome dropping out. A sensitization meeting was organized with the Ministry of Education primary school authorities, the aims and necessity of the study was briefed. We also informed the schoolteachers, parents about the purpose and activities of the survey, sought their co-operation and requested to ensure maximum attendance on the day of survey. A pre-designed pre-tested schedule was used for data collection. Investigators were trained before data collections to minimize inter observer variation during the survey.

Clinical Assessment

A team of four family physicians faculty members from Primary Care Directorate, Ministry of Health, determined the presence of goiter by standard palpation method and also graded the goiter according to the criteria recommended by the joint WHO/UNICEF/ICCIDD (Grade 0: No palpable or visible goiter; Grade 1: A mass in the neck that is consistent with an enlarged thyroid that is palpable but not visible when the neck is in normal position. It moves upwards in the neck as the subject swallows; Grade 2: A swelling in the neck that is visible when the neck is in a normal position and is consistent with an enlarged thyroid when the neck is palpated)[12,13]. The sum of grades 1 and 2 divided by total examined provided the Total Goiter Rate (TGR). We interpreted TGR based on the criteria on goiter prevalence in school-aged children suggested by WHO/UNICEF/ICCIDD[12].

Data Collection Tools and Urine Sample Collection

Data on socio-demographic characteristics were collected from the children using a structured questionnaire. A casual urine sample of ~10 mL also was collected in a plain tube from each child participating in the survey and was stored at ≤ 20 °C until analyzed.

From a total 100 urine samples, an aliquot of urine (2 mL)was transferred to a tube with a tight cap and was shipped to the International Council for the Control of Iodine Deficiency Disorders (ICCIDD) iodine reference laboratory in the Nutritional Intervention Research Unit (NIRU) of the Medical Research Council (MRC), Cape Town, South Africa, for determination of iodine concentrations and for the purpose of validating the results obtained from Public Health Laboratory of Bahrain. Another aliquot of urine (5–6 mL) was kept as a reference material at the Public Health laboratory of Bahrain. Urine samples were analyzed using a modified microplate method based on manual digestion with ammonium persulfate followed by the colorimetric determination of the Sandel-Kolthoff reaction by using 96-multiwell plates and an absorbance microplate reader at 405 nm. The absolute iodine value is expressed in µg/L.

Ethical Considerations

Written informed consent was obtained from all the parents of participating children prior to their inclusion in interview and clinical examination. The study was approved by the regional education authorities from Ministry of Education.

Statistical Analysis

We entered the data in Microsoft Excel and analyzed accordingly to find out the outcome variables. Results are presented as means ± standard deviation (SD), medians and frequencies as well as percentages. Comparisons between two means were conducted using Student's t-test for continuous variables. The chi-square test was used to compare some selected categorical variables. We considered p values less than 0.05 or 0.01. SPSS 19.0statistical software program was used for correlation coefficient and regression analysis.

Chi-square and Logistic regression analysis were used to investigate the relationship between prevalence of iodine deficiency and age, sex, parents' education, parents' working status, frequency of dietary consumption, presence of apparent goitre (≥ 2 grade), and the use of iodized salt.

Results

The characteristics of the 1051 investigated schoolchildren aged 6-12 years are listed in Table 1. Of the students we surveyed 512(48.7%) were males and 539 (51.3%) females. About 4.85% (51), 15.12% (159), 15.31% (161), 16.74% (176), 15.79% (166), 18.74% (197), and 13.3% (141) of them belonged to six, seven, eight, nine, ten, eleven, and twelve years of age respectively. The mean age of the total sample of children was9.35 y in this study (2012-2013) compared to that in 2000 (10.78). 35.8% of the study children were from Northern, 22.8% from Muharraq, 21.6% from Central, and 14% from Capital and 5.8% Southern governorates **(Table 1)**.

Table 1: Gender Distribution According to Age, Geographical Location and BMI

Variables	Boys		Girls		Total	
Ages	**N**	**%**	**N**	**%**	**N**	**%**
6	40	7.8	11	2.0	51	4.9
7	82	16.0	77	14.3	159	15.2
8	79	15.5	82	15.3	161	15.3
9	68	13.3	108	20.0	176	16.8
10	58	11.3	108	20.0	166	15.7
11	102	19.9	95	17.7	197	18.8
12	83	16.2	58	10.8	141	13.3
Total	512	100	539	100	1015	100
Governorates						
Muharraq	122	23.8	118	21.9	240	22.8
Capital	67	13.1	80	14.8	147	14.0
Northern	186	36.3	190	35.3	376	35.8
Central	107	20.9	120	22.3	227	21.6
Southern	30	5.9	31	5.8	61	5.8
Total	512	100	539	100	1051	100
BMI(Kg/m²)	**Mean**	**S.D**	**Mean**	**S.D**	**Mean**	**S.D**
	18.71	12.81	18.76	7.48	18.73	10.42

Data on education indicators of socioeconomic status showed average of 57.99 %of secondary level of education, fewer unemployed fathers (13.85%), more housewives involved (78.26%), and more professional people (university education) among the heads of households (25.52%) **(Table 2)**.

Table 2: Gender Distribution According To Parental Education Levels and Occupation

Variables	Boys		Girls		Total	
	N	%	N	%	N	%
Father Education						
Primary	91	18.64	75	14.45	166	16.49
Secondary	287	58.82	297	57.22	584	57.99
University	110	22.54	147	28.33	257	25.52
Total	488	100	519	100	1007	100
Mother Education						
Primary	95	19.23	82	15.58	177	17.36
Secondary	278	56.27	296	56.28	574	56.27
University	121	24.50	148	28.14	296	26.37
Total	494	100	526	100	1020	100
Father Occupation						
Employed	417	85.10	477	87.14	864	86.15
Unemployed	73	14.90	66	12.86	139	13.85
Total	490	100	513	100	1003	100
Mother Occupation						
Employed	96	19.16	129	24.15	225	21.74
Unemployed	405	80.83	405	75.85	810	78.26
Total	501	100	534	100	1035	100

- 44 samples data is missing for father education for both girls and boys
- 48 samples data is missing for father occupation for both girls and boys
- 31 samples data is missing for mother education for both girls and boys
- 16 samples data is missing for mother occupation for both girls

Validation data of iodine concentrations obtained from ICCIDD iodine reference laboratory in NIRU of MRC, Cape Town, South Africa compared to that obtained from Public Health Laboratory of Bahrain show no significant difference in mean values between the two samples and highly correlated ($r= 0.978$, $P < 0.01$)(PP data: South Africa & PHD Lab Bahrain).

Prevalence of Goiter

Table 3 depicts the goiter prevalence by age and sex. Over all total goiter prevalence rate (TGR) among the surveyed group was 2.09% with only 1.80% and 0.28% prevalence of grade 1 and grade 2 (visible goiter), respectively. TGR was significantly higher among girls compared to that of boys (2.96% vs.1.17%)($x^2= 6.95$,p =0.005).Overall age specific TGR among 6, 7, 8, 9, 10, 11, and 12years old children respectively was1.96%, 0%, 1.86%, 2.84%, 3.61%, 3.04%, and 0.70%; however, there was no statistical significance among different ages (= 1.668, p= 0.469).

TGR values were different among governorates. Muharraq governorate showed slight increase in TGR (8.34%) (x^2= 14.83, p<0.01) compared to others. However, 91.7% of Muharraq population were normal **(p < 0.01),**7.1% were grade 1 and only 1.3% were grade 2.

Table 3: Prevalence of Goiter and TGR and its Significance According to Age, Gender and Geographic Location

Variables	Goiter Level						Total		TGR(Total Goiter Rate)
	0		1		2				
	n	%	n	%	n	%	n	%	
Age									
6	50	98	1	2	0	0	51	4.85	1.96
7	159	100	0	0	0	0	159	15.12	0
8	158	98	0	0	3	2	161	15.31	1.86
9	171	97	5	3	0	0	176	16.74	2.84
10	160	96	6	4	0	0	166	15.79	3.61
11	191	97	6	3	0	0	197	18.74	3.04
12	140	99	1	1	0	0	141	13.41	0.70
Total	**1029**	**97.9**	**19**	**1.80**	**3**	**0.28**	**1051**	**100**	**2.09**
Gender									
Boys	506	98.8	3	0.58	3	0.58	512	48.71	**1.17***
Girls	523	97.0	16	2.97	0	0	539	51.29	**2.96***
Total	**1029**	**97.9**	**19**	**1.80**	**3**	**0.28**	**1051**	**100**	**2.09**
Governorates									
Muharraq	**220**	**91.7**	**17**	**7.1**	**3**	**1.3**	**240**	**22.83**	**8.34****
Capital	146	99.3	1	0.7	0	0	147	13.98	**0.68****
Northern	376	100	0	0	0	0	376	35.77	**0****
Central	226	99.6	1	0.4	0	0	227	21.59	**0.44****
Southern	61	100	0	0	0	0	61	5.80	**0****
Total	**1029**	**97.9**	**19**	**1.80**	**3**	**0.28**	**1051**	**100**	**2.09**

*Correlation is highly significant =p<0.05
** Correlation is highly significant p<0.01,

Urinary Iodine Concentration (UIC) Level

59.27% (623/1051) is the proportion of urine samples had UIC above requirement (200–299 µg/l) and 17.69% had excessive level (≥300µg/l).While 21.21% (223/1051) urine samples had UIC within the optimal level of 100-199 µg/l. Only 1.52% of the children had urinary iodine concentration levels in the mild range (50-99 µg/l) of iodine deficiency, and 0.28% of the children had less than 50 µg/l (Table 4).The median UIC level of all investigated children was 247 µg/l, clearly above the threshold level of 100 µg/l for iodine deficiency12.

We also calculated the median UIC values according to age and gender of the study population **(Table 5)**.UIC values significantly increased with age (r= 0.015, p<0.001), however, values showed no difference among girls compared to that of boys (r= -0.981, p<0.211).

Table 4: Urinary Iodine Distribution According to Gender and Geographical Location

Variables	Gender			Governorates					
	Boys	Girls	Total	Muharraq	Capital	Northern	Central	Southern	Total
(<20)									
N	0	0	0(0%)	0	0	0	0	0	0(0%)
Mean	0	0	0	0	0	0	0	0	0
Median	0	0	0	0	0	0	0	0	0
SD	0	0	0	0	0	0	0	0	0
(20 – 49)									
N	0	3	3(0.28%)	0	3	0	0	0	3(0.28%)
Mean	0	34.36	34.36	0	34.36	0	0	0	34.36
Median	0	36.80	36.80	0	36.80	0	0	0	**36.80**
SD	0	4.74	4.74	0	4.74	0	0	0	4.74
(50 – 99)									
N	5	11	16(1.52%)	2	5	7	2	0	16(1.52%)
Mean	75.38	73.31	74.71	94.40	74.16	64.90	88.75	0	74.71
Median	78.70	73.90	75.75	94.40	75.80	57.80	88.75	0	**75.75**
SD	20.17	14.91	15.18	3.95	8.38	19.93	14.21	0	15.18
(100 – 199)									
N	97	126	223(21.21%)	43	42	80	44	14	223(21.21%)
Mean	169.17	164.71	166.64	160.28	170.16	168.80	169.25	155.28	166.64
Median	171.90	171.60	171.80	163.20	173.15	173.90	175.30	156.35	**171.80**
SD	22.20	26.31	24.64	24.02	22.17	25.31	24.07	28.11	24.64
(200 – 299)									
N	322	301	623(59.27%)	144	74	226	131	44	623(59.27%)
Mean	275.33	263.75	260.56	249.63	244.18	267.61	253.89	264.17	260.56
Median	256.55	248.60	249.50	250.65	244.65	250.00	254.00	258.75	**249.50**
SD	118.32	82.44	25.65	24.42	23.11	95.51	35.04	66.81	25.65
(≥ 300)									
N	88	98	186(17.69%)	51	23	63	50	3	186(17.69%)
Mean	551.39	592.45	573.02	506.62	648.86	603.98	553.55	786.00	573.02
Median	518.25	548.50	543.09	480.00	548.00	610.00	525.00	844.50	**543.09**
SD	173.42	205.23	191.44	118.65	233.20	210.62	173.98	136.50	191.44
Total									
N	512	539	1051(100%)	240	147	376	227	61	1051(100%)
Mean	300.71	295.20	285.89	286.94	276.28	302.47	302.47	264.84	285.89
Median	254.35	242.90	247.00	253.70	230.10	248.40	248.40	245.70	**247.00**
SD	170.35	183.22	162.07	133.18	191.92	184.78	184.78	142.73	162.07

Table 5: Median Urinary Iodine Concentration and Its Correlation according to Age, Gender and Geographic Location

Characteristics	n	Median
Age		
6	51	246.30
7	159	246.80
8	161	242.40
9	176	**252.70***
10	166	**249.15***
11	197	**254.10***
12	127	251.70
13	14	210.60
Gender		
Boys	512	254.35
Girls	539	242.90
Governorates		
Muharraq	240	**253.70****
Capital	147	230.10
Northern	376	248.40
Central	227	**255.10****
Southern	61	245.70

*Correlation is highly significant at P<0.05

**Correlation is highly significant at P<0.05

Logistic Regression analysis (Table 6) showed significant high UIC values with increase of age 7-11 years among girls (p= 0.01), and with governorates (Muharraq for both gender and Southern for girls only) (p = 0.05).

Table 6: Logistic Regression Analysis between Urinary Iodine and Governorates and Age among the Sample

Boys

Dependent Variable	Parameters	B	S.E	Wald	P Value	Estimated Odd Ratios
Urinary Iodine	Muharraq	0.87	0.33	4.26	0.001*	1.22
	Capital	0.26	0.40	0.11	0.30	0.97
	Northern	-0.51	0.21	0.42	0.40	1.84
	Central	-0.70	0.07	0.55	0.52	1.30
	Southern	0.31	0.51	0.27	0.24	0.43
	6	-0.59	0.20	0.30	0.99	1.52
	7	-0.12	0.35	0.02	0.60	1.51
	8	-0.77	0.39	0.09	0.29	1.32
	9	0.83	0.53	2.34	0.13	1.17
	10	0.44	0.27	2.22	0.85	0.14
	11	0.19	0.26	0.69	0.80	0.25
	12	-0.21	0.31	0.81	0.49	1.77
	Constant	-1.17	1.22	0.60	0.50	1.02

Overall model Performance is not significant on the bases of age (P=0.504)
Overall model Performance is significant on the bases of Governorates (P=0.001)
* Correlation is significantly useful for the model P<0.05.

Girls

Dependent Variable	Parameters	B	S.E	Wald	P Value	Estimated Odd Ratios
Urinary Iodine	Muharraq	-0.29	0.89	7.83	0.005*	1.16
	Capital	-0.55	0.61	0.42	0.50	1.29
	Northern	-1.78	0.77	0.68	0.22	0.94
	Central	0.56	0.34	0.34	0.49	0.50
	Southern	0.91	0.52	7.41	0.001*	1.39
	6	0.28	0.12	0.02	0.27	1.11
	7	-0.04	0.45	6.95	0.001**	1.40
	8	0.30	0.90	0.56	0.59	0.36
	9	-1.22	0.79	4.67	0.021**	0.70
	10	-0.98	0.20	4.28	0.015**	1.03
	11	-0.29	0.65	7.19	0.009**	0.81
	12	0.47	0.40	0.07	0.72	0.68
	Constant	0.68	0.89	0.42	0.58	1.19

Overall model Performance is significant according to age P= 0.01 and governorates P=0.05

* Correlation is significantly useful for the model, $p<0.05$;

** Correlation is significantly useful for the model, $p<0.01$

Dietary Habits

About 63.6 % of the households reported using iodized table salt. Total daily bread consumption 65.7% was almost similar for boys and girl: 68.3%, 61.9%, respectively. About 57.7% of the households used iodized table salt (as per lab analysis of Potassium Iodine household salt content) **(Table 7).**

Table 7: Iodized Salt and Frequency of Consumption of Food Item Among the Sample

Variables		Boys (Total = 512)		Girls (Total = 539)	
		n	%	n	%
Iodized Salt[1]	yes	279	60.5	328	66.2
	No	182	39.5	167	33.8
	Total	**461**	**100**	**495**	**100**
Vegetables[2]	≥ 5 times/week	318	63.0	323	60.4
	3 to 4 times/week	102	20.1	121	22.6
	1 to 2 times/Week	52	10.2	69	12.8
	Never	33	6.5	22	4.1
	Total	**505**	**100**	**535**	**100**
Fruits[3]	≥ 5 times/week	427	84.2	443	82.6
	3 to 4 times/week	61	12.1	64	11.9
	1 to 2 times/week	15	2.9	24	4.4
	Never	4	0.8	5	0.9
	Total	**507**	**100**	**536**	**100**
Sea Food[4]	≥ 5 times/week	171	33.8	178	33.3
	3 to 4 times/week	168	33.2	182	34.0
	1 to 2 times/week	128	25.3	126	23.5
	Never	39	7.7	49	9.2
	Total	**506**	**100**	**535**	**100**
Milk[5]	≥ 5 times/week	**205**	**40.9[a]**	**219**	**40.9[a]**
	3 to 4 times/week	144	28.7	154	28.7
	1 to 2 times/week	123	24.5	129	24.1
	Never	29	5.8	33	6.2
	Total	**501**	**100**	**535**	**100**
Egg[6]	≥ 5 times/week	62	**12.4[a]**	**54**	**10.1[a]**
	3 to 4 times/week	173	34.4	172	32.2
	1 to 2 times/week	217	43.2	270	50.5
	Never	50	10.0	38	7.1
	Total	**502**	**100**	**534**	**100**

Table 7: Continued…….

Variables		Boys (Total = 512)		Girls (Total = 539)	
		n	%		n
Bread[7]	≥ 5 times/week	**344**	**68.3[a]**	**332**	**61.9[a]**
	3 to 4 times/week	118	23.4	143	26.6
	1 to 2 times/week	40	7.9	53	9.8
	Never	2	0.4	8	1.5
	Total	**504**	**100**	**536**	**100**
Rice[8]	≥ 5 times/week	319	63.0	317	59.2
	3 to 4 times/week	143	28.2	151	28.2
	1 to 2 times/week	39	7.7	64	11.9
	Never	5	0.99	4	0.74
	Total	**506**	**100**	**536**	**100**
Cheese[9]	≥ 5 times/week	**287**	**57.2[a]**	**289**	**54.5[a]**
	3 to 4 times/week	121	24.1	146	27.5
	1 to 2 times/week	75	14.9	76	14.3
	Never	19	3.8	19	3.6
	Total	**502**	**100**	**530**	**100**
Chips[10]	≥ 5 times/week	**312**	**61.8[a]**	**342**	**64.0[a]**
	3 to 4 times/week	116	23.0	117	21.9
	1 to 2 times/week	70	13.9	68	12.7
	Never	7	1.4	7	1.3
	Total	**505**	**100**	**534**	**100**

1 Missing Data in Salt for boys are 51 and for girls are 44
2 Missing Data in Vegetables for boys are 7 and for girls are 4
3 Missing Data in Fruits for boys are 5 and for girls are 3
4 Missing Data in Sea Food for boys are 6 and for girls are 4
5 Missing Data in Milk for boys are 11 and for girls are 4
6 Missing Data in Eggs for boys are 10 and for girls are 5
7 Missing Data in Bread for boys are 8 and for girls are 3
8 Missing Data in Rice for boys are 6 and for girls are 3
9 Missing Data in Cheese for boys are 10 and for girls are 9
10 Missing Data in Chips for boys are 7 and for girls are 5

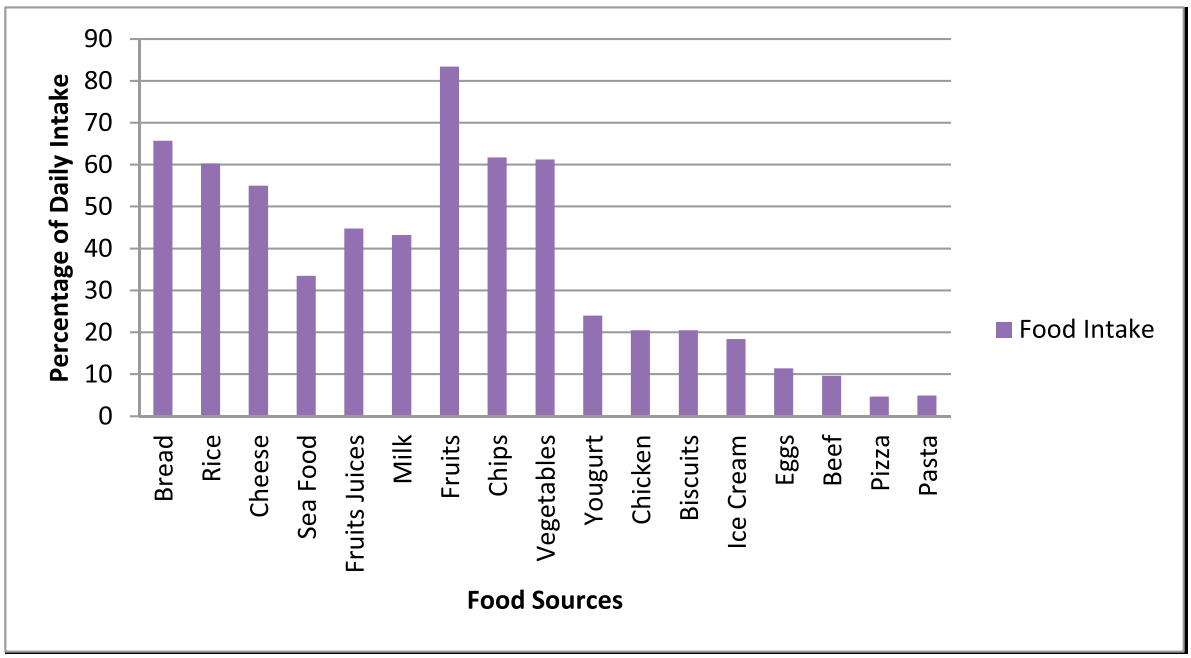
***Correlation is not significant P = 0.591**

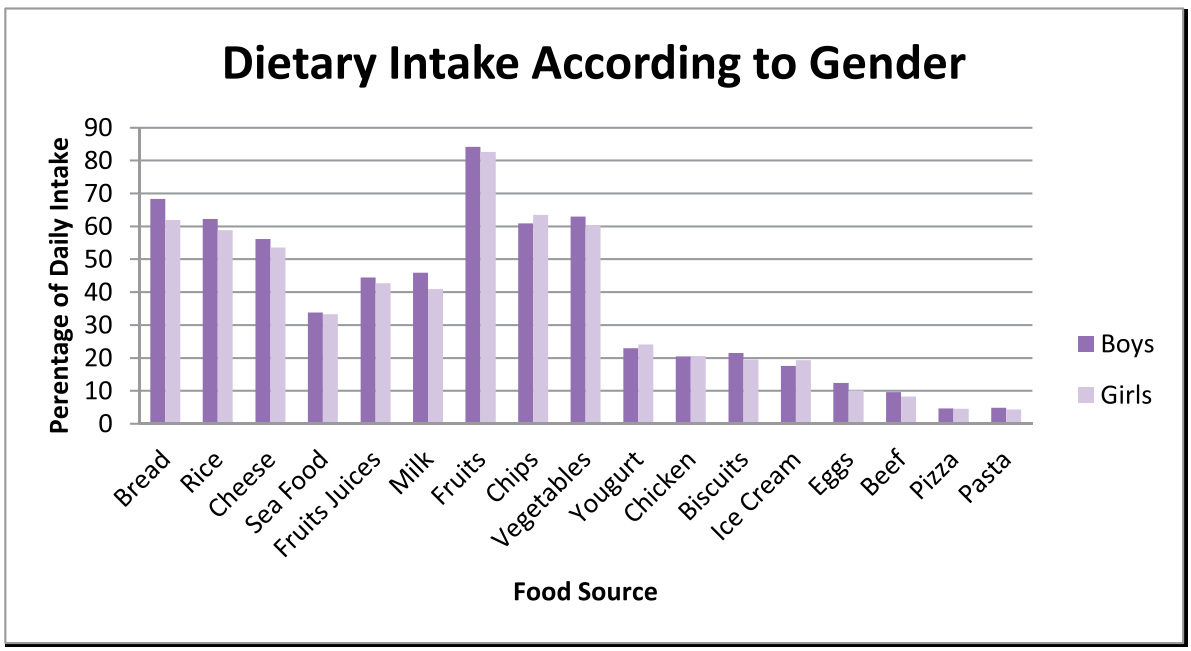
Dietary habits as assessed from the Food Frequency Questionnaires (FFQ) are presented in Table7. Milk drinkers were same among both boys and girls (40.9%). The mean children who ate 1-2, 3-4, and ≥ 5 seafood meals/week were 24.4%, 33.9%, and 33.6% of total girls and boys, respectively. However, seafood was consumed almost same for both boys and girls. The consumption of egg was around 11.2%. The contribution of bread, rice, cheese, dairy products and chips to the daily total intake 65%, 61%, 55.8%, 23.9% and 62.9% respectively. Daily consumption of bread, rice, cheese, dairy products and chips was almost same among girls compared to that of boys ($x^2 = 4.75$, P= 0.591).

Figure1 illustrates how different foods contributed as a percentage of the type of food intake to the overall dietary intakes from the five major food groups (breads, rice, fruits & vegetables, dairy products, fish and chips). Although information on the average iodine intake from different foods among the group provides important information on iodine in the food supply, the iodine content of the food, the amount consumed, and the proportion of children consuming the food are important in identifying feeding practices that place children at risk of a high or low iodine intake. In the present study (total: girls & boys), the breads and rice was the greatest food sources of iodine from salt for

65% and 61%of the children, respectively. Whereas dairy products(milk, cheese, yogurt) were the next greatest food sources of salt for another 52.4% of the children. Fish and sea food were the greatest food sources of iodine for only 26.1% of children. Also meats (chicken, beef, Meat Products) were good food sources of iodine for 15.6% of children. However, the contribution of a food group to the total iodine intake also depends on the iodine content of the food.

Figure 1. Dietary Intake Distribution among the Sample





Iodine Content of Salts

Of the 1051 salt samples tested using titration method, 36.9% had adequate iodine content of 15-40 ppm. 42.3% salt samples had no iodine and another 20.1% salt samples had iodine content of <15 ppm **(Table 8)**. 0.67% households consuming above 40 ppm. However, consumption of adequately iodized salt was significantly higher among Southern Governorate as compared to Capital and Muharraq governorates households (44.2% vs. 31.9% and 32.1% , p <0.01). While Central governorate showed the least in consumption of no iodized salt (p<0.05)

Table 8: Distribution of Gender and Demographic Location According to Intake of Potassium Iodine (mg/kg of KI) in Salt

Variables	Gender				Total		Governorates										Total	
	Boys		Girls				Muharraq		Capital		Northern		Central		Southern			
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
No Iodine	234	45.7	211	39.1	445	42.3	112	46.6	70	47.6	159	42.2	82	29.7*	22	36.0	445	42.3
(<15)	85	16.6	126	23.3	211	20.1	49	20.4	29	19.7	72	19.1	49	17.7	12	19.6	211	20.1
(15 – 40)	188	36.7	200	37.1	388	36.9	77	32.1	47	31.9	141	37.5	96	34.7	27	44.2**	388	36.9
(>40)	5	0.98	2	0.38	7	0.67	2	0.84	1	0.69	4	1.07	0	0	0	0	7	0.67
Total	512	100	539	100	1051	100	240	100	147	100	376	100	276	100	61	100	1051	100

*Correlation is significant at p<0.05,
**Correlation is significant at p<0.01

Discussion

Absence of iodine deficiency disorders

The WHO/UNICEF/ICCIDD have recommended that if more than 5% school children (6–12 years) suffer from goiter, the area should be classified as endemic to iodine deficiency[12].

The present survey clearly indicates the absence of endemic goiter in the Kingdom of Bahrain according to WHOcriteria[12,20,21]: the prevalence of goiter (grade I or higher by inspection and palpation) was <5% (2%), and the median urinary iodine concentration was >100 µg/l among the investigated schoolchildren. The conclusion is supported by a median urinary iodine level of >100µg/l in early study conducted in 2000 among school children aged 8-12 years old in Bahrain[9]. In fact, urinary iodine concentration in the present survey (median 247 µg/l) is well above the threshold values for iodine deficiency in 95% of the studied population, indicating an absence of iodine deficiency in the Kingdom (Table 4). Indeed, urinary iodine concentration was different between the governorates Table 5 ($r = -0.023$, $p<0.05$).

Urinary iodine concentrations are the most reliable indicator of IDD. The WHO/UNICEF/ICCIDD have also recommended that no iodine deficiency be indicated in a population when median urinary iodine excretion (UIE) level is 10 µg/dl or more i.e. more than 50% of the urine samples have UIE level of ≥10 µg/dl and not more than 20% of the samples have UIE level of less than 5 µg/dl[22,23].

According to the national study on assessment of the prevalence of iodine deficiency disorders conducted among school children aged 8-12 years old in Bahrain in 2000[9] it was showed that out of 1600 children examined, only 26 (1.7%) were found to have goiter. While in this study it was showed that total goiter prevalence rate (TGR) among the surveyed group 2.1% (22)with only 1.8% (19) and 0.3% (3) prevalence of grade 1 and grade 2 (visible goiter) respectively.

In our study the median UIC level of all investigated children was 247.0µg/l, clearly above the threshold level of 100 µg/l for iodine deficiency (3), and 180 µg/l at the national level24. This median UIC reflects excessive iodine intake in the population based on WHO cut-off points[12]. The median UIC was slightly higher among male participants (254.35µg/l) than female participants (242.90µg/l), although was not significant($p= 0.21$).

While only 1.52% of the children had urinary iodine concentration levels in the mild range (50-99 µg/l) of iodine deficiency, 0.28% of the children had less than 50 µg/land 0 per cent of students had a urine iodine level below 20µg/dl. 59.27% is the proportion of urine samples had UIC above requirement (200–299 µg/l) and 17.69% had excessive level (≥300µg/l).While 21.2% urine samples had UIC within the optimal level of 100-199 µg/l (Table 4).However, previous study 9 among Bahraini

school children (8-12 years) showed higher number of children tested had low urinary iodine levels (16.5%). This prevalence of IDD was slightly lower for boys (15.8%) compared to girls (16.5%), and showed some geographic variation in the same study 9.

In conclusion, in Bahrain we found a desirable value for both these two indicators. Median UIC level (247µg/l) was above the threshold level of the recommended level of 100–200µg/l. Overall, around 21.21% of the children had UIC levels in the ranges of optimal iodine nutrition (100–200µg/l), and 0.28% of the children had concentrations <50µg/l. These results indicate that iodine deficiency is currently not a public health problem in Bahrain.

Our results were in the normal range according to the indicator of iodine deficiency elimination. Although it is obvious that Bahrain to be a country with a low risk of iodine deficiency, however, the population of Bahrain might be subjected to excessive iodine intake with a risk of adverse health consequences like iodine-induced hyperthyroidism and autoimmune thyroid diseases[1, 25-28]. A similar phenomenon was observed in 34 countries after the implementation of Universal Salt Iodization (USI), which emphasized the importance of establishing and strengthening the monitoring system to guide USI to provide optimal iodine nutrition and protect against excessive intake[1,29].

Goiter rate

According to the national study on assessment of the prevalence of iodine deficiency disorders conducted among school children aged 8-12 years old in Bahrain in 2000[9] it was showed that out of 1600 children examined, only 26 (1.7%) were found to have goiter.

Goiter prevalence in the studied governorates was low only found among 22 children (2.1%) and ranged from only 1.8% (19) (grade 1) to 0.3% (3) (grade 2). The TGR was significantly higher ($P<0.05$) among female participants (2.96%) than male participants (1.17%).This was not statistically significant from the same value of the previous study [9](2000) which reported a goiter prevalence rate of 1.7 % (26) in school children aged 8-12 years. Study of the same age group was not conducted till this current study.

The discrepancy with the high goiter rate observed in Muharraq governorate was significant ($P=0.005$).One of the main causative factors that should be considered is the inter-observer and palpitation variation measurement that could happen even among experienced examiners[9]. Also might be that the goiter prevalence in Muharraq governorate has been overestimated, as misclassification of thyroid size by inspection and palpation can be rather high[30-33].ZimmermannM et al.[34]showed that the clinical assessment of thyroid size to be imprecise for small goiters. Misclassification between thyroid size grade 0 and 1 can be as high as 40%, resulting in an incorrect prevalence rate.

Therefore, the frequency distribution of thyroid volume measured by ultra sonography is highly recommended, especially in areas where the visible goiter rate is low. Brahmbhatt S. etal.[35] reported that thyroid palpation is of limited value for epidemiological surveys of IDD and is insensitive in the assessment of schoolchildren. The best clinical indicator for the assessment of the severity and extent of IDD is estimation of thyroid volume by ultra sound. Additionally, Zimmermann MB et al. illustrated that inter-observer variation in the sonographic measurement in children can be high, even among experienced examiners[36], and probably contributes to the current disagreement on normative values in iodine-sufficient children.

However, Goiter prevalence in Bahrain is much less than what is reported by many countries in the Eastern Mediterranean region. In Saudi Arabia Abu-Eshy et al. in 2001 reported a goiter prevalence rate of 24% in Ascerregion[37]and Alsanosy RM et al. in 2010 reported a total goiter rate (TGR) among the sample of schoolchildren in Jazan was 11%, with significant variations between rural and urban populations and by gender[38].
In the Gulf region, in Yemen the TGR was 16.8%[8,39], in the United Arab Emirates the TGR in 2010 was 8.2%[40],in Oman 10%, in Saudi Arabia 24% in Aseer region[37] (2001) and 11% in Jazan[38] (2010). On the other hand in other Arab countries the TGR is 65% in Algeria, 36.3% in Tunisia, 30.9% in Mauritania, 25.7% in Lebanon, and 21.4% in Egypt[8]. In Jordan, the TGR was reduced from 33.5%in 2000 to only 4.9% in 2010[41]. Similar to Iran, the TGR was reduced from 68.0% in 1989 to only 5.7% in 2007 through implementation of a comprehensive IDD control program[42].

In 2007, a national study reported 27.8% of Turkish schoolchildren had moderate and severe iodine deficiency, indicating an improvement of iodine status, in comparison to 1997 and 2002 surveys (58% and 38.9%, respectively). This study showed in two thirds of cities survey iodine deficiency has been eliminated, 73.5% of accessible salt were iodized and 56.5% contained sufficient iodine[43]. However, iodine deficiency and goiter is still a public health problem in some regions of Turkey, e.g. Isparta, Kayseri and Malatya provinces[44-47].

Universal salt iodization is the recommended intervention for preventing and correcting iodine deficiency[1]. In order to provide 150 µg/day of iodine through iodized salt, iodine concentration in the salt of 20–40 mg (or 34–66 mg potassium iodate) per kg of salt. According to GCC (GSO 1843/2012 recommends that the amount of iodine to be between 20-40 ppm in the form of sodium and potassium iodides or iodates[11].In the present study the use of iodized salt was reported in almost 63.4 per cent of families. A larger population was found using the iodized salt of 15–40 ppm (37%), and 0.7%

of families. A larger population was found using the iodized salt of 15–40 ppm (37%), and 0.7% using salt even more than 40 ppm. But only 20% of the studied population was using salt less than 15 ppm of iodine and 42.3% population was not using iodized salt at all.

This adequate consumption (around 37.6 %) of iodized salt (> 15 ppm) is probably because of the iodized salt type that been sold in the market. However, non-iodized type is still being sold in groceries in Bahrain and data revealed that household was using non iodized salt (36.7%) and iodized salt less than 15 ppm or totally not iodized could be the future threat.
This might be due to the poor quality of salt, incorrect salt iodization, exposure to moisture, light, heat and contaminants, iodine losses can be 50 per cent or more from the moment the salt is produced until it is actually consumed[32].

Dietary habits

Bread and rice consumption remains the main sources of dietary iodine in Bahrain. Whereas cheese, milk, and yogurt appeared to be second in consumption rate. However, the contribution of sea fish is limited. Egg consumption was not high. These dietary habits findings indicate that iodine nutrition among Bahraini children clearly sufficient (Fig 1).

From the dietary habits revealed from nutrition surveillance of ages 6-12 years of year 2012-201348 we calculated the daily iodine intake, assuming an average iodine content of 4 mcg per 80g of two slice bread (white), of 7mcg per 200g (1 cup) cooked white rice, of 12 mcg per 40g (one slice) cheddar cheese, traces per 200g (1/2cup) fruit juice, 62mcg per 200g (1 cup) whole milk (flavored), 75 mcg of 150g (1 pack) whole yogurt, 7mcg of 120g of chicken, 13mcg per 256gm potato chips, 57 mcg of 100g of dairy ice cream, average of 22mcg per burger sandwiches or pizza, Additionally, 150 mcg per sea fish meal (as average of a variety of fishes, and 100gm as the average size meal), 27mcg per 200gm (1cup) of macaroni, enriched, boiled, and 67mcg iodized table salt with an average consumption of 1.5g/ day(approx.1/4 teaspoon) [49].

Taking into account the food frequency consumption of different food items/groups (at least 5 times per week) are: bread, rice, cheese, milk, yogurt & ice cream, chicken and sea fish, potato chips, for the dinner one of the following items daily consumed: shawarma or burger sandwiches or pizza, we calculated the total (boys and girls) average iodine intake for the above food items as follows: 4mcg (bread), 7mcg (rice), 51.5mcg (average of cheese, milk, yogurt, ice cream), 7mcg (chicken), 13mcg (other sources such as potato chips), 67 mcg (iodized salt) amounting to total of 149.5mcg/day (0.15 mg/day). Additional 22mcg could be added of (shawarma or burger sandwiches or pizza) for dinner amounting to total of 171.5mcg/day (0.17mg/day). These figures are in good agreement with the measured urinary iodine concentrations of 254.35mg/dl in boys and 242.9mg/dl in girls.

In line with Al-Atta's study which quantified the iodine content of foods in the KSA and concluded that food consumed by Saudis appears to have an adequate iodine concentration50. The high level of UIC may be explained, in light of the finding of nutrition surveillance 48, by the high level of iodine concentrations in salt, increased consumption of bread, rice, dairy products, and ready-prepared salty snacks crisps that may have substantially changed the amount of salt and iodine consumed by the school population. Al-Atta's suggested reconsidering the level of salt iodization in the KSA following the latest WHO recommendation in light of local dietary patterns. It will be important to provide optimal iodine nutrition and to protect the population from the adverse health consequences of excessive iodine intake.

Conclusion

TGR of 2.1% indicates that Bahrain Goiter prevalence in the studied governorates was low and IDD is not a public health problem. Median urinary iodine level (247µg/l) was above the threshold level of the recommended level of 100–200µg/l. Interpreting these two indicators of the present study together, it may be concluded that absence of endemic goiter in the Kingdom of Bahrain according to WHO criteria[12,20,21].

Adequately iodized salt consumption at the household level (63.6 %) is fair enough. However, the UIC reflects excessive iodine intake and may put the population at risk of adverse health consequences like iodine-induced hyperthyroidismand autoimmune thyroid diseases. The levels of iodine in the salt and revision of salt specifications is highly recommended. Establishing surveillance and monitoring systems will protect the population and help in guiding the implementation of USI in the country.

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Appendixes

Appendix 1: Clusters and Selection of Schools

clusters	مجموع الطلاب	عدد الطلاب	المحافظة	أسم المدرسة	
		485	العاصمه	أبو بكر الصديق الابتدائية للبنين	1
	795	310	العاصمه	العلاء الحضرمي الابتدائية للبنين	2
	1086	291	العاصمه	أم الحصم الابتدائية للبنين	3
	1170	84	العاصمه	الجزيرة الابتدائية للبنين	4
	1449	279	العاصمه	حطين الابتدائية للبنين	5
1	1856	407	العاصمه	الخميس الابتدائية للبنين	6
	2015	159	العاصمه	الرشيد الابتدائية للبنين	7
	2531	516	العاصمه	السنابس الابتدائية للبنين	8
	2888	357	العاصمه	المتنبي الابتدائية للبنين	9
	3286	398	العاصمه	المعهد الديني الابتدائية للبنين	10
	3635	349	العاصمه	ام ايمن الابتدائية للبنات	11
2	4348	713	العاصمه	البلاد القديم الابتدائية للبنات	12
	4805	457	العاصمه	رابعة العدوية الابتدائية للبنات	13
	4942	137	العاصمه	سكينة بنت الحسين الابتدائية للبنات	14
	5433	491	العاصمه	السلام الابتدائية للبنات	15
	5809	376	العاصمه	سمية الابتدائية للبنات	16
3	6247	438	العاصمه	السنابس الابتدائية للبنات	17
	6449	202	العاصمه	فاطمة الزهراء الابتدائية للبنات	18
	6821	372	العاصمه	القدس الابتدائية للبنات	19
	6932	111	العاصمه	النبيه صالح الابتدائية للبنات	20
	7117	185	العاصمه	المأمون الابتدائية للبنين	21
	7694	577	المحرق	مريم بنت عمران الابتدائية للبنات	22
4	8222	528	المحرق	زبيدة الابتدائية للبنات	23
	8644	422	المحرق	عراد الابتدائية للبنات	24
	9329	685	المحرق	أسماء ذات النطاقين الابتدائية للبنات	25
	9618	289	المحرق	ابو فراس الحمداني الابتدائية للبنين	26
5	10428	810	المحرق	البسيتين الابتدائية للبنين	27
	10875	447	المحرق	الحد الابتدائية للبنين	28
	11625	750	المحرق	حسان بن ثابت الابتدائية للبنين	29
6	12041	416	المحرق	الخوارزمي الابتدائية للبنين	30
	12202	161	المحرق	الدير الابتدائية للبنين	31
	12396	194	المحرق	عراد الابتدائية للبنين	32
	13060	664	المحرق	عمر بن عبد العزيز الابتدائية للبنين	33
	13348	288	المحرق	قلالي الابتدائية للبنين	34
	13705	357	المحرق	ابو العلاء المعري الابتدائية للبنين	35
	13884	179	المحرق	الشيخ محمد بن عيسى الابتدائية للبنين	36
7	14684	800	المحرق	آمنة بنت وهب الابتدائية للبنات	37
	15559	875	المحرق	البسيتين الابتدائية للبنات	38

clusters	مجموع الطلاب	عدد الطلاب	المحافظة	أسم المدرسة	
8	16164	605	المحرق	رقية الابتدائية للبنات	39
	16846	682	المحرق	المحرق الابتدائية للبنات	40
	17394	548	المحرق	العروبة الابتدائية للبنات	41
	17680	286	المحرق	الحد ابتدائية اعدادية بنين	42
	17773	93	المحرق	عمر بن الخطاب ابتدائية اعدادية بنين	43
	17992	219	المحرق	عبدالرحمن الناصر ابتدائية اعدادية بنين	44
9	18219	227	المحرق	سماهيج ابتدائية اعدادية بنين	45
	18373	154	المحرق	عراد ابتدائية اعدادية بنين	46
	18910	537	المحرق	الدير ابتدائية اعدادية بنات	47
	19597	687	الشمالية	أبوصيبع الابتدائية للبنين	48
	20534	937	الشمالية	أسامة بن زيد الابتدائية للبنين	49
10	21248	714	الشمالية	ابن سينا الابتدائية للبنين	50
	21928	680	الشمالية	ابن طفيل الابتدائية للبنين	51
	22304	376	الشمالية	باربار الابتدائية للبنين	52
	22840	536	الشمالية	البديع الابتدائية للبنين	53
11	23151	311	الشمالية	بوري الابتدائية للبنين	54
	23502	351	الشمالية	عمار بن ياسر الابتدائية للبنين	55
	24101	599	الشمالية	الأندلس الابتدائية للبنات	56
	24297	196	الشمالية	الأمام علي الابتدائية الاعدادية للبنين	57
12	24796	499	الشمالية	ابن النفيس الابتدائية للبنين	58
	25358	562	الشمالية	الوادي الابتدائية للبنين	59
	25982	624	الشمالية	الرازي الابتدائية للبنين	60
13	26581	599	الشمالية	جابر بن حيان الابتدائية للبنين	61
	27324	743	الشمالية	جدحفص الابتدائية للبنين	62
	27450	126	الشمالية	الجسرة الابتدائية للبنين	63
	27921	471	الشمالية	سار الابتدائية للبنين	64
14	28498	577	الشمالية	سعد بن ابي وقاص الابتدائية للبنين	65
	29027	529	الشمالية	كرزكان الابتدائية للبنين	66
	29483	456	الشمالية	سمو الشيخ محمد بن خليفه الابتدائية للبنين	67
	29817	334	الشمالية	السهلة الابتدائية للبنين	68
	30120	303	الشمالية	ام القرى الابتدائية الاعداديه للبنات	69
15	30525	405	الشمالية	فاطمة بنت أسد الابتدائية للبنات	70
	31251	726	الشمالية	كرانة الابتدائية للبنات	71
	31800	549	الشمالية	مدينة حمد الابتدائية للبنات	72
	32228	428	الشمالية	خالد بن الوليد الابتدائية للبنين	73
16	32925	697	الشمالية	الخنساء الابتدائية للبنات	74
	33347	422	الشمالية	مدينة حمد الابتدائية للبنين	75
	34066	719	الشمالية	بلقيس الابتدائية للبنات	76
17	34866	800	الشمالية	الدراز الابتدائية للبنات	77
	35316	450	الشمالية	الروضة الابتدائية للبنين	78
	36011	695	الشمالية	سار الابتدائية للبنات	79
	36596	585	الشمالية	سبأ الابتدائية للبنات	80
18	37192	596	الشمالية	السهلة الابتدائية للبنات	81
	37561	369	الشمالية	شهركان الابتدائية للبنات	82
	38073	512	الشمالية	طليطلة الابتدائية للبنات	83
	38443	370	الشمالية	صفية بنت عبد المطلب الابتدائية للبنات	84

clusters	مجموع الطلاب	عدد الطلاب	المحافظة	أسم المدرسة	
19	38972	529	الشمالية	المنهل الابتدائية للبنات	85
	39674	702	الشمالية	نسيبة بنت كعب الابتدائية للبنات	86
	40075	401	الشمالية	هاجر الابتدائية للبنات	87
	40610	535	الشمالية	النزهة الابتدائية للبنات	88
20	41278	668	الشمالية	حفصة أم المؤمنين الابتدائية للبنات	89
	41753	475	الشمالية	الروضة الابتدائية للبنات	90
	42290	537	الشمالية	الدية ابتدائية اعدادية بنات	91
21	42895	605	الشمالية	البديع ابتدائية اعدادية بنات	92
	43736	841	الوسطى	الرفاع الشرقي الابتدائية للبنات	93
	44181	445	الوسطى	القادسية الابتدائية للبنات	94
	44609	428	الوسطى	سترة الابتدائية للبنين	95
22	45162	553	الوسطى	المعامير الابتدائية للبنين	96
	45573	411	الوسطى	عالي الابتدائية للبنات	97
	45727	154	الوسطى	عين جالوت الابتدائية للبنات	98
	46290	563	الوسطى	غرناطة الابتدائية للبنات	99
	46864	574	الوسطى	العكر الابتدائية للبنين	100
23	47445	581	الوسطى	مدينة عيسى الابتدائية للبنين	101
	47826	381	الوسطى	الامام الطبري الابتدائية للبنين	102
	48100	274	الوسطى	سند الابتدائية للبنين	103
24	49049	949	الوسطى	صلاح الدين الايوبي الابتدائية للبنين	104
	49743	694	الوسطى	الامام مالك بن انس الابتدائية للبنين	105
	50129	386	الوسطى	اليرموك الابتدائية للبنين	106
	50544	415	الوسطى	الصفا الابتدائية للبنات	107
25	51095	551	الوسطى	النويدرات الابتدائية للبنات	108
	51354	259	الوسطى	سند الابتدائية للبنات	109
	51666	312	الوسطى	بوري الابتدائية للبنات	110
	52264	598	الوسطى	بيت الحكمة الابتدائية للبنات	111
	52923	659	الوسطى	المستقبل الابتدائية للبنات	112
26	53898	975	الوسطى	فاطمة بنت الخطاب الابتدائية للبنات	113
	54353	455	الوسطى	توبلي الابتدائية للبنين	114
	55153	800	الوسطى	عقبة بن نافع الابتدائية للبنين	115
27	55654	501	الوسطى	الرفاع الشرقي الابتدائية للبنين	116
	56259	605	الوسطى	بدر الكبرى الابتدائية للبنين	117
	56517	258	الوسطى	الضياء الابتدائية للبنين	118
	56881	364	الوسطى	سترة الابتدائية للبنات	119
28	57587	706	الوسطى	توبلي الابتدائية للبنات	120
	58108	521	الوسطى	عالي الابتدائية للبنات	121
	58335	227	الوسطى	سلماباد الابتدائية للبنات	122
	58437	102	الجنوبية	عسكر الابتدائية الاعدادية للبنين	123
	58821	384	الجنوبية	سافرة الابتدائية الاعدادية للبنين	124
	58952	131	الجنوبية	جو الابتدائية الاعدادية للبنات	125
29	59325	373	الجنوبية	سافرة الابتدائية الاعدادية للبنات	126
	59544	219	الجنوبية	الزلاق الابتدائية الاعدادية للبنات	127
	59775	231	الجنوبية	الحنينية الابتدائية للبنات	128
	60344	569	الجنوبية	الرفاع الغربي الابتدائية للبنات	129
	60947	603	الجنوبية	الرفاع الغربي الابتدائية للبنين	130
	61303	356	الجنوبية	احمد الفاتح الابتدائية الاعدادية للبنين	131
30	61679	376	الجنوبية	الزلاق الابتدائية الاعدادية للبنين	132

Appendix 2

Consent form for parents

إدارة الصحة العامة
قسم التغذية

استمـــارة موافقـة ولـي الأمـر
للمرحلـــة الابتدائيـة فقط

- لا مانع لدي من مشاركة ابني/ابنتي..... في الصف ..... في الفرقة.....، في البحث الميداني الذي سيجري لاكتشاف مشاكل سوء التغذية مثل السمنة وفقر الدم واليود. وسيتضمن البحث قياس الطول والوزن كلا من: قياس هيموجلوبين الدم من الإصبع، قياس الضغط، أخذ عينة من البول.

☐ موافق ☐ غير موافق

اسم ولي الأمر: .....
التوقيع: .....
التاريخ: .....

في حالة الموافقة المطلوب من أولياء الأمور

- ملأ استبيان غذائي لنوعية الأطعمة المتناولة (ملاحظة: سيتم إرساله مع الطالب و يرجى إعادته في الوقت المطلوب)
- إرسال عينة (ملعقتين طعام فقط) من الملح المستخدم في المنزل في كيس شفاف محكم
- قراءة الورقة التعريفية ببرنامج المسح الوطني للتعرف على نوعية البرنامج و الفحوصات المتطلبة

Appendix 3

Brochure for schools and parents (presenting the IDD study, goals, importance and procedures)

وزارة الصحة
إدارة الصحة العامة
قسم التغذية

المسح الوطني لاضطرابات عوز اليود لطلبة المدارس من 6-12 سنة

يعمل قسم التغذية على الإعداد لبدء المسح الوطني الثاني لاضطرابات عوز اليود لأطفال فئة السن المدرسي 6-12 سنة و ذلك من منطلق الحرص على حماية صحة و تغذية أبناء و بنات مجتمعنا عن طريق التأكيد على خلو البحرين من اضطرابات عوز اليود، وذلك حسب ما جاء في توصيات منظمة الصحة العالمية والتي تنص على ضرورة الاستمرار في مراقبة وتقييم الوضع خصوصاً عند صغار السن والمتمثلين بطلبة المدارس من 6-12 سنة.

الأهداف الأساسية:

- تقييم الوضع التغذوي لعنصر اليود في مملكة البحرين .
- تحديد نسبة انتشار اضطرابات عوز اليود بين طلبة المدارس .
- تحديد نسبة اليود في الملح المستخدم في المنازل و مقارنته بالمعايير الدولية .

خطوات العمل للطلبة المشاركين من قبل فريق العمل في المدرسة

1- ملأ استمارة البيانات الشخصية والعادات الغذائية المتعلقة باستهلاك أنواع الأطعمة الغنية باليود .
2- الفحص الإكلينيكي الخارجي باليد للرقبة لمعرفة وجود تضخم الغدة الدرقية من قبل الطبيب المختص .
3-عينة من البول لقياس نسبة اليود، سيكون على الطالب ملأ أنبوب خاص بالبول في حمام المدرسة و تسليمها إلى فنيين المختبر
4-استلام عينة من الملح المستخدم في المنزل بالإضافة إلى الاستبيان الغذائي الخاص بولي أمر الطالب.

أهمية عنصر اليود

- ضروري لقيام الغدة الدرقية بوظائفها الحيوية.
- مهم لتطور النمو ونشاط الأعصاب وصحة المخ.

الوقاية خير من العلاج

علاج نقص اليود يتم بتوفير نظام غذائي غني باليود.

فرق العمل ليوم المسح الوطني لليود في المدرسة

- أطباء العائلة للفحص الإكلينيكي لتقييم الغدة الدرقية .
- التمريض.
- أخصائي التغذية لعمل التقييم الغذائي
- فني المختبر .

Appendix 4

(Check list and Data collection form)

الاستبيان الخاص بفريق العمل

اسم الطالب / الطالبة: _____

☐ تم استلام الملح

☐ تم استلام البول

☐ تم مليء الاستبيان الخاص بأولياء الأمور

Physical Examination		
Weight (cm)	Height (cm)	BMI (kg/m^2)
Z- scores	☐ (>+1SD) ☐ (>+2SD) ☐ (-2SD – 1SD) ☐ (<-2SD) ☐ (<-3SD)	
Goiter Level	☐ 0 ☐ 1 ☐ 2	
BP	1st reading (/) 2nd reading (/)	BP Percentile (%)
Hb		
Urinary iodine level		
Iodine content of salt		

Appendix 5

(Questionnaire for parents)
الاستبيان الخاص بأولياء الأمور لطلبة المدارس الابتدائية

يرجى مليء الاستمارة وإعادتها إلى المدرسة بأسرع وقت ممكن

المعلومات الشخصية للطالب/الطالبة:

الاسم: _____ الجنس: ☐ ذكر ☐ أنثى

العمر: _____ الرقم السكاني: _____ رقم الهاتف: _____

المستوى التعليمي للأب ☐ أمي ☐ ابتدائي ☐ ثانوي ☐ جامعي

الوضع الحالي للأب ☐ يعمل ☐ لا يعمل

المستوى التعليمي للأم ☐ أمي ☐ ابتدائي ☐ ثانوي ☐ جامعي

الوضع الحالي للأم ☐ تعمل ☐ ربة بيت

عدد الأولاد في المنزل ☐ ترتيب الطفل بينهم ☐

المعلومات الصحية:

هل يعاني طفلك من مرض (وراثي،عضوي،..) ☐ نعم ☐ لا

إذا نعم حدد ☐ السمنة ☐ السكر ☐ فقر الدم الحديدي ☐ فقر الدم المتجلي ☐ الغدة الدرقية (خاملة / نشيطة) ☐ أخرى .....

هل يأخذ أدوية ☐ نعم ☐ لا ☐ لا أعرف **إذا نعم هل يأخذ أي من هذه الأدوية:**

☐ Lithium ☐ Methimazole (MMI) ☐ Minocycline (MN)

☐ Propylthiouracil (PTU) ☐ Thioamides ☐ Thioureylene ☐ Thyroxin

هل يعاني احد من العائلة من مرض ☐ نعم ☐ لا

إذا نعم حدد ☐ الأم ☐ الأب ☐ الأخ ☐ الأخت ☐ آخرين .....

إذا نعم حدد ☐ السمنة ☐ السكر ☐ الضغط ☐ الغدة الدرقية (خاملة / نشيطة) ☐ أخرى .....

اذكر اسم ملح الطعام المستخدم في المنزل للطبخ وإذا كان مدعم باليود _____

(الرجاء إعطاء الطفل عينة من ملح الطعام ووضعه في الكيس المرفق)

(Food Frequency questionnaire)

كم مره يتناول طفلك هذه الأطعمة ضع (✓) في المربع وضع O حول الاختيارات الموجودة في خانة الملاحظات

	من 5 مرات أو أكثر في الأسبوع	4-3 أمرات يام في الأسبوع	2-1 مرات في الأسبوع	أبدا	الملاحظات
الخبز/ السندويش	☐	☐	☐	☐	اسمر / ابيض
الرز	☐	☐	☐	☐	اسمر / ابيض
الباستا (المعكرونه، السبجتي، النودلز،..)	☐	☐	☐	☐	عادي/ صلصات
حبوب الافطار مثل (الكورن فلكس،...)	☐	☐	☐	☐	
المكسرات (الفستق، الكازو، الحب،...)	☐	☐	☐	☐	
البيتزا والمعجنات	☐	☐	☐	☐	بالجبنه/ بالزعتر/ بالسبانخ/ باللحم/ بالدجاج/ بالخضراوات
البطاطس المقلية	☐	☐	☐	☐	
الفواكه (تفاح، برتقال،...)	☐	☐	☐	☐	
الخضراوات الورقية (الخس، البربير،السبانخ،...)	☐	☐	☐	☐	
الخضراوات الأخرى (الجزر، الطماطم، الخيار،...)	☐	☐	☐	☐	
اللحم	☐	☐	☐	☐	مقلي/ مسلوق/ مشوي
الدجاج	☐	☐	☐	☐	مقلي/ مسلوق/ مشوي
السمك (الصافي، الكنعد، الهامور،...)	☐	☐	☐	☐	مقلي / مشوي
منتجات اللحوم (المبرجر، الشاورما، السجق،...)	☐	☐	☐	☐	مقلي/ مسلوق/ مشوي
الأكلات البحرية (الربيان، اقباقب، الخثاق،..)	☐	☐	☐	☐	مقلي / مشوي
البقوليات (النخي، الباجلاء، اللوبيا، الطعميه، الفول)	☐	☐	☐	☐	مقلية / مسلوقة
البيض	☐	☐	☐	☐	مسلوق/ مقلي
الحليب / الحليب بنكهاته	☐	☐	☐	☐	كامل الدسم / قليل الدسم/ خالي الدسم
الجبن	☐	☐	☐	☐	كامل الدسم / قليل الدسم/ خالي الدسم
الروب/ اللبن	☐	☐	☐	☐	كامل الدسم / قليل الدسم/ خالي الدسم
الايس كريم	☐	☐	☐	☐	بالحليب / مثلج
الشيبس / المينو	☐	☐	☐	☐	كم كيس ( )
الشوكلاته	☐	☐	☐	☐	كم واحد ( )
البسكويت	☐	☐	☐	☐	مالح /بالكريمه/ عادي
السكاكر / العلكة	☐	☐	☐	☐	
الدونت	☐	☐	☐	☐	بالسكر / بالشوكلاته/ عادي
كاتشب/ مايونيز	☐	☐	☐	☐	
المشروبات الغازيه	☐	☐	☐	☐	عدد العلب/ الكأس ( )
عصير الفواكه	☐	☐	☐	☐	محلى / غير محلى عدد العلب/ الكأس ( )
شراب الفواكه	☐	☐	☐	☐	عدد العلب/ الكأس ( )
مشروبات الطاقة	☐	☐	☐	☐	عدد العلب ( )

Appendix 6

الترصد التغذوي والمسح الوطني لاضطرابات عوز اليود لطلبة المدارس

السيد الفاضل ولي امر الطالب/الطالبة .....

الرقم السكاني.....

مدرسة .....

فحص الطالب / الطالبة

نشكر لكم مشاركة ابنكم/ابنتكم في المسح الوطني التغذوي لقياس انتشار عوز اليود لطلبة المدارس و نوافيكم بالنتائج التالية:

نوع الفحص	النتيجة	منخفض	طبيعي	مرتفع
كتلة الجسم				
وجود تضخم في الغدة الدرقية				
نسبة اليود في البول				
نمط الحياة (نشاط بدني و غذاء صحي)				

الإجراءات التي من الواجب عملها

1	**للمحافظة على كتلة الجسم الطبيعية و نمط حياة صحي**	• تناول وجبة إفطار صحية كل يوم. • تناول 5 حصص أو أكثر من الخضروات والفواكه في اليوم. • قلل من تناول الأطعمة الدهنية والسكريات. • قلل أو ابتعد عن استهلاك المشروبات السكرية. • أكثر من تناول الوجبات المحضرة في البيت ما يعادل 5-6 مرات في الأسبوع. • مارس النشاط الحركي 60 دقيقة في اليوم. • قلل من الجلوس امام شاشة التلفاز والألعاب الإلكترونية الى أقل من ساعتين في اليوم.
4	**وجود تضخم في الغدة الدرقية**	مراجعة الطبيب في المركز الصحي التابع له لعمل TSH T3, T4 وتحويله الى اخصائي الغدد الصماء لعمل الاشعة الفوق صوتية للغدة الدرقية.
5	**نسبة اليود في البول**	**طبيعي**: التزم بالتوصيات للمحافظة على نمط حياة صحي.
		منخفض : استخدام الملح المدعم باليود في الطبخ. تناول الاطعمة الغنية باليود مثل الحليب ومنتجاته من2 الى 3 اكواب في اليوم والبيض والسمك البحري مرتين في الاسبوع وتناول الخضروات والفواكه 5 حصص في اليوم.
		مرتفع: تقليل كمية الملح المستخدم في الطعام. تجنب الاطعمة التي تحتوي على كمية عالية من الملح مثل الوجبات السريعة والمحضرة في المطاعم والجبس والأطعمة المعلبة والمخللة
للاستفسار ومزيد من المعلومات الاتصال بقسم التغذية إدارة الصحة العامة هاتف 17279218		