Burden of Goitre and Urinary Iodine Status among Primary School Children in Kashmir, India—Evidence from a Population-Based Iodine Deficiency Disorder Survey

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Abstract

Introduction: Iodine deficiency is the leading cause of preventable brain damage, with 30% of the world's population suffering from iodine deficiency disorders (IDDs). The objectives of the study are to estimate the prevalence of goitre among schoolchildren in the age group of 6–12 years, to find out the proportion of households with adequately iodised salt, and to assess the dietary iodine intake by measuring urinary iodine levels in the urine samples of school-going children. **Methods:** A cross-sectional study was conducted in four pre-selected districts of the Kashmir division of Jammu and Kashmir in school-going children aged 6 to 12 years. Multi-stage 30 cluster sampling was used to select the study sample. For the selection of 30 clusters in each district, probability proportional to size (PPS) was employed. From each cluster, 90 children were selected. From a sub-sample of children in each district, 540 salt samples and 270 urine samples were also collected. **Results:** A total of 10,800 children aged 6–12 years were examined. Grade I goitre was present in 1382 (12.8%) and 116 (1.07%) which were having Grade II goitre. The weighted prevalence of goitre for four districts was 12.6%, lowest for district Ganderbal and highest for district Shopian. Half of the population in all the districts consumed salt with iodine levels of <15 ppm. Urinary iodine levels <99.9 µg/L were present in 15.7% indicating mild to moderate iodine deficiency. **Conclusion:** Though the present survey showed some decline in the total goitre rate (TGR) from a prevalence of 14.8% in 2017 to 12.6% in 2022, it continues to be a public health problem of mild to moderate intensity in Kashmir. The salt consumed at the household level was inadequately iodised. Hence, efforts in IDD elimination activities need to be scaled up further with emphasis on iodised salt quality control and intensive education at the community level.

Keywords: Iodine deficiency disorder, Kashmir, primary school children, total goitre rate

Introduction

Iodine is an essential trace element that is required in minute quantities for the growth and development of an individual.[1] Inadequate iodine intake may result in a variety of disorders which include goitre, cretinism, spontaneous abortion, perinatal mortality and heart failure.

Globally, iodine deficiency is the leading cause of preventable brain damage.[2] It is estimated that 30% of the world's population is at risk of developing iodine deficiency disorders (IDDs).[3] An estimated 150 million people around the world have IDDs, with a prevalence of goitre ranging from 4.7% in America to 28.3% in Africa.[4]

In India, it is one of the major preventable public health problems for decades. According to the National Family Health Survey 5 (NFHS 5), the prevalence of goitre or thyroid disorder in the general population was 2.9%.[5] Studies conducted in various parts of India, including the sub-Himalayan belt have shown that the prevalence of goitre still poses a public health

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problem. A recent study conducted in Himachal Pradesh found the prevalence of goitre in the area to be 16% while a study in Northeast India estimated the prevalence as 7.2%.[6,7] Moreover, the NFHS 5 reported that out of every one lakh female population aged between 15-49 years in J and K, 6809 women had thyroid gland disorder.[5]

The recommended dietary allowance (RDA) of iodine is 90 µg per day for children aged 1 to 9 years, and for children aged 10 to 12 years, it is 100 µg per day. As the age increases, so does the RDA, being 140 µg per day for adolescents from 13 years to 18 years.[8] The World Health Organization (WHO) has identified an insufficient amount of iodine provided by food, leading to a greater risk of developing iodine insufficiency and related thyroid disorders. As such, the WHO recommends fortifying food-grade salt with iodine as a prevention measure. This fortification of food-grade salt with iodine can ensure that the physiological needs of iodine are met, helping to reduce the risk of developing iodine insufficiency and related thyroid disorders.[9]

The measurement of the urinary iodine concentration in a single urine sample is the most commonly used index to assess iodine status in school-going children. In addition, the iodisation level of salt can also be measured. Because school-going children are highly vulnerable to IDDs, measuring iodine deficiency among school children is deemed to reflect the iodine status of the entire population. Moreover, schools provide convenient access to children, serving as an ideal platform for community-based surveys. Assessing the prevalence of goitre in school-going children serves as a widely acknowledged indicator for evaluating the severity of IDDs. In accordance with the guidelines set by the National Iodine Deficiency Disorders Control Programme (NIDDCP), clusters having a school enrolment rate of 90% or more do not require samples from out-of-school children in the area and sampling may be restricted to only school children.[10] With this background, the present study was conducted in four districts of the Kashmir division of Jammu and Kashmir with the following objectives: to estimate the prevalence of goitre among school children in the age group of 6–12 years; to find out the proportion of households with adequately iodised salt; and to assess the dietary iodine intake by measuring urinary iodine levels in the urine samples of school-going children.

Materials and Methods

Study design

It was a cross-sectional survey.

Study setting

The survey was conducted in four pre-selected districts of the Kashmir division of Jammu and Kashmir-Bandipora, Ganderbal, Kupwara, and Shopian. The survey was conducted under the aegis of NIDDCP which allots the districts chosen for the survey every alternate year.[10] Uniquely nestled among the Pir Panjal range of the Himalayas, the Valley of Kashmir is at an average altitude of 1,800 meters above sea level. In the Himalayan region, iodine deficiency leads to goitre in both animals and humans due to the lack of iodine in soil and water. As a result, goitre is a frequent occurrence in the sub-Himalayan parts of India. The average altitude of Bandipora, Ganderbal and Kupwara districts is around 1600 meters while district Shopian has an average altitude of 2100 meters.

Study period

The data collection for the study was conducted for ten days from 22nd March 2022 to 31st March 2022.

Sample size and sampling

Calculation of sample size was done according to the Revised NIDDCP guidelines.[10] Two-stage cluster sampling was used to select the study sample. According to the NIDDCP guidelines, 30 villages/wards were selected. For the selection of 30 clusters in each district, probability proportional to size (PPS) was employed. In each cluster, a sample of 90 children (equal proportion of boys and girls) of age group 6–12 years was selected from the schools listed on the sampling frame. According to NIDDCP guidelines, wherever the school enrolment/attendance rate is 90% or more, the samples may be restricted to the school itself and out-of-school samples are not required. Thus, the sample size in each district was calculated to be 2700 children and the total sample size was 10800 children in four districts. In each cluster, every fifth child examined was asked to bring a sample of the edible salt used in their house, while every tenth child examined was asked to provide a freshly voided sample of urine. Thus, a total of 18 children from each school and 540 from each district were selected to collect the salt sample while nine children from each school and 270 from each district were selected for the collection of urine samples.

Data collection

The teams of data collectors included faculty, resident doctors and medical interns from the Department of Community Medicine, Government Medical College, Srinagar, Kashmir. The data collectors received training related to the clinical examination of the thyroid gland for identification and grading of goitre, collection of salt and urine samples, and storage and transport before the commencement of the study. The training of the data collectors for clinical examination was conducted by the otorhinolaryngologists from the same institute. Four teams were created, each for one district, comprising of faculty members (assistant professors/lecturers), senior residents, junior residents (postgraduate students) and medical interns. The clinical examination was conducted by the faculty members and resident doctors.

The salt and urine samples collected on any day were brought to the designated storage site daily. The salt samples were collected in impenetrable airtight pouches to ensure that iodine does not evaporate. The urine samples were collected in sterile bottles with screw caps. The urine samples were kept at a temperature of 2–8 ºC in the field while in the storage facility, the samples were kept at a temperature of -70 ºC. Every possible measure was undertaken to ensure that the cold chain was maintained during the collection, transportation and storage of urine samples.

The data collection was done with the help of a pre-designed questionnaire that captured information about the child concerning age, sex, school and district. The clinical examination of the thyroid gland was carried out through inspection and palpation methods by the members of each team. Inspection and palpation were done by facing the child, palpating the isthmus and the lobes with two thumbs, and the fingers of both hands spread around the lateral side of the neck. The extent of swelling present, if any, was classified using the WHO's grading for goitre.[11] The total goitre rate (TGR) was calculated considering the presence of Goitre Grade I and Grade II (visible or palpable neck swelling consistent with enlarged thyroid gland).

Laboratory procedure

The estimation of iodine content in salt samples was done using iodometric titration. The preparation of solutions needed for the estimation of iodine in salt was done according to the Revised NIDDCP guidelines.[10]

Ten grams of salt sample were taken and dissolved in about 50 ml of water. To this, 1 ml of 2N sulphuric acid and 5 ml of 10% potassium iodide solution were added. The solution was then kept in the dark for 10 minutes. After that 1 ml of starch solution was added. This was followed by titration using a thiosulphate solution. The amount of iodine (in ppm) in the salt samples was then calculated as follows:

Iodine in salt (ppm) = (normality of thiosulphate*net volume of titration*21.15*1000)/weight of salt in grams.

The estimation of iodine content in urine samples was done using the Sandell–Kolthoff reaction. The principle of the reaction is based on the determination of iodine using its catalytic property of reduction of Ceric ions (Ce^{4+}) to Cerus ions (Ce^{3+}) as observed by the change in colour of ceric ammonium sulphate added to the solution. The optical density of the colour change is read using a spectrophotometer. The actual iodine content is calculated using a linear equation constructed by plotting the optical densities of solutions containing known quantities of iodine. The preparation of solutions needed for the estimation of iodine in urine was done according to the WHO-UNICEF-ICCIDD guidelines.[12] The estimation of iodine content in salt samples and urine samples was done at the Multidisciplinary Research Unit-Indian Council of Medical Research (MRU-ICMR) and Public Health Laboratory of the Department of Community Medicine, Government Medical College Srinagar.

Outcome variables

1. Goitre grade-the survey included a goitre grading system using WHO grading for goitre. The TGR was calculated considering the presence of Grade I and Grade II goitre.
2. Iodine level in salt-An iodine level of less than 15 ppm at the household level was considered an inadequate intake of iodine in salt.
3. Urinary iodine level-Urine iodine level of ≤99.9 μg/L was taken as mild to moderate deficiency of iodine (50–99.9 as mild deficiency and 20–49.9 as moderate deficiency). Urinary iodine level of <20 μg/L was taken as severe iodine deficiency.

Statistical analysis

Data was entered in Microsoft Excel 2016 and analysed using STATA 13 software. Iodine levels in salt and urine are measured in parts per million (ppm) and micrograms per litre (μg/L), respectively. Categorical variables are expressed as frequency and percentages. We calculated the 95% confidence interval for the TGR. Iodine levels in salt are expressed as quartiles and median.

Ethical Aspect

The requisite permissions were sought and received from the Institutional Review Board of Government Medical College Srinagar (IRBGMC) before the commencement of the study vide approval number IRBGMC/21-10 psm dated 21st October 2021. Permission was also sought from the Department of School Education, Kashmir division. Informed written consent/assent was obtained from the study participants before inclusion in the study and the use of patient data for research and educational purposes. The procedures used follow the guidelines laid down in the Declaration of Helsinki (2008).

Results

A total of 10,800 school-going children were screened for IDDs. From each of the four districts, 2700 children were screened clinically for an enlarged thyroid. On analysis, two incomplete entries were removed. The total number of salt and urine samples analysed as shown in Figure 1.

We examined 5364 boys and 5434 girls in the age group of 6 to 12 years from all four districts of Kashmir [Supplementary Table 1]. The largest proportion of children (17.02%) fell within the 10-year age bracket, closely followed by those aged 12 years (16.81%). Additionally, 11.96% of the children

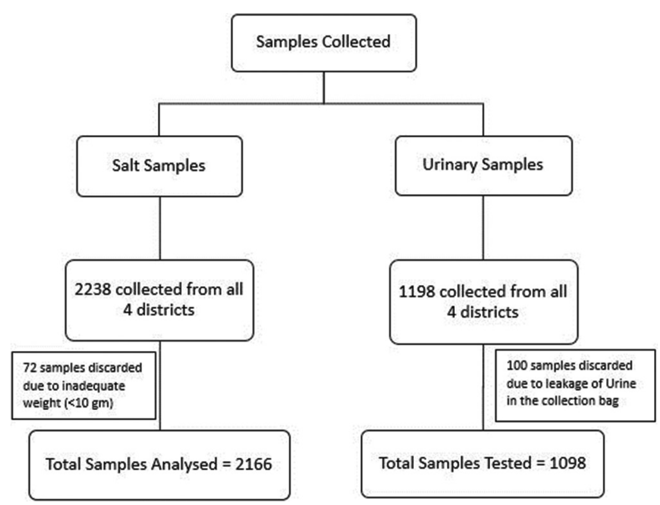

Figure 1: Flowchart showing total salt and urine samples analysed

belonged to the 6-year age group. Among them, school-going students, 1382 (12.8%) were found to have Grade I goitre and 116 (1.07%) had Grade II goitre. The prevalence of Grade I ranged from 3.3% to 24.3%, lowest in district Ganderbal and highest in district Shopian. Regarding Grade II goitre, the prevalence ranged from 0.3% in the district Ganderbal to 1.9% in the district Bandipora [Supplementary Table 2].

The TGR among school children ranged from 3.6% (95% CI; 2.9 to 4.3) to 25.9% (95% CI; 24.2 to 27.5), the lowest for district Ganderbal and highest for district Shopian, respectively. The overall weighted prevalence of goitre was calculated to be 12.6% (95% CI; 12.56 to 12.65). Overall TGR was higher in boys in all four districts (P-value = 0.00908). Gender and district-wise distribution of TGR is shown in Table 1.

In all four districts, goitre prevalence was higher at the ages of 10 years and 11 years [Figure 2].

The iodine levels in salt samples ranged from 0 to 87.83 ppm [Table 2]. Approximately 99% of salt samples in Kupwara and Bandipora and 100% of salt samples in Ganderbal and Shopian showed a concentration of iodine less than 15 ppm at the household level. Moreover, we received 26 samples of rock salt (ten from Shopian, eight from Bandipora, five from Kupwara, and three from Ganderbal district). There were some samples of salt with either no iodine content or minimal content and were found to display noticeable contamination with other spices, typically red chilli powder and turmeric. In some cases, traces of soil were also detected.

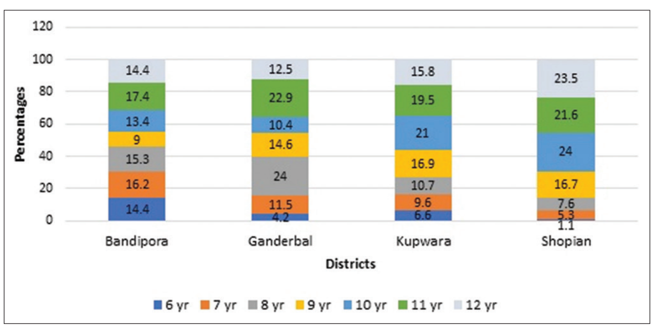

Figure 2: Prevalence of Goitre in examined children across age groups 6-12 years in four districts

We also analysed urine samples of 1098 children for iodine concentration. About 16% of children had urinary iodine levels <99.9 μg/L [Table 3]. The median urinary iodine levels (IQR) in districts Bandipora, Kupwara, Ganderbal and Shopian were 290.8 μg/L (301.3), 395.9 μg/L (185.4), 379.8 μg/L (256.4) and 258.2 μg/L (302.9), respectively [Figure 3]. Figure 4 depicts the trend in TGR in J and K since 1997.

Discussion

IDDs are globally acknowledged as one of the leading causes of preventable brain damage leading to psychomotor impairment and learning disabilities.[12] Studies have shown that the intelligence quotient in children who live in iodine-deficient areas is lower in comparison with those living in iodine-sufficient areas.[13] School-going children aged 6–12 years are considered an important group in IDD surveillance as they are one of the most vulnerable population groups and often reflect the status of the general population. Further, the children can be easily accessed through schools which act as a platform for conducting community-based surveys.[12] The prevalence of goitre among school-going children is one of the most widely accepted markers for the

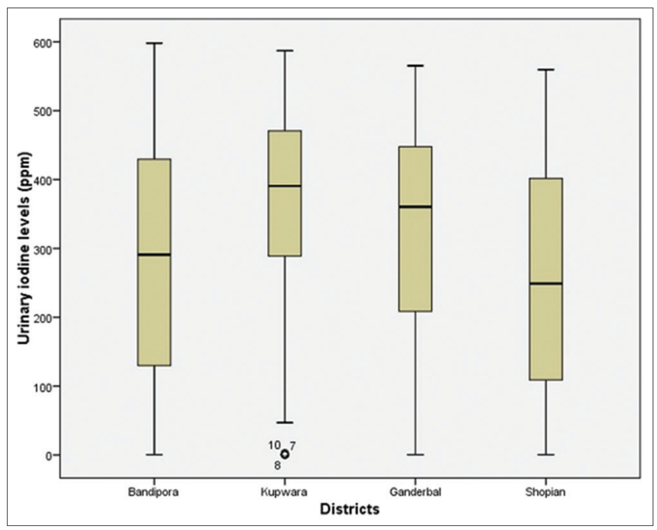

Figure 3: Box and Whisker plot showing urinary iodine levels in examined children in the four districts

Table 1: District-wise distribution of goitre cases according to gender among examined school children

District	Children screened	Total goitre rate		Total goitre rate (95% CI)
		Males *n* (%) (95% CI)	Females *n* (%) (95% CI)	
Bandipora	2699	228 (17.2%) (15.2-19.2)	204 (14.9%) (12.9-16.7)	16.0 (14.6-17.4)
Ganderbal	2700	63 (4.7%) (3.5-5.8)	33 (2.4%) (1.6-3.3)	3.6 (2.9-4.3)
Kupwara	2700	150 (11.2%) (9.5-12.9)	122 (9.0%) (7.4-10.5)	10.1 (8.9-11.2)
Shopian	2699	350 (26.0%) (23.6-28.3)	348 (25.8%) (23.4-28.1)	25.9 (24.2-27.5)

evaluation of the severity of IDDs.[13] Based on this, a TGR of 5.0% to 19.9% indicates a mild deficiency, 20.0 to 29.9% indicates moderate deficiency while a TGR of 30.0% and above suggests severe deficiency.[11]

The present survey was conducted in four districts of Kashmir which included Bandipora, Shopian, Kupwara and Ganderbal. The weighted prevalence of goitre in all districts is 12.6%, with the highest TGR at 25.9% in district Shopian followed by 16.0% in Bandipora, 10.1% in Kupwara, and lowest at 3.6% in district Ganderbal. The results of our study showed moderate iodine deficiency in the Shopian district and mild iodine deficiency in the other three districts. Multiple surveys conducted under the NIDDCP in different districts of Kashmir over the last decade have shown a significant decline in the TGR. A survey conducted in 2013 by Masoodi SR *et al.* reported the goitre prevalence as 3.6% in Kupwara District while in our study it was 10.1%.[14] This reflects that there may have been a re-emergence of iodine deficiency in Kupwara due to greater use of non-iodised salt over the years. Goitre surveys conducted in 2010 and 2012 reported a TGR of 48.3% in district Bandipora and 18.5% in Kulgam, respectively.[15,16] Another survey conducted in the Jammu division in 2016 reported the TGR as 18.87%.[17] IDD surveys conducted in different parts of Jammu and Kashmir reflect a steady decline in the TGR over the years. Figure 4 depicts the trend in TGR in J and K since 1997.[15-22] With an initial 33.2% drop in TGR in 15 years from 1997 to 2012, there has not been much decline in the following decade[21,22] [Figure 4].

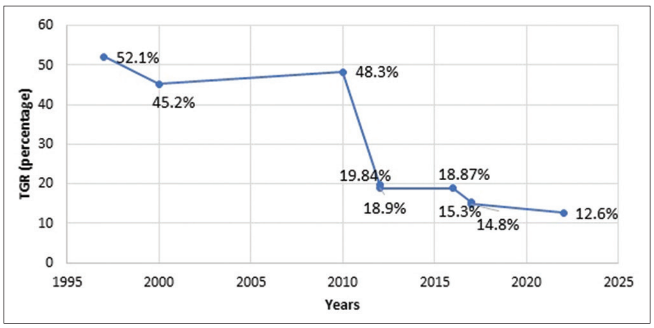

Figure 4: Comparison of Goitre prevalence in Jammu & Kashmir over a span of 25 years

This provides evidence that the campaigns for universal iodisation of salt and advocating its use at the household level led to a dramatic reduction in the prevalence of goitre initially. As universal iodisation of edible salt is one of the cornerstone intervention strategies to achieve a reduction in the prevalence of IDDs, it has faced certain programmatic challenges in the past decade which is creating a major hurdle in achieving the elimination target for IDD.[23]

Like Kashmir, goitre is found to a significant extent in Himachal Pradesh. This could be because it is a part of the world's largest goitre belt with TGR reported to the tune of 15.8%.[24] In contrast, the goitre prevalence is quite low in the rest of India ranging between 1.9% in Madhya Pradesh to 4.0% in Gujarat.[25,26] This variation could be due to the varied geographical and environmental conditions seen in the country.

In the present study, we found a significant difference between TGR across genders ($P < 0.05$). A systematic review and meta-analysis of the relationship between goitre and gender showed the overall proportional prevalence of goitre in favour of males but thereafter female prevalence was higher which is consistent with the literature found in many parts of India.[15,17,27] Iodine levels in ppm in salt samples were found to be lowest in the Shopian district ranging from 0 to 9.81 ppm, which is also reflected in the TGR of the district (25.9%). Possible reasons for low iodine content in the majority of the salt samples tested in all four districts could be due to weak quality monitoring of the iodisation of salt at the production level.[23] At the consumer level, inappropriate practices like improper storage of iodised salt, use of rock salt, and contamination of salt with other condiments could be the contributory factors. Samples of salt that exhibited no iodine content or minimal content also

Table 2: Iodine levels (in ppm) in salt samples collected from four districts among examined school children

Salt iodine levels (ppm)	Districts			
	Bandipora	Ganderbal	Kupwara	Shopian
Minimum	0.39	0	0.75	0
25th percentile	5.29	5.28	4.71	4.31
50th percentile	8.74	5.99	5.69	4.90
75th percentile	10.33	6.54	6.29	5.29
Maximum	25.05	11.41	87.83	9.81

Table 3: Urinary iodine levels according to W.H.O classification among examined school children

Urinary iodine level (mcg/L)	Bandipora *n* (%)	Ganderbal *n* (%)	Kupwara *n* (%)	Shopian *n* (%)	Total *n* (%)
≤99.9 Mild–moderate deficiency	57 (33.0)	33 (19.1)	18 (10.4)	65 (37.5)	173 (15.7)
100 to 199.9 Adequate intake	43 (31.1)	27 (19.5)	17 (12.3)	51 (37.1)	138 (12.6)
200 to 299.9 Above requirement	36 (24)	40 (26.7)	35 (23.3)	39 (26)	150 (13.7)
300 and above Excessive	128 (20.1)	193 (30.3)	200 (31.4)	116 (18.2)	637 (58.0)
Total	264 (24)	293 (26.7)	270 (24.6)	271 (24.7)	1098 (100)

exhibited visible contamination with other spices usually red chilli powder, turmeric and sometimes soil.

More than half (58.4%) of the goitre cases were observed in 10–12-year-olds in all four districts. This corroborates similar findings from earlier studies.[15,17,20] Studies conducted in different parts of the country and outside also support the observation.[28,29] The reason for this could be that with increasing age, the requirement for iodine increases in children, which given the state of inadequate intake of iodine might result in the development of IDDs in such children. During puberty, an increase in thyroid volume is a normal adaptation that often leads to the formation of goitre in pathological conditions. In both genders, the size of the thyroid is best correlated with body surface area. Additionally, changes in body composition may also influence the association between pubertal growth and the increase in thyroid size. This implies that multiple growth factors can affect the hypothalamic-pituitary-thyroid gland axis positively, possibly through TSH-independent pathways within the thyroid itself.

Urinary iodine is a well-accepted, cost-efficient and easily obtainable indicator for iodine status. Since the majority of iodine absorbed by the body is excreted in the urine, it is considered a sensitive marker of current iodine intake and reflects recent changes in iodine status.[30-32] In this study, Urinary Iodine Estimation (UIE) was done on the sub-sample of the population. We found 15.7% of children had mild-moderate deficiency having UIE levels of ≤99.9 µg/L. All four districts had a median urinary iodine level of >199 µg/L. This is in line with the findings from the study conducted by Sharma DP *et al.* in Gujarat where the median UIE was found to be 194 µg/L.[25] Anil NS *et al.* reported the median UIE in Bangalore as 139 µg/L.[28] The global scorecard of iodine nutrition 2021 released by the WHO shows that the median urinary iodine in the Indian population was found to be 178µg/L.[33] It might seem implausible when we compare the TGR and UIE levels in our study. In our study, we found inconsistencies between TGR and UIE levels. This could be because UIE levels only provide information about the current iodine status while the prevalence of goitre gives a long-term picture of the iodine status in the population. Therefore, the prevalence of IDD as determined by the two indicators does not necessarily need to agree.[34] Similar results were observed in a study conducted in Gujarat where TGR was reported as 23.2% while the UIE of 100 mcg/dl and above was seen in 56.4% of the samples.[35] Sharma DP *et al.* also reported a similar picture showing a 33% prevalence of goitre in the population while the median UIE was 194 µg/L.[25]

Limitations

The study is subject to some limitations. Firstly, the study did not take into account the iodine content of dietary food items (other than salt) which could act as a potential confounder in the population. However, since salt is the major source of dietary iodine in the population, the present study reflects the nutritional status of iodine intake to a large extent. Secondly, due to feasibility issues, urinary iodine analysis was done using ‘on-spot’ single urine samples instead of early morning fasting urine samples or 24-hour urinary iodine as recommended by WHO. Since the iodine content in the urine reflects the iodine ingested in the preceding hours or days, greater variation is not seen in a single-spot sample. Additionally, the primary benefit of spot urine collection as compared to 24-hour urine sampling is its practicality.

Conclusion and Recommendations

The present survey of Iodine Deficiency Disorders in four districts of Kashmir showed an insignificant decline in the total goitre rate from a prevalence of 14.8% in 2017 to 12.6% in 2022. Iodine deficiency disorder continues to be a public health problem of local and national significance as evidenced by the presence of mild to moderate deficiency based on TGR. This is also reflected in the median urinary iodine levels, with 15.7% of the population having less than 99.9 µg/L urinary iodine. In addition, 50% of the population in all the districts consumed salt with iodine levels of less than 15 ppm. Hence, the importance of consuming iodised salt, storage, and cooking practices should be emphasized through tailored interventions and nutritional education. This focus should also involve surveillance of salt fortification and the estimation of iodine content in salt at production and consumption levels. Based on these findings, efforts in IDD elimination activities need to be scaled up further focusing on iodised salt quality control and conducting intensive education at the community level regarding the effects of storage and cooking practices on the iodine content of salt.

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Authors’ contribution

S. Muhammad Salim Khan - Formulation of plan, concepts and guidance, Tanzeela B Qazi and Tazean Z Malik- Laboratory testing, manuscript preparation and literature search, Mariya A Qurieshi- Design and manuscript review, Mohammad Iqbal Pandit- Design and guidance, Inaamul Haq- Data and statistical analysis, Khalid Bashir- Data collection & Manuscript editing, Sabira A Dkhar, Iqra N Chowdri and Sahila Nabi- Data collection and Laboratory testing.

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Conflicts of interest

There are no conflicts of interest.

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Supplementary Table 1: Age and gender distribution of participants

Age (years)	Bandipora		Shopian		Kupwara		Ganderbal		Total *n* (%)
	Male *n* (%)	Female *n* (%)	Male *n* (%)	Female *n* (%)	Male *n* (%)	Female *n* (%)	Male *n* (%)	Female *n* (%)	
6	224 (51.4)	237 (48.6)	35 (51.5)	33 (48.5)	209 (52.0)	193 (48.0)	161 (44.7)	199 (55.3)	1291 (11.96)
7	212 (62.4)	129 (37.7)	71 (50.0)	71 (50.0)	181 (43.2)	238 (56.8)	260 (66.7)	130 (33.3)	1292 (11.97)
8	176 (55.0)	144 (45.0)	109 (50.0)	109 (50.0)	163 (50.0)	163 (50.0)	160 (41.0)	230 (59.0)	1254 (11.61)
9	129 (43.3)	169 (56.7)	189 (44.3)	238 (55.7)	200 (48.9)	209 (51.1)	213 (54.6)	177 (45.4)	1524 (14.11)
10	170 (45.7)	202 (54.3)	328 (47.7)	359 (52.3)	193 (49.6)	196 (50.4)	231 (59.2)	159 (40.8)	1838 (17.02)
11	188 (42.8)	251 (57.2)	294 (53.6)	255 (46.4)	211 (52.1)	194 (47.9)	168 (43.1)	222 (56.9)	1783 (16.51)
12	227 (48.5)	241 (51.5)	323 (53.1)	285 (46.9)	181 (51.7)	169 (48.3)	158 (40.5)	232 (59.5)	1816 (16.81)
Total	1326 (49.1)	1373 (50.9)	1349 (49.99)	1350 (50.01)	1338 (49.6)	1362 (50.4)	1351 (50.1)	1349 (49.9)	10798 (100)

Supplementary Table 2: District-wise distribution of participants according to goitre grade

Goitre grade	Bandipora *n* (%)	Ganderbal *n* (%)	Kupwara *n* (%)	Shopian *n* (%)	Total *n* (%)
0	2267 (84.0)	2604 (96.4)	2428 (89.9)	2001 (74.1)	9300 (86.13)
1	381 (14.1)	90 (3.3)	255 (9.4)	656 (24.3)	1382 (12.8)
2	51 (1.9)	6 (0.3)	17 (0.7)	42 (1.6)	116 (1.07)
Total	2699 (100.0)	2700 (100.0)	2700 (100.0)	2699 (100.0)	10798 (100)