Original Research Article

Prevalence of iodine deficiency disorders and its determinants among school children aged 6 to 12 years in rural areas of Koppal district, Karnataka

Vijaykumar P. Mane, Yuvaraj Banot Yenkanaik*, Smita M. Nimbannavar, Anilkumar L., Sharankumar Holyachi, Chetana K. V.

INTRODUCTION

Iodine is an essential dietary micronutrient that helps the body to produce thyroxin hormone which regulates normal growth, development and functions of body. Inadequate/poor intake of iodine can cause a spectrum of disorders like stillbirth, mental retardation, deaf mutism, squint, dwarfism, goiter, neuromotor defects etc. collectively referred as Iodine deficiency disorders (IDD).

It affects people of all ages, both sexes and of different socio-economic backgrounds. It is the world’s most prevalent, yet easily preventable, cause of brain damage.1-4

Globally, about 2 billion people including 266 million school aged children are at risk of Iodine deficiency disorders due to insufficient intake of iodine and the estimated prevalence of goiter is 15.8%. In India alone,
200 million people live in iodine deficient areas and 71 million persons are already suffering from goiter and other disorders. Surveys conducted in various states showed that no state in the country is free from IDD and revealed that out of 282 districts surveyed, IDD poses a major public health problem in 241 districts where the prevalence is more than 10%.1,2,4,7

The Government of India launched National Goiter Control Program (NGCP) in the year 1962 considering the burden of IDD in the country and renamed it as National Iodine Deficiency Disorders Control Program (NIDDCP) in the year 1992. Universal salt iodization was identified as the main strategy to eliminate IDD form India and was made mandatory in the year 1997. Despite this, only half of households in India are currently using sufficiently iodized salt.4,6,8,9 All health interventions require an effective system for monitoring and evaluation and assessment of Iodine status of population by goiter survey and iodine levels of salt are the two important components of NIDDCP program monitoring.5,6 With this background, the following study was undertaken.

**Objectives**

The objectives of this study was to estimate the prevalence of Goitre among children aged 6 to 12 years in rural areas of Koppal district, to determine various factors associated with goiter among children, to estimate the level of urinary iodine excretion among urine samples collected from children and to estimate the level of iodine content among salt samples collected in the study setting.

**METHODS**

**Study design**

The present study was a community based cross sectional study done by the department of Community Medicine, KIMS, Koppal (rural areas) for a duration of 6 months from June 2018 to November 2018 in Koppal district as per guidelines from IDD cell, Directorate of Health and Family Welfare, Bangalore.

**Study population:** All the children aged 6 to 12 years residing in rural areas of Koppal district

**Sampling technique**

Cluster sampling technique was used for sample selection as per guidelines. All the villages in Koppal district were considered as Individual clusters and 30 such clusters/ villages were selected by population proportional to size sampling. As the school enrolment rate was more than 90% in Koppal district, the survey was restricted only to children aged 6 to 12 years studying in schools located in selected villages of the district. In each of the selected cluster/ village, one school was selected by simple random sampling and in each selected school a total of 105 children (15 each from class 1 to 7) were selected and included as study participants by systematic sampling technique as per guidelines. If the required number of children were unavailable at that particular school, other schools in the vicinity were visited till a sample of 105 children was reached for that particular cluster. As per protocol, we also collected 10 urine samples from children at each school and 20 salt samples from households of children at each school by systematic sampling technique.

**Detection of goiter**

Goiter was detected and graded by inspection and palpation of the neck of study participants as per standard techniques mentioned in guidelines for the survey after obtaining their accent and informed consent from Headmasters of the schools. Goiter was graded as follows: Grade 0- no palpable or visible goiter/ no goiter, Grade I- A mass in the neck that is consistent with an enlarged thyroid, which is palpable but not visible, when the neck is in normal position. It moves upward in the neck as the subject swallows, Grade II- 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/goiter visible and palpable.

**Analysis of iodine content of iodized salt by iodometric titration method**

Salt samples were sent to Model Rural Health Research Unit (MRHRU), Sirwar, Raichur for analysis.

**Estimation of urinary iodine excretion (UIE) by Sandell Kolthoff reaction**

Urine samples were sent to MRHRU, Sirwar, Raichur for estimation and were classified as per guidelines.10

**Data collection**

Data were collected using pretested and semi structured questionnaires from study subjects after taking their accent and consent from teacher.

**Statistical analysis**

Data were entered and analyzed using Epi info software version 3.5.4.

**RESULTS**

The survey team examined a total of 3150 school children for goitre and collected 600 salt samples and 300 urine samples from 30 clusters as per protocol. However, some of the questionnaires and urine/ salt samples collected had to be discarded for being incomplete and for being insufficient for analysis respectively thereby making a final sample of 3047 children, 282 urine and 566 salt samples. The prevalence of goitre among school children aged 6 to 12 years in rural areas of Koppal district was
442 (14.5%), out of which 367 (12.04%) were found to have Grade I goiter and the rest 75 (2.46%) were suffering from Grade II goiter.

Figure 1 demonstrates gender wise prevalence of goitre in Koppal district. The prevalence of goiter (both Grade I and II) was little higher i.e., 235 (15.72%) among male children as against 207 (13.32%) among females as seen in the figure but this difference was not found to be statistically significant (p>0.05).

Table 1 demonstrates prevalence of goiter among children according to certain dietary factors and source of drinking water. As seen in Table 1, none of the dietary factors were found to be significantly associated (p>0.05) with prevalence of goiter among children in the present study. However, the prevalence of goiter was significantly more (p<0.05) in children who relied on surface water sources for drinking purposes compared to those whose source of drinking water was ground water.

![Figure 1: Gender wise prevalence of goitre (n=3047). Chi square=3.5382; p=0.059.](image)

![Figure 2: Age wise prevalence of goitre (n=3047). Chi square=27.025, p=0.000.](image)

Table 2 shows distribution and classification of urine samples according to iodine content in them. Majority i.e., 154 (54.60%) of the urine samples in the present survey had mild iodine deficiency as indicated by urinary excretion followed by 96 (34.04%) of samples with no iodine deficiency as seen in the Table 2. Mean iodine content among urine samples was 84.95 µg/l and median was 75 µg/l.

Figure 3 shows distribution of salt samples according to iodine content in Koppal. Majority i.e., 448 (79.15%) of the salt samples collected during the survey had iodine content less than 15 PPM and the rest had more than that as seen in the Figure 3.

Table 1: Prevalence of goiter among children according to certain dietary factors.

| Dietary factors | Classification               | Children Observed | Goiter status | Present (%) | Absent (%) | χ² | p   |
|----------------|------------------------------|-------------------|---------------|-------------|------------|----|-----|
| Type of diet   | Vegetarian                  | 727               | N (%)         | 92 (12.65)  | 635 (87.35)| 2.638 | 0.104 |
|                | Mixed                       | 2320              | N (%)         | 350 (15.08) | 1970 (84.92)|    |      |
| Intake of pickle | No                          | 244               | N (%)         | 24 (9.83)   | 220 (90.17)| 4.889 | 0.086 |
|                | Occasional                  | 1978              | N (%)         | 299 (15.11) | 1679 (84.89)|    |      |
|                | Regular                     | 825               | N (%)         | 119 (14.42) | 706 (85.58)|    |      |
| Intake of papad | No                          | 285               | N (%)         | 34 (11.92)  | 251 (88.08)| 2.086 | 0.352 |
|                | Occasional                  | 2523              | N (%)         | 376 (14.90) | 2147 (85.10)|    |      |
|                | Regular                     | 239               | N (%)         | 32 (13.38)  | 207 (86.62)|    |      |
| Intake of cabbage | No                          | 344               | N (%)         | 47 (13.66)  | 297 (86.34)| 4.559 | 0.102 |
|                | Occasional                  | 2505              | N (%)         | 376 (15)    | 2129 (85) |    |      |
|                | Regular                     | 198               | N (%)         | 19 (9.59)   | 179 (90.41)|    |      |
| Intake of cauliflower | No                          | 302               | N (%)         | 44 (14.56)  | 258 (85.44)| 2.222 | 0.329 |
|                | Occasional                  | 2591              | N (%)         | 382 (14.74) | 2209 (85.26)|    |      |
|                | Regular                     | 154               | N (%)         | 16 (10.38)  | 138 (89.62)|    |      |

Continued.
The present study found significant association between the prevalence of goiter and the age group of study participants similar to the findings of a number of studies done both within and outside the country. This difference in prevalence of goiter could be due to differences in study settings, differences in study periods, differences in profile of study participants, sampling errors etc.

Similarly, prevalence of goiter was significantly more among children who relied on surface water sources for drinking purposes in the present survey. But the role of source of drinking water was not evaluated by any of the studies mentioned earlier. However, neither gender nor any of the dietary factors were found to have any significant association with the prevalence of goiter among children, as opposed to many studies which found prevalence to be significantly more among female children.

Nearly two third of the urine samples collected from study subjects in the present survey had iodine excretion levels less than optimum with median urinary excretion in many other studies as confirmed by other studies. However, while few other studies had median urinary excretion in their urine samples more than the optimum, another study by Sebotsa et al in South Africa had median urinary excretion levels much lesser than the present study. In the present survey, only one in every five salt samples had adequate iodine content which is highly worrisome, as confirmed by other studies. On the contrary, many other studies found more than half of the salt samples adequately iodized.

In the present survey, nearly two third of the urine samples collected from study subjects in the present survey had iodine excretion levels less than optimum with median of 75 µg/l similar to the findings of many other studies. However, while few other studies had median urinary excretion in their urine samples more than the optimum, another study by Sebotsa et al in South Africa had median urinary excretion levels much lesser than the present study.

In the present survey, only one in every five salt samples had adequate iodine content which is highly worrisome, as confirmed by other studies. On the contrary, many other studies found more than half of the salt samples adequately iodized.

**CONCLUSION**

Goiter constitutes a mild public health problem in the study setting and was significantly associated with age and source of drinking water among school children. Majority of the urine samples collected from them were excreting iodine below optimum levels indicating poor iodine nutrition. Only 20% of salt samples collected, had adequate iodine content emphasizing the need to improve the same.

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