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PREVALENCE OF GOITER (IODINE DEFICIENCY DISORDER) AMONGST SCHOOL AGE CHILDREN IN INDIA

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ABSTRACT

Aim: Iodine is an essential micronutrient required for normal human growth and development as it is needed for the synthesis of thyroid hormones produced by thyroid glands. The deficiency of Iodine leads to a number of Iodine Deficiency Disorders (IDD). In India by, 167 million people are at risk of IDD, 54.4 million people have goiter, and 8.8 million people have IDD-related mental / motor handicaps. Therefore, the present review article aims to assess the prevalence of Goiter (Iodine Deficiency Disorders) amongst school age children in India to generate more scientific evidence which would help in further research in this context. **Methods:** Globally, India has the largest number of children born vulnerable to iodine-deficiency. School age children are an especially useful population group for the assessment of IDD, both because of their physiological vulnerability and their accessibility through schools. To collect the relevant scientific evidence for the present review article, databases such as pub med, Google scholar were accessed. **Results:** The scientific findings reveal that in India the highest prevalence of Goiter amongst school age children is in Karnataka (30%) followed by Himachal Pradesh (Kullu-23.4%; Kangra-15.8%). **Conclusion:** Goiter is a major problem in developing countries like India but from the scientific evidence it can be concluded that overall, India is in a phase of transition from Iodine inadequacy to adequacy.

KEYWORDS: Goiter, Inadequacy, Iodine, Micronutrient, Thyroid Gland, Transition.

INTRODUCTION

Iodine is an essential micronutrient. A daily consumption of 100-150 micrograms of iodine is recommended for normal human growth and development. Iodine is widespread in the environment, but it is chiefly derived from the ocean and the soil.[1] Iodine is typically present in relatively low concentrations in the sea and soil; because of its biological importance, iodine tends to be present in living organisms in higher concentrations. It is found in varying amounts in plants and animals, and the amount of Iodine present in plants depends on the concentration of iodine in the soils in which they are grown. The most potent source of iodine in the human diet is marine fish and other seafood.[2] Iodine is an essential component of thyroid hormones produced by the thyroid gland. Thyroid hormones are involved in regulation of various metabolic processes such as growth, physical development and normal functioning of brain. Thus the deficiency of Iodine can lead to a number of Iodine Deficiency Disorders (IDD).

Enlargement of the thyroid gland (goiter) is the common manifestation of IDD and goiter survey is used as diagnostic tool to identify areas of IDD.[3] School age children are an especially useful population group for the assessment of IDD, both because of their physiological vulnerability and their accessibility through schools.[4]

Iodine deficiency disorders (IDD) are a major public health problem all over the world, including India.[5] Globally, 2.2 billion people live in areas with iodine deficiencies, with the risks of resulting complications, while in India; 167 million people are at risk of IDD, 54.4 million people have Goiter, and 8.8 million people have IDD-related mental / motor handicaps.[6] In the past, iodine deficiency was thought to cause only goiter and cretinism. However, over the last quarter of the century, it has become increasingly clear that iodine deficiency leads to a much wider spectrum of disorders commencing with the intrauterine life and extending through childhood into adult life with serious health and social problems. The spectrum of diseases includes goiter, cretinism, hypothyroidism, brain damage, abortion, still birth, mental retardation, psychomotor defects and hearing and speech impairment.[7] Although goiter is the most visible sequelae of iodine deficiency, the major impact of hypothyroidism due to iodine deficiency is impaired neurodevelopment, particularly in early life.[8] According to the World Health Organization, iodine deficiency is the single most preventable cause of mental retardation and brain damage.[9]

Globally, India has the largest number of children born vulnerable to iodine-deficiency.[10] Children living in iodine-deficient areas on an average have lower intelligence quotient (IQ), by as much as 13.5 IQ points as compared to children living in iodine-sufficient areas.[11] Out of 587 districts in the country, 282 have been surveyed for IDD and 241 have been found to be goiter-endemic.[12] On the other hand, IDD are among the easiest and cheapest of all disorders to prevent. The addition of a small, constant amount of iodine to the salt that people consume every day is all that is needed. The elimination of IDD is a critical development issue, and should be given the highest priority by government and international agencies.[13] Therefore, keeping this in view, this article reviews the prevalence of goiter in India with the aim of analyzing the current scientific data available and to generate more scientific evidence which would help in further research in this context.

Table 1: The spectrum of the Iodine Deficiency Disorders (IDD)[13]

AGE GROUP	IODINE DEFICIENCY DISORDERS
Fetus	Abortions Stillbirths Congenital anomalies Increased perinatal mortality Increased infant mortality Neurological cretinism: mental deficiency, deaf mutism, spastic Diplegia squint Myxoedematous cretinism: mental deficiency, dwarfism, hypothyroidism Psychomotor defects
Neonate	Neonatal hypothyroidism
Child & Adolescent	Retarded mental and physical development
Adult	Goitre and its complications Iodine-induced hyperthyroidism (IIH)
All Ages	Goitre Hypothyroidism Impaired mental function Increased susceptibility to nuclear radiation

METHODS

For the present review article, the scientific literature was collected from various online databases such as Pubmed, Google Scholar. The studies reviewed and included in the article were undertaken in the different parts of India with the aim to assess the prevalence of Goiter (Iodine Deficiency Disorders) amongst school age children in India so as to generate scientific evidence which can be further utilized to conduct other studies.

RESULTS

Prevalence of Goiter amongst school age children

Rao et al. (2002) carried out a study to find out the prevalence of goiter among a total of 722 school children in the age group of 8-10 years. Children were clinically examined for the presence of goiter and graded according to WHO guidelines. Urine and salt samples were collected from subsample to estimate the urinary iodine excretion level and iodine content in the salt, respectively. Over all prevalence of goiter was found to be 30%. Prevalence among males was 28.8% and among females it was 31.2%. In the both sexes goiter rate increased with the advancement of age. Prevalence of goiter was significantly higher among children who had urinary iodine excretion level less than optimum (<10 mcg/dl). Estimation of iodine content in the salt sample revealed that 48.3% of samples had adequate iodine content (>=15ppm). There was significant increase in the goiter rate as the iodine content in the salt decreased.[14]

Table II: Daily iodine intake recommendations[13]

Group	Iodine intake	
	(µg/day)	(µg/kg/day)
Infants and children, 0–59 months	90	6.0–30.0
Children, 6–12 years	120	4.0
Adolescents and adults, from 13 years of age through adulthood	150	2.0
Pregnant women	200	3.5
Lactating women	200	3.5

A multicentre study to assess iodine deficiency disorders (goitre and deaf-mutism/cretinism) in 1, 45, 264 children (6 - <12 years old) from 15 districts of ten states was carried out during 1997-2000. Urinary iodine excretion was determined in 27481 children, while iodine content was estimated in 5881 samples of edible salt. It was found that the overall prevalence of goitre was 4.78% (4.66% of grade I and 0.12% of grade II) amongst the children examined. The highest prevalence of goitre was observed in Dehradun district (31.02%), while the lowest prevalence of goitre was recorded in Bishnupur and Badaun districts (0.02% each). The overall prevalence of cretinism among children examined from seven districts was 0.072% whereas that of deaf-mutism was 0.27% among children examined from 8 districts. Median urinary iodine values were marginally less than the WHO cut-off values only in

children of the 3 out of the 15 districts surveyed. Iodine content was found to be adequate in 55.45% of the salt samples.[15]

A study was conducted by Sarkar et al. (2007) to assess the status of iodine deficiency amongst 315 school children (9-13 yr) from 30 schools in Pondicherry by finding out the urinary excretion of iodine and the prevalence of goiter. The results reported that prevalence of goiter was 15.24% and children who had inadequate iodine intake with urinary iodine level of less than 100 mcg/ L was 44.4%. Amongst them, 14.3% had a greater degree of iodine deficiency with less than 50 mcg/L of iodine in urine.[16]

The prevalence of goitre, urinary iodine excretion (UIE) levels and salt iodine content at the household level was assessed in Howrah district of West Bengal by Das et al. (2008). A total of 2400 school children aged 8-10 years participated in the study. The results revealed that the Total Goitre Rate (TGR) was 13.7%. Grade 1 was 11.4% and Grade 2 (visible goitre) was 2.3%. The TGR was influenced by the age and sex. The median urinary iodine excretion level was 13microg/dL and none had a value less than 5 microg/dL. Almost 80% of salt samples tested had adequate iodine content (>or= 15 ppm).[17]

Table III: Median Population Urinary Iodine Values and Iodine Nutrition [13]

Median Urinary Iodine Concentration (µg/L)	Corresponding Iodine Intake (µg/day)	Iodine Nutrition
<20	<30	Severe deficiency
20-49	30-74	Moderate deficiency
50-99	75-149	Mild deficiency
100-199	150-299	Optimal
200-299	300-449	More than adequate
>299	>449	Possible excess

Pandav et al. (2010) conducted a community-based survey to examine a total of 1230 children aged between 6 and 12 years to study the current status of IDD in Tamil Nadu and it was found that TGR was 13.5%. The median urinary iodine excretion was found to be 89.5µg/L. Fifty-six per cent of the urinary iodine excretion values were <100µg/L. The proportion of households consuming adequately iodized salt (iodine content ≥ 15 parts per million) was only 18.2%.[18]

Another similar study was done by Chudasama et al. (2011) amongst a total of 70 children (6-12 years) in Kutch district, Gujrat to assess the prevalence of goiter; to determine median urinary iodine concentration; and, to assess level of salt iodization. The results of the study

reported a goiter prevalence of 11.2% among primary school children (grade 1- 8.6% and grade 2-2.6%). As the age increased, the goiter prevalence also increased except in age group of 8 years. Median urinary iodine excretion level was 110µg/L. Iodine level more than 15 ppm was found in 92.3% salts samples tested at the household level. It was concluded that there was mild goiter prevalence amongst school children.[19]

Chander et al. (2013) conducted a study in district Kullu, Himachal Pradesh to assess the prevalence of IDD in school age children. Clinical examination of the thyroid of 1986 children was done and on the spot urine and salt samples was collected. The Total Goiter Rate was found to be 23.4% indicating moderate iodine deficiency and median urinary iodine excretion was 175µg/L indicating no biochemical deficiency of iodine in the population studied.[20]

The prevalence of iodine deficiency disorders in 1898 school-age children in the age-group of 6-12 years was assessed by Kapil et al. (2013). Clinical examination of the thyroid of children was conducted and urine and salt samples were collected. The total goiter rate was found to be 15.4%. Median urinary iodine excretion level was 62.5µg/l. Only 39% of the salt samples had iodine content of ≥15 ppm. It was concluded that mild iodine deficiency was present in the subjects studied.[21]

Kapil et al. (2013) conducted another study in district Kangra, Himachal Pradesh to assess the prevalence of iodine deficiency in school-age children. A total of 1864 children in the age group of 6-12 years were included. Clinical examination of thyroid of all children was undertaken. 'On the spot' urine samples were collected from 463 children. The salt samples were collected from 327 children. The results of the study showed that the total goiter was 15.8%. The proportion of children with urinary iodine excretion (UIE) levels <50.0, 50.0-99.9 and ≥ 100 µg/l was 2.2, 14.3 and 83.5%, respectively and the median UIE level was 200 µg/l.[22]

Iodine deficiency disorder is a public health problem in NCT of Delhi. A study was conducted in NCT of Delhi to assess the current iodine nutrition status among 1393 school age children (6-11 years). Urine samples were collected and tested for urinary iodine excretion (UIE). The Median UIE was found to be 200µg/L. The salt samples collected from study subjects revealed that 87% of salt samples had stipulated level of iodine of 15ppm and more.[23]

In a study to find out the prevalence of Goitre among 3757 school children (6-12 years) in Chamarajanagar district, India, and to estimate iodine in salt samples, the overall prevalence of Goitre was found to be 7.74%. It was higher in female children compared to male children. The difference was more evident in Grade II cases where 64.47% cases were females and 35.53% cases were males and it showed an increasing trend with age. Analysis of salt samples suggested that 28.42% samples had Iodine less than 15ppm.[1]

In another study conducted to estimate the prevalence of goiter in 10,082 children (6-12 years) in the rural areas of Mysore and Coorg districts in India and to estimate iodine levels in salt samples, the total prevalence of goiter was reported to be 19.01% in children in Coorg district and 8.77% in Mysore district and it was more in females than in males. Analysis of salt samples suggested that most of the samples were inadequately iodised (73.92% in Coorg and 45.92% in Mysore).[24]

Table IV: Prevalence of Total Goiter Rate amongst school age children in India

S.No.	Author	Year	Location	CB/HB	Study group	Age group	TGR	Ref.
1.	Rao et al.	2002	Karnataka	CB	School children	8-10 years	30%	[14]
2.	Toteja et al.	2004	NA	CB	School children	6-<12 years	4.78%	[15]
3.	Sarkar et al.	2007	Pondicherry	CB	School children	9-13 years	15.2%	[16]
4.	Das et al.	2008	West Bengal	CB	School children	8-10 years	13.7%	[17]
5.	Pandey et al.	2010	Tamil Nadu	CB	School children	6-12 years	13.5%	[18]
6.	Chudasama et al.	2011	Gujrat	CB	School children	6-12 years	11.2%	[19]
7.	Chander et al.	2013	Kullu, HP	CB	School children	NA	23.4%	[20]
8.	Kapil et al.	2013	Solan, HP	CB	School children	6-12 years	15.4%	[21]
9.	Kapil et al.	2013	Kangra, HP	CB	School children	6-12 years	15.8%	[22]
10.	Zamal et al.	2013	Chamarajanagar, Karnataka	CB	School children	6-12 years	7.74%	[1]
11.	Ahmed et al.	2014	Mysore Coorg	CB	School children	6-12 years	8.77% 19.01%	[24]

HB- Hospital Based; CB- Community Based; NA- Not Available; TGR- Total Goiter Rate

CONCLUSION

Iodine is required for the synthesis of thyroid hormones which is essential for the normal growth and development of an individual. The deficiency of Iodine in body leads to IDD such as goitre, cretinism, hypothyroidism, brain damage, abortion, still birth, mental retardation, psychomotor defects and hearing and speech impairment goiter being the most visible sequelae of iodine deficiency. From the scientific data reviewed in this paper it can be concluded that even after universal iodization of salt with Iodine, goiter is prevalent in many parts of the country in the school age children. The deficiency of iodine, will also affect the

potential of school age children to achieve their maximum physical growth and mental development resulting in decreased level of intelligence quotient (IQ). But overall, country is in a phase of transition from Iodine inadequacy to adequacy. Thus, with more efforts from the government to make the iodized salt more accessible to the people residing in the goiter prone areas, TGR can be reduced further amongst school age children.

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