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Age- and Sex-Specific Goitre Prevalence in Selected Areas of Purba Medinipur and Howrah Districts of West Bengal

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Abstract

Goitre prevalence with respect to age and sex was evaluated in the unconventional iodine-sufficient areas of Purba Medinipur and Howrah districts of West Bengal during the post-salt iodization phase. The study was carried out on 4603 school-going children aged 6–12 years of both sexes from 13 randomly selected community development (CD) blocks in these two districts. Children were clinically examined for goitre and categorized by age and sex. The results showed that goitre prevalence reached endemic levels in these districts. A gradual increase in goitre rate was observed from age 6 years up to age 10 years, followed by a decline, suggesting that compensatory adjustment of the thyroid gland may occur after a certain age. Overall, the prevalence of Grade 2 (visible) goitre was significantly higher in girls than in boys, indicating that girls are more susceptible to goitre than boys.

Keywords: Goitre prevalence, iodine deficiency, age, sex, school-age children, post-salt iodization, thyroid

Introduction

Iodine is an important micronutrient for human development as it is a constituent of the thyroid hormones thyroxine (T₄) and triiodothyronine (T₃). These hormones play crucial roles in human metabolism and are essential for normal growth, as well as mental and physical development. Iodine deficiency is a global problem that leads to goitre and endemic cretinism, along with clinical and subclinical defects in motor and cognitive functions. In 1999, the World Health Organization (WHO) estimated that 13% of the world's total population was affected by goitre ^[1]. Although goitre is the most visible indicator, iodine deficiency produces a spectrum of disorders collectively termed iodine deficiency disorders (IDD) ^[2]. These include goitre, hypothyroidism, cretinism, congenital abnormalities, neurological dysfunctions, stillbirth, impaired reproduction, and spontaneous abortions.

No state in India is free from iodine deficiency and endemic goitre. IDD is not confined to the classical hilly sub-Himalayan goitre-endemic belt; it has also been reported from sub-Himalayan flat lands (terai), plains (especially those subject to annual flooding), riverine areas, deltas, and even coastal regions ^[3, 4, 5, 6, 7, 8, 9].

The northern part of West Bengal is hilly and lies in the classical iodine-deficient goitre-endemic belt ^[10], while the major southern region is the fertile, densely populated Gangetic basin. In the post-salt iodization phase, endemic goitre has been reported from many areas in India ^[11], including West Bengal ^[8, 12, 13].

A retrospective study among schoolchildren in the Sundarban delta of West Bengal reported high goitre prevalence (38.2% and 33.1% in the South and North 24-Parganas districts, respectively), despite the absence of nutritional iodine deficiency, as evidenced by urinary iodine excretion ^[14, 15]. Based on preliminary surveys of IDD in the Ganga basin and Bay of Bengal region, 13 CD blocks located on opposite sides of the Sundarban delta were selected for the present study.

The multifactorial nature and complex interactions between host factors (age and sex) and region-specific environmental conditions pose a major challenge in understanding and controlling endemic goitre ^[16]. Therefore, this study aimed to examine the interaction of

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host factors specifically age and sex on goitre prevalence among school children in the post-salt iodization phase.

Materials and Methods

Howrah is one of the most densely populated districts in Gangetic West Bengal, with a population of 4, 850, 029 (2011 census) distributed across 14 CD blocks. Most residents live in rural areas, with some in industrial-rural settings. Purba Medinipur has a population of 5, 095, 875 (2011 census) spread across 25 CD blocks. The people are primarily engaged in agriculture, factory work, and fisheries. Their diet is mainly non-vegetarian, consisting of cereals, pulses, fish, vegetables (including those from the Brassicaceae family), and others.

Thirteen CD blocks located in the Ganga basin and Bay of Bengal region were selected. From each block, one area was chosen randomly using purposive sampling^[17]. In each area, one primary school and the nearest secondary school were selected (or a single combined school when available). This ensured coverage of children aged 6–10 years (primary) and 10–12 years (secondary)^[14, 15]. Where boys' and girls' schools were separate, both were included.

All students in the recommended age group present on the survey day(s) were clinically examined for goitre. Age was recorded from school registers and rounded to the nearest whole number. A total of 4603 students were examined by palpation. The clinical examination was conducted by two

trained research staff experienced in IDD survey methodology. Goitre grading followed WHO/UNICEF/ICCIDD criteria^[18]:

- **Grade 0:** No goitre.
- **Grade 1:** Thyroid palpable but not visible
- **Grade 2:** Thyroid visible with the neck in normal position.

Results

A total of 4603 children aged 6–12 years were examined. Boys constituted 50.9% and girls 49.03% of the sample. Goitre was detected in 1656 children (35.9%). Grade 1 goitre was present in 31.5% and Grade 2 in 4.4%. A progressive increase in goitre prevalence occurred from age 6 to 10 years, followed by a slight decline at ages 11 and 12 years. Visible (Grade 2) goitre reached its highest prevalence (7.9%) in the 10-year age group (Table 2).

Goitre prevalence (Grade 1, Grade 2) was compared between boys and girls across age groups (6–12 years) (Table 1). For Grade 1 (palpable) goitre, differences between boys and girls in percentages were not statistically significant across age groups. For Grade 2 (visible) goitre, girls were more affected than boys (except at age 9 years), though statistical significance was not reached in individual age groups. Overall, the prevalence of Grade 2 goitre was higher in girls than in boys in the total study population.

Table 1: Age-specific goitre prevalence among boys and girls

Age (years)	Boys				Girls			
	Examined	Grade 1	Grade 2	Total	Examined	Grade 1	Grade 2	Total
6	343	108 (31.5%)	0 (0.0%)	108 (31.5%)	386	101 (26.2%)	10 (2.6%)	111 (28.8%)
7	401	126 (31.4%)	5 (1.2%)	131 (32.7%)	367	121 (33.0%)	14 (3.8%)	135 (36.8%)
8	399	140 (35.1%)	10 (2.5%)	150 (37.6%)	334	107 (32.0%)	24 (7.2%)	131 (39.2%)
9	324	115 (35.5%)	18 (5.6%)	133 (41.0%)	376	125 (33.2%)	17 (4.5%)	142 (37.8%)
10	346	105 (30.3%)	23 (6.6%)	128 (36.9%)	324	136 (42.0%)	30 (9.3%)	166 (51.2%)
11	287	74 (25.8%)	16 (5.6%)	90 (31.4%)	245	75 (30.6%)	15 (6.1%)	90 (36.7%)
12	244	65 (26.6%)	8 (3.3%)	73 (29.9%)	227	53 (23.3%)	15 (6.6%)	68 (29.9%)
Total	2344	733 (31.3%)	80 (3.4%)	813 (34.7%)	2259	718 (31.8%)	125 (5.5%)	843 (37.3%)

Table 2: Overall goitre prevalence (Total study population)

Age (years)	Examined	Grade 1	Grade 2	Total
6	729	209 (28.7%)	10 (1.4%)	219 (30.1%)
7	768	247 (32.2%)	19 (2.5%)	266 (34.6%)
8	733	247 (33.7%)	34 (4.6%)	281 (38.3%)
9	700	240 (34.3%)	35 (5.0%)	275 (39.3%)
10	670	241 (36.0%)	53 (7.9%)	294 (43.9%)
11	532	149 (28.0%)	31 (5.8%)	180 (33.8%)
12	471	118 (25.1%)	23 (4.9%)	141 (30.0%)
Total	4603	1451 (31.5%)	205 (4.4%)	1656 (35.9%)

Discussion

The prevalence of endemic goitre among school children is the most widely accepted marker for assessing the severity of IDD in a region^[19]. According to WHO/UNICEF/ICCIDD criteria^[19], a prevalence of 5–19.9% is mild, 20–29.9% moderate, and $\geq 30\%$ severe. The overall goitre prevalence of 35.9% in the study area indicates a severe public health problem. Although most cases were palpable (31.5%), the presence of visible goitre (4.4%) further underscores the severity during the post-salt iodization period. A gradual increase in goitre prevalence from age 6 to 10 years, followed by a decline, was observed.

Similar patterns have been reported in other surveys, where goitre prevalence rises steadily in both sexes up to a certain age and then declines^[6, 8]. The reduction in older children is likely due to compensatory adjustment of the thyroid gland with advancing age.

The thyroid-releasing hormone (TRH) regulates thyroid-stimulating hormone (TSH) secretion from the anterior pituitary thyrotrophic cells. TSH, in turn, controls thyroid growth, development, and hormone synthesis/secretion^[20]. TRH secretion from the hypothalamus is feedback-regulated by circulating T3 levels, particularly in the brain excess T3 suppresses TRH, and vice versa^[21].

Goitre develops in areas with environmental iodine deficiency or in areas with goitrogenic factors that interfere with iodine nutrition^[22]. In such conditions, circulating T4 declines, while T3 is preferentially maintained for a period^[23]. Maintenance of normal T3 levels likely supports normal TRH and TSH secretion, thereby limiting further thyroid enlargement and enabling compensatory adjustments with age.

The prevalence of Grade 2 goitre was higher in girls (5.5%) than boys (3.4%). This sex difference is generally attributed to increased physiological demands during puberty, pregnancy, and lactation^[24]. Thyroid disorders, including endemic goitre, are more common in women, especially in iodine-deficient regions^[25]. Estrogens enhance the response to TRH, possibly by increasing the number of TRH receptors in pituitary thyrotrophic cells^[26, 27].

Conclusion

The present study clearly demonstrates that the entire surveyed region in Purba Medinipur and Howrah districts of West Bengal is severely affected by endemic goitre, making it a serious public health concern even in the post-salt iodization phase. The overall goitre prevalence of 35.9% places the area in the severe category per WHO/UNICEF/ICCIDD guidelines, with a notable 4.4% rate of visible (Grade 2) goitre further underscoring the gravity of the situation. The age-specific pattern observed a steady rise in goitre prevalence from 6 to 10 years, followed by a decline at 11 and 12 years strongly suggests compensatory physiological adjustments in the thyroid gland as children advance in age. Such adjustments appear to mitigate further enlargement of the gland, possibly through improved hormonal regulation involving the hypothalamic-pituitary-thyroid axis. However, a detailed exploration of the precise biochemical and molecular mechanisms responsible for this compensatory phenomenon lies beyond the scope of the current investigation and warrants future research.

Furthermore, the study highlights a clear sex disparity, with girls exhibiting significantly higher rates of Grade 2 goitre (5.5%) compared to boys (3.4%). This finding aligns with established knowledge that females are more susceptible to thyroid disorders in iodine-deficient or goitrogen-exposed environments. The increased vulnerability in girls may be linked to higher physiological demands during periods of rapid growth and the influence of estrogens on enhancing the responsiveness of the pituitary to TRH, thereby promoting greater thyroid stimulation. These observations emphasize the need for targeted interventions focusing on adolescent girls in endemic areas.

Taken together, even after widespread salt iodization, endemic goitre continues to pose a significant and ongoing challenge in the studied coastal and riverine areas of West Bengal. The present data emphasize the multifactorial character of iodine deficiency disorders, in which host-related factors like age and sex interact with local environmental conditions. To effectively combat this issue, sustained surveillance, improved iodine delivery systems, goitrogen reduction measures, and community-based health education programs are critically needed. Additionally, long-term follow-up research that includes key biochemical indicators such as urinary iodine levels, thyroid function tests, and autoimmunity markers would yield valuable insights for more efficient control strategies. Ultimately,

addressing endemic goitre is essential to promote the healthy physical and cognitive development of children in these regions.

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