

ABSTRACT

Introduction: Iodine deficiency is the single most important and preventable cause of mental retardation worldwide. Iodine deficiency leads to mental retardation, deaf mutism, squint, dwarfism, spastic diplegia, neurological defects and congenital anomalies. Uttarakhand state is a known endemic region to iodine deficiency.

Pregnant mothers, neonates, school age children (6-12 years) and adolescent girls are the most vulnerable groups as they are especially sensitive to even marginal iodine deficiency. There are some reports covering small populations from different districts of Uttarakhand which have reported high prevalence of iodine deficiency amongst school age children. NFHS-3 data also reported only the household iodized salt consumption in India.

However, data on iodine nutritional status amongst pregnant mothers, neonates and adolescent girls of this region is not available. Thus there is lack of data available on the effects of iodine deficiency on these 4 vulnerable age groups from Uttarakhand state. Environmental influences like food and water also play a major role in iodine status of the population. As consumption of crops and plants grown on iodine deficient soils leads to iodine deficiency in populations solely dependent on this vegetation for their iodine requirements. We do not have data on the environmental influences (iodine content in water and food samples) on iodine deficiency from Uttarakhand state. Hence, the study was conducted to assess the environmental influences (iodine content in water and food samples) and iodine nutritional status amongst pregnant mothers, neonates, school age children (6-12 years) and adolescent girls in three districts of Uttarakhand state, utilizing indicators recommended by WHO (2007). Thus to fill the gap in the existing knowledge the present study was conducted with the following objectives:

Objectives: **1)** Assessment of iodine nutritional status amongst pregnant mothers, neonates, school age children (6-12 years) and adolescent girls in the selected 3 districts namely Nainital, Udham Singh Nagar and Pauri Garhwal, from three regions of Uttarakhand namely: i) Kumaon, ii) Terain (Plain) and iii) Garhwal **2)** Assessment of Iodine content of salt consumed by the population in the selected 3 districts namely Nainital, Udham Singh Nagar and Pauri Garhwal, from three regions of Uttarakhand namely: i) Kumaon, ii) Terain (Plain)

and iii) Garhwal. **3)** To assess Environmental influences; iodine content in water and food samples of Uttarakhand state

Methodology: Three districts, namely: Udham Singh Nagar, Nainital and Pauri Garhwal were selected. In each district, thirty clusters (schools/villages) were identified by utilizing the population-proportional-to-size cluster sampling methodology. Total of 1727 Pregnant Mothers (Udham Singh Nagar; 632, Nainital; 614, Pauri Garhwal: 481), 2013 Neonates (Udham Singh Nagar; 649, Nainital; 670, Pauri Garhwal: 694), 6143 School Age Children (Udham Singh Nagar; 1807, Nainital; 2269, Pauri Garhwal: 2067) and 5430 Adolescent Girls (Udham Singh Nagar; 1823, Nainital; 1811, Pauri Garhwal: 1796), were included in the study. Clinical examination of thyroid of each pregnant mother, school age children and adolescent girl was conducted. Spot urine and salt samples were collected from pregnant mother, school age children and adolescent girl. Cord blood samples were collected on filter paper for estimation of Thyroid Stimulating Hormone amongst neonates and venous blood sample was collected on filter paper for confirmation of neonatal hypothyroidism. For Environmental Influences: A total of 90 water samples (30 from each district) and 45 food samples i.e cereals and pulses (15 from each district) were collected for iodine content in water and food samples from each of the district.

Results: In Pregnant mothers: Total Goiter Rate was found to be 16.1% (Udham Singh Nagar), 20.2 % (Nainital) and 24.9% (Pauri Garhwal). Median urinary iodine concentration level was 124 μ g/l (Udham Singh Nagar), 117.5 μ g/l (Nainital) and 110 μ g/l (Pauri Garhwal), respectively. It was found that higher percentage of pregnant mothers; 49.7% (Udham Singh Nagar), 42.1% (Pauri Garhwal) and 33.0% (Nainital) were consuming salt with iodine intake of less than 15ppm

In Neonates: Thyroid Stimulating Hormone levels of more than 5mIU/L were found in 55.3 (Udham Singh Nagar), 76.4 (Nainital) and 72.8 (Pauri Garhwal) percent of neonates. Only 0.3% cases of neonatal hypothyroidism were found from district Nainital and no such cases were found from districts Udham Singh Nagar and Pauri Garhwal.

In School age children: Total Goitre Rate was found to be 13.2% (Udham Singh Nagar), 15.9% (Nainital) and 16.8% (Pauri Garhwal). Median urinary iodine concentration level was 150 μ g/l (Udham Singh Nagar), 125 μ g/l (Nainital) and 115 μ g/l (Pauri Garhwal), respectively.

It was found that higher percentage of families of school age children 59.6% (Pauri Garhwal), 53.3% (Udham Singh Nagar) and 42.3% (Nainital) were consuming salt with iodine intake of less than 15ppm.

In adolescent girls: Total Goitre Rate was found to be 6.8% (Udham Singh Nagar), 8.2% (Nainital) and 5.6% (Pauri Garhwal). Median urinary iodine concentration level was 250 μ g/l (Udham Singh Nagar), 200 μ g/l (Nainital) and 183 μ g/l (Pauri Garhwal). It was found that higher percentage of families of adolescent girls 59.5% (Udham Singh Nagar), 46.7% (Pauri Garhwal) and 44.0% (Nainital) were consuming salt with iodine intake of less than 15ppm.

Environmental Influences: The mean iodine content in water samples were 5.0 μ g/l (Udham Singh Nagar), 1.0 μ g/l (Nainital) and 3.5 μ g/l (Pauri Garhwal), respectively. The pooled mean of iodine content of food samples was $5.31 \pm 1.01\mu$ g per 100g (Udham Singh Nagar), $4.86 \pm 1.09\mu$ g per 100g (Nainital) and $4.46 \pm 1.62\mu$ g per 100g (Pauri Garhwal), respectively.

Conclusion: Low median urinary iodine concentration level (<150 μ g/l) in pregnant mothers and high percentage of neonates with TSH level of >5mIU/L indicates iodine deficiency in all three districts studied. The school age children and adolescent girls were in a transition phase from iodine deficiency (as revealed by Total Goiter Rate) to iodine sufficiency (as revealed by median Urinary Iodine Concentration level) in all the three districts of Uttarakhand state, India.

Keywords: Goitre, Iodine-deficiency disorders, Salt iodization, Urinary iodine concentration, Thyroid Stimulating Hormone, School age children, Adolescent girls, Pregnant mothers, Neonates