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Mini Review

Utility of Iodine Concentrations in Urine as a Non- Invasive, Cost Effective Mass Screening Biomarker for Early Detection of Thyroid Gland Disorders in Pregnancy

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Abstract

Iodine an essential micronutrient is emerging as a "major metabolic mediator" in view of its pivotal role in the human biological system particularly in thyroid gland and mammary gland patho physiologies. Iodine deficiency is the single most important cause of preventable mental impairment in paediatric population. It has also been observed that women with breast related disorders have lower levels of urinary iodine which further supports the vital role of iodine in endocrine related metabolic disorders. Iodine related disorders are experiencing a comeback with increasing occurrence of thyroid dysfunctions especially in the most vulnerable pregnant women and their newborn babies. The unique property of iodine to cross placenta freely when compared to thyroid stimulating hormone causes abnormal biochemical changes much earlier .This facilitates timely detection of thyroid disorders in pregnancy. The need of the hour is to attempt and define a non- invasive, cost effective mass screening biomarker of iodine status for early detection of thyroid gland dysfunctions in various populations. World Health Organization has defined several indicators for monitoring iodine status in populations among which urinary iodine levels serve as a good indicator of recent iodine intake and can be utilized to assess thyroid gland functions and predict outcomes. Several Sandell Kolthoff reaction based methods are available for iodine estimation. While 24 hours urinary excretion levels is "gold standard" in view of practical difficulties particularly in pregnant women, spot urinary iodine concentrations are preferred. A modified microplate method for spot urinary iodine concentrations combined with spot urinary creatinine levels corrected for age and weight are more reliable. As iodized salt is the major source of iodine assessment of current iodine status , impact of salt iodization programs. and regular are essential. Further short and long term evaluation of health outcomes of vulnerable populations will facilitate planning public health protective and preventive strategies.

Keywords: *Urinary Iodine Concentrations; Preventable Mental Impairment; Congenital Hypothyroidism; Maternal Hypothyroidism; Breast Disorders*

Introduction

Iodine deficiency is the single most important cause of preventable mental impairment among paediatric population [1,2]. The increasing occurrence of thyroid dysfunctions especially in the most vulnerable pregnant women and reports of women diagnosed with mammary gland diseases having low urinary iodine levels support the role of iodine as a "major metabolic mediator" in human biology [3]. Among various thyroid dysfunctions in the most vulnerable pregnant women of particular importance is maternal hypothyroidism in that neonates born to hypothyroid mothers have higher chances of impaired intelligence quotients. The ultimate impact of thyroid

hormones disorders is significant leading to increase in maternal and neonatal morbidity rates and overall reduced socioeconomic productivity of the entire nation. Hence there is an urgent need to define and utilize a non- invasive, cost effective mass screening biomarker for early detection of thyroid gland disorders especially in the most vulnerable pregnant women.

Unfolding role of iodine as a major etiology

Iodine intake levels serve as the most important determinant of thyroid functions in human population. When women especially pregnant women have abnormal thyroid functions it is mostly due to two major reasons which are iodine imbalances both as deficiency and in excess states and autoimmune disorders. Iodine imbalances are usually multifactorial predominantly due to environmental, diet related and genetic factors while autoimmunity is usually due to independent individual related cause. With Indian population having higher CH prevalence when compared to world prevalence interestingly iodine related pathophysiologies referred as "dyshormonogenesis" are leading causes of CH while dysgenesis are more commonly reported in western literature. The major role of iodine in etiopathogenesis of CH in Indian newborns is slowly unravelling. As thyroid gland functions and iodine metabolism are strongly influenced by environmental, social and geo-ethnic factors ideally region specific and population specific reference values are necessary. Early diagnosis and timely therapy are crucial to prevent disability and further plan public health therapeutic and prevention strategies.

Indian research data

Earlier in 1989, Indian Council Of Medical research (ICMR) study reported iodine deficiency in all Indian states [4]. Recent research studies conducted in State of Tamil Nadu in children between 6 to 12 years of age have documented that consumption of iodized salt is currently below 80% [5] as against WHO defined criteria of more than 90% [1]. A multi-centric pilot study by ICMR in 5 states during 2008 to 2012 has revealed a high panendemic prevalence of congenital hypothyroidism [CH] in India at "1 in 1172" with a much higher prevalence of "1 in 727" in South India population [6,7].

Current status in State of Tamil Nadu

Few studies conducted in India from Northern, Eastern and Western regions in pregnant women report prevalence of iodine deficiency as 38% [8]. As per data from Department of Public Health and Preventive Medicine, 28 districts in Tamil Nadu are endemic for IDD. As there is paucity of studies in pregnancy from South Indian population particularly in State of Tamil Nadu which is unique in its demographic, cultural and cooking practices, priority should be to conduct pilot studies in residing pregnant women to assess the current prevailing iodine status [9]. There is a need to monitor salt iodization program impact on the current iodine content in various market brands of salt types. Screening of the pregnant population deserves topmost priority in that undetected iodine deficiencies and resulting thyroid disorders result in "double penalty" causing disease in both pregnant mother and her dependent fetus accordingly.

Screening tools for iodine status

Among pregnant women where physiological demand is more, epidemiological surveillance measures are required to monitor populations iodine status to improve performance of public health indicators [10]. Screening can be planned at population and individual levels. World Health Organization [WHO] has defined several epidemiological indicators to assess iodine status both at population and an individual level. These mainly include 1) Goitre rates, 2) Urinary iodine Concentrations [UIC], 3) Iodine content in consumed salt at household levels, 4) Thyroglobulin levels, 5) Neonatal screening thyroid stimulating hormone (TSH) levels [1]. The sensitivity and practical feasibility of designing a mass screening program for early diagnosis of maternal thyroid disorders particularly among vulnerable pregnant women cannot be overemphasized. The specificity of thyroid function profiles in that TSH and T4 levels as unique for an individual is not debated against urinary iodine levels. Among pregnant women where physiological demand is more, epidemiological surveillance measures are required to monitor populations iodine status to improve performance of public health indicators [11].

Advantages of urinary iodine concentrations as a mass screening tool

The human biological system or "internal metabolic milieu" is reflected in urinary iodine levels as an earlier manifestation of thyroid gland dysfunctions when compared with TSH, T4 and T3 respectively. Truly speaking iodine levels in urine will be deficient if iodine intake is less when demand is more. The thyroid gland responds after a latent period by reducing thyroxine levels and has constant or low T3 levels. It is failure of adaptability of thyroid gland when iodine is deficient that triggers the same thyroid gland to further increase the TSH levels leading to goitre and initiates a cascade of metabolic events with iodine as the central focus or epicenter. Iodine readily crosses human placenta and represents both maternal and fetal thyroid functions. Another added advantage of iodine concentrations not altered by circulating human chorionic gonadotrophin and estrogen levels justify utility of iodine concentrations as an efficient screening tool for earlier detection of maternal hypothyroidism at population level [12,13]. With developing countries facing more socio economic challenges , utility of an easy , non-invasive and cost effective tool with less requirement of skilled staff to collect biological samples will be rewarding .

Preferred methodology of urinary iodine estimation in pregnancy

Evaluation of iodine intake is best assessed by urinary iodine levels as more than 90% of iodine ingested are excreted in the urine [1]. WHO has stated that median urinary iodine levels represent iodine status of the population and values below 100 microgram per litre in children and normal adults indicate deficiency. As iodine is required in larger amounts in pregnancy at 250 microgram /day as against 150 microgram mg/day in normal adults, it is ideal to have a different set of reference median levels of urinary iodine in pregnancy and lactating women. WHO has set values of less than 150 microgram/litre as deficiency status in these vulnerable groups. Sandell Kolthoff reaction based biochemical methods are most suited for evaluation of iodization process within a population [14]. A modified method with both spot urinary iodine and spot urinary creatinine concentrations corrected for age and weight is more reliable. As haemodilution is a major physiological change in pregnancy ,utility of creatinine levels and calculation of corrected spot urinary iodine levels are ideal . This method will reduce the false positives and prevent overdiagnosis of iodine deficiency. Ammonium persulfate wet digestion method is most suitable in view of being less toxic and costeffective. Stringent internal and external quality control measures are necessary to validate results.

Conclusion

Focus on iodine as a "major metabolic screening bio-marker" for early detection of thyroid dysfunctioning seems promising in the near future and utility of urinary iodine concentrations will be most useful as a cost-effective, non-invasive mass screening tool.

Conflict of Interest

None.

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Bibliography

1. Geneva: World Health Organization. ICCIDD, UNICEF, WHO. "Assessment of iodine deficiency disorders and monitoring their elimination: a guide for programme managers" (2007).

2. WHO, UNICEF & International Council for the Control of Iodine Deficiency Disorders. Global Prevalence of Iodine Deficiency Disorders, WHO, Geneva (1993).

3. Dong Liangbo., *et al*. "Review of the possible association between thyroid and breast carcinoma". *World Journal of Surgical Oncology* 16.1 (2018): 130.

4. Kaur G., *et al*. "Past, present, and future of iodine deficiency disorders in India: Need to look outside the blinkers". *Journal of Family Medicine and Primary Care* 6.2 (2017): 182-190.

5. An ICMR Task Force Study. New Delhi: ICMR. Indian Council of Medical Research (ICMR). Epidemiological survey of endemic goitre and endemic cretinism (1989).

6. ICMR Task Force on Inherited Metabolic Disorders. "Normative Data for Thyroid Stimulating Hormone for Screening of Congenital Hypothyroidism". *The Indian Journal of Pediatrics* 85.11 (2018): 941-947.

7. ICMR Task Force on Inherited Metabolic Disorders. "Newborn Screening for Congenital Hypothyroidism and Congenital Adrenal Hyperplasia". *The Indian Journal of Pediatrics* 85.11 (2018): 935-940.

8. Yadav K and Pandav CS. "National Iodine Deficiency Disorders Control Programme: Current status & future strategy". *Indian Journal of Medical Research* 148.5 (2018): 503-510.

9. Pandav CS., *et al*. "A review of tracking progress towards elimination of iodine deficiency disorders in Tamil Nadu, India". *Indian Journal of Public Health* 54.3 (2010): 120-125.

10. Kapil U., *et al*. "Profile of iodine content of salt and urinary iodine excretion levels in selected districts of Tamil Nadu". *Indian Journal of Pediatrics* 71.9 (2004): 785-787.

11. Jacob JJ. "Neonatal Screening for Congenital Hypothyroidism with Focus on Developing an Indian Screening Programme". *European Endocrinology* 12.2 (2016): 99-103.

12. Sanghvi U and Diwakar KK. "Universal screening for congenital hypothyroidism". *Indian Pediatrics* 45 (2008): 331-332.

13. National Family Health Survey (NFHS-3), 2005-06: India. I. Mumbai: IIPS International Institute for Population Sciences (IIPS) and Macro International (2007).

14. Sandell EB and Kolthoff IM. "Micro determination of iodine by a catalytic method". *Microchimica Acta* 1.1 (1937): 9-25.

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