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Review Article

Iodine nutrition and its assessment during pregnancy: a need for concern

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ABSTRACT

Micro nutrient iodine was essential in biosynthesis of thyroid hormones (TH). These hormones play a vital role in the growth and development of human beings at various stages of life. TH are required for normal brain development at embryonic, fetal and at past natal stages. If deficiency of iodine occurs then thyroid hormone production was impaired, if deficiency of TH occurs it can cause irreversible damage of brain which leads to various disorders like metal retarded ness, cretinism and goiter known as iodine deficiency disorders (IDD). When compared to normal adults, pregnant women and school children 5-12 years age are more vulnerable IDD. Due to the physiological variations during pregnancy iodine requirements rose significantly from 150 μg/day in non-pregnant adult women to 250 μg/day. However recent iodine nutrition studies showed adequate iodine status but few countries like Sweden and South Africa showed iodine deficiency. This review gives an over view on iodine nutrition on global front.

Keywords: Iodine nutrition, Pregnant women, Iodine deficiency

INTRODUCTION

Iodine is a requisite micronutrient obtained from food and plays a vital role in the production of TH. The thyroid gland synthesizes TH such as thyroxine (T4) and triiodothyronine (T3), which contains four iodine and three iodine molecules respectively. These hormones are primarily responsible for various functions such as the regulation of metabolism, normal growth of an individual and particularly participate in the optimal brain development in the fetal and postnatal stages. Insufficiency of iodine intake can alter thyroid gland function, resulting in inadequate secretion of thyroid hormone which can lead to hypothyroidism and a set of disorders known as IDD.[1-5] Table 1 represents a list of IDD, which include disorders at all stages of life. Presently iodine deficiency is treated as the main cause of preventable brain damage. In this current scenario, it is estimated that more than 2 billion populations have inadequate iodine nutrition.[5-6]

To prevent iodine deficiency two cardinal ways have been recommended, Universal salt iodization and continuous epidemiological monitoring. Universal salt iodization promoted the iodization of food and salt with iodine. Epidemiological monitoring includes periodical assessment of iodine content in the salt and determination of intake of iodine which can be measured by urinary iodine concentration (UIC), and this is recommended every five years in children between 8-12 years.[7]

Table 1: Iodine deficiency disorders.

Groups	Sign
All ages	Goitre and increased thyroid susceptibility to goitrogens
Fetus	Abortions, still births, congenital abnormalities, perinatal mortality
Neonates	Infant mortality, endemic cretinism (mental retardation and psychomotor irreversible damage)
Childhood and adolescence	Damage in mental function, delayed physical development
Adult	Damage in mental function, toxic nodular goiter, hypothyroidism in moderate and severe deficiency of iodine, increased risk of iodine induced hyperthyroidism

Source: Reference[1]

NORMAL CHANGES IN THYROID FUNCTION IN PREGNANCY

Due to changes in thyroid hormone production and iodine metabolism in pregnancy, pregnant women with insufficient iodine intake are susceptible to iodine deficiency and related disorders. To maintain thyroid homeostasis the feedback mechanisms of the hypothalamic-pituitary-thyroid axis function during pregnancy.[8-9]

During the first-trimester thyroid hormone concentrations increase, this is likely due to the influence of human chorionic gonadotrophin hormone (hCG), which is an analogue of thyroid stimulating hormone (TSH), leading to the rise of thyroid hormone levels via the feedback of the pituitary-thyroid axis as well as the rise in thyroxine-binding globulin (TBG) concentrations due to the elevation of oestrogen levels, transplacental transfer of TH and increased renal clearance.[8]

As hCG reaches a peak level near the end of the first trimester, a decrease of free tri-iodo thyronine (fT3) and free thyroxine (fT4) and an increase in TSH were often observed due to the progression of pregnancy. However, the changes in thyroid metabolism that occur in pregnancy may be complex and dependent on several factors including the wide variation in thyroid function between women prior to pregnancy, the prevalence of thyroid abnormalities and the variations in the iodine intake status between populations.

The changes that occur in the earlier stages of pregnancy lead to a new equilibrium which accounts for the increased hormonal demands throughout pregnancy, likely due to the higher T4 turnover and a possible increase in renal excretion which are sustained until birth. In areas of iodine sufficiency, the maternal thyroid gland should be able to adapt to these changes, however, this may not be the case in areas of iodine deficiency.[8-9]

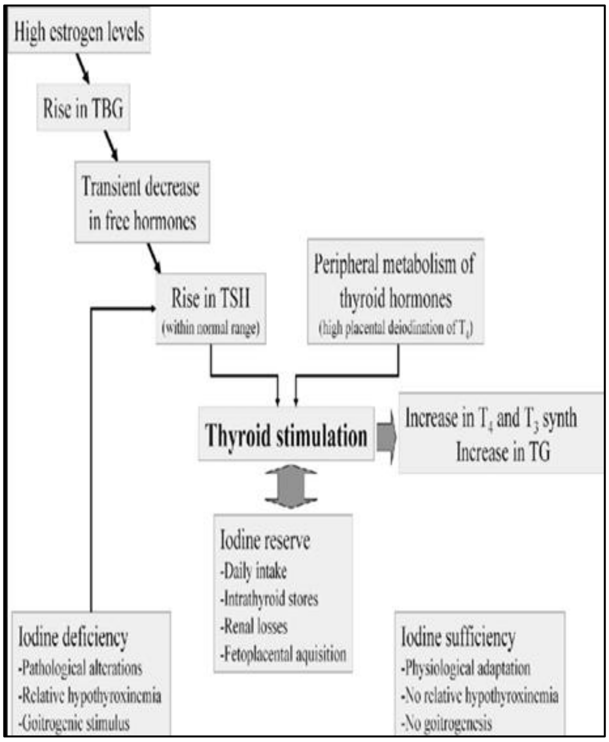

Figure 1: Alteration of thyroid hormones during pregnancy.[10]

TRAN'S PLACENTAL TRANSFER OF THYROID HORMONE

During the first trimester, the foetus dependents on the maternal supply of thyroid hormone, as the foetal thyroid does not develop until 10-12 weeks' gestation and is completed at birth. This dependency decreases during the second half of gestation when the maturation of the foetal hypothalamus-pituitary-thyroid axis results in an increased foetal T4 production. Maternal T4 is thought to be the primary thyroid hormone that is transported across the placenta. In the first trimester, the concentrations of fT4 in the amniotic fluids are less than maternal fT4 concentrations. As pregnancy progresses, cord serum concentration of TH increases and by early in the third trimester the levels of TSH and fT4 in cord serum reach a peak that is higher than maternal levels at the same time, however, cord serum levels of fT3 are thought to remain lower. Because of the complex mechanisms and influences involved in the transplacental transfer of thyroid hormone, a deeper understanding of these processes is required to assist with ensuring normal foetal development in diseased situations.[10]

INCREASED IODINE REQUIREMENTS IN PREGNANCY

The ingested inorganic iodine and iodate (extensively used in salt iodization) are nearly completely absorbed from the gastrointestinal tract. It has been estimated that more than 90% of ingested iodine is ultimately excreted in the urine, being the kidney the main route of excretion; about twenty percentage is excreted in the feces, and five percentages appears in the sweat, saliva and bile. Iodine requirements are increased in pregnancy due to the increased maternal thyroid hormone production, transfer of iodine from the mother to the foetus and greater renal clearance of iodine. In pregnancy, iodine intake should be increased ≥ by fifty percentage, ensuring an adequate level of thyroid hormone in early pregnancy is essential to ensure an ample supply of thyroid hormone to the foetus at this crucial time of early gestation. Due to the Trans placental transfer of thyroid hormone, there was a need for an increase in the synthesis of thyroid hormone which resulted in an increased requirement for micronutrient iodine, which is essential for thyroid hormone synthesis.[8]

Table 2: Recommended dietary allowance (RDA) for iodine.

Micro-nutrient	RDA non pregnant women	RDA pregnant women	Increase in requirement
Iodine	100 µg/d	160 µg/d	60 µg/d

Source: NIN, 2020; RDA: Recommended dietary allowance

ASSESSMENT OF IODINE STATUS

Today several methods are recommended for the assessment of iodine nutrition in populations among those methods the best method was an assessment of median UIC obtained from spot urine samples from a representative sample using Sandell-Kolthoff (S-K) method.[7] Table 3 represents epidemiologic criteria for assessment of iodine nutrition in a population based on the median or range of median urinary iodine concentration. The median urinary iodine concentration of school children between the eight to twelve years of age is mainly the indicator of the iodine nutrition in the general population.

Table 3: Epidemiologic criteria for assessment of iodine nutrition in a population based on median or range of median UICs.

Median UIC (µg/l)	Iodine intake
School-aged children	
<20	Insufficient
20-49	Insufficient
50-99	Insufficient
100-299	Adequate
>300	Excessive
Pregnant women	
<150	Insufficient
150–249	Adequate
250–499	More than adequate
≥500	Excessive
Lactating women	
<100	Insufficient
≥100	Adequate
Children less than 2 years of age	
<100	Insufficient
≥100	Adequate

Source: Reference[7]

IODINE NUTRITION ASSESSMENT STUDIES GLOBALLY DURING PREGNANCY

Globally iodine status related studies are been conducted widely to assess iodine nutrition in most susceptible population i.e., pregnant women. Studies conducted at South Africa, Sweden, Ghana and India (North India) showed that iodine deficiency was still prevailing, in spite of universal salt iodination program, awareness programs about IDD during pregnancy. On other hand studies conducted at Taiwan and Egypt showed that iodine suffiency. Few studies also showed more than adequate iodine status, which need to be focused. As iodine deficiency is harmful equally iodine excess is also harmful, which can occur autoimmunity and goiter.

Table 4: Studies on iodine nutrition in pregnant women globally.

Country or location	Year	Number of subjects	trimester	M UIC (µg/l)	Iodine status
Mexico[11]	2011	First n=60, second n=103, third n=131	All three trimesters	273, 285, and 231 in the first, second, and third trimesters of gestation	More than adequate
Taiwan[12]	2013	257	First trimester	225.3 (109.1-514.2)	Adequate
North India[13]	2013	50	All three trimesters	1st trimester 285 (102-457), 2nd trimester 318 (102-805), 3rd trimester 304 (172-859)	Adequate
Sweden[14]	2015	459	Third trimester	98 (57-148)	Inadequate
Egypt[15]	2016	400	Third trimester	231	Adequate
Ballabgarh, Haryana[16]	2017	1031	All three trimesters	260 (199, 323)	Adequate
Tamil Nadu[17]	2018	100	Third trimester	290.17±91.71	More than adequate
Ghana[18]	2018	125	All three trimesters	<150	Inadequate

Continued.

Country or location	Year	Number of subjects	trimester	M UIC (µg/l)	Iodine status
Lucknow[19]	2020	300	All three trimesters	246.5 (194.9-383.4)	Inadequate
Sweden[20]	2020	737	Second trimester	101 (95, 108)	Inadequate
Asturias[21]	2021	318	First trimester	171.5 (116-265)	Adequate
South Africa[22]	2022	312, first (n=99), second (n=262), third (n=174)	All three trimesters	133 (81-316), 145 (84-236), 156 (89-245)	Inadequate (border line)

CONCLUSION

Micro nutrient iodine daily requirement has been increased during pregnancy due to physiological alterations, hence this increased requirement must be full filled by dietary intake of iodine rich substances, most commonly available product was iodized salt, hence the universal salt iodination program was initiated by WHO worldwide. If the increased requirement was not given emphasis it may lead to disorders known as IDD which include goitre, decreased IQ and cretinism. These disorders are preventable by proper intake of iodine during pregnancy and after pregnancy. Urinary iodine determination (UIC) in pregnant women should be made mandatory to know the iodine status. More awareness programs regarding IDD and utilization of iodized salt are required.

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