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Iodine Requirement during Pregnancy

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ABSTRACT

Thyroid hormones, manage different aspects of body metabolism. Iodine is an essential micronutrient for thyroid hormones synthesis. Humans depend on exogenous sources of iodine to maintain the normal concentration of thyroid hormones. Pregnancy changes iodine turnover and is associated with significant alterations in thyroid function. During pregnancy daily iodine requirement is 250µg, compared with 150µg for non-pregnant women. Many scientific organizations, recently have advised that all pregnant and breast feeding women should take 150µg of iodine supplementation, not only in iodine-deficient regions but also in iodine-sufficient areas. However, recent studies have confirmed that iodine supplementation of mildly iodine-deficient pregnant women has no clear benefits on maternal thyroid function or child neurodevelopment.

INTRODUCTION

Iodine is used by the thyroid gland to produce thyroid hormones. For women, thyroid hormones is necessary for optimal function of the reproductive system and for normal fetal growth and development [1]. There is consistent evidence that severe iodine deficiency during pregnancy and lactation (Urinary Iodine Concentration (UIC) < 50 µg/L) is associated with impaired neurocognitive development of the fetus and neonate [2]. However, it is still uncertain whether mild-to-moderate maternal iodine deficiency (UIC between 50-150 µg/L) may have a long term negative impact on child neurodevelopment. Observational studies indicate that correction of mild-to-moderate iodine deficiency in pregnancy has substantial health, especially on children neuro cognitive development and economic benefits, but it lacks of an argumentation in this regard.

IODINE TURNOVER

Humans depend on exogenous sources of iodine [3,4]. In conditions of iodine sufficiency, the thyroid gland takes up less than 10% of absorbed iodine, whereas in chronic iodine deficiency, this fraction exceeds 80% [5,6]. In lactating women, iodine is concentrated in the mammary gland and is secreted into breast milk to provide iodine for the newborn [7,8]. Approximately 90% of absorbed iodine is finally excreted by the kidney, which is why urinary iodine concentration (expressed in µg/L) correlates well with the level of recent iodine intake [9]. Based on the recommendation of the World Health Organization (WHO) and the Iodine Global Network (IGN), the median Urinary Iodine Concentration (UIC) in schoolchildren is the main indicator of iodine nutrition of a community. A UIC of between 100 and 199µg/L in school-aged children and adults and between 150 and 249µg/L in pregnant women is considered adequate [10].

IODINE REQUIREMENTS DURING PREGNANCY AND LACTATION

Many studies have established the benefits of iodine supple-mentation during pregnancy in areas of severe iodine deficiency [11-13]. In a meta-analysis of five studies by Taylor et al, it was shown that when iodine supplementation was introduced as early as at 4 weeks' gestation, it was associated with markedly increased IQ in children [14]. Iodine requirements of women during pregnancy and lactation are increased to provide adequate iodine for the fetus and neonate (Table 1). Salt iodization is one of the preferred strategies to eradicate iodine-deficiency disorders worldwide.

Table 1: Iodine requirement in pregnancy and lactation (µg/day).

DURING PREGNANCY	
Basal	150
40 – 50% increased T4 requirements	50 - 100
Transfer of T4 and iodine from mother to fetus	50
Increased renal clearance of iodine	?
TOTAL	**250 -300**
DURING LACTATION	
Basal	150
0.5 – 1.1 L milk/day ×150 – 180 µg iodine /L	75 -200
TOTAL	**225 - 350**

It is generally assumed that the iodine requirements of all population groups are covered in settings where Universal Salt Iodization (USI) has been implemented for more than 2 years and the median UIC in school-age children (6-12 years) is ≥100µg/L [10]. However, studies assessing UIC in school-age children in parallel with that in pregnant women deliver mixed results. Some studies report adequate iodine intake in all population groups [15,16], whereas others report iodine sufficiency in school-age children, but iodine deficiency in pregnant and lactating women [17-19]. A recent national survey on iodine status in Iran by Hossein Delshad et al. revealed that while school-age children were iodine-sufficient, pregnant women were moderately iodine-deficient [20]. A Norwegian study has also produced similar results [21]. In China, the median iodine excretion in pregnancy was 50µg/L lower than in non-pregnant women, despite adequate iodine intake in the general population [22]. It has also been reported that even in the USA, where pregnant women have an adequate median UIC (173µg/L), the lower 95% confidential interval found UIC to be below 150µg/L [23]. Furthermore, a report from the Boston area showed that approximately half of pregnant women had UICs below 150µg/L and 9% had values below 50µg/L [24]. In a meta-analysis by Nazeri et al., it was shown that the median UIC of lactating mothers of most countries with voluntary programs of USI, and also in countries with mandatory iodine fortification are still within the iodine deficiency range [25]. In addition, studies from the northeast of England [26] and from Australia [27], in which the populations are assumed to be iodine-replete, demonstrated insufficient UIC in about 50% of pregnant women. In contrast, a recent cross-sectional multicenter study revealed that USI provides sufficient dietary iodine to achieve adequate iodine nutrition during the first 1000 days [16]. In this inter-national, multicenter study in three countries (China, Philippines, and Croatia) with mandatory USI legislation, six population groups (5860 participants) were assessed for UIC and thyroid function. The salt iodine concentration of house-holds was adequate (15-40 mg/kg) in these areas. The median UIC showed adequate iodine nutrition in all population groups, except for excessive iodine intake in school-age children in the Philippines and borderline low intake in pregnant women in Croatia. Taken together, these findings suggest that USI programs may not be adequate for individual pregnant women, especially in countries in which UIC programs have been recently introduced or in conditions with unstable dietary iodine intake. To meet the daily iodine requirements, the WHO, UNICEF, ING [28], and the American Institute of Medicine [29] have provided daily iodine intake recommendations for the different age groups (Table 2). WHO recommends that adults consume less than 5 grams (just under a teaspoon) of salt per day. For children the recommended maximum intake of salt for adults be adjusted downward for children aged 2 to 15 years based on their energy requirements relative to those of adults. Excessive iodine intake can also be harmful because it inhibits thyroid hormone synthesis and its release into the circulation (the Wolff-Chaikoff effect) [30]. Excessive consumption of iodized salt should be avoided. It is difficult to determine the threshold upper limit of iodine intake because the amount of iodine intake before exposure to iodine excess has detrimental effects. The WHO considers iodine intake > 500μg/day to be excessive [31], while the US Institute of Medicine and the European Food Safety Agency recommend this level at 600μg/day and 1100μg/day, respectively [29,32]. The optimal and safe upper limits of iodine intake for different age groups are depicted in table 3.

Table 2: Recommended daily iodine intakes (μg) for different age groups (65,66).

Age and population group	WHO/UNICEF/IGN	US Institute of medicine
0-5 years	99	-
6-12 years	120	-
>12 years	150	-
0-12 months	-	110-130
1-8 years	-	90
9-13 years	-	120
>14 years	-	120
Pregnant women	250	220
Lactating women	250	290

Table 3: Optimal and safe upper limits of iodine intake for different age groups recommended by WHO.

Life stage	Upper limits
Children 4-8 years	300 μg
Children 9-14 years	600 μg
Teens 14-18 years	900 μg
Adult	1100μg

CONCLUSION

Adults need 150μg iodine per day, ranging from 90 to 290μg per day, based on the individual's age and physiological status. Many physiological changes are responsible for the increased iodine requirements during pregnancy. In iodine-sufficient areas, pregnant women increase their thyroid iodine uptake to regulate the level of thyroid hormones. However, recently, iodine intake during pregnancy has been reported to be insufficient, even in areas that have been iodine sufficient for several decades. Dietary modifications are necessary when a woman becomes pregnant, such as increasing the intake of iodine, which helps to ensure optimum fertility, conception, and pregnancy. Adequate intake of iodine in this period is associated with proper functioning of the thyroid gland. Intra thyroidal iodine stores in women should be adequate. The main method of iodine prophylaxis, in pregnancy also, is USI, but they may not always adequately fulfill the increase in iodine demand during pregnancy and breastfeeding. However, particularly if there is not sufficient coverage of households with iodized salt, additional measures, such as oral supplementation with potassium iodide tablets, are necessary in pregnant women to provide adequate iodine nutrition. Prevention of fetal iodine deficiency is feasible, provided that an iodine supply of 200-300μg/day even in iodine-sufficient areas to the mother is ensured before and throughout gestation as well as during the lactating period.

REFERENCES

1. Zimmermann MB. (2012). The effects of iodine deficiency in pregnancy and infancy. Paediatr Perinat Epidemiol. 26: 108-117.
2. Zimmermann MB, Gizak M, Abbott K, Maria Andersson, John H Lazarus. (2015). Iodine deficiency in pregnant women in Europe. Lancet Diabetes Endocrinol. 3: 672–674.
3. Clar C, Wu T, Liu G, Li P. (2002). Iodized salt for iodine deficiency disorders. A systematic review. Endocrinol Metab Clin N Am. 31: 681-698.
4. Vought R, London W. (1967). Iodine intake, excretion and thyroidal accumulation in healthy subjects. J Clin Endocrinol Metab. 27: 913-919.
5. Zimmermann MB, Jooste PL, Pandav CS. (2008). Iodine-deficiency disorders. Lancet. 372: 1251-1262.
6. Fisher DA, Oddie TH. (1969). Thyroid iodine content and turnover in euthyroid subjects: validity of estimation of thyroid iodine accumulation from short-term clearance studies. J Clin Endocrinol Metab 29: 721-727.
7. Azizi F, Smyth P. (2009). Breastfeeding and maternal and infant iodine nutrition. Clin Endocrinol. 70: 803-809.
8. Bruhn JC, Franke AA. (1983). Iodine in human milk. J Dairy. Sci 66: 1396-1398.
9. Cavalieri RR. (1997). Iodine metabolism and thyroid physiology: current concepts. Thyroid. 7: 177-181.
10. (2007). World Health Organization. United Nations Children's Fund &International Council for the Control of Iodine Deficiency Disorders. Assessment of iodine deficiency disorders and monitoring their elimination. 3rd ed. WHO, Geneva.
11. Zimmermann MB. (2008). Iodine deficiency in pregnancy and the effects of maternal iodine supplementation on the offspring: a review. Am J Clin Nutr. 89: 668S-672S.

12. Liesenkötter KP, Göpel W, Bogner U, Gruters A. (1996). Earliest prevention of endemic goiter by iodine supplementation during pregnancy. Eur J Endocrinol. 134: 443-448.
13. Pedersen K, Laurberg P, Iversen E, Knudsen PR, Gregersen HE, et al. (1993). Amelioration of some pregnancy-associated variations in thyroid function by iodine supplementation. J Clin Endocrinol Metab. 77: 1078-1083.
14. Taylor PN, Okosieme OE, Dayan CM, John H Lazarus. (2014). Therapy ofendocrine disease: impact of iodine supplementation in mild-to-moderate iodine deficiency: systematic review and meta-analysis. Eur J Endocrinol. 170: R1-R15.
15. Pastorelli AA, Stacchini P, Olivieri A. (2015). Daily iodine intake and the impact of salt reduction on iodine prophylaxis in the Italian population. Eur J Clin Nutr. 69: 211-215.
16. Dold S, Zimmermann MB, Jukic T, Zvonko Kusic, Qingzhen Jia, et al. (2018). Universal salt iodization provides sufficient dietary iodine to achieve adequate iodine nutrition during the first 1000 days: a cross-sectional multi-center study. J Nutr. 148: 587-598.
17. Gowachirapant S, Winichagoon P, Wyss L, Bennan Tong, Jeannine Baumgartner, et al. (2009). Urinary iodine concentrations indicate iodine deficiency in pregnant Thai women but iodine sufficiency in their school-aged children. J Nutr. 139: 1169-1172.
18. Wong EM, Sullivan KM, Perrine CG, Lisa M Rogers, Juan Pablo Peña-Rosas. (2011). Comparison of median urinary iodine concentration as an indicator of iodine status among pregnant women, school-age children, and non-pregnant women. Food Nutr Bull. 32: 206-212.
19. Vandevijvere S, Mourri AB, Amsalkhir S, Freddy Avni, Herman Van Oyen, et al. (2012). Fortification of bread with iodized salt corrected iodine deficiency in school-aged children, but not in their mothers: a national cross-sectional survey in Belgium. Thyroid. 22: 1046-1053.
20. Delshad H, Touhidi M, Abdollahi Z, Hedayati M, Salehi F, et al. (2016). Inadequate iodine nutrition of pregnant women in an area of iodine sufficiency. J Endocrinol Investig. 39: 755-762.
21. Dahl L, Wik Markhus M, Sanchez PVR, Vibeke Moe, Lars Smith, et al. (2018). Iodine deficiency in a study population of Norwegian pregnant women—results from the little in Norway Study (LiN). Nutrients. 10: 513.
22. Yan YQ, Chen Z-P, Yang XM, Liu H, Zhang JX, et al. (2005). Attention to the hiding iodine deficiency in pregnant and lactating women after universal salt iodization: a multi-community study in China. J Endocrinol Investig. 28: 547-553.
23. Caldwell KL, Makhmudov A, Ely E, Robert L Jones, Richard Y Wang. (2011). Iodine status of the US population, National Health and Nutrition Examination Survey, 2005-2006 and 2007-2008.Thyroid. 21: 419-427.
24. Pearce EN, Bazrafshan HR, He X, Sam Pino, Lewis E Braverman. (2004). Dietary iodine in pregnant women from the Boston, Massachusetts area. Thyroid. 14: 327-328.
25. Nazeri P, Mirmiran P, Shiva N, Yadollah Mehrabi, Mehdi Mojarrad, et al. (2015). Iodine nutrition status in lactating mothers residing in countries with mandatory and voluntary iodine fortification programs: an updated systematic review. Thyroid. 25: 611-620.
26. Bath SC, Rayman MP. (2015). A review of the iodine status of UK pregnant women and its implications for the offspring. Environ Geochem Health. 37: 619-629.
27. Condo D, Huyhn D, Anderson AJ, Sheila Skeaff, Philip Ryan, et al. (2017). Iodine status of pregnant women in South Australia after mandatory iodine fortification of bread and the recommendation for iodine supplementation. Mater Child Nutr. 13: e12410.
28. World Health Organisation. United Nations Children's Fund. International Council for the Control of Iodine Deficiency Disorders. (2007) Assessment of iodine deficiency disorders and monitoring their elimination. A guide for programme managers. World Health Organization; Geneva, Switzerland.
29. Institute of Medicine, Food and Nutrition Board. (2001). Dietary reference intakes for vitamin A, vitamin K, arsenic ,boron, chromium, copper, iodine, iron, manganese, molybdenum, nickel, silicon, vanadium, and zinc. Washington, DC: National Academy Press.

30. Markou K, Georgopoulos N, Kyriazopoulou V, Vagenakis AG. (2001). Iodine-induced hypothyroidism. Thyroid. 11: 501-510.

31. Secretariat W, Andersson M, De Benoist B, Delange F, Zupan J. (2007). Prevention and control of iodine deficiency in pregnant and lactating women and in children less than 2-years-old: conclusions and recommendations of the technical consultation. Public Health Nutr. 10: 1606-1611.

32. (2014). Scientific Opinion on Dietary Reference Values for iodine. EFSA Panel on Dietetic Products, Nutrition and Allergies (NDA) European Food Safety Authority (EFSA), Parma, Italy EF.