Original Article

Maternal iodine dietary supplements and neonatal thyroid stimulating hormone in Gippsland, Australia

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Background and Objectives: Pregnant women are at particular risk of iodine deficiency due to their higher iodine requirements. Iodine is known to be essential for normal growth and brain development, therefore neonatal outcomes in mildly iodine deficient areas, such as Gippsland, are a critical consideration. This study aimed to investigate whether iodine supplementation prevented iodine insufficiency as determined by neonatal thyroid stimulating hormone (TSH) screening criteria. **Methods and Study Design:** Gippsland-based women aged ≥18 years, in their third trimester of pregnancy, provided self-reported information regarding their iodine supplement use and consent to access their offspring's neonatal TSH screening data. 126 women consented to participate, with 111 women completing all components of this study. **Results:** Only 18.9% of participants followed the National Health and Medical Research Council (NHMRC) recommendation of 150 μg/day iodine supplement, with 42.3% of participants not taking any supplements, or taking supplements with no iodine or insufficient iodine. The remaining women (38.7%) were taking supplements with doses of iodine much higher (200-300 μg) than the NHMRC recommended dose or were taking multiple supplements containing iodine. When correlating iodine intake to their neonates' TSH, no correlation was found. When iodine supplementation usage was categorised as below, equal to, or above NHMRC recommendations there was no significant difference in neonatal TSH. **Conclusion:** This study found that iodine supplementation appeared to prevent maternal iodine insufficiency when measured against neonatal TSH screening criteria.

Key Words: nutritional supplements, pregnancy, iodine, neonatal screening, thyroid stimulating hormone

INTRODUCTION

Iodine is required to produce thyroid hormones, essential for normal growth and brain development, starting early in embryonic life.[1] The effects of iodine deficiency can occur throughout life, however, although controversial there is some indications that even mild maternal iodine deficiency during pregnancy may diminish intelligence and cognitive development in the offspring.[2-7] Recent studies looking at the relationship between maternal hypothyroxinaemia (which can be equivalent to low iodine intake) during pregnancy and outcome 6 years post-birth, found a significant relationship between iodine deficiency during pregnancy and increased autism risk.[8-9] These effects are permanent and irreversible, however may be preventable with adequate iodine during pregnancy.[2-4] Pregnant women are at particular risk of iodine deficiency due to their higher iodine requirements,[10-15] and an increased maternal renal filtration rate concurrently increases iodine clearance by the mother, especially in the third trimester.[16]

The World Health Organization (WHO) has previously classified Australia as a country with mild iodine deficiency[17] based on studies, showing mild to moderate iodine deficiency in the most populated South Eastern states.[18-19] The Gippsland region of Victoria is a known iodine deficient area.[20-21] Research by Rahman et al. indicated that the Gippsland region is one of the most environmentally iodine deficient areas in the world.[22] Both Gippsland neonatal Thyroid Stimulating Hormone (TSH) values[23] and Urinary iodine status[15] among pregnant Gippsland women have been indicative of inadequate iodine nutrition. Food intake patterns among pregnant women from the Gippsland region have also indicated inadequate dietary iodine intake.[15,24]

Food Standards Australia and New Zealand (FSANZ) responded to Australia's iodine deficiency by introducing mandatory iodine fortification in bread in 2009.[25] In 2010, the National Health and Medical Research Council (NHMRC) also released a public statement recommending that all pregnant and breastfeeding women take a daily iodine supplement of 150 μg to achieve the recom-

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mended dietary intake (RDI) of 220 and 270 μg of iodine, respectively.[26-27]

The aim of this research project was to investigate self-reported iodine supplement usage of pregnant women in Gippsland and compare this to their neonate's corresponding TSH, to investigate whether iodine supplement use corresponded to prevention of iodine insufficiency in the neonate using neonatal TSH screening criteria.

PARTICIPANTS AND METHODS

This cross-sectional study included pregnant women from all birthing hospitals across Gippsland, Victoria, Australia recruited between August 2011 and May 2012. The women were recruited through the hospital where they planned to give birth, via antenatal clinics and antenatal education classes. To be eligible for the study, participants must have resided in Gippsland, be 18 years of age or older and be in their third trimester of pregnancy (≥28 weeks gestation). Multiparous women were excluded from the study. The researchers collected information regarding their multivitamins, vitamins, minerals, herbs or food supplements intake during their pregnancy. Women who reported taking a supplement were asked to identify the supplement/s (from a detailed list of commonly used supplements) and to indicate the dosage and frequency of use. Women were also able to record the names of any supplements not on the list. Contact details and written consent to access their child's neonatal screening data (heel-prick) for TSH values was obtained. Supplement use and infant's birth details were then verified with the women via a phone call after the birth of their baby. Their infant's birth details were matched to the neonatal screening database to determine their neonatal TSH. Any neonatal screening tests which indicated congenital hypothyroidism were excluded from this study, therefore neonates with TSH values >15 mIU/L were excluded. The first measurement was used only in situations that required measures to be repeated. Any neonatal screening tests undertaken in the first 48 hours would be excluded due to the fluctuations and variability in TSH over the first 2 days.

Approval to conduct the study was granted by the Monash University Human Research Ethics University Human Research Ethics Committee (CF11/1239 - 2011000686), Latrobe Regional Hospital Ethics Committee (2011-05), West Gippsland Healthcare Group Ethics Committee (Health Knowledge and Iodine intake during pregnancy) and the Victorian Royal Children's Hospital Ethics Committee (HREC 32061). Participation in the research was voluntary and all women provided written consent to collect their data and that of their child.

All data were analysed using SPSS statistical package (v.20; IBM Corp., Armonk, NY, USA). Data were analysed using Pearson product moment correlation coefficient and One-way ANOVA. $p \leq 0.05$ was taken as statistically significant.

RESULTS

There were 126 women who consented to participate in this study. A total of 111 women completed all components of this study and TSH levels were able to be matched from the Victorian Clinical Genetic Services Neonatal Screening database. The 15 other women, either were unable to be contacted by phone to confirm their details or the details provided were unable to be matched to an infant in the database. Any neonatal screening tests indicative of congenital hypothyroidism (TSH values >15 mIU/L) would have been excluded, although none were present in this cohort. Equally, early neonatal screening tests would have been excluded, however all tests were performed between 48-96 hours after birth (average 2.41±0.49 days).

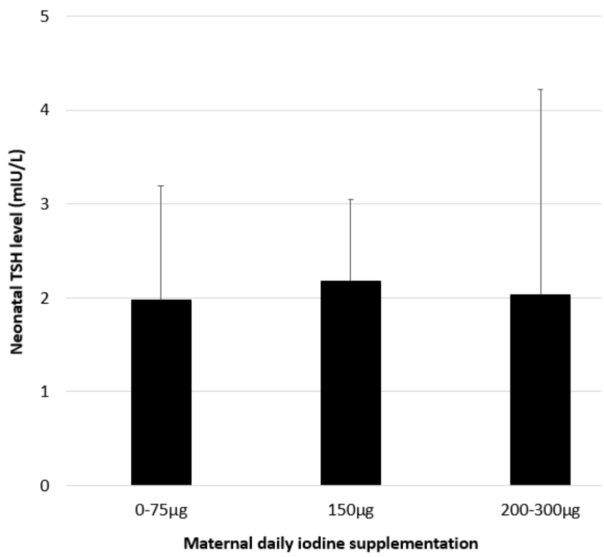

Figure 1. The average neonatal TSH (mean±SD) separated into maternal daily iodine supplementation (as suboptimum (0-75 μg); optimum (150 μg); and above optimum (200-300 μg) based on the NHMRC recommendations for pregnant women.

Based on the NHMRC recommended daily iodine supplementation (150μg iodine supplementation), the neonatal TSH levels were categorised according to whether their mother's iodine supplementation was absent (0 μg) or below (75 μg) the NHMRC recommended daily dose, equal to the NHMRC recommended daily dose (150 μg); or above the NHMRC recommended daily dose (200 μg, 250 μg or 300 μg) (Figure 1). Neonatal TSH levels were also correlated against the exact self-reported daily iodine supplementation of the mother (Figure 2a). In both instances, statistical analysis showed no significant difference between categories.

Of particular importance, is the frequency of neonatal TSH values >5.0 mIU/L, since population percentages of 3% or more[28] are considered indicative of maternal iodine deficiency. Two infants from mothers who were not taking an iodine supplement and one infant from a mother who was taking a 250 μg daily iodine supplement had TSH >5.0 mIU/L (Figure 2b).

DISCUSSION

The NHMRC recommends all pregnant and breastfeeding women take a daily supplement containing 150 μg of iodine.[26-27] This study found most women were not following this recommendation, however their babies had TSH levels within the normal range.

An inadequate iodine supplementation of pregnant and

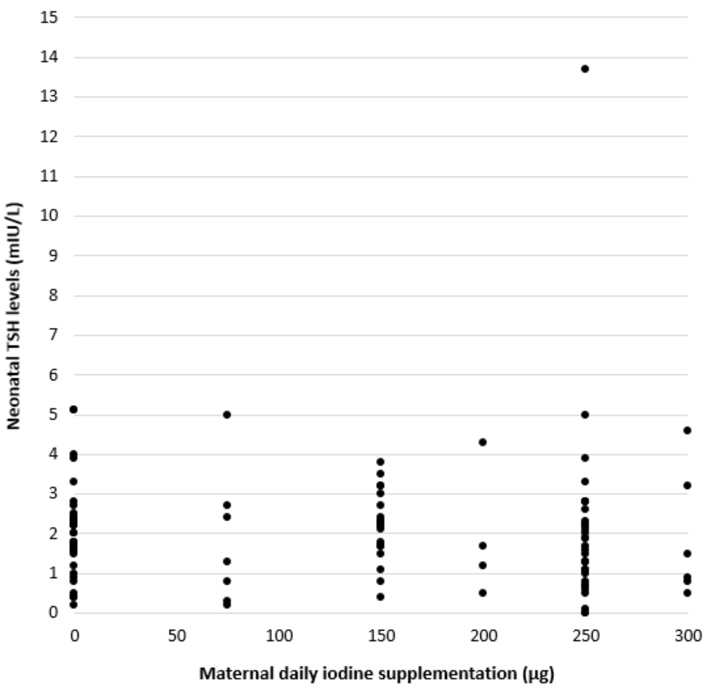

Figure 2a. Individual neonatal TSH scores by maternal daily iodine supplementation.

Maternal daily iodine supplementation (µg)	Neonatal TSH (mIU/L) (mean±SD)	Neonatal TSH (mIU/L) range
0 (n=40)	2.01±1.12	0.2-5.1
75 (n=7)	1.81±1.71	0.2-5.0
150 (n=21)	2.18±0.87	0.4-3.8
200 (n=4)	1.93±1.66	0.5-4.3
250 (n=33)	2.06±2.37	0.0-13.7
300 (n=6)	1.92±1.63	0.5-4.6

Figure 2b. Individual neonatal TSH scores by maternal daily iodine supplementation.

breastfeeding women has also been found in other Australian studies.[13-15,24,29-32] Prior to the NHMRC iodine supplementation recommendations, two separate studies demonstrated the inadequacy of maternal iodine status among women living in Gippsland.[15,23] Rahman et al. (2010) analysed data from 2001 to 2006 that was extracted from the Victorian Neonatal Screening database.[23] These analyses showed that the mean percentage of TSH concentrations above 5mIU/L exceeded the WHO, UNICEF and ICCIDD criteria of 3%, which is indicative of iodine insufficiency.[23] Furthermore, these percentages worsened over this time period and in 2006 accounted for around 8.0% of neonates born to women residing in Gippsland and 9.6% of the overall Victorian neonatal population.[23] The cohort of Gippsland pregnant women surveyed by Rahman et al (2011) measured the urinary iodine concentrations (UICs) of a cohort of pregnant women that straddled the national bread iodine fortification program.[15] Bread iodine fortification had no discernible effect on median UICs and only 28% of women were deemed iodine sufficient (UICs >150 g/L).[15] There were however, significant differences in the median UICs of participants who reported taking dietary supplements containing iodine compared to those that were not, namely UICs of 121.5 g/L and 64.5 g/L respectively.[15] They showed many of those women were iodine deficient, however Rahman et al (2011) did not look at the effect on the neonate.[15] Although our neonatal TSH values were not indicative of inadequate iodine nutrition, as previously described.[15,23] It would appear that the introduction of mandatory iodine fortification in bread[25] along with 57.7% of pregnant women taking iodine supplementation equal to or above the National Health and Medical Research Council (NHMRC) recommendations[26-27] have combined to curb iodine insufficiency in neonates, with only 2.7% of this population showing TSH concentrations greater than 5 mIU/L.

The results showed most women not taking an iodine supplement had babies who did not demonstrate iodine insufficiency according to neonatal TSH screening criteria. Similar to recent international studies, maternal iodine intake did not seem to influence the neonatal TSH concentrations.[33-34] However, it cannot be assumed these women were iodine sufficient. The amount of iodine required varies among individuals and so iodine intakes that fall below the recommended daily intake does not necessarily reflect a deficiency, since these recommendations are designed to cover the needs of approximately 98% of all healthy populations.

It would be important to more closely study the iodine supplementation and diet of the pregnant women, and correlate these measures to both the mother and the neonate's urinary iodine concentrations and their thyroid health. Also for ethical reasons, all study participants were provided with information about the importance of iodine in pregnancy and so some women who had previously reported not taking iodine supplements prior to the survey may have commenced iodine supplementation after receiving this information. While most women were followed up after the delivery of their baby to ascertain any changes in their supplementation habits, this data was not able to be fully obtained for 22 of women. The possibility that some of these women may have commenced iodine supplementation (without our knowledge) may have potentially confounded the results, although, the percentage of elevated neonatal TSH concentrations from this non-supplemented group were similar to Rahman's neonatal TSH study.[23]

The focus of this study was to gauge the effectiveness of the NHMRC recommendations regarding iodine supplementation for the susceptible at-risk neonates. This study did not measure iodine intake from food sources, so we cannot estimate the quantity of iodine from dietary sources. However, it has already been shown that most pregnant women in this area are unlikely to receive adequate iodine from food sources alone,[15,24] as good sources of iodine are essentially limited to commercial bread, marine foods, dairy foods and iodised salt. Previous findings indicated that the vast majority of women reported eating insufficient (average of 2.5 slices) iodised bread, and were not regular consumers of fish or iodised salt.[24] Most pregnant women avoided many common varieties of fish due to fear of potential listeriosis and high mercury-levels.[24] Given more than 40% of pregnant women in this study did not take sufficient iodine supplementation (based on the NHMRC guidelines), this suggests these national supplementation recommendations are not being enacted to ensuring all pregnant women are iodine sufficient.

Our results show that only three neonates (2.7%) had a TSH >5.0 mIU/L, which suggests overall this population is iodine sufficient based on WHO guidelines.[28] Therefore addressing maternal iodine deficiency through iodine supplementation appears to have been effective in this study population. However, when focusing solely on neonates from the group of mother's not taking iodine supplements, the percentage of elevated TSH concentrations >5.0 mIU/L represented 5% of this population. On a population-level, 5% of neonates with a TSH >5.0 mIU/L is indicative of mild iodine deficiency,[28] which again reiterates the need for proper iodine nutrition and the continuation of the recommendation to take iodine supplements during pregnancy. Therefore, it is important for health professionals to reinforce the NHMRC recommendations regarding iodine supplementation. Further studies are required to monitor the iodine status of pregnant women and the barriers to taking supplements. In understanding the barriers better, it may be important to consider providing iodine-containing supplements free of charge or broadening the food fortification program to effectively address the sizable proportion of women who, despite the NHMRC recommendations, failed to take iodine supplements. This would help to ensure all newborns are given the best chance of optimum brain development.

Conclusion

This study found that iodine supplementation appeared to prevent maternal iodine insufficiency when measured against neonatal TSH screening criteria.

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AUTHOR DISCLOSURES

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