A case for universal salt iodisation to correct iodine deficiency in pregnancy: another salutary lesson from Tasmania

John R Burgess, Judy A Seal, Georgina M Stilwell, Peter J Reynolds, E Roscoe Taylor and Venkat Parameswaran

ABSTRACT

Objective: To assess the impact of iodine fortification of bread on the iodine status of pregnant women, and to determine if studies of iodine levels in school-age children were indicative of women's gestational iodine status.

Design: Urinary iodine surveys of pregnant Tasmanian women before and after bread was fortified with iodine in October 2001.

Participants and setting: 285 women attending the Royal Hobart Hospital (RHH) antenatal clinic from 1 October 2000 to 30 September 2001 and 517 women attending the RHH antenatal clinic or primary health care centres in 2003–2006.

Main outcome measures: Median urinary iodine concentration (UIC) for comparison against the World Health Organization recommendation of of 150–249 μg/L for pregnant women.

Results: Before supplementation, the median UIC of the 285 women attending the RHH antenatal clinic was 76 μg/L. After supplementation, median UICs were 81 μg/L for 288 women attending primary health care centres and 86 μg/L for 229 women attending the RHH antenatal clinic. Differences in mean UIC were not significant for either the antenatal clinic group ($P = 0.237$) or the primary health care group ($P = 0.809$) compared with the pre-supplementation group.

Conclusions: Iodine deficiency in pregnancy persists despite being corrected in Tasmanian children. Successful iodine supplementation must target reproductive-age and pregnant women and be substantiated by ongoing monitoring during pregnancy and lactation. A robust national program for correcting iodine deficiency is urgently needed. Mandatory universal salt iodisation has international endorsement, and should be considered the preferred strategy for eliminating iodine deficiency in Australia.

MJA 2007; 186: 574–576

Adequate iodine nutrition in a population is conventionally assessed by measuring median urinary iodine concentration (UIC) in a representative sample of primary school children.[1] The World Health Organization International Council for Control of Iodine Deficiency Disorders recommends a median UIC of at least 100 μg/L, with fewer than 20% of individuals returning a UIC below 50 μg/L as indicative of adequate population iodine nutrition.[1] In pregnant women, dietary iodine requirements are about 70 μg per day higher than those of the non-pregnant population, equating to a UIC of 150–249 μg/L.[1-3]

Mild degrees of iodine deficiency during pregnancy have been linked to maternal goitre and reduced intellectual function in children.[2,4] A number of recent reports have highlighted the broad extent of iodine deficiency in Australia and, more specifically, in pregnant women.[5-8] The National Iodine Nutrition Study confirmed that iodine deficiency was endemic in Victoria and New South Wales, and borderline in South Australia.[5]

Additional studies from Victoria and NSW have all shown iodine deficiency in pregnant populations.[6-8] A 1999 report identified iodine deficiency in women attending antenatal clinics at a Sydney teaching hospital, with a median UIC of 52 μg/L and 48.4% of women having values less than 50 μg/L.[6] A subsequent Victorian study in 2005 had comparable results, with a median UIC of 52–61 μg/L and a UIC of less than 50 μg/L in 38%–48% of pregnant women from various ethnic subgroups in Melbourne.[7] In 2006, ongoing gestational iodine deficiency was confirmed in a NSW central coast population, with only 12% of women achieving the minimum target iodine concentration for pregnancy of 150 μg/L.[2,8]

The Tasmanian Government began an iodine supplementation program in October 2001.[9-13] As a consequence, about 80% of bread baked and sold in Tasmania was made with salt containing iodine at a concentration of 45 parts per million, in place of regular salt.[12] The program was supported by a memorandum of understanding between bakers and the Department of Health and Human Services.[12,13] This protocol was adopted as an interim measure until iodine supplementation could be undertaken as a national strategy.

To determine the efficacy of the interim supplementation program for pregnant women, and the relevance of school-age iodine monitoring studies for iodine nutrition in pregnancy, we evaluated the extent of gestational iodine deficiency before and after the addition of iodised salt to bread.

METHODS

The study involved an opportunistic sample of pregnant Tasmanian women recruited from (i) Royal Hobart Hospital antenatal clinic and (ii) first presentations for confirmation of pregnancy at primary health care centres (general practice and family planning clinics).

Women with obstetrically uncomplicated pregnancy attending morning antenatal clinics at the Royal Hobart Hospital were recruited as part of an extensive evaluation of iodine nutrition and thyroid disease in pregnancy. All women, irrespective of gestational stage and age were invited to participate. Random urine samples were collected from 1 October 2000 to 30 September 2001 (the 12 months immediately before iodine supplementation of bread) and from 1 September to 30 November 2006 (5 years after commencement of iodine supplementation).

In addition, random urine samples were obtained from pregnant women on first presentation of pregnancy to randomly selected general practice and family planning clinics around Tasmania between 1 February 2003 and 31 August 2006 (2–5 years after commencement of iodine supplementation).

The iodine concentration of all samples was measured at the Institute of Clinical Pathology and Medical Research at Westmead Hospital in NSW by the modified acid digestion method based on the Sandell–Kolthoff reaction. This method is validated against the manual acid digestion technique

Iodine status of pregnant Tasmanian women before and after bread supplementation, and comparison with published data for Tasmanian school children

		Pregnancy data			Published data for Tasmanian school children[11,13]	
Period	Total samples	Median UIC (IQR)	Samples with UIC <50 μg/L	Samples with UIC ⩾150 μg/L	Median UIC	Samples with UIC <50 μg/L
Pre-intervention*						
2000–2001†	285	76 μg/L (43–189 μg/L)	30.9%	30.2%	72 μg/L	19%
Post-intervention*						
2003‡	61	88 μg/L (70–128 μg/L)	14.8%	16.4%	105 μg/L	10%
2004‡	93	86 μg/L (64–109 μg/L)	16.1%	15.1%	109 μg/L	10%
2005‡	88	78 μg/L (50–113 μg/L)	22.7%	13.6%	105 μg/L	9%
2006‡	46	79 μg/L (55–98 μg/L)	21.7%	13.0%	na	na
2006†	229	86 μg/L (57–160 μg/L)	19.2%	26.6%	na	na

* Intervention commenced October 2001. † Samples collected at the Royal Hobart Hospital antenatal clinic (from 1 October 2000 to 30 September 2001 and from 1 September to 30 November 2006). ‡ Samples collected at general practices and family planning clinics (from 1 February 2003 to 31 August 2006).
UIC = urinary iodine concentration. IQR = interquartile range (25th–75th percentile). na = not available. ◆

and the laboratory is accredited by the National Association of Testing Authorities in compliance with International Organization for Standardization/International Electrotechnical Commission standard 17025. Results are expressed as micrograms of iodine per litre of urine.[13]

We used the Mann–Whitney *U* test for non-parametric data. Results are presented as either mean ± SEM or median and interquartile range (IQR).

All samples were collected from consenting women, and the studies were approved by either the Human Research Ethics Committee of the Royal Hobart Hospital or the Human Research Ethics Committee (Tasmania) Network.

RESULTS

Royal Hobart Hospital

From 1 October 2000 to 30 September 2001, random urine samples were collected from 285 pregnant women. These women had a mean age of 28.3 ± 0.3 years and mean weeks' gestation of 25.1 ± 0.6.

The median UIC for samples collected from the 285 pregnant women in the 12 months before iodine supplementation was 76 μg/L (IQR, 43–189 μg/L); 88 women (30.9%) had a UIC of less than 50 μg/L and 86 (30.2%) had a UIC in the adequate range of 150 μg/L or above.

From 1 September to 30 November 2006, (5 years after instigation of iodine supplementation), random urine samples were collected from 229 pregnant women. Age and weeks' gestation were not available for these women.

The median UIC for these 229 pregnant women was 86 μg/L (IQR, 57–160 μg/L); 44 women (19.2%) had a UIC of less than 50 μg/L and 61 (26.6%) had a UIC in the adequate range of 150 μg/L or above (Box).

The difference between mean pre-intervention and post-intervention UICs in pregnant women who gave samples at the Royal Hobart hospital antenatal clinic was not significantly different ($P = 0.237$)

Primary health care centres

Post-intervention urine samples were collected between 1 February 2003 and 31 August 2006 from 288 women at the time of initial attendance for confirmation of pregnancy. Data for weeks' gestation were available for 148 of these women; their mean gestation was 7.6 ± 0.3 weeks.

The median UIC for these 288 women was 81 μg/L (IQR, 63–115 μg/L); 54 women (18.8%) had a UIC of less than 50 μg/L and 42 (14.6%) had a UIC in the adequate range of 150 μg/L or above (Box).

The difference between the mean pre-intervention UIC in women who gave samples at the Royal Hobart Hospital antenatal clinic and the mean post-intervention UIC in women who gave samples at primary health care centres was not significant ($P = 0.809$).

DISCUSSION

We found that pregnant women in Tasmania show ongoing evidence of iodine deficiency despite a population-based (iodine supplementation of bread) approach to correct this problem. This contrasts with evidence of improved iodine nutrition in children as indicated by the population monitoring program (using school-aged children as the indicator).[13] Our findings highlight both the importance of an iodine supplementation strategy capable of delivering adequate iodine nutrition to the entire population, and the potential for underestimating the severity of iodine deficiency in subgroups such as pregnant women if a broad-based monitoring strategy encompassing all major population demographics is not adopted.

The American Thyroid Association has recently recommended that pregnant and lactating women in the United States and Canada receive an additional 150 μg of iodine daily through a vitamin and mineral supplement.[2] This recommendation arose from concern that the median UIC during pregnancy in the US (173 μg/L) is close enough to the lower acceptable limit to place the community at risk of the consequences of gestational iodine deficiency.[2] It is notable that the median UIC during pregnancy for much of the Australian population is half the level of that in the US.

In the Tasmanian population, bread alone has been an ineffective vector for correcting iodine nutrition in pregnancy. This is probably because women of childbearing age have different dietary patterns from those of the school-age study population.[13] The level of iodine-fortified bread consumption by women of child-bearing age during pregnancy and lactation is apparently insufficient to meet their increased iodine requirements.[2] Internationally, the recommended strategy for iodine supplementation of the population's diet has been the universal iodisation of all commercially available salt.[1,2,14]

Food Standards Australia New Zealand is currently considering a bi-national (Australian and New Zealand) program for mandating the addition of iodised salt to a limited range of foods.[15] While this is welcome given the extent of iodine deficiency in Australia and New Zealand, it still may not achieve iodine sufficiency for all. Our results indicate that anything short of international best practice (mandatory universal salt iodisation) needs to be substantiated by robust dietary modelling and ongoing monitoring of iodine nutrition in all key population subgroups, particularly pregnant and lactating women.

There are a number of limitations to our study. The study population is an opportunistic sample, comprising a heterogeneous group of women of varying ages and gestational stages at the time of urine sampling and UIC measurement. However, the expected impact of these factors does not negate the consistent finding of iodine deficiency in pregnancy that has persisted despite a supplementation program for correcting iodine deficiency in Tasmania.

We call for (i) urgent implementation at a national level of mandatory iodine fortification of the food supply through an appropriate vector (preferably, universal salt iodisation) and (ii) regular national monitoring of iodine nutrition in such key populations as children and women who are pregnant, lactating or of childbearing age.

In the interim, in keeping with international recommendations, we suggest consideration be given to promoting use of iodine supplements (150 μg daily) by Australian women who are pregnant, lactating or intending to become pregnant.

ACKNOWLEDGEMENTS

Financial support for this study was provided by (i) the Tasmanian Government (Dick Buttfield Memorial Fellowship), (ii) the Royal Hobart Hospital Research Foundation, and (iii) the Department of Health and Human Services, Tasmania (the Tasmanian Iodine Monitoring Program). We thank Zelda Doyle of Broad Street Consultants, and staff at the Royal Hobart Hospital antenatal clinic for undertaking logistical activities in relation to sample collection. Preliminary data were presented at the 11th International Congress of Endocrinology, Sydney, 2000 (Abstract P778).

COMPETING INTERESTS

None identified.

AUTHOR DETAILS

John R Burgess, BMedSc, MD, FRACP, Endocrinologist[1]
Judy A Seal, MPH, AdvAPD, Senior Scientific Officer, Population Health[2]
Georgina M Stilwell, MB BS, Endocrinology Registrar[1]
Peter J Reynolds, MB BS, FRACOG, Obstetrician and Gynaecologist[1]
E Roscoe Taylor, GradDipEpid, MRNZCGP, FAFPHM, Director of Public Health[2]
Venkat Parameswaran, PhD, Chief Scientist, Endocrinology Laboratory[1]
1 Royal Hobart Hospital, Hobart, TAS.
2 Department of Health and Human Services, Tasmania, Hobart, TAS.
Correspondence: jburges@utas.edu.au

REFERENCES

1 Assessment of iodine deficiency disorders and monitoring their elimination. Geneva: World Health Organization, 2001. (WHO/NHD/01.1) http://www.who.int/nutrition/publications/en/idd_assessment_monitoring_eliminination.pdf (accessed May 2007).
2 Becker DV, Braverman LE, Delange F, et al. Iodine supplementation for pregnancy and lactation — United States and Canada: recommendations of the American Thyroid Association. *Thyroid* 2006; 16: 949-951.
3 Nutrient reference values for Australia and New Zealand including recommended dietary intakes. Canberra: National Health and Medical Research Council, 2006.
4 Dunn JT, Delange F. Damaged reproduction: the most important consequence of iodine deficiency. *J Clin Endocrinol Metab* 2001; 86: 2360-2363.
5 Li M, Eastman CJ, Waite KV, et al. Are Australian children iodine deficient? Results of the Australian National Iodine Nutrition Study. *Med J Aust* 2006; 184: 165-169.
6 Gunton JE, Hams G, Fiegert M, McElduff A. Iodine deficiency in ambulatory participants at a Sydney teaching hospital: is Australia truly iodine replete? *Med J Aust* 1999; 171: 467-470.
7 Hamrosi MA, Wallace EM, Riley MD. Iodine status in pregnant women living in Melbourne differs by ethnic group. *Asia Pac J Clin Nutr* 2005; 14: 27-31.
8 Travers CA, Guttikonda K, Norton CA, et al. Iodine status in pregnant women and their newborns: are our babies at risk of iodine deficiency? *Med J Aust* 2006; 184: 617-620.
9 Gibson HB. Surveillance of iodine deficiency disorders in Tasmania 1949–1984. 2nd ed. Launceston: Myola House of Publishing, 2006.
10 Tasmanian Thyroid Advisory Committee. Study in disease surveillance, 1950–1979. *Med J Aust* 1981; 2: 234-238.
11 Guttikonda K, Burgess JR, Hynes K, et al. Recurrent iodine deficiency in Tasmania, Australia: a salutary lesson in sustainable iodine prophylaxis and its monitoring. *J Clin Endocrinol Metab* 2002; 87: 2809-2815.
12 Seal JA, Johnson EM, Doyle Z, Shaw K. Tasmania: doing its wee bit for iodine nutrition. *Med J Aust* 2003; 179: 451-452.
13 Seal JA, Doyle Z, Burgess JR, et al. Iodine status of Tasmanians following voluntary fortification of bread with iodine. *Med J Aust* 2007; 186: 69-71.
14 Dunn JT. Seven deadly sins in confronting endemic iodine deficiency, and how to avoid them. *J Clin Endocrinol Metab* 1996; 81: 1332-1335.
15 Food Standards Australia New Zealand. Proposal P230 — Iodine Fortification. http://www.foodstandards.gov.au/standardsdevelopment/proposals/proposalp230iodinefo 2802.cfm (accessed Nov 2006).

(Received 30 Nov 2006, accepted 8 Feb 2007) ❑