

**IODINE STATUS OF PREGNANT AND LACTATING WOMEN AND THEIR  
INFANTS IN SOUTH AUSTRALIA AND THE IMPACTS OF CURRENT AND  
PERINATAL IODINE NUTRITION STATUS ON BODY COMPOSITION AND  
INSULIN SENSITIVITY AT 5 YEARS OF AGE**

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# TABLE OF CONTENTS

TABLE OF CONTENTS.....	i
LIST OF TABLES.....	xiii
LIST OF FIGURES.....	xvi
ABSTRACT.....	xix
DECLARATION.....	xxi
ACKNOWLEDGEMENTS.....	xxii
PUBLICATION ARISING FROM THIS THESIS.....	xxv
COMMONLY USED ABBREVIATIONS.....	xxvi
<b>Chapter 1 LITERATURE REVIEW.....</b>	<b>1</b>
<b>1.1 GENERAL OVERVIEW OF IODINE’S PHYSIOLOGICAL FUNCTION.....</b>	<b>1</b>
1.1.1 Iodine and thyroid hormone synthesis.....	1
1.1.2 The regulation of thyroid hormone synthesis in the human body.....	2
1.1.2.1 The regulation of thyroid hormone synthesis in the general population.....	2
1.1.2.2 The regulation of thyroid hormone synthesis during pregnancy, lactation and infancy.....	5
<b>1.2 RECOMMENDED DIETARY IODINE INTAKE.....</b>	<b>9</b>
1.2.1 Iodine requirements in pregnancy, lactation and infancy.....	9
1.2.2 Natural sources of dietary iodine.....	12
1.2.2.1 Drinking water.....	12

1.2.2.2	Food.....	13
<b>1.3</b>	<b>IODINE DEFICIENCY.....</b>	<b>13</b>
1.3.1	Etiology.....	13
1.3.2	Prevalence.....	14
1.3.3	Consequences of iodine deficiency.....	15
1.3.4	Specific risks of iodine deficiency in pregnant and lactating women .....	15
<b>1.4</b>	<b>ASSESSMENT OF IODINE STATUS.....</b>	<b>17</b>
1.4.1	Circulating Tg, TSH, T3 and T4 concentrations as indicators of iodine nutrition status .....	17
1.4.1.1	Thyroid hormone concentration (T3 and T4 levels).....	17
1.4.1.2	TSH concentration.....	18
1.4.1.3	Tg concentration.....	19
1.4.2	Urinary iodine concentration (UIC) as an indicator of iodine nutrition status ...	20
1.4.2.1	Background.....	20
1.4.2.2	Methods of UIC measurement.....	23
1.4.3	Breast milk iodine level as an indicator of iodine intake of breastfed infants ....	23
<b>1.5</b>	<b>IODINE FORTIFICATION IN AUSTRALIA .....</b>	<b>24</b>
<b>1.6</b>	<b>IODINE STATUS OF PREGNANT AND LACTATING WOMEN AND INFANTS IN AUSTRALIA .....</b>	<b>25</b>

<b>1.7</b>	<b>THYROID HORMONES AND METABOLIC HEALTH .....</b>	<b>33</b>
1.7.1	Thyroid function and body composition.....	33
1.7.1.1	Association between thyroid status and body weight.....	33
1.7.1.2	Thyroid function and percent body fat .....	42
1.7.2	Thyroid function and insulin sensitivity .....	43
1.7.3	The relationship between thyroid status in early life and metabolic health outcomes later childhood.....	48
<b>1.8</b>	<b>AIMS OF THIS THESIS.....</b>	<b>50</b>
<b>Chapter 2</b>	<b>ANALYTICAL METHODOLOGY AND VALIDATION PROCEDURES FOR MEASUREMENT OF UIC, TSH AND TG LEVELS.....</b>	<b>54</b>
<b>2.1</b>	<b>URINARY IODINE CONCENTRATION .....</b>	<b>54</b>
2.1.1	Principle of the method.....	54
2.1.2	Materials .....	55
2.1.3	Reagents and standards preparation.....	55
2.1.4	Procedure .....	56
2.1.5	Calculation of results .....	57
2.1.6	Method validation .....	57
2.1.6.1	Linearity .....	57
2.1.6.2	Recovery test .....	58

2.1.6.3	Parallelism .....	59
2.1.6.4	Accuracy .....	59
2.1.6.5	Precision .....	59
2.1.6.6	Limit of detection (LOD), method quantitation Limit (MQL) and instrument quantitation limit.....	59
2.1.6.7	Contamination check of components used in urine collection and analysis ... ..	60
2.1.7	Validation results .....	60
2.1.7.1	Linearity .....	60
2.1.7.2	Recovery test .....	60
2.1.7.3	Parallelism test.....	61
2.1.7.4	Accuracy .....	62
2.1.7.5	Precision .....	62
2.1.7.6	LOD, MQL and IQL.....	62
2.1.7.7	Contamination check of components used in urine collection and analysis ... ..	63
<b>2.2</b>	<b>ANALYSIS OF PLASMA TSH AND TG LEVELS.....</b>	<b>63</b>
2.2.1	TSH ELISA method.....	63
2.2.1.1	Principle of the assay .....	63
2.2.1.2	Assay procedure .....	64

2.2.1.3	Calculation of results .....	65
2.2.1.4	Validation .....	65
2.2.1.5	Result of validation.....	66
2.2.2	Tg ELISA method.....	67
2.2.2.1	The principle of assay.....	67
2.2.2.2	Calculation of results .....	68
2.2.2.3	Validation .....	68
2.2.2.4	Results of the validation .....	69
2.2.3	Summary .....	71

**Chapter 3 VALIDATION OF AN OPTIMISED METHOD FOR THE DETERMINATION OF IODINE IN HUMAN BREAST MILK BY INDUCTIVELY COUPLED PLASMA MASS SPECTROMETRY (ICPMS) AFTER TETRAMETHYLAMMONIUM HYDROXIDE EXTRACTION .....76**

<b>3.1</b>	<b>SUMMARY .....</b>	<b>76</b>
<b>3.2</b>	<b>INTRODUCTION.....</b>	<b>77</b>
<b>3.3</b>	<b>MATERIALS AND METHODS .....</b>	<b>79</b>
3.3.1	Reagents and equipment .....	79
3.3.2	Reagents and standard solution preparation .....	80
3.3.2.1	Internal standard stock solutions. ....	81
3.3.2.2	Iodide spiked solutions. ....	81

3.3.2.3	Thyroxine spiked solutions.....	81
3.3.2.4	Iodine calibration solutions .....	81
3.3.2.5	Iodine drift correction standard solutions.....	82
3.3.2.6	Blanks .....	82
3.3.2.7	Wash solutions.....	82
3.3.3	Instrumentation .....	83
3.3.4	Sample Digestion .....	84
3.3.5	Method Optimisation .....	85
3.3.5.1	Optimal digestion time and temperature for iodine (iodide and T4) extraction from human breast milk.....	85
3.3.5.2	Instrument/system memory effect .....	85
3.3.5.3	Sample-to-sample carryover.....	86
3.3.5.4	Stability of the iodine calibration standards .....	86
3.3.5.5	Stability and reliability of internal standards.....	86
3.3.5.6	Human breast milk homogeneity.....	87
3.3.5.7	Stability of extracted samples.....	87
3.3.5.8	Contamination check of components used in the milk collection and analysis .....	87
3.3.6	Method Validation .....	88

3.3.6.1	Linearity .....	88
3.3.6.2	Recovery .....	88
3.3.6.3	Precision .....	88
3.3.6.4	Accuracy .....	89
3.3.6.5	Limit of Detection (LOD) and Method Quantitation Limit (MQL) .....	89
<b>3.4</b>	<b>RESULTS.....</b>	<b>90</b>
3.4.1	Method optimisation .....	90
3.4.1.1	Optimal digestion time and temperature for iodine extraction from human breast milk.....	90
3.4.1.2	Instrument/system memory effect .....	90
3.4.1.3	Sample-to-sample carryover.....	92
3.4.1.4	Stability of the iodine calibration standards .....	93
3.4.1.5	Stability and reliability of internal standards.....	93
3.4.1.6	Human breast milk homogeneity.....	94
3.4.1.7	Stability of extracted samples.....	94
3.4.1.8	Contamination check of components used in milk collection and analysis. ... .....	95
3.4.2	Method Validation .....	95
3.4.2.1	Linearity .....	95

3.4.2.2	Recovery .....	95
3.4.2.3	Precision .....	96
3.4.2.4	Accuracy .....	96
3.4.2.5	Detection limits .....	96
<b>3.5</b>	<b>DISCUSSION .....</b>	<b>97</b>
<b>3.6</b>	<b>Acknowledgments .....</b>	<b>101</b>
<b>Chapter 4</b>	<b>CURRENT IODINE STATUS OF PREGNANT WOMEN, LACTATING WOMEN AND THEIR INFANTS IN SOUTH AUSTRALIA .....</b>	<b>103</b>
<b>4.1</b>	<b>INTRODUCTION .....</b>	<b>103</b>
<b>4.2</b>	<b>METHODS .....</b>	<b>105</b>
4.2.1	Study design .....	105
4.2.2	Participants and recruitment .....	105
4.2.3	Assessments of UIC .....	106
4.2.3.1	Sample collection .....	106
4.2.3.2	UIC assessment .....	106
4.2.4	Other assessments .....	106
<b>4.3</b>	<b>Data analysis .....</b>	<b>107</b>
<b>4.4</b>	<b>RESULTS .....</b>	<b>108</b>
4.4.1	Iodine status during pregnancy .....	109

4.4.2	Iodine status at 3 month postpartum .....	114
4.4.3	Iodine status of infants at 3 months of age .....	119
<b>4.5</b>	<b>DISCUSSION .....</b>	<b>119</b>
4.5.1	Iodine status of pregnant women in Australia after the introduction of mandatory iodine fortification .....	120
4.5.2	Iodine status of lactating women at 3 months postpartum after the introduction of mandatory iodine fortification.....	122
4.5.3	Iodine status of infants at 3 months of age after the introduction of mandatory iodine fortification .....	124
4.5.4	The limitations of the present study.....	126
4.5.5	Summary.....	127
<b>Chapter 5 BREAST MILK IODINE CONCENTRATION OF LACTATING WOMEN IN SOUTH AUSTRALIA PRE AND POSTFORTIFICATION .....</b>		<b>129</b>
<b>5.1</b>	<b>INTRODUCTION.....</b>	<b>129</b>
<b>5.2</b>	<b>METHODS .....</b>	<b>130</b>
5.2.1	Study design.....	130
5.2.1.1	DOMInO study population (pre iodine fortification) .....	130
5.2.1.2	PINK cohort (post iodine fortification) .....	132
5.2.2	Assessments .....	132
5.2.2.1	Breast milk iodine concentration (BMIC).....	132

5.2.2.2	Other assessments.....	134
<b>5.3</b>	<b>DATA ANALYSIS .....</b>	<b>134</b>
<b>5.4</b>	<b>RESULTS.....</b>	<b>135</b>
5.4.1	Breast milk iodine concentration of breast feeding women before and after the introduction of mandatory iodine fortification .....	135
5.4.1.1	Before mandatory iodine fortification .....	135
5.4.1.2	After mandatory iodine fortification .....	140
5.4.2	Comparison of breast milk iodine concentrations pre and post fortification....	143
<b>5.5</b>	<b>DISCUSSION .....</b>	<b>146</b>
5.5.1	The breast milk iodine concentrations of mothers pre and post-fortification...	146
5.5.2	The comparison of breast milk iodine concentrations pre and post fortification ... .....	149
5.5.3	The limitations of the present study.....	150
5.5.4	Summary .....	151
<b>Chapter 6</b>	<b>THE RELATIONSHIP OF CURRENT AND PERINATAL IODINE NUTRITION STATUS WITH BODY COMPOSITION AND INSULIN SENSITIVITY AT 5 YEARS OF AGE .....</b>	<b>154</b>
<b>6.1</b>	<b>INTRODUCTION.....</b>	<b>154</b>
<b>6.2</b>	<b>METHODS .....</b>	<b>157</b>
6.2.1	Study design.....	157

6.2.2	Participants and recruitment .....	157
<b>6.3</b>	<b>ASSESSMENTS .....</b>	<b>158</b>
6.3.1	Thyroid status .....	158
6.3.1.1	Thyroid function of DOMInO children at birth .....	158
6.3.1.2	Thyroid function of children at 5 years of age .....	158
6.3.2	Anthropometric parameters and body composition.....	159
6.3.2.1	Anthropometrics and body mass index (BMI) .....	159
6.3.2.2	Body fat mass .....	160
6.3.3	Insulin sensitivity .....	160
6.3.4	Other assessments .....	161
6.3.4.1	Maternal socioeconomic and demographic background at DOMInO trial entry .....	161
6.3.4.2	Pregnancy-related outcomes at birth .....	161
6.3.4.3	Maternal measures at 5 years follow up .....	161
6.3.5	Sample collection and processing.....	161
<b>6.4</b>	<b>DATA ANALYSIS .....</b>	<b>162</b>
<b>6.5</b>	<b>RESULTS.....</b>	<b>162</b>
6.5.1	Anthropometric and hormonal measures in different sex.....	163

6.5.2	Correlation between neonatal thyroid function anthropometric parameters at birth .....	166
6.5.3	Correlations between neonatal TSH levels and metabolic parameters of children at 5 years of age .....	167
6.5.4	Correlation between thyroid function and metabolic parameters of children at 5 years of age.....	176
<b>6.6</b>	<b>DISCUSSION .....</b>	<b>184</b>
6.6.1	The association between TSH status in the neonatal period and metabolic health at 5 years of age .....	184
6.6.2	The association between markers of current thyroid function and metabolic health at 5 years of age .....	188
6.6.3	Limitations of the present study.....	190
6.6.4	Summary .....	191
<b>Chapter 7</b>	<b>SUMMARY AND CONCLUSIONS .....</b>	<b>193</b>
	<b>BIBLIOGRAPHY .....</b>	<b>198</b>

## LIST OF TABLES

Table 1.1: Australia and New Zealand Iodine Reference Value .....	10
Table 1.2: The spectrum of iodine deficiency disorders.....	15
Table 1.3: Epidemiological criteria for assessing iodine nutrition of population based on median urinary iodine concentration of school-age children ( $\geq 6$ years) .....	22
Table 1.4: The median or range of UIC used to categorise the iodine intake of pregnant women, lactating women and children less than 2 years of age .....	22
Table 1.5: Summary of studies of iodine status in pregnant women and lactating women in Australia.....	28
Table 1.6: Summary of population-based studies investigating associations between thyroid function and body composition.....	37
Table 1.7: Summary of population-based studies of thyroid function and insulin sensitivity .	45
Table 2.1: The evaluation of linearity.....	61
Table 2.2: Recovery percentage of 2 tested urine samples.....	61
Table 2.3: Recovery percentage of 5 samples in recovery test.....	70
Table 3.1 Agilent ICPMS operating conditions.....	84
Table 3.2: Comparison of iodine concentration determined in the sample NIST 1549 milk powder and human breast milk samples for each of the 3 digestion conditions .....	90
Table 3.3: The stability of extracted samples .....	94
Table 3.4: Iodine recovery percentage for samples spiked with iodide and T4. ....	96

Table 4.1: Demographic, lifestyle and pregnancy-related characteristics of women at enrolment .....	109
Table 4.2: UICs at enrolment and 28 weeks of gestation .....	110
Table 4.3: Differences in median UIC at baseline and 28 weeks of gestation in relation to demographic, lifestyle and clinical characteristics of the women .....	112
Table 4.4: UICs in women and their infants at 3 month postpartum.....	115
Table 4.5: Differences in median UIC at 3 months postpartum in relation to demographic, lifestyle and clinical characteristics of the women .....	116
Table 5.1: The relative standard deviation of 7 samples during 18 month storage .....	134
Table 5.2 Average relative standard deviation of breast milk samples stored at -20 <sup>0</sup> C vs -80 <sup>0</sup> C .....	134
Table 5.3: Demographic information of DOMInO women at trial entry .....	137
Table 5.4: Differences in breast milk iodine levels (µg/l) in relation to demographic, lifestyle and clinical parameters of women in both pre and post fortification .....	138
Table 5.5: Breast milk iodine levels of breast feeding mothers post fortification.....	141
Table 6.1: Maternal anthropometric and demographic characteristics at trial entry and follow-up of 5 years.....	164
Table 6.2: Neonatal anthropometric and biochemical parameters of participants according to sex .....	164
Table 6.3: Anthropometric and biochemical parameters of participants at 5 years of age according to sex .....	166

Table 6.4 The correlation between neonatal TSH level and anthropometric parameters at birth .....	167
Table 6.5: Correlations between neonatal TSH level and TSH/Tg level and metabolic parameters of children at 5 years of age .....	175
Table 6.6: Correlation analysis between either TSH or Tg concentrations and metabolic parameters in children at 5 years of age .....	183

## LIST OF FIGURES

Figure 1.1: A schematic diagram of the key steps involved in thyroid hormone synthesis .....	2
Figure 1.2: Feedback regulation of thyroid hormone synthesis.....	4
Figure 1.3: Physiological adaption of the thyroid function during pregnancy .....	7
Figure 2.1: The Sandell-Kolthoff reaction.....	54
Figure 2.2: Linear relationship between urine volumes and iodine concentration in the parallelism test .....	62
Figure 2.3: The principle of the TSH sandwich ELISA .....	64
Figure 2.4: Spiking recovery test.....	65
Figure 2.5: The correlation between observed and expected concentration in recovery test ...	66
Figure 2.6: The correlation between plasma volume (i.e. dilution factor) and TSH concentration in parallelism test. ....	67
Figure 2.7: The procedure of Tg analysis .....	68
Figure 2.8: The correlation between absorbance and ASYBUF volume in the parallelism test .....	70
Figure 3.1 Instrument/system memory effect .....	92
Figure 3.2 Sample-to-sample carryover: .....	93
Figure 4.1: UIC during pregnancy according to the use of iodine supplements at baseline, and 28 weeks of gestation. Different superscripts indicate median values that were significantly different.....	111

Figure 4.2: UIC at 3-months postpartum in mothers and infants in relation to the average dose of iodine supplements consumed during pregnancy. Different superscripts indicate median values that were significantly different.....	118
Figure 5.1: The difference in breast milk iodine levels between iodine supplement groups at birth and 3-month postpartum. Different superscripts indicate median values which are significantly different.....	142
Figure 5.2: The difference in breast milk iodine level between pre and post fortification in all women and in the sub-group of mother who were not taking iodine supplements. Different superscripts indicate median values which are significantly different. ....	144
Figure 5.3: The proportion of women with BMIC above and below 100µg/l before and after fortification in the whole sample and in women not consuming dietary iodine supplements during pregnancy. ....	145
Figure 6.1: The distribution and differences in BMI z-score, body fat mass and HOMA-IR between male and female children. Different superscripts indicate median values which are significantly different.....	165
Figure 6.2: The relationship between neonatal TSH levels and glucose level at 5 years of age (a) all children; (b) male children and (c) female children.....	169
Figure 6.3: The relationship between neonatal TSH levels and BMI z-score at 5 years of age, (a) all children, (b) male children, (c) female children.....	170
Figure 6.4: The relationship between neonatal TSH levels and HOMA-IR at 5 years of age, (a) all children, (b) male children, (c) female children.....	171
Figure 6.5 The relationship between neonatal TSH levels and height at 5 years of age (a) all children, (b) male children and (c) female children.....	172

Figure 6.6: The relationship between neonatal TSH levels and height z-score at 5 years of age, (a) all children, (b) male children and (c) female children .....	173
Figure 6.7: The relationship between neonatal TSH levels and body fat mass at 5 years of age, (a) all children, (b) male children (c) female children.....	174
Figure 6.8: Correlation of TSH level among all children with metabolic parameters; (a) BMI z-score, (b) Body fat mass, (c) HOMA-IR .....	177
Figure 6.9: Correlation of Tg level among all children with metabolic parameters; (a) BMI z- score, (b) Body fat mass, (c) HOMA-IR .....	178
Figure 6.10: The correlation of TSH level among male children with metabolic parameters: (a) BMI z-score, (b) body fat mass, (c) HOMA-IR .....	179
Figure 6.11: The correlation of Tg level among male children with metabolic parameters: (a) BMI z-score, (b) body fat mass, (c) HOMA-IR .....	180
Figure 6.12: The correlation of TSH level among female children with metabolic parameters: (a) BMI z-score, (b) body fat mass, (c) HOMA-IR .....	181
Figure 6.13: The correlation of Tg level among female children with metabolic parameters: (a) BMI z-score, (b) body fat mass, (c) HOMA-IR .....	182

## ABSTRACT

Iodine deficiency was not considered a major public health problem in Australia in the 1990s. However, the Australian National Iodine Nutrition Study in the early 2000s provided evidence of the resurgence of iodine deficiency in the Australian population. As a result, mandatory iodine of bread flour was introduced in Australia in late 2009. However, while several studies had assessed the iodine status of Australian children post fortification there were limited data regarding the impact of fortification on the iodine status of pregnant and lactating women and their infants.

The results of this thesis demonstrate that the urinary iodine concentrations (UIC) of lactating, pregnant women and their infants in South Australia post iodine fortification are consistent with an iodine sufficient status, independent of the intake of iodine supplements. However, iodine status of women who did not consume iodine supplements during pregnancy may be suboptimal as indicated by a borderline UIC level.

Breast milk is a sole source of iodine for exclusively breastfed infants, making the measurement of iodine concentration in breast milk clinically relevant. However, there had been limited previous attempts to assess breast milk iodine concentrations (BMICs), largely due to the lack of robust methods for routine analysis. This thesis describes the development and validation of a new method for assessing iodine concentrations in human breast milk. This method was subsequently applied to measure BMIC in samples collected from women from the same region of South Australia before and after the introduction of mandatory iodine fortification. Median BMICs post fortification was well above the suggested cut-off for providing a sufficient iodine supply for full-term infants. Importantly, the median BMICs in the post fortification samples were significantly higher than those of the women before mandatory iodine fortification, independent of iodine supplements, while the proportion of women in the sample with BMICs below 100µg/l was reduced by 28%. These data suggest

that mandatory iodine fortification and recommendations regarding iodine supplements in pregnancy and lactation have been effective in increasing the iodine supplied to the average South Australian infants.

Obesity and insulin resistance are currently major public health issues worldwide, and there is increasing evidence that the nutritional environment experienced in early life is an important determinant of long-term metabolic health. Chapter 6 of this thesis assessed relationships between markers of neonatal and current thyroid function and metabolic health of young children. Fasting glucose concentrations, HOMA-IR and height z-score in male children at 5 years of age were inversely related to neonatal TSH level at birth, however there was no evidence to suggest that current TSH or Tg concentrations were associated with measures of growth or insulin resistance at 5 years of age, in either males or females.

In conclusion, this thesis presents the first data regarding the iodine status of pregnant and lactating women and their infants after the introduction of mandatory iodine fortification, from a large and representative population, and has provided evidence that BMICs have been significantly improved since the introduction of iodine fortification in Australia. This adds important new information regarding the current iodine status of pregnant, lactating women and their infants in Australia, and provides insights into the potential role of neonatal iodine nutrition/thyroid status for long-term metabolic health.

## **DECLARATION**

This work contains no material which has been accepted for the award of any other degree or diploma in any university or other tertiary institution to Dao Hoa Anh Huynh and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text.

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Dao Hoa Anh Huynh

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*I dedicate this thesis....*

*...To my parents and my aunt, Le Nguyen, for always believing and supporting me throughout my life*

*...To my husband, Trung Nguyen, and my son, Khoa Nguyen, for bringing me so much love and happiness*

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## COMMONLY USED ABBREVIATIONS

µg/l	microgram per litter
µIU	micro international unit
AI	Adequate Intake
BFB	body fat percentage
BFM	body fat mass
BIA	bioelectrical impedance analysis
BMI	body mass index
BMIC	breast milk iodine concentration
BMR	basal metabolic rate
BW	body weight
CI	confidence interval
CV	coefficient of variation
DEXA	dual-energy X-ray absorptiometry
DHA	Docosahexaenoic acid
DIT	Diiodotyrosine
DOMInO	DHA to Optimise Mother Infant Outcome
EAR	estimated average requirement
ELISA	enzyme-linked immunosorbent assay
HOMA-IR	homeostatic model assessment-insulin resistance
HPLC	high performance liquid chromatography
I/I <sup>0</sup>	Iodide/Iodine
ICCIDD	International Council for the Control of Iodine Deficiency Disorders
ICPMS	inductively coupled plasma mass spectrometry
IMVS	Institute of Medical and Veterinary Sciences
IQR	interquartile range
ISI	insulin sensitivity index
ISIS	integrated sample introduction system
IUPAC	International Union of Pure and Applied Chemistry
LCPUFA	long chain polyunsaturated fatty acid
LOD	limit of detection
mg/kg	milligram per kilogram
min	minute
MIT	Monoiodotyrosine

ml	millilitre
MQL	method quantitation limit
NATA	National Association of Testing Authorities, Australia
NHMRC	The National Health and Medical Research Council of Australia
NIST	National Institute of Standard and Technology
PF	peritoneal fat
PINK	Pregnancy Iodine and Neurodevelopment in Kids
QC	quality control
QUICKI	quantitative insulin sensitivity check index
RDI	Recommended dietary intake
RSD/SD	Relative standard deviation/standard deviation
Sb	Antimony
SF	abdominal subcutaneous fat
T3/fT3	Triiodothyronine/free Triiodothyronine
T4/fT4	Thyroxine/free Thyroxine
Te	Tellurium
TFM	total fat mass
Tg	Thyroglobulin
TMAH	Tetramethylammonium hydroxide
TPO	Thyropoxidase
TRH	Thyrotropin releasing hormone
TSH	Thyroid stimulating hormone
UIC	urinary iodine concentration
UL	Upper Level
WHO	World Health Organisation