Ministry for Primary Industries
Manatū Ahu Matua

Mandatory iodine fortification in New Zealand:

Supplement to the Australian Institute of Health and Welfare 2016 report - *Monitoring the health impacts of mandatory folic acid and iodine fortification*

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Contents

Page

1 Executive Summary

The purpose of this supplementary report is to provide a summary of the iodine status of New Zealand adults using the 2014/15 New Zealand Health Survey (NZHS) data following mandatory fortification of bread with iodine in September 2009. It should be considered as a companion document to the 2016 Australian Institute of Health and Welfare (AIHW) report[1] with respect to iodine status in New Zealand.

The NZHS methodology included the collection of spot urine samples from 4997 respondents aged 15 years and over. Samples were measured for iodine and compared against international criteria for assessing population iodine status (WHO, UNICEF, & ICCIDD, 2007). A population median urinary iodine concentration (MUIC) of 100-199 µg/L indicates an adequate iodine status, where as an MUIC of 50-99 µg/L is indicative of mild iodine deficiency (WHO et al., 2007).

Results show that the iodine status of the New Zealand adult population has improved since the last 2008/09 New Zealand Adult Nutrition Survey (2008/09 ANS), which was conducted prior to mandatory fortification. The iodine status of all New Zealand adults 15 years and over was 103 µg/L. This is close to double that in 2008/09 where the MUIC was 53 µg/L for all adults.

Post-fortification, the results of the NZHS indicate that the New Zealand population of women of childbearing age (16-44 years) have adequate iodine nutrition. In 2008/09, the iodine status for all women of childbearing age was indicative of moderate iodine deficiency (48 µg/L). In 2014/15, the MUIC for Māori, Pacific and NZEO women of childbearing age was 114 µg/L, 117 µg/L and 96 µg/L respectively.

This report will contribute to the overall findings of an independent review of the mandatory fortification of bread coordinated by the Food Regulation Standing Committee (FRSC). One of the key monitoring questions being asked in the AIHW review is whether the iodine status of the population has improved, in particular in women of childbearing age. Overall, the results show that the iodine status has improved in both the New Zealand adult population and in women of childbearing age.

Key findings post-mandatory fortification:

- The MUIC of the New Zealand population aged 15+ years was 103 µg/L, compared to 53 µg/L pre-fortification (2008/09)
- The MUIC of all women of childbearing age (16-44 years) was 104 µg/L; compared to 48 µg/L pre-fortification (2008/09)
- The MUIC for Māori, Pacific and NZEO women of childbearing age was 114 µg/L, 117 µg/L and 96 µg/L respectively

[1] http://www.aihw.gov.au/publication-detail/?id=60129555435

2 Background

The purpose of this supplementary report is to provide data from the 2014/15 New Zealand Health Survey (NZHS) on iodine status that were unavailable at the time of drafting the 2016 Australian Institute Health and Welfare (AIHW) report titled *Monitoring the health impacts of mandatory folic acid and iodine fortification* (AIHW, 2016). This report will contribute to the overall findings of an independent review of the mandatory fortification of bread that is being coordinated by the Food Regulation Standing Committee.

At the request of the then Australia and New Zealand Food Regulation Ministerial Council (the Ministerial Council), Food Standards Australia New Zealand developed mandatory fortification requirements for folic acid and iodine to address two important public health issues: to reduce the prevalence of neural tube defects (NTDs) (serious birth defects) in Australia, and deal with the re-emergence of iodine deficiency in both Australia and New Zealand. The mandatory requirements to add iodised salt to bread was accepted in 2007 and became effective as part of Standard 2.1.1 *Cereals and cereal products* in the Australia New Zealand Food Standards Code (the Code) from September–October 2009. As a result, in New Zealand, most bread (excluding organic and unleavened breads) is required to be fortified with iodine, through the replacement of salt with iodised salt used in bread making.

Given iodine requirements are higher in pregnant and breastfeeding women, from July 2010 the Ministry of Health has recommended that all healthy pregnant and breastfeeding women take a 150 microgram iodine-only tablet every day. These iodine tablets are subsidised when prescribed by a midwife or doctor.

In agreeing to the changes to the Code, the Ministerial Council requested a comprehensive and independent review be initiated two years after their implementation; and that the Food Regulation Standing Committee and the Australian Health Ministers' Advisory Council oversee the review process. The review consists of three stages, comprising an assessment of:

1. food industry compliance and impacts on enforcement agencies;
2. population health effects of mandatory fortification; and
3. the effectiveness of the mandatory folic acid and iodine fortification initiatives.

At the time the 2016 AIHW report was drafted only limited data were available on the iodine status of the New Zealand population post-fortification. Since then, the results from the 2014/15 NZHS have become available.

One of the key monitoring questions being asked in the second stage of the review is whether the iodine status of the population has improved, in particular in women of childbearing age and young children.

This supplementary report provides updated data on the iodine status of New Zealand adults to inform the one of the key monitoring questions and is best considered as a companion document to the 2016 AIHW report with respect to mandatory iodine fortification in New Zealand.

3 Biomedical reference values for iodine status

As stated in the AIHW Baseline report, for the purposes of monitoring population iodine status in Australia and New Zealand, median urinary iodine concentrations (MUIC) are used to measure the impact of mandatory iodine fortification (AIHW, 2011). This is in line with the guidelines produced by the World Health Organization (WHO), in collaboration with the United Nations Children's Fund (UNICEF) and International Council for Control of Iodine Deficiency Disorders (ICCIDD). An MUIC of 100 – 299 µg/L indicates adequate iodine status at the population level; and an MUIC of more than 300 µg/L represents excessive iodine intake, and could pose a risk of adverse health consequences (such as iodine-induced hyperthyroidism, autoimmune thyroid diseases) (refer to Table 1) (WHO et al., 2007). Based on the recommendations of WHO, UNICEF and ICCIDD, the most important population groups to be monitored for MUIC are school-aged children and women of childbearing age (aged 16-44 years).

Table 1: Epidemiological criteria for assessing iodine nutrition based on median urinary iodine concentrations of school-aged children (≥6 years)*

Median Urinary Iodine (µg/L)	Iodine intake	Iodine status
<20	Insufficient	Severe iodine deficiency
20-49	Insufficient	Moderate iodine deficiency
50-99	Insufficient	Mild iodine deficiency
100-199	Adequate	Adequate iodine nutrition
200-299	Above requirements	Slight risk of more than adequate intake in the overall population
≥300	Excessive	Risk of adverse health consequences (iodine-induced hyperthyroidism, autoimmune thyroid diseases)

*Applies to adults, but not pregnant and lactating women
Source: (WHO et al., 2007)

As stated in the 2016 AIHW report, the WHO/UNICEF/ICCIDD criteria for assessing population iodine status have been derived from the MUIC for school children, who have an average daily urine volume of 1.0 L. As there are no validated criteria for adults, the WHO/UNICEF/ICCIDD criteria are often applied to adults. It is important to note that adults often have a larger daily urine volume, assumed to be 1.5 L, and this larger urine volume can dilute iodine concentrations and result in lower MUICs. Therefore, caution is needed when assessing the iodine status of an adult population using the WHO/UNICEF/ICCIDD criteria. Further studies are currently being undertaken to validate the criteria for MUIC in adults (Zimmermann & Andersson, 2012).

WHO, UNICEF and ICCIDD have established separate MUIC criteria for assessing iodine intakes of pregnant women (refer to Table 2). An MUIC of 150 – 249 µg/L indicates an adequate iodine intake, whereas more than or equal to 500 µg/L indicates excessive iodine

intake (that is, in excess of the amount required to prevent and control iodine deficiency) (WHO 2007).

Table 2: Epidemiological criteria for assessing iodine nutrition based on median urinary iodine concentrations of pregnant women*

Median Urinary Iodine (µg/L)	Iodine intake
<150	Insufficient
150-249	Adequate
250-499	Above requirements
≥500	Excessive

* For lactating women and children <2 years of age a median urinary iodine concentration (MUIC) of 100 µg/L can be used to determine adequate iodine intake, but no other categories of iodine intake are defined. Although lactating women have the same requirement as pregnant women, the MUIC is lower because iodine is excreted in breast milk.
Source: (WHO et al., 2007)

4 Methods

The NZHS has a multi-stage, stratified, probability-proportional-to-size sampling design. The study was designed to yield an annual sample size of approximately 13,000 adults, and aimed to include a proportionately higher number of Māori, Pacific and Asian people to ensure sub-group analyses could be made.

Approximately half of the adult respondents were selected for the biomedical module. The probability of selection varied by ethnicity, age and sex; with all Māori and Pacific respondents selected, and between one third and one half of other respondents selected. The 2014/15 NZHS included pregnant women, although the survey was not designed to provide reliable estimates for this group.

Spot urine samples were collected from 4997 respondents aged 15 years and over. These samples were used to measure urinary iodine concentration using Inductively Coupled Plasma-Mass Spectrometry (ICP-MS). The MUIC was calculated for various sex, age and ethnic population groups and compared against international criteria for assessing iodine status. Details of the survey design and methodology are provided in the Appendix.

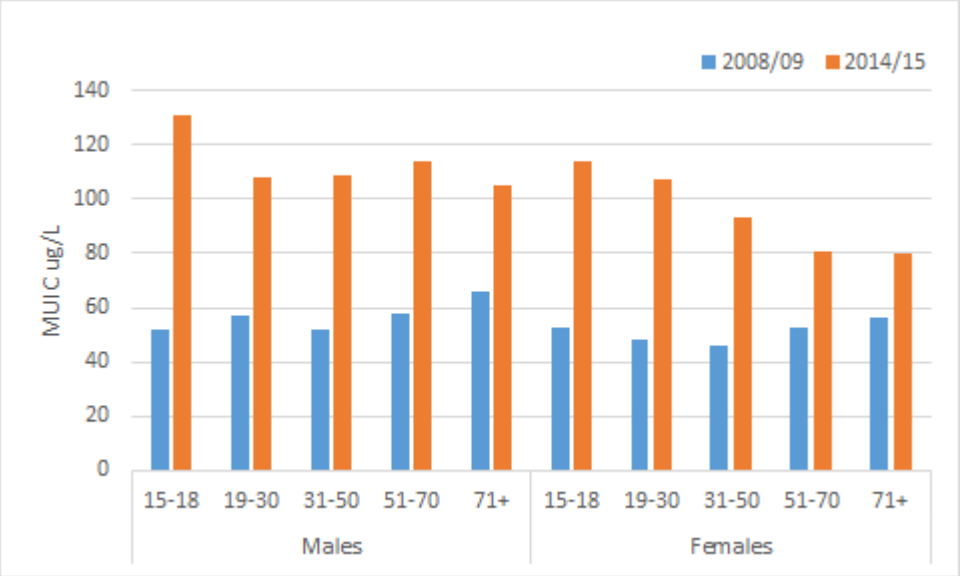
5 Results

5.1 IODINE STATUS FOR ADULTS AGED 15 YEARS AND OVER

In the 2014/15 NZHS, for adults aged 15+ years the MUIC was 103 µg/L, up from 53 µg/L pre-fortification in 2008/09 (Table 3). Using the WHO/UNICEF/ICCIDD criteria, this post-

fortification result is within the range of 100-199 µg/L indicating adequate iodine status. The 2008/09 pre-fortification iodine results indicated mild iodine deficiency in the adult population (WHO et al., 2007). Figure 1 provides a summary of the 2008/09 and 2014/15 MUICs by sex and age group.

Figure 1: Median urinary iodine concentration, by sex and age group, 2008/09 and 2014/15



The MUIC was higher in males (110 µg/L) than females (91 µg/L). For males the MUIC was highest in those aged 15-18 years and similar across other age groups. For females, the MUIC declined with age. Post-fortification results by sex and age were within the range of 100-199 µg/L for adequate iodine status for all groups, with the exception of females aged 31 years and over whose iodine status was indicative of mild iodine deficiency (80-93 µg/L).

Table 3: Urinary iodine status, by sex, age group, ethnic group, and NZDep for 2008/09 and 2014/15 *

		2008/09			2014/15		
Sex	**Age group (years)**	**Median (µg/L)**	**Moderate iodine deficiency %<50 µg/L (95%CI)**	**Mild iodine deficiency %<100 µg/L (95%CI)**	**Median (µg/L)**	**Moderate iodine deficiency %<50 µg/L**	**Mild iodine deficiency %<100 µg/L**
All	15+	53	47 (44-50)	79 (77-81)	103	20 (18-22)	48 (46-51)
Males	15-18	52	46 (37-56)	80 (71-87)	131	5 (2-11)	30 (14-53)
	19-30	57	39 (30-49)	79 (70–86)	108	14 (10-21)	46 (37-55)
	31-50	52	47 (40–54)	81 (75–85)	109	16 (12-20)	45 (39-51)
	51-70	58	44 (38–51)	76 (70–81)	114	15 (11-19)	41 (36-47)
	71+	66	38 (31–45)	71 (65–76)	105	12 (8-17)	47 (40-54)
	Total	55	44 (40–48)	78 (75–81)	110	14 (12-16)	43 (40-47)
Females	15-18	53	45 (38–52)	78 (70–84)	114	15 (8-29)	39 (25-56)
	19-30	48	51 (42–60)	82 (75–87)	107	18 (14-23)	47 (41-53)
	31-50	46	53 (46–59)	82 (77–86)	93	28 (23-33)	53 (47-59)
	51-70	53	48 (41–54)	80 (75–85)	81	31 (26-37)	57 (52-62)
	71+	56	45 (39–51)	73 (67–79)	80	28 (14-47)	60 (48-72)
	16-44	48	52 (46-58)	81 (77-85)	104	21 (18-25)	48 (44-53)
	Total	50	50 (46–54)	80 (78–83)	91	26 (23-30)	53 (50-57)
Ethnicity	**Sex/Age group (years)**						
Māori	Males	55	43 (35–53)	79 (70–86)	117	15 (11-20)	37 (32-43)
	Females - all	57	44 (37–51)	80 (74–85)	108	17 (14-21)	46 (42-50)
	Females - 16-44	52	48 (38-57)	83 (77-90)	114	16 (12-20)	44 (39-51)
Pacific	Males	74	30 (21–42)	68 (58–76)	137	10 (5-19)	28 (18-40)
	Females	72	30 (23–38)	65 (55–73)	117	9 (5-17)	39 (31-48)
	Females 16-44	71	30 (21-39)	67 (58-77)	117	6 (2-14)	36 (25-49)
NZEO	Males	55	44 (40–49)	79 (75–82)	109	15 (13-18)	47 (43-50)
	Females - all	48	51 (47–56)	82 (79–84)	89	29 (25-33)	57 (53-61)
	Females - 16-44	47	53 (47-60)	82 (78-86)	96	24 (20-29)	54 (47-60)
By NZDep* quintile†							
Males	1	55	45 (36–53)	78 (70–84)	102	17 (12-25)	48 (39-57)
	2	51	48 (38–57)	81 (73–88)	112	14 (9-21)	42 (35-49)
	3	56	46 (37–55)	84 (76–89)	101	14 (10-19)	48 (40-56)
	4	55	44 (36–52)	78 (69–85)	117	14 10-19)	41 (34-47)
	5	66	36 (29–44)	69 (62–75)	123	10 (7-13)	37 (31-43)
Females	1	51	49 (42–56)	83 (76–88)	93	25 (18-35)	52 (41-63)
	2	45	54 (45–62)	80 (73–85)	91	28 (22-35)	53 (46-61)
	3	48	51 (43–59)	86 (80–90)	80	34 (25-45)	61 (53-68)
	4	48	52 (45–59)	77 (70–83)	94	25 (20-30)	53 (47-59)
	5	56	42 (36–49)	76 (71–81)	105	19 (15-24)	46 (41-51)

* The New Zealand Index of Deprivation (NZDep) 2006 was used for 2008/09 and NZDep2013 for 2014/15.

† Quintile 1 represents the 20% of areas with the lowest levels of deprivation and quintile 5 represents the 20 percent of areas with the highest level of deprivation

CI = confidence interval

Table 3 provides a detailed summary of the urinary iodine status, by sex, age group, ethnic group, and New Zealand Index of Deprivation 2013 (NZDep2013) for 2008/09 and 2014/15.

Post-fortification, the MUIC increased across all ethnic groups (Māori, Pacific and NZEO) for both males and females. All had MUICs within the range considered adequate (100-199 µg/L), except for NZEO females. The MUIC was 117 µg/L for Māori males and 108 µg/L for Māori females; 137 µg/L for Pacific males and 117 µg/L for Pacific females. The MUIC was 109 µg/L for NZEO males and 89 µg/L for NZEO females.

When analysed by NZDep, the MUIC post-fortification was highest for males (123 µg/L) and females (105 µg/L) in quintile 5 (representing the 20% most deprived areas) compared to quintiles 1-4 (quintile 1 representing the 20% least deprived areas). The same trend is observed in 2008/09. In 2014/15, the MUICs for males in each of the quintiles indicated an adequate iodine status (100-199 µg/L), however females in quintiles 1-4 had an MUIC indicative of mild iodine deficiency.

5.2 IODINE STATUS FOR WOMEN AGED 16 - 44 YEARS

For women of childbearing age (16-44 years), excluding pregnant women, the MUIC was 104 µg/L, up from 48 µg/L pre-fortification. This post-fortification result is within the range of 100-199 µg/L, indicating adequate iodine status (refer to Table 3).

The MUIC for Māori and Pacific women of childbearing age, excluding pregnant women, was 114 µg/L and 117 µg/L, respectively. The MUIC for NZEO women of childbearing age was 96 µg/L, which is just below the range for adequate iodine status.

The NZHS survey also included a small number of pregnant women (n=110). Using the WHO/UNICEF/ICCIDD criteria for pregnant women, an MUIC of less than 150 µg/L indicates an insufficient iodine intake. The MUIC of all pregnant women included in the NZHS was 114 µg/L (95% CI: 87, 141 µg/L) indicative of insufficient iodine intakes. Intakes for pregnant women aged 16–44 (116 µg/L) were still inadequate to meet their increased requirements during pregnancy and breastfeeding.

5.3 ADDITIONAL CRITERIA FOR ASSESSMENT OF IODINE STATUS

In addition to the general population WHO/UNICEF/ICCIDD criteria for assessing iodine status, it is also recommended that no more than 50% of a studied population have an MUIC less than 100 µg/L and no more than 20% have an MUIC less than 50 µg/L.

In the 2014/15 NZHS, 20% of all adults had an MUIC less than 50 µg/L; borderline on meeting this criteria (refer to Tables 3 and 4). This target was met for males in all age groups,

with 14% overall having an MUIC <50 µg/L. In comparison, the target was met by females aged 15-30 years only, with 26% of all females and 21% of women of childbearing age having an MUIC less than 50 µg/L.

The WHO/UNICEF/ICCIDD target of no more than 50% of the population having an MUIC less than 100 µg/L was met for adults overall (48%). Males in all age groups also met this target, with 43% of all males having an MUIC less than 100 µg/L. Only females aged 15-18 years (39%), 19-30 years (47%) and 16-44 years (48%) years met this criteria (Tables 3 and 4).

In contrast, the 2008/09 Adult Nutrition Survey data showed that for all adults, males and females 15+ years and females 16-44 years, none of the WHO/UNICEF/ICCIDD targets were met (refer to Table 5). In particular, 47% of all adults had an MUIC <50 µg/L with 79% having an MUIC <100 µg/L.

Table 4: Proportion of the population meeting the WHO/UNICEF/ICCIDD targets for population iodine assessment in 2014/15 New Zealand Health Survey

Age group (years)	MUIC* <50 µg/L (percent)	Target met?	MUIC* <100 µg/L (percent)	Target met?
Males 15+	14	Yes	43	Yes
Females 15+	26	No	53	No
Females 16-44	21	No	48	Yes
Total 15+	20	Yes	48	Yes

* MUIC = Median urinary iodine concentration

Table 5: Proportion of the population meeting the WHO/UNICEF/ICCIDD targets for population iodine assessment in 2008/09 Adult Nutrition Survey

Age group (years)	MUIC* <50 µg/L (percent)	Target met?	MUIC* <100 µg/L (percent)	Target met?
Males 15+	44	No	78	No
Females 15+	50	No	80	No
Females 16-44	52	No	81	No
Total 15+	**47**	**No**	**79**	**No**

* MUIC = Median urinary iodine concentration

As noted earlier, WHO/ UNICEF/ICCIDD have established separate MUIC criteria for the assessment of iodine status for pregnant women. An MUIC of <150 µg/L indicates insufficient iodine intakes. Of the pregnant women who provided urine samples, 64 percent had an MUIC < 150 µg/L.

5.4 EXCESS IODINE INTAKES

An MUIC of more than 300 µg/L represents excessive iodine intake and could pose a risk of adverse health consequences. In addition, the MUIC for pregnant women should not exceed 500 µg/L.

In 2014/15, 6% of adults aged 15+ years had an MUIC of 300 µg/L or higher. Two percent of pregnant women had an MUIC of 500 µg/L or higher.

6 Conclusion

The results of the 2014/15 NZHS indicate that the iodine intake and iodine status of the New Zealand adult population has improved since the last 2008/09 ANS. The 2008/09 survey was conducted prior to mandatory fortification and the Ministry of Health recommendation for pregnant and breastfeeding women to take a 150 microgram iodine-only tablet every day.

The iodine status of all New Zealand adults 15 years and over was 103 µg/L; males had an MUIC of 110 µg/L and females 91 µg/L. Results are close to double that in 2008/09 where the MUIC was 53 µg/L for all adults (55 µg/L for males and 50 µg/L for females). Although all females had an MUIC less than 100 µg/L, all women of childbearing age (16-44 years) had an MUIC of 104 µg/L. In 2008/09, the MUIC for all women of childbearing age was 48 µg/L.

Based on the MUIC and the WHO/UNICEF/ICCIDD criteria, the iodine status of adults (103 µg/L) and women of childbearing age (16-44 years) (104 µg/L) is now adequate. A population median urinary iodine concentration (MUIC) of 100-199 µg/L indicates an adequate iodine status, where as an MUIC of 50-99 µg/L is indicative of mild iodine deficiency (WHO et al., 2007).

The iodine status of specific population sub-groups (sex and age) is also adequate (within the range of 100-199 µg/L), except for females aged 31-50, 51-70 and 71+ years (93, 81 and 80 µg/L respectively). Both Māori and Pacific males and females have an adequate iodine levels (Māori males 117 µg/L and females 108 µg/L; Pacific males 137 µg/L and females 117 µg/L), however of NZEO ethnic group, only the males achieved an adequate iodine status (NZEO males 109 µg/L and females 89 µg/L). For women of childbearing age, the MUIC for Māori, Pacific and NZEO was 114 µg/L, 117 µg/L and 96 µg/L respectively.

Of the small number of pregnant women included in the NZHS, iodine intakes were still inadequate to meet their increased requirements during pregnancy and breastfeeding (MUIC: 114 µg/L; criteria for adequacy >150 µg/L).

The WHO/UNICEF/ICCIDD targets of no more than 50% of the population having an MUIC <100 µg/L and no more than 20% having an MUIC <50 µg/L was met for adults overall;

48% and 20% respectively). This is an improvement on the 2008/09 ANS, where 79% of all adults had an MUIC <100 µg/L and 47% having an MUIC <50 µg/L.

In response to the monitoring question as whether the iodine status of the adult population and specifically women of childbearing age has improved, analysis of the 2014/15 NZHS and 2008/09 ANS results show that the iodine status is now adequate for both groups.

7 Appendix: New Zealand Health Survey methodology

The New Zealand Health Survey (NZHS) is a population-based health survey commissioned by the New Zealand Ministry of Health. Since July 2011 the NZHS has operated as a continuous survey comprising a core set of questions and measurements that are repeated every year and a series of modules that change each year.

The core component of the survey covers health status, long-term conditions, health behaviours and risk factors, health service utilisation and socio-demographics. The periodic modules collect more detailed information on these topics, and in the 2014/15 NZHS a biomedical module was included for adults.

A brief description of the survey methodology is provided below. More detailed descriptions of sampling procedures and survey content can be found in the NZHS Methodology Report (Ministry of Health (NZ), 2015).

7.1 SAMPLING

The target population for the NZHS is the New Zealand usually resident population of all ages including those living in non-private accommodation. Approximately 98 percent of the New Zealand resident population of all ages are eligible to participate in the NZHS. The survey includes people living in aged-care facilities (rest homes) and those temporarily living away from their household in student accommodation (university hostels and boarding schools), but for practical reasons excludes people living in other types of non-private dwellings (prisons, hospitals, hospices, dementia care units and hospital-level care in aged-care facilities) and households in remote areas.

The NZHS has a multi-stage sampling design that involves randomly selecting a sample of small geographic areas, households within the selected areas, and individuals within the selected households. The design yields an annual sample size of approximately 13,000 adults and 4500 children. The survey aims to include a proportionately higher number of Māori, Pacific and Asian people to provide sufficient sample sizes for sub-group analyses. One adult and one child (if any in the household) were chosen at random from each selected household to take part in the survey.

Of those invited to participate in the 2014/15 NZHS, 79 percent of selected adults (13,497 adults) and 83 percent of parents/caregivers of selected children (4754 children) agreed to be interviewed. The 2014/15 results refer to the sample selected from 1 July 2014 to 30 June 2015, with data collection completed by the end of July 2015.

Of those invited to participate in the 2014/15 NZHS, 79 percent of selected adults (13,497 adults) and 83 percent of parents/caregivers of selected children (4754 children) agreed to be

interviewed. The 2014/15 results refer to the sample selected from 1 July 2014 to 30 June 2015, with data collection completed by the end of July 2015.

7.2 DATA COLLECTION

The NZHS is a voluntary survey and households selected were invited to participate through an invitation letter from the Ministry of Health mailed to their address with an information pamphlet. Interviewers took copies of the information pamphlet in 11 languages when they subsequently visited households to seek agreement to participate in the survey (Ministry of Health (NZ), 2015). Respondents were able to elect a friend or family member to act as an interpreter during the survey, or for a professional interpreter to be present. Where possible, attempts were made to match respondents and interviewers by ethnicity and sex when requested.

Professional social research interviewers conducted interviews and measurements for the NZHS in participants' homes, with the interviewer entering responses directly into a laptop computer.

7.3 BIOMEDICAL MODULE

At the end of their NZHS interview a little over half (55 percent) of the 2014/15 adult respondents were selected for the biomedical module. The probability of selection varied by ethnicity, age and sex; with all Māori and Pacific respondents selected, and between one third and one half of other respondents selected. The biomedical module included pregnant women, although the survey was not designed to provide reliable estimates for this group.

Respondents selected for the biomedical module were provided with an information sheet and had the opportunity to ask the interviewer questions before signing the biomedical consent form. Nearly all (92 percent) respondents selected for the biomedical module consented to take part. Consenting respondents were given a sample collection kit (containing tubes and instructions) and asked to attend their local medical laboratory to provide a blood and urine sample.

A total of 4997 adults provided a urine sample, which represents 67 percent of those invited to take part in the biomedical module. Respondents who provided samples were sent their test results and a $50 gift (or koha).

7.4 URINARY IODINE ANALYSIS

Urine samples collected by local medical laboratories were sent to Canterbury Health Laboratories in Christchurch for analysis. Samples were transported according to standard procedures to ensure specimen integrity was maintained during transportation and storage. Urinary iodine was measured in µmol/L using Inductively Coupled Plasma-Mass Spectrometry (ICP-MS). The lower limit of detection was 0.1 µmol/L and the upper limit of detection (without dilution) was 975 µmol/L. Three levels of quality control (QC) samples

were run with every batch, with provisional QC results as follows: level 1 mean 3.85 µmol/L (CV 4.4 percent), level 2 mean 1.71 µmol/L (CV 5.8 percent), level 3 mean 0.19 µmol/L (CV 26.1 percent).

Urinary iodine results were converted from µmol/L to µg/L by multiplying by the atomic mass of iodine (126.90447).

7.5 SURVEY WEIGHTS

The NZHS used the calibrated weighting method to construct survey weights that rate up the responding sample to represent the target population. This method takes into account the probability of selection of each respondent, and uses external population benchmarks (typically based on the most recent population census) to correct for any discrepancies between the sample and population benchmarks (by age, sex, ethnicity and the 2013 New Zealand Index of Deprivation (NZDep)).

Because the biomedical module was conducted in a sub-sample of adult respondents from the main survey, a separate weight for biomedical analysis was constructed for each respondent who participated in the biomedical module. The first step was to divide each respondent's main survey weight by their probability of being selected for the biomedical module. The second step calibrated the biomedical weights to minimise the impact of any differences in the characteristics of people who did or did not choose to participate in the biomedical module. The calibration ensured that:

- the sum of the biomedical weights agreed with the same population figures used in the calibration of the final NZHS weights, by age, sex, ethnicity and NZDep.
- key statistics generated from only the biomedical sample agreed with the same statistics generated from the full NZHS sample. These key statistics focused on health conditions, behaviours and measurements collected from all NZHS respondents that are likely to be related to biomedical test results.

7.6 DATA ANALYSIS

Weights were used in all analyses so that estimates of medians and proportions presented in this report can be said to be representative of the usually resident population (aged 15 + years) of New Zealand. Results are reported with 95 percent confidence intervals. Differences in medians and proportions between subgroups are statistically significant if the 95 percent confidence intervals surrounding the two estimates do not overlap. It should be noted that testing for a significant difference between two subgroups using the above method is conservative compared to testing at the two-sided 0.05 level.

Ethnicity was output to the following three ethnic groups: New Zealand European and Other (NZEO), Māori, and Pacific. The 'total response standard output' was used to classify ethnicity, with participants counted in each of the ethnic groups they identified with. Using

the ‘total response standard output’ means that ethnic groups overlap, so it is not appropriate to make comparisons between ethnic groups.

Neighbourhood deprivation refers to the New Zealand Index of Deprivation (NZDep), which measures the level of socioeconomic deprivation for each neighbourhood according to a combination of Census variables such as income, benefit receipt, household crowding, home ownership, employment status, and qualifications. NZDep 2013 was used for the 2014/15 New Zealand Health Survey and NZDep 2006 was used for the 2008/09 Adult Nutrition Survey. Results are presented for quintiles: quintile 1 represents the 20 percent of areas with the lowest levels of deprivation and quintile 5 represents the 20 percent of areas with the highest level of deprivation.

8 References

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