

# CADMIUM IN THE DIET: UPDATING AND EXPANDING THE EXPOSURE MODEL FOR NEW ZEALAND CONSUMERS

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## Introduction

The New Zealand Total Diet Study (NZTDS) has been used as the primary monitoring tool to determine trends of contaminant exposure through the New Zealand population. Amongst the primary contaminant elements targeted for analysis is cadmium. Cadmium presents a potential dietary hazard if ingested at sufficient doses, leading to chronic kidney failure and also osteomalacia. Cadmium has a long retention time in the human body, with a half-life of approximately 15 years in the kidney (WHO, 2011). Cadmium exposure is characterised against the World Health Organization Provisional Tolerable Monthly Intake (PTMI) of 25 µg/kg body weight (bw) to determine its acceptability in the diet for long-term exposure (WHO, 2011).

In the most recent New Zealand study (2009 NZTDS) the estimated cadmium exposures were all below the PTMI (Vannoort & Thomson, 2011). Exposure to cadmium however was the highest of the contaminants analysed in the NZTDS, ranging between 22-46% of the PTMI for the different population age/gender groups. Primary contributors to exposure were potatoes and related products, breads, shellfish and carrots. In the 2009 NZTDS the two week model diet used to estimate exposures was based on the 1997 New Zealand National Nutrition Survey. Due to drift in consumption trends the use of a 12 year old diet could be under- or over-estimating current exposures.

In 2008/9 the New Zealand Ministry of Health ran the latest New Zealand Adult Nutrition Survey (09ANS) (University of Otago & Ministry of Health, 2011). However due to the time taken to collate the over 100,000 food records from this survey the calculated consumption habits for New Zealand were not available for use in the 2009 NZTDS. Upon the data from the nutrition survey becoming available for analysis an extended and updated dietary modelling exercise for cadmium was undertaken from the 2009 NZTDS results.

## Methods

Cadmium concentration data for the 123 foods analysed in the 2009 NZTDS were combined with individual consumption data mapped to the NZTDS foods and the body weights of the associated consumers to generate estimates of dietary exposure. Exposure estimates were determined for a range of different age-gender cohorts. Best statistical mean estimates were determined based on 'not detected' results assigned to half the limit of detection. Adult consumption values were derived from the 2008/09 New Zealand Adult Nutrition Survey (University of Otago & Ministry of Health, 2011). For consistency the diets for children were also recalculated based on mapping to consumption data from the 2002 Children's Nutrition Survey (02CNS)(MoH, 2003).

## Discussion

For exposure estimates based on single-day food consumption records, the age-gender cohort with the lowest arithmetic mean best statistical estimate was 4.0 µg/kg bw/month for 25+ year females and the highest was 10.1 µg/kg bw/month for 5-6 year old children. The corresponding 95<sup>th</sup> percentile best statistical dietary exposure estimates were 8.4 and 20.1 µg/kg bw/month, respectively. This dietary modelling of cadmium calculated that exposures are 28-34% lower for adults groups and 3-15% lower for children when using the latest consumption values compared to those estimated in the 2009 NZTDS (Table 1).

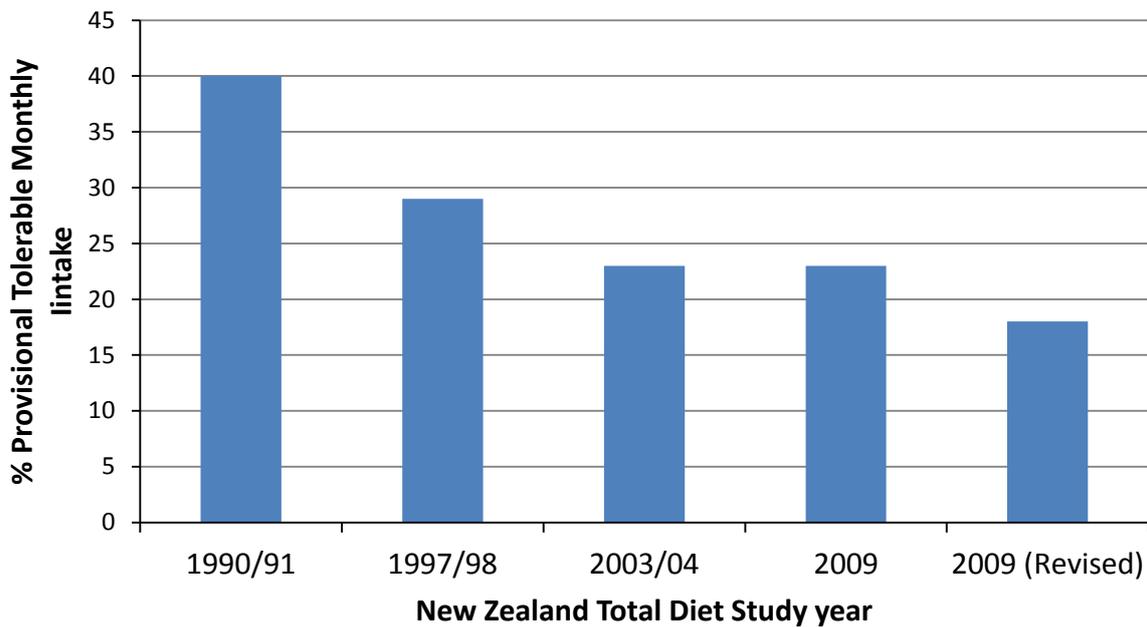
Table 1: Calculated cadmium exposure for age/gender cohorts in the New Zealand population based on cadmium concentrations from the 2009 New Zealand Total Diet Study and the use of either the 2009 Total Diet Study simulated diet or the Adult, or Child, nutrition surveys for food intake values.

Gender-age groups	Estimated best statistical mean cadmium exposure (µg/kg bw/month) (% Provisional Tolerable Monthly Intake)		
	2009 New Zealand Total Diet Study	2009 Adult Nutrition Survey	2002 Children's Nutrition Survey
Males (25+yr)	6.8 (27%)	4.5 (18%)	-
Females (25+yr)	5.5 (22%)	4.0 (16%)	-
Males (19-24yr)	6.9 (28%)	4.5 (18%)	-
Males (11-14yr)	7.7 (31%)	-	7.5 (30%)
Females (11-14yr)	6.5 (26%)	-	5.6 (22%)
Children (5-6yr)	11.5 (46%)	-	10.1 (40%)

The basis of the decrease in cadmium exposure is a reduction in consumption quantities of potato based foods, hot chips, peeled potatoes and crisps and white bread. For example for 25+ year males consumption of peeled potatoes had reduced from 102 g/day in the 2009 NZTDS to 68 g/day in the 09ANS, similarly white bread had reduced from 84 g/day to 71 g/day. However these two foods still make up the majority of the contribution to exposure with 28-43% contribution for potatoes and 13-18% contribution for bread. Additionally oyster consumption has significantly dropped with the consumption values for 25+ year males reducing from 3.57 g/day in the 2009 NZTDS to 0.27 g/day in the 09ANS, and for 19-24 year male group no consumption was reported in the 09ANS compared to the 2.14 g/day used in the 2009 NZTDS. Exposure contribution through oysters, estimated at 26% for adult males in the 2009 NZTDS, is now estimated as being at 3%.

The 2009 NZTDS indicated that cadmium exposures had remained at a similar level to that in the previous NZTDS (2003/04). However as an outcome of the extended dietary modelling it is suggested that exposure trends for dietary cadmium have continued to decline (Figure 1).

Figure 1: Dietary exposure trend for Cadmium in the New Zealand Total Diet Study by year of publication extended to use the revised intake values from the 2009 New Zealand Adult Nutrition Survey. Using dietary intakes for Males 19-24 and excluding oyster consumption.



### Conclusion

Extension of the New Zealand TDS by using dietary modelling of 2009 NZTDS cadmium concentration data with 09ANS and 02CNS consumption data has provided important information about mean and upper percentiles of exposure. The dietary modelling using the latest 09ANS consumption data produced estimated dietary exposures for adults which were 28-34% lower than those obtained from a simulated diet using 1997 data. Changes in food consumption data between the 1997 NNS and 09ANS for key contributors such as potatoes and breads help explain this and demonstrate the importance of using the latest national nutrition survey data available.

The results of this work feed into MPIs continuing risk management on cadmium in the diet and inform the planning of the forthcoming 2015/6 NZTDS.

### References

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