The First Hong Kong Total Diet Study Report No. 5

The First Hong Kong Total Diet Study: Metallic Contaminants

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EXECUTIVE SUMMARY

The First Hong Kong Total Diet Study: Metallic Contaminants

The Centre for Food Safety (CFS) is conducting the First Hong Kong Total Diet Study (the 1st HKTDS) to estimate dietary exposures of the Hong Kong general population and various population subgroups to a range of substances, including contaminants and nutrients, and to assess any associated potential health risks. The 1st HKTDS comprises food sampling and preparation, laboratory analysis and dietary exposure estimation. A total of 1,800 samples, comprising 150 different TDS food items with three purchases on each of the four occasions from March 2010 to February 2011, were collected and prepared, and then combined into 600 composite samples for testing of various selected substances.

2. This is the 5th report of the TDS series. It presents the dietary exposure assessment to seven metallic contaminants, namely, aluminium, antimony, cadmium, lead, methylmercury, nickel and tin. In addition, level of vanadium in food was reported as it was simultaneously analysed with other metallic contaminants.

3. Metallic contaminants are often present in foods in trace amounts. They can enter the food supply through environmental elements, such as air, soil, and water, or during food processing and cooking. For ordinary adults, diet is the main source of exposure to some common metallic contaminants such as cadmium, lead and methylmercury.

Therefore, potential health risk associated with dietary exposure to metallic contaminants is of particular concern.

Results

4. The dietary exposures of average and high consumers of the population to aluminium accounted for 30% and 77% of the Provisional Tolerable Weekly Intake (PTWI) of 2 mg/kg body weight (bw), to antimony accounted for 0.3-0.7% and 0.5-1.1% of the Tolerable Daily Intake (TDI) of 6 µg/kg bw, to cadmium accounted for 33% and 75% of the Provisional Tolerable Monthly Intake (PTMI) of 25 µg/kg bw, to nickel accounted for 26% and 48% of the TDI of 12 µg/kg bw, and to tin accounted for 0.2% and 1.1-1.2 % of the PTWI of 14 mg/kg bw. All dietary exposure estimates to aluminium, antimony, cadmium, nickel and tin were below their respective health-based guidance values.

5. For lead, health-based guidance values are not available. The estimated exposures to lead for average and high consumers were 0.21 and 0.38 µg/kg bw/day, respectively which were below the level of 1.2 µg/kg bw/day considered by the Joint Food and Agriculture Organization / World Health Organization Expert Committee on Food Additives (JECFA) to have a low risk of increasing the systolic blood pressure in adults.

6. For methylmercury, according to JECFA, exposure up to 3.3 µg/kg bw (i.e. PTWI established in 2000) would not pose any risk of neurotoxicity in adults. However, in the case of women of childbearing age, it should be borne in mind that intake should not exceed the new PTWI of 1.6 µg/kg bw, in order to protect the embryo and foetus. The

estimated dietary exposures of average and high consumers of the population accounted for 22% and 82% of the PTWI of 3.3 µg/kg bw. However, about 11% of women aged 20-49 (childbearing age) had dietary exposure to methylmercury exceeded the PTWI of 1.6 µg/kg bw.

Conclusions and Recommendations

7. The findings suggested that the general adult population was unlikely to experience major undesirable health effects of the seven metallic contaminants mentioned above. The critical effect of methylmercury is on the developing central nervous system and pregnant women are considered to be the most susceptible population because of the potential risk to the foetus. Therefore, methylmercury exposure during pregnancy is a public health concern.

8. The public is advised to maintain a balanced and varied diet so as to avoid excessive exposure to metallic contaminants from a small range of food items. Fish contain many essential nutrients, such as omega-3 fatty acids and high quality proteins. Moderate consumption of a variety of fish is recommended. Pregnant women, women planning pregnancy and young children should avoid eating large or predatory fish and the types of fish which may contain high levels of methylmercury (e.g. tuna, alfonsino, shark, swordfish, marlin, orange roughy and king mackerel).

9. The trade should observe good agricultural and manufacturing practices to minimise metallic contamination of foods, obtain food supplies from reliable sources and maintain proper records to enable source tracing when required.

Chapter 1

Background

1.1 Total Diet Study (TDS) has been recognised internationally as the most cost effective way to estimate dietary exposures to food chemicals or nutrients for various population groups and to assess their associated health risks. It provides a scientific basis for assessing food safety and regulating food supply. Since 1960s, various countries including the United Kingdom (UK), the United States of America (USA), Canada, Australia, New Zealand, and Mainland China have been conducting their own TDS.

Introduction of the First Hong Kong Total Diet Study (1st HKTDS)

1.2 This was the first time a TDS was carried out in Hong Kong by the Centre for Food Safety (CFS). It aimed to estimate dietary exposures of the Hong Kong general population and various population subgroups to a range of substances including contaminants and nutrients, and to assess any associated potential health risks.

1.3 The 1st HKTDS was a large and complex project that comprised food sampling and preparation, laboratory analysis and dietary exposure estimation. It covered the majority of foods normally consumed by the Hong Kong population, with laboratory analysis of over 130 substances including contaminants and nutrients.

Metallic Contaminants

1.4 Metallic contaminants are often present in foods in trace amounts. They can enter the food supply through environmental elements, such as air, soil and water, or during food processing and cooking. For ordinary adults, diet is the main source of exposure to some common metallic contaminants such as lead, cadmium and methylmercury. Although acute poisoning from metallic contaminants is possible, it is more likely that it happens through non-food route. In fact, the chronic toxicity associated with dietary exposure to metallic contaminants is the main concern for general population since they may accumulate in the body and cause organ damage. In Hong Kong, the control on metallic contaminants in food is governed by the Food Adulteration (Metallic Contamination) Regulations, Cap 132V. The Cap 132V stipulates the maximum levels for arsenic, antimony, cadmium, chromium, lead, mercury and tin in foods.

1.5 The 1st HKTDS on inorganic arsenic, the more toxic form of arsenic, was reported in February 2012. This report focused on metallic contaminants, namely, aluminium, antimony, cadmium, lead, methylmercury, nickel and tin. The dietary exposures of the Hong Kong population to these metallic contaminants and their associated potential health risks have been assessed. In addition, vanadium in food was analysed simultaneously with the metallic contaminants mentioned above so its levels in food were also reported.

Chapter 2

Methodology and Laboratory Analysis

Methodology of the 1st HKTDS

2.1 The 1st HKTDS involved purchasing samples of food commonly consumed throughout Hong Kong, preparing them as consumed, homogenising the foods, combining them into food composites, and then analysing them for a range of substances. The analytical results were then combined with food consumption information of various population groups, which were captured from the Hong Kong Population-based Food Consumption Survey (FCS)[1], to obtain the dietary exposures.

2.2 One hundred and fifty TDS food items were selected for the study, based on the food consumption data of the FCS. Three samples of each TDS food item were collected on four occasions from March 2010 to February 2011 and prepared in a form of food normally consumed. A total of 1,800 samples were collected and combined into 600 composite samples for laboratory analysis.

2.3 Dietary exposure estimation was performed with the aid of an in-house developed web-based computer system, Exposure Assessment System, named as EASY, which involved food mapping and weighting of data. The mean and 95th percentile of the exposure levels were used to represent the dietary exposures of average and high consumers of the population, respectively.

2.4 Details of the methodology are given in the same series of report on Methodology.[2]

Laboratory Analysis

2.5 Laboratory analysis of metallic contaminants was conducted by the Food Research Laboratory (FRL) of the CFS. Having taken into account the occurrence in food, all samples of the 150 TDS food items taken from the four occasions have been tested for aluminium, antimony, cadmium, lead, nickel, tin and vanadium. The composite samples were digested in concentrated nitric acid using Teflon high pressure closed vessels and microwave heating. The contents were determined by high resolution inductively coupled plasma – mass spectrometry. The limits of detection (LODs) and limits of quantification (LOQs) in general food as well as in water and tea samples are tabulated as follows:

Metal	general food		water & tea	
	LOD µg/kg	LOQ µg/kg	LOD µg/kg	LOQ µg/kg
Aluminium	100	500	20	100
Antimony	1	5	0.2	1
Cadmium	2	10	0.4	2
Lead	2	10	0.4	2
Nickel	20	100	4	20
Tin	10	50	2	10
Vanadium	3	15	0.6	3

2.6. For methylmercury, 51 TDS food items (204 composite samples) have been tested which were mainly food of animal origin and seafood. The composite samples were washed with acetone and toluene and then hydrolyzed enzymatically by pancreatin. Subsequently, the sample was extracted with 50% v/v hydrochloric acid. An aliquot of the extract was buffered to pH 4.1-5.0 prior to derivatization using sodium tetraphenylborate. The resulting derivative was extracted by iso-octane and the methylmercury content was quantified by gas chromatograph coupled with inductively coupled plasma mass spectrometry. Propylmercury was employed as the internal standard. The LOD and LOQ were 0.3 and 1.5 μg/kg (as mercury) in food, respectively. The levels of methylmercury in food were calculated as mercury. For the estimation of dietary exposures, a conversion factor of 1.075, the molar mass ratio of methylmercury and mercury, was applied to the results so that the estimation was based on methylmercury levels in food.

Treatment of Analytical Values Below LOD

2.7. In this study, recommendation from the World Health Organization (WHO) regarding evaluation of low-level of contamination of food was followed when treating analytical value below LOD.[3] When less than or equal to 60% of results of the concentrations of a metallic contaminant in food were below LOD, the medium bound dietary exposure estimations (a value of 1/2 LOD was assigned to all analytical values below LOD) for the overall population were presented. When more than 60 but less than or equal to 80 % of results were below LOD, dietary exposure estimations of both lower and upper bounds (values of 0 and LOD were assigned to all analytical values below LOD, respectively) were presented.

Chapter 3

Aluminium

3.1 Aluminium is the most abundant metallic element in the Earth's crust. It occurs naturally in the environment as silicates, oxides, and hydroxides, combined with other elements (e.g. sodium and fluoride), and as complexes with organic matter. Aluminium compounds are used as food additives, and can be found in drugs (e.g. antacids, astringents, and buffered aspirin) as well as consumer products such as antiperspirants. Aluminium metal is used as a structural material in the construction, automotive and aircraft industries, in the production of metal alloys, in the electric industry, in cooking utensils and in food packaging. Its powdered form is often used in explosives and fireworks. They are also widely used in water treatment as coagulants.[4,5]

Sources of Exposure

3.2 The major route of exposure to aluminium for the general population is through food. Aluminium in drinking water represents another minor source of exposure.[6] Sources of exposure to aluminium other than in the diet were air, cosmetic, and toiletry products, as well as medicines. Aluminium is present in drinking water at usual levels of less than 0.2 mg/L, and is also present in most foods naturally (normally at levels of less than 5 mg/kg) or due to the use of aluminium cooking utensils and foil, in which the magnitude of this increase is generally not of practical importance. Tea leaves may contain very high concentrations of aluminium, >5000 mg/kg in old leaves.[5] Black tea infusion (normally prepared) had an aluminium concentration of 4.2 mg/l.[6] Aluminium is also present in food owing to the use of aluminium-containing food additives, which has been regarded as the main dietary source.[4,7]

Toxicity

3.3 Aluminium compounds are not likely to cause acute adverse effects. There was no evidence that aluminium compounds have carcinogenic potential. Available toxicological data from animal studies demonstrated that aluminium compounds may affect development. Regarding neurotoxicity, there was no conclusive evidence to demonstrate the association of aluminium with Alzheimer's disease. In 2006, the Joint Food and Agriculture Organization / World Health Organization Expert Committee on Food Additives (JECFA) concluded that no pivotal epidemiology studies were available for the risk assessment.[7]

3.4 In 2011, JECFA reviewed the Provisional Tolerable Weekly Intake (PTWI) for aluminium. The Committee established a PTWI of 2 mg/kg body weight (bw) based on a developmental and chronic neurotoxicity study in experimental animals.[8]

The Previous Local Study

3.5 The CFS conducted a study on aluminium in food in 2009. The study covered food products in which aluminium-containing food additives might have been used. The average dietary exposure to aluminium of a 60-kg adult was estimated to be 0.60 mg/kg bw/week, which accounted for 60% of the old PTWI (1 mg/kg bw) established by JECFA in 2006. Steamed bread, buns, and cakes were the largest contributors to the total dietary exposure to aluminium, accounting for about 60% of the total exposure. The results indicated that dietary exposure to aluminium was unlikely to cause adverse health effects for the general population. However, the risk to some populations who regularly consume foods with aluminium-containing food additives cannot be ruled out.[9] The previous study focused on food products that were likely to contain aluminium-containing food additives while the current study covered the whole diet and therefore the intake of aluminium from natural food sources and drinking water had been taken into account.

Results and Discussion

Concentrations of Aluminium in TDS Foods

3.6 A total of 600 composite samples on four occasions were tested for aluminium and the results in 15 TDS food groups are summarised in Table 3.1 and the results in 150 TDS food items are shown in Table A in Appendix I.

Table 3.1. Aluminium Content (mg/kg) in TDS Food Groups of the 1st HKTDS

Food Group	Number of composite samples	% of composite samples < LOD	Mean (mg/kg) [range]	
Cereals and their products	76	13	20	ND-450
Vegetables and their products	140	19	4.1	ND-45
Legumes, nuts and seeds and their products	24	0	5.5	0.11-31
Fruits	68	68	0.25	ND-2.8
Meat, poultry and game and their products	48	19	2.5	ND-19
Eggs and their products	12	67	0.23	ND-0.91
Fish and seafood and their products	76	50	4.9	ND-110
Dairy products	20	45	1.2	ND-12
Fats and oils	8	100	0.050	ND
Beverages, alcoholic	8	50	0.21	ND-0.47
Beverages, non-alcoholic	40	40	1.9	ND-14
Mixed dishes	48	2	16	ND-240
Snack foods	4	0	6.4	3.1-15
Sugars and confectionery	8	50	5.6	ND-19
Condiments, sauces and herbs	20	20	4.3	ND-11
Total	600	31		

Notes: ND denotes non-detected, i.e. results less than LOD.

3.7 In this study, about one third (31%) of the composite samples were not detected with aluminium. The highest aluminium level was detected in food group "cereals and their products" (mean: 20 mg/kg). By comparing the aluminium levels in 150 food items, deep-fried dough was found to contain the highest level (mean: 250 mg/kg), followed by steamed barbecued pork bun (mean: 170 mg/kg) and oyster (mean: 62 mg/kg). Aluminium naturally present in most foods at low level. The high levels of aluminium found in the deep-fried dough and steamed barbecued pork bun was likely to be caused by the use of aluminium-containing additives as raising agents in these products. As for oysters, they are known to accumulate metallic contaminants in their tissue in proportion to their surrounding environment. The mean aluminium concentration found in oyster samples in this study was comparable to that of a study conducted by the US Food and Drug Administration in 1996.[5]

3.8 The aluminium levels of certain leafy vegetables (e.g. Chinese spinach, range 25-35 mg/kg) were relatively high when compared to other plant foods. It may partly due to the ability to uptake of aluminium from soil of this leafy vegetable. It was reported that the uptake factor (concentration of aluminium in the plant/concentration of aluminium in soil) of leafy vegetables was six times of than that of fruits and tubers.[5]

Dietary Exposure to Aluminium

3.9 The PTWI established by JECFA in 2011 was 2 mg/kg bw. Dietary exposures to aluminium of average and high consumers of the population were 0.60 mg/kg bw/week and 1.5 mg/kg bw/week which accounted for 30% and 77% of the PTWI, respectively. The dietary exposure of average consumers was in line with that obtained in the previous study in 2009.

3.10 The breakdowns of dietary exposures of the individual age-gender population subgroups are shown in Figure 3.1 and Table A in Appendix II. Except high consumers of male aged 70-84 who had dietary exposure (2.1 mg/kg bw/week) slightly exceeded the PTWI, the dietary exposures of all individual age-gender population subgroups were below the PTWI. Therefore, the general population was unlikely to experience major undesirable health effects of aluminium. Although high consumers of a population subgroup was found slightly exceeding the PTWI, an intake above the PTWI does not automatically mean that health is at risk provided that the average intake over long period is not exceeded as PTWI is emphasised on a lifetime exposure.

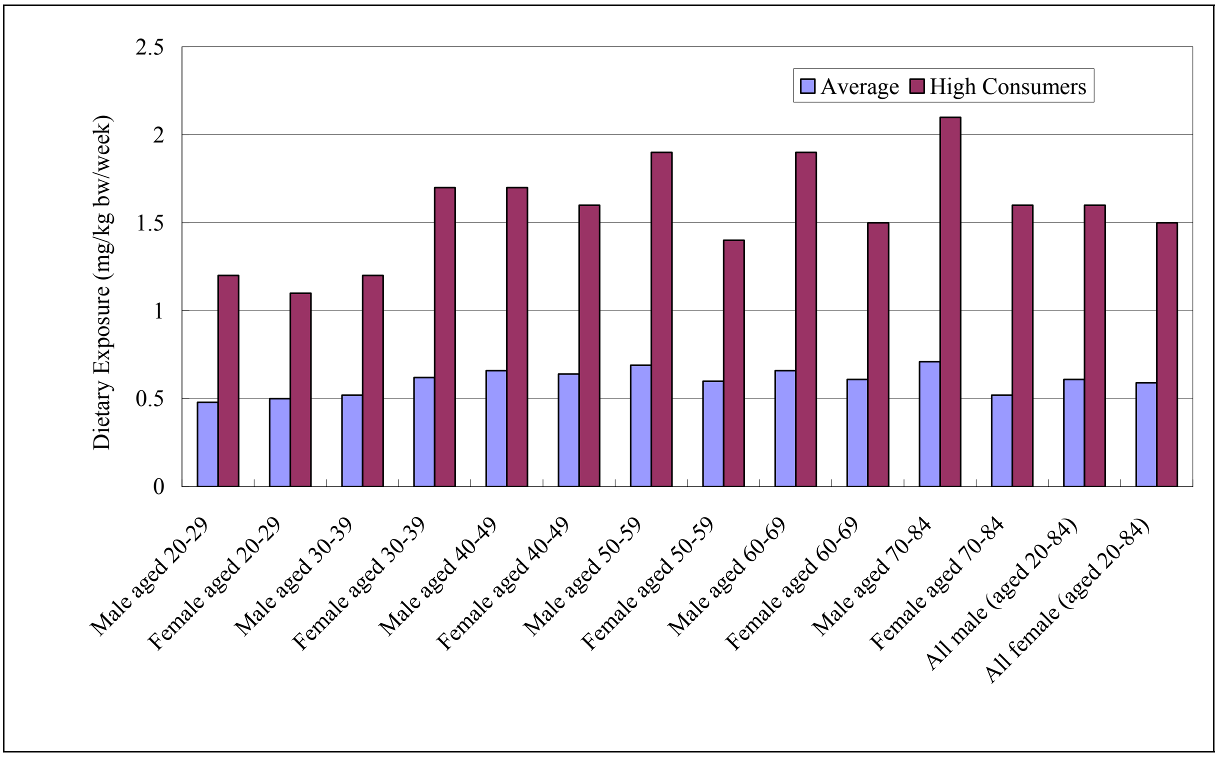

Figure 3.1. Dietary Exposures to Aluminium of Average and High Consumers by Individual Age-gender Groups

Major Food Contributors

3.11 The percentage contribution to dietary exposures to aluminium of an average consumer by food groups is shown in Figure 3.2. The main dietary source of aluminium was "beverages, non-alcoholic" which contributed to 33% of the total exposure. Among non-alcoholic beverages, milk tea contained the highest level (11 mg/kg) of aluminium, followed by Chinese tea and malt drinks (3.2 mg/kg each). These levels were not considered as high. However, due to the high consumption (1625 g/person/day) of non-alcoholic beverages, they became the major food contributor of aluminium. Similar finding were also revealed in a TDS of Australia in 2011 where Australians aged 17 years and above, tea (35%) was the major contributor to aluminium dietary exposures followed by "cakes, muffin and puddings" (23%).[10]

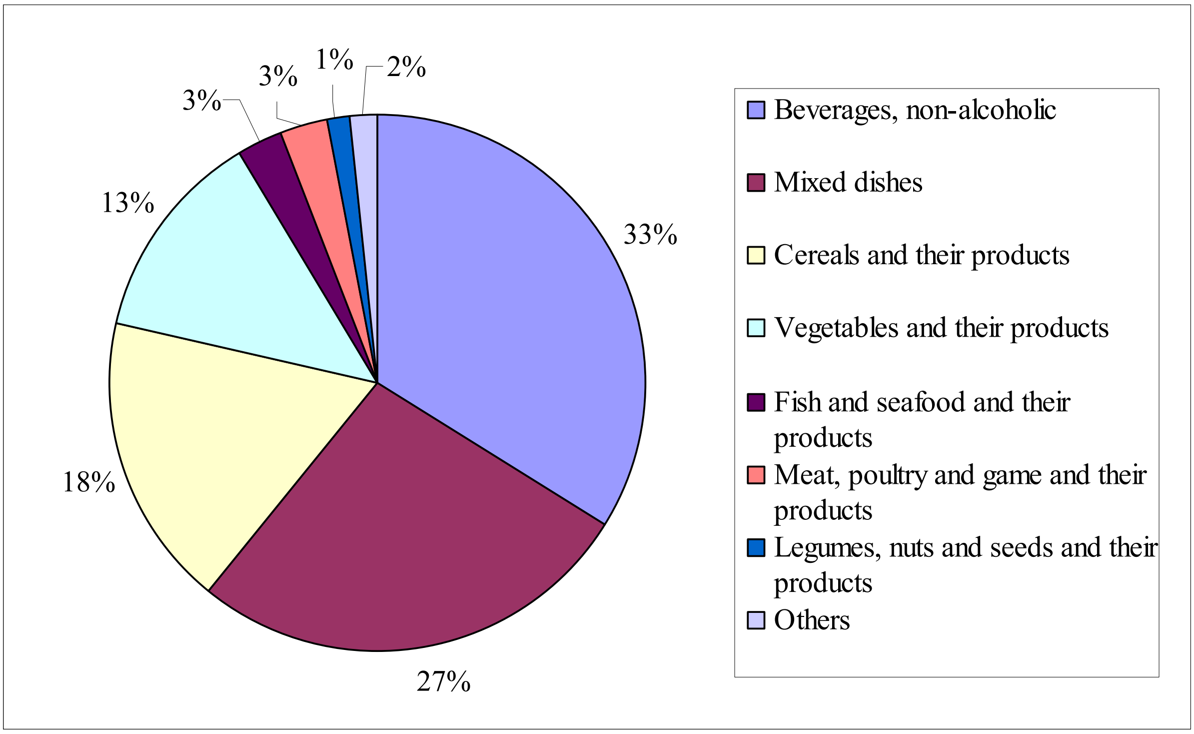

Figure 3.2. Percentage Contribution to Dietary Exposure to Aluminium by Food Groups

International Comparison

3.12 The dietary exposures to aluminium found in current study were compared to those obtained from other places and are summarised in Table

3.2. The dietary exposures estimated in our study were comparable with exposure estimates obtained from other places. However, direct comparison of the data has to be done with caution due to the difference in time when the studies were carried out, research methodology, methods of collection of consumption data, methods of contaminants analysis and methods of treating results below detection limits.

Table 3.2. A Comparison of Dietary Exposures to Aluminium

Places	Dietary Exposure of Adult (mg/kg bw/week)	
	Average Consumers	High Consumers
Europe 2008[6]	0.2-1.3[a]	-
Australia 2011[10]	0.27-0.28[b]	0.51-0.52 (90th percentile)
Ireland 2011[11]	0.35	0.77 (97.5th percentile)
UK 2006[12]	0.50 [c]	1.0 (97.5th percentile)
Hong Kong (current study)	0.60	1.5 (95th percentile)
Canada 2007[13]	0.63-0.81[d]	-
China 2011[14]	0.64-2.9	-
USA 1995[15]	0.70–0.90 [e]	-

Notes:

[a] Exposure data of different European countries (i.e. Netherlands Hungary, Germany, Italy, Sweden and France) were presented in range. The dietary exposures of the average consumer were 2.03-13 mg/day (i.e. about 0.20-1.3 mg/kg bw/week for a 70-kg adult).

[b] Exposure data of lower and upper bound were presented in range. The dietary exposures of the average consumer were 2.7-2.8 mg/day (i.e. about 0.27-0.28 mg/kg bw/week for a 70-kg adult) and for high consumer were 5.1-5.2 mg/day (i.e. about 0.51-0.52 mg/kg bw/week for a 70-kg adult).

[c] The dietary exposures of the average consumer were 71 μg/kg bw/day (i.e. about 0.50 mg/kg bw/week) and of the high consumer were 144 μg/kg bw/day (i.e. about 1.0 mg/kg bw/week).

[d] Exposure data of different groups of male and female from 20+ to 65+years were presented in range.

[e] Exposure data of male and female adult were presented in range. The dietary exposures of the average consumer were 7-9 mg/day (i.e. about 0.70-0.90 mg/kg bw/week for a 70-kg adult).

Summary

3.13 The dietary exposures to aluminium for average and high consumers of the population accounted for 30% and 77% of the PTWI, respectively. On this basis, the general population was unlikely to experience major undesirable health effects of aluminium.

Chapter 4

Antimony

4.1 Antimony has been classified as both a metal and a metalloid. It is a silvery-white, brittle solid present in the Earth's crust. Antimony has four valence states, with the trivalent form being the most common and stable.[16,17,18] Antimony, usually in the form of antimony trioxide, enters the environment mainly as a result of industrial activities such as coal burning or smelting of antimony-containing ores. Antimony can also be naturally present in the environment via weathering of rocks and runoff from soils. Antimony compounds have also been used for treating diseases such as parasitic infection in humans. On the other hand, antimony oxide can be used in fire-retardant formulations for plastics, rubbers, textiles, paper, and paints whereas antimony trisulfide is used in the production of explosives, pigments, antimony salts, and ruby glass.[16,18,19]

<u>Sources of Exposure</u>

4.2 Once released, most antimony ends up in soil with low level in air and water. It is not degradable in the nature and it does not bio-accumulate in living organisms. Therefore, dietary exposure to antimony is expected to be low. Antimony has been reported to be present in food, including fruit, vegetables, meat, freshwater fish, meat and poultry, with higher level being detected in marine food. Trace amount of antimony in tap water may leach from household piping and non-leaded solders under certain condition, e.g. after 7 days of contact.[16,18,20]

Toxicity

4.3 Chronic occupational exposure to lower doses of antimony compounds may lead to myocardial effects.[18] Repeated oral exposure to therapeutic doses of antimony(III) in humans was associated to optic nerve destruction, uveitides and retinal bleeding, generally accompanied by symptoms including headache, coughing, anorexia, troubled sleep and vertigo.[20] Regarding reproductive and developmental toxicity, there is no conclusive evidence demonstrating such effects.[18,20]

4.4 WHO in 2003 concluded that soluble antimony(III) salts are genotoxic *in vitro* and *in vivo* whereas antimony trioxide, due to its low bioavailability, is genotoxic only in some *in vitro* tests but not *in vivo*.[20] The International Agency for Research on Cancer (IARC) of the WHO classified antimony trioxide as Group 2B agent (i.e. possibly carcinogenic to humans) and antimony trisulfide as Group 3 agent (i.e. not classifiable as to its carcinogenicity to humans), respectively.[19]

4.5 JECFA has not evaluated the safety of antimony. In developing the Guidelines for Drinking-water Quality, WHO in 2003 established a Tolerable Daily Intake (TDI) of 6 μg/kg bw for antimony.[20]

The Previous Local Study

4.6 The CFS conducted a study on dietary exposure to antimony of secondary school students in 2007.[21] The dietary exposures to antimony for average and high consumers of the secondary school students were 0.036 and 0.081 μg/kg bw/day, respectively. Both levels fell well below the TDI of 6 μg/kg bw/day and accounted to less than 2% of this safety reference value. The study concluded that both the average and high consumers of the secondary school students were unlikely to experience major toxicological effects of antimony.

Results and Discussion

Concentrations of Antimony in TDS Foods

4.7 A total of 600 composite samples on four occasions were tested for antimony and the results in 15 TDS food groups are summarised in Table 4.1 and the results in 150 TDS food items are shown in Table B of Appendix I.

Table 4.1. Antimony Content (μg/kg) in TDS Food Groups of the 1st HKTDS

Food Group	Number of composite samples	% of composite samples < LOD	Mean (μg/kg) [range]	
Cereals and their products	76	46	2	ND-8
Vegetables and their products	140	76	0.9	ND-5
Legumes, nuts and seeds and their products	24	33	1	ND-7
Fruits	68	85	0.7	ND-5
Meat, poultry and game and their products	48	42	3	ND-13
Eggs and their products	12	75	1	ND-2
Fish and seafood and their products	76	66	2	ND-18
Dairy products	20	80	1	ND-6
Fats and oils	8	88	0.6	ND-1
Beverages, alcoholic	8	63	0.7	ND-4
Beverages, non-alcoholic	40	73	1	ND-3
Mixed dishes	48	54	1	ND-5
Snack foods	4	50	1	ND-2
Sugars and confectionery	8	13	4	ND-14
Condiments, sauces and herbs	20	40	1	ND-7
Total	600	63		

Notes: ND denotes non-detected, i.e. results less than LOD.

4.8 In this study, about two third (63%) of the composite samples were not detected with antimony. Antimony was detected in low levels in all of the food groups which agreed with those reported in literature.[20]

Dietary Exposure to Antimony

4.9 The dietary exposures to antimony of average and high consumers of the population were 0.016-0.039 μg/kg bw/day and 0.031-0.063 μg/kg bw/day which accounted for only 0.3-0.7% and

0.5-1.1% of the TDI established by WHO, respectively. Therefore, the general population was unlikely to experience major undesirable health effects of antimony.

4.10 The estimated dietary exposures of this study were comparable to those (0.036 and 0.081 μg/kg bw/day) of secondary school students found in the previous study in 2007.

Major Food Contributors

4.11 As the dietary exposure to antimony of an average consumer from all food groups contributed to less than 1% of the TDI, none of the food groups could be considered as a significant food contributor.

International Comparison

4.12 The dietary exposures estimated in our study were comparable with those reported by the studies of Australia and UK (Table 4.2). However, direct comparison of the data has to be done with caution due to the difference in time when the studies were carried out, research methodology, methods of collection of consumption data, methods of contaminants analysis and methods of treating results below detection limits.

Table 4.2. A Comparison of Dietary Exposures to Antimony

Places	Dietary Exposure of Adult (µg/kg bw/day)	
	Average Consumers	High Consumers
Australia 2003[22]	<0.01-0.08	-
Hong Kong (current study)	0.016-0.039	0.031-0.063 (95th percentile)
UK 2006[12]	0.030	0.060 (97.5th percentile)

Summary

4.13 The dietary exposures to antimony for average and high consumers of the population accounted for only 0.3-0.7% and 0.5-1.1% of the TDI of 6 µg/kg bw/day, respectively. On this basis, the general population was unlikely to experience major undesirable health effects of antimony.

Chapter 5

Cadmium

5.1 Cadmium is a metallic element that occurs naturally in the Earth's crust. Cadmium has a number of industrial applications such as electroplating, pigment production, manufacture of plastic stabilisers and pigments, nickel-cadmium batteries, and electronics, etc.[23] Cadmium is emitted to soil, water, and air by non-ferrous metal mining and refining, manufacture and application of phosphate fertilizers, fossil fuel combustion, and waste incineration and disposal. Cadmium can accumulate in aquatic organisms and agricultural crops.[24]

Sources of Exposure

5.2 The pathways of exposure to cadmium include air, water, food, and cigarette smoking. Food represents the major source of cadmium exposure, although tobacco smoking adds significantly to the body's burden. Highest cadmium levels are found in the kidney and liver of mammals fed with cadmium-rich diets and in certain species of oysters, scallops, mussels and crustaceans. Lower cadmium concentrations are found in vegetables, cereals and starchy roots. Owing to the larger consumption of such food items, they represent the greater part of daily cadmium intake in most populations. Some crops, such as rice, can accumulate high concentrations of cadmium if grown on cadmium-polluted soil. Acidification of cadmium-containing soils may increase the cadmium concentrations in crops.[23]

Toxicity

5.3 The acute toxicity of cadmium due to dietary exposure is very unlikely. With chronic toxicity to cadmium, the kidney is the critical target organ. Cadmium accumulates primarily in the kidneys, and its biological half-life in humans is 10–35 years. This accumulation may lead to renal tubular dysfunction, which results in increased excretion of low molecular weight proteins in the urine. This is generally irreversible. High intake of cadmium can lead to disturbances in calcium metabolism and the formation of kidney stones.[23]

5.4 IARC in 1993 classified cadmium and cadmium compounds as Group 1 agents (i.e. carcinogenic to humans) upon occupational exposure.[25] However, available evidence suggested that cadmium did not appear to have significant genotoxic and carcinogenic potential via the oral route. JECFA in 2010 established a Provisional Tolerable Monthly Intake (PTMI) of 25 μg/kg bw to cadmium.[26]

Previous Study

5.5 The FEHD conducted a study on dietary exposure to heavy metals of secondary school students in 2002. Dietary exposure to cadmium was estimated by using the local food consumption data obtained in secondary school students in 2000 and the concentrations of cadmium in food samples taken from the local market. It was estimated that the dietary exposures to cadmium for average and high consumers were 2.49 and 5.71 μg/kg bw/week (~10 and 23 μg/kg bw/month), respectively.

They fell within the old PTWI 7 µg/kg bw/ week for cadmium established by JECFA in 1998.[27]

Results and Discussion

Concentrations of Cadmium in TDS Foods

5.6 A total of 600 composite samples on four occasions were tested for cadmium and the results in 15 TDS food groups are summarised in Table 5.1 and the results in 150 TDS food items are shown in Table C of Appendix I.

Table 5.1. Cadmium Content (µg/kg) in TDS Food Groups of the 1st HKTDS

Food Group	Number of composite samples	% of composite samples < LOD	Mean (µg/kg)	[range]
Cereals and their products	76	9	12	ND-70
Vegetables and their products	140	7	33	ND-310
Legumes, nuts and seeds and their products	24	25	53	ND-290
Fruits	68	88	1	ND-7
Meat, poultry and game and their products	48	63	5	ND-46
Eggs and their products	12	100	1	ND
Fish and seafood and their products	76	51	150	ND-1800
Dairy products	20	85	1	ND-6
Fats and oils	8	100	1	ND
Beverages, alcoholic	8	100	1	ND
Beverages, non-alcoholic	40	80	1	ND-7
Mixed dishes	48	8	8	ND22
Snack foods	4	0	120	80-150
Sugars and confectionery	8	50	39	ND-120
Condiments, sauces and herbs	20	40	14	ND-58
Total	600	42		

Notes: ND denotes non-detected, i.e., results less than LOD.

5.7 In this study, 42% of the composite samples were not detected with cadmium. The highest cadmium level was detected in food group "fish and seafood and their products" (mean: 150 μg/kg). By comparing the cadmium levels in 150 food items, oyster was found to contain the highest level (mean: 1300 μg/kg), followed by scallop (mean: 730 μg/kg) and crab (mean: 540 μg/kg). These results agreed with findings from literature that certain species of oysters, scallops, mussels, and crustaceans contained relatively high levels of cadmium.[23]

Dietary Exposure to Cadmium

5.8 The PTMI for cadmium established by JECFA in 2010 is 25 μg/kg bw. Dietary exposures to cadmium of average and high consumers of the population were 8.3 μg/kg bw/month and 19 μg/kg bw/month which accounted for 33% and 75% of the PTMI, respectively. These exposure estimates were comparable to those (10 and 23 μg/kg bw/month) for secondary school students found in the previous study in 2002.

5.9 The breakdowns of dietary exposures of the individual age-gender population subgroups are shown in Figure 5.1 and Table C of Appendix II. Except high consumers of male aged 30-39 who had dietary exposure (25 μg/kg bw/month) slightly exceeded the PTMI, the dietary exposures of all individual age-gender population subgroups were below the PTMI. Therefore, the general population was unlikely to experience major undesirable health effects of cadmium. Although high consumers of a population subgroup was found slightly exceeding the PTMI, an intake above the PTMI does not automatically mean that health is at risk provided that the average intake over long period is not exceeded as PTMI is emphasised on a lifetime exposure.

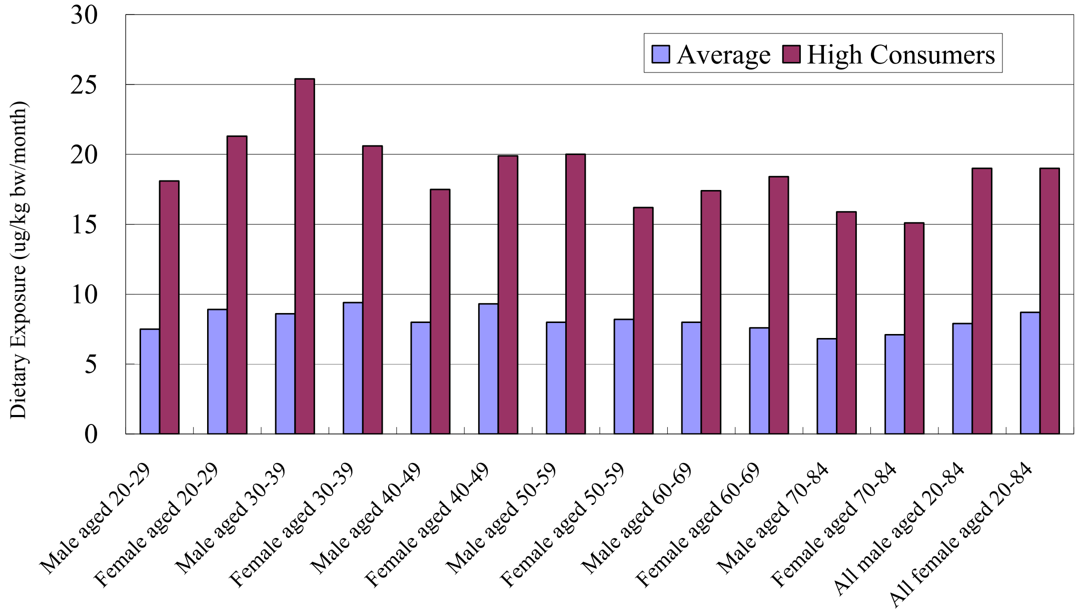

Figure 5.1. Dietary Exposures to Cadmium of Average and High Consumers by Individual Age-gender Groups

Major Food Contributors

5.10 The percentage contribution to dietary exposures to cadmium for an average consumer by food groups is shown in Figure 5.2. The main dietary source of cadmium was “vegetables and their products”, “fish and seafood and their products” and “cereals and their products” which contributed to 36%, 26% and 21% of the total exposure, respectively. The major food contributors of cadmium of different populations depend on consumption patterns and the cadmium levels in foods. For examples, similar to our findings, in New Zealand, seafood (oysters and mussels), cereals, and vegetables (carrots and potatoes) were major food contributors of cadmium.[28] A Korean study also showed that seaweed, fish, seafood and vegetables were major food contributors of cadmium.[29] However, in Australia and Europe, cereals and vegetables were reported as major food contributors of cadmium while fish and seafood were not.[10,30]

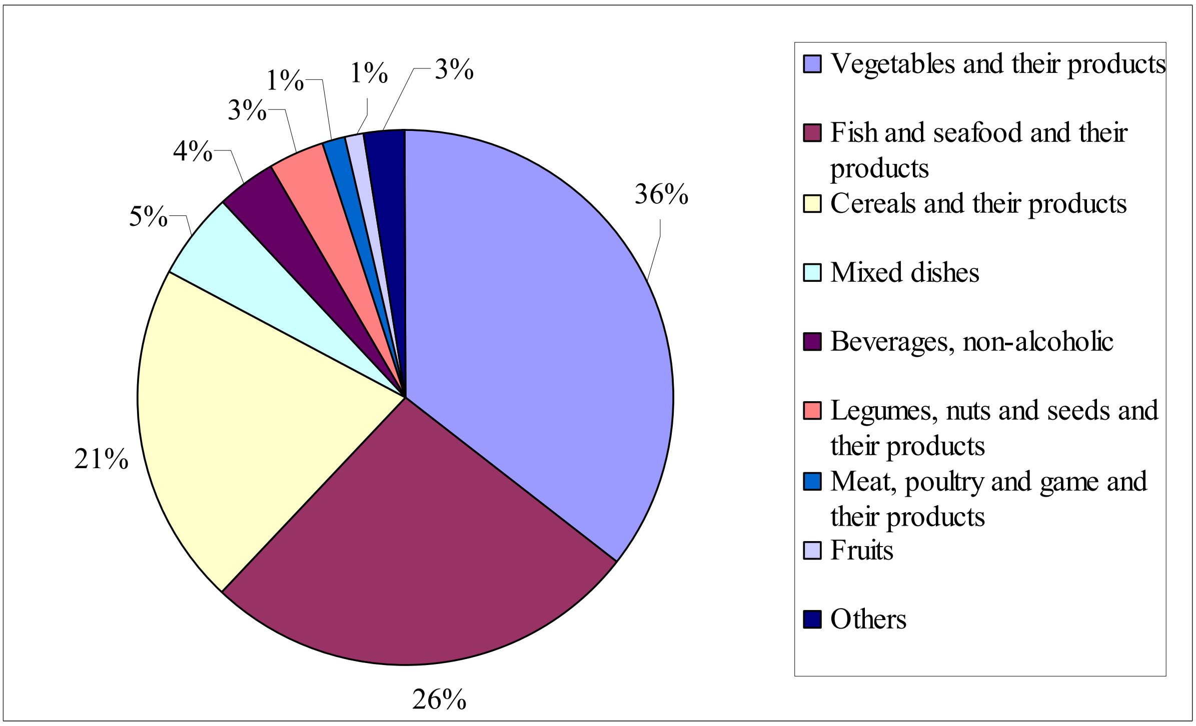

Figure 5.2. Percentage Contribution to Dietary Exposure to Cadmium by Food Groups

International Comparison

5.11 The dietary exposures to cadmium found in current study were compared to those obtained from other places and are summarised in Table 5.2. The dietary exposure estimates in our study are comparable with exposure estimates obtained from other places. However, direct comparison of the data has to be done with caution due to the difference in time when the studies were carried out, research methodology, methods of collection of consumption data, methods of contaminants analysis and methods of treating results below detection limits.

Table 5.2. A Comparison of Dietary Exposures to Cadmium

Places	Dietary Exposure of Adult (μg/kg bw/month)	
	Average Consumers	High Consumers
Australia 2011[10]	2.8-3.4[a]	5.2-5.8 (90th percentile)
USA 2002[31]	3.2-6.3[b]	-
UK 2006[12]	4.2-5.1[c]	7.5-8.7 [d] (97.5th percentile)
Canada 2007[13]	4.5-7.5[d]	-
New Zealand 2009[28]	5.5-6.8[e]	-
Europe 2012[30]	7.6[f]	13.4 (95th percentile)
South Korea 2006[29]	7.7[g]	-
Hong Kong (current study)	8.3	19 (95th percentile)
Ireland 2011[11]	10-13[h]	23-26 (97.5th percentile)
China 2006[32]	11[i]	-
Japan 2011[26]	12	-

Notes:
[a] The dietary exposures of the average consumer were 0.0065-0.0079 mg/day (i.e. about 2.8-3.4 μg/kg bw/month for a 70-kg adult).
[b] The dietary exposures of the average consumer (male and female 20-50 yrs) were 6.4-12.5 μg/day (i.e. about 3.2-6.3 μg/kg bw/month for a 60-kg adult).
[c] The dietary exposures of the average consumer were 0.14-0.17 μg/kg bw/day (i.e. about 4.2-5.1 μg/kg bw/month) and of the high consumer were 0.25-0.29 μg/kg bw/day (i.e. about 7.5-8.7 μg/kg bw/month).
[d] Exposure data of different groups of male and female from 20+ to 65+yrs were presented in range. The dietary exposures of the average consumer were 0.15-0.25 μg/kg bw/day (i.e. about 4.5-7.5 μg/kg bw/month).
[e] Exposure data of males, 25+ years male and 25+ years female were presented in range.
[f] The median dietary exposures of the average consumer was 1.77 μg/kg bw/week (i.e. about 7.6 μg/kg bw/month) and of the high consumer was 3.13μg/kg bw/week (i.e. about 13.4 μg/kg bw/month).
[g] The dietary exposures of the average consumer (>1 yrs) was 1.8 μg/kg bw/week (i.e. about 7.7 μg/kg bw/month).
[h] The dietary exposures of the average consumer were 0.34-0.44 μg/kg bw/day (i.e. about 10-13 μg/kg bw/month) and of high consumer were 0.77-0.87 μg/kg bw/day (i.e. about 23-26 μg/kg bw/month).
[i] The dietary exposures of the adult males were 22.2 μg/ day (i.e. about 11 μg/kg bw/month for a 63 kg males stated in the report)

Summary

5.12 Dietary exposures to cadmium of average and high consumers of the population were 8.3 μg/kg bw/month and 19 μg/kg bw/month which accounted for 33% and 75% of the PTMI, respectively. On this basis, the general population was unlikely to experience major undesirable health effects of cadmium.

Chapter 6

Lead

6.1 Lead occurs in the environment both naturally and, to a greater extent, from human activities such as mining and smelting, battery manufacturing and the use of leaded petrol (gasoline). Lead contamination of food arises mainly from the environment or from food processing, food handling and food packaging. Atmospheric lead can contaminate food through deposition on agricultural crops. Water is another source of lead contamination of food. Although lead exists in both organic and inorganic forms, only inorganic lead has been detected in food.[26]

Sources of Exposure

6.2 Lead can enter the human body via ingestion, inhalation, and skin absorption. For those people who are involved in occupations such as painting and decorating, plumbing, construction work, and car repair, they are exposed to higher levels of lead from their work environment. For ordinary adults, diet is the main source of lead exposure whereas diet, air and dust or soil are the main exposure sources for children. Young children frequently put their fingers and other objects into their mouths, and thus are more prone to ingestion of lead paint chips and house dust or soil that may contain lead particles. For tobacco smokers, smoking is another source of lead exposure. As lead can exist as an airborne contaminant, all people are exposed to certain amounts of lead through breathing.[33] In Hong Kong, lead pipes and fittings are not used in the plumbing system, therefore drinking water is not a significant source of lead (average concentration <0.003 mg/L) in the territory.[34]

Toxicity

6.3 Lead is a classical chronic or cumulative poison. Health effects are generally not observed after a single exposure.[33] The central nervous system is the main target organ for lead toxicity. JECFA in 2010 concluded that for children, the weight of evidence is greatest, and evidence across studies is most consistent, for an association of blood lead levels with impaired neurodevelopment, specifically reduction of intelligence quotient (IQ). Moreover, this effect has generally been associated with lower blood lead concentrations than those associated with the effects observed in other organ systems. For adults, the adverse effect associated with lowest blood lead concentrations for which the weight of evidence is greatest and most consistent is a lead-associated increase in systolic blood pressure.[35]

6.4 IARC in 2006 classified inorganic lead compounds as Group 2A agent (i.e. probably carcinogenic to humans) and organic lead compounds as Group 3 agent (i.e., not classifiable as to its carcinogenicity to humans).[36] JECFA in 2010 withdrew the PTWI of 25 µg/kg bw/week established in 1999 for lead as it could no longer be considered health protective. JECFA concluded that for children aged 1-4 years of age, a lead exposure of 0.3 µg/kg bw/day may result in population decrease of 0.5

IQ points. For adults, an exposure of 1.2 µg/kg bw/day may result in a population increase in systolic blood pressure of 1 mmHg (0.1 kPa).[35]

Previous Study

6.5 The FEHD conducted a study on the dietary exposure to lead of the secondary school students in Hong Kong in 2005. Dietary exposure to lead was estimated by using the local food consumption data obtained in secondary school students in 2000 and the concentrations of lead in food samples taken from the local market. The dietary exposures to lead for average and high consumers of secondary school students were 1.98 and 5.09 µg/kg bw/week (~0.28 and 0.73 µg/kg bw/day), respectively. Both levels were well below the old PTWI of 25 µg/kg bw/week for lead established by JECFA in 1986.[37]

Results and Discussion

Concentrations of Lead in TDS Foods

6.6 A total of 600 composite samples on four occasions were tested for lead and the results in 15 TDS food groups are summarised in Table 6.1 and the results in 150 TDS food items are shown in Table D of Appendix I.

Table 6.1. Lead Content (μg/kg) in TDS Food Groups of the 1st HKTDS

Food Group	Number of composite samples	% of composite samples < LOD	Mean (μg/kg) [range]	
Cereals and their products	76	17	7	ND-40
Vegetables and their products	140	10	21	ND-280
Legumes, nuts and seeds and their products	24	0	19	4-120
Fruits	68	15	5	ND-32
Meat, poultry and game and their products	48	0	9	3-50
Eggs and their products	12	0	6	3-9
Fish and seafood and their products	76	1	24	ND-300
Dairy products	20	25	4	ND-7
Fats and oils	8	0	5	2-7
Beverages, alcoholic	8	25	6	ND-14
Beverages, non-alcoholic	40	23	4	ND-19
Mixed dishes	48	0	11	4-27
Snack foods	4	0	7	6-7
Sugars and confectionery	8	0	9	ND-29
Condiments, sauces and herbs	20	10	12	ND-32
Total	600	9.8		

Notes: ND denotes non-detected, i.e. results less than LOD.

6.7 In this study, only 9.8% of the composite samples were not detected with lead. The highest lead level was detected in food group "fish and seafood and their products" (mean: 24 μg/kg), followed by "vegetables and their products" (mean: 21 μg/kg) and "legumes, nuts and seeds and their products" (mean: 19 μg/kg). By comparing the lead levels in 150 food items, oyster was found to contain the highest level (mean: 230 μg/kg), followed by ear fungus (mean: 100 μg/kg) and watercress (mean: 96 μg/kg).

Dietary Exposure to Lead

6.8 Dietary exposures to lead of average and high consumers of the population were 0.21 µg/kg bw/day and 0.38 µg/kg bw/day, respectively. They were lower than the exposure estimates for secondary school students (0.28 and 0.73 µg/kg bw/day) found by the previous study in 2005.

6.9 As mentioned previously, there is currently no safety reference value established by JECFA for lead, so the risk assessment has been based on the Margin of Exposure (MOE)[i] approach. According to JECFA, an exposure of 1.2 µg/kg bw/day may result in a population increase in systolic blood pressure in adults. This level is an approximate estimation of where the risk of an adverse effect is considered to be low, if the exposure is equal or lower than this level, the risk is considered to be acceptably low (i.e., MOE>1).[10] Our results showed that the MOEs of average and high consumers were 6 and 3, respectively.

6.10 The breakdowns of dietary exposures of the individual age-gender population subgroups are shown in Figure 6.1 and Table D of Appendix II.

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[i] The MOE was calculated by dividing the dose at which adverse effect (increase in systolic blood pressure of 1 mm Hg in adults) by the estimated exposure to lead from food.

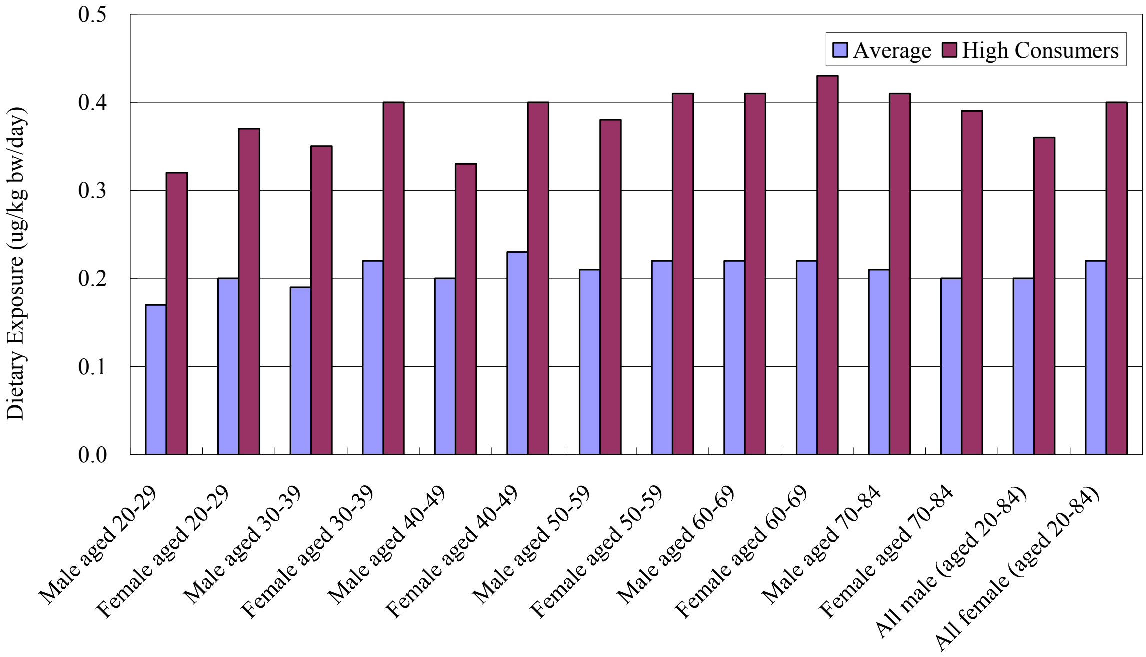

Figure 6.1. Dietary Exposures to Lead of Average and High Consumers by Individual Age-gender Groups

Major Food Contributors

6.11 The percentage contribution to dietary exposures to lead of an average consumer by food groups is shown in Figure 6.2. The main dietary source of lead was "vegetables and their products" which contributed to 30% of the total exposure. Other major sources were "non-alcoholic beverage", "mixed dishes" and "cereals and their products" which contributed to 16%, 14% and 13% of the total exposure, respectively.

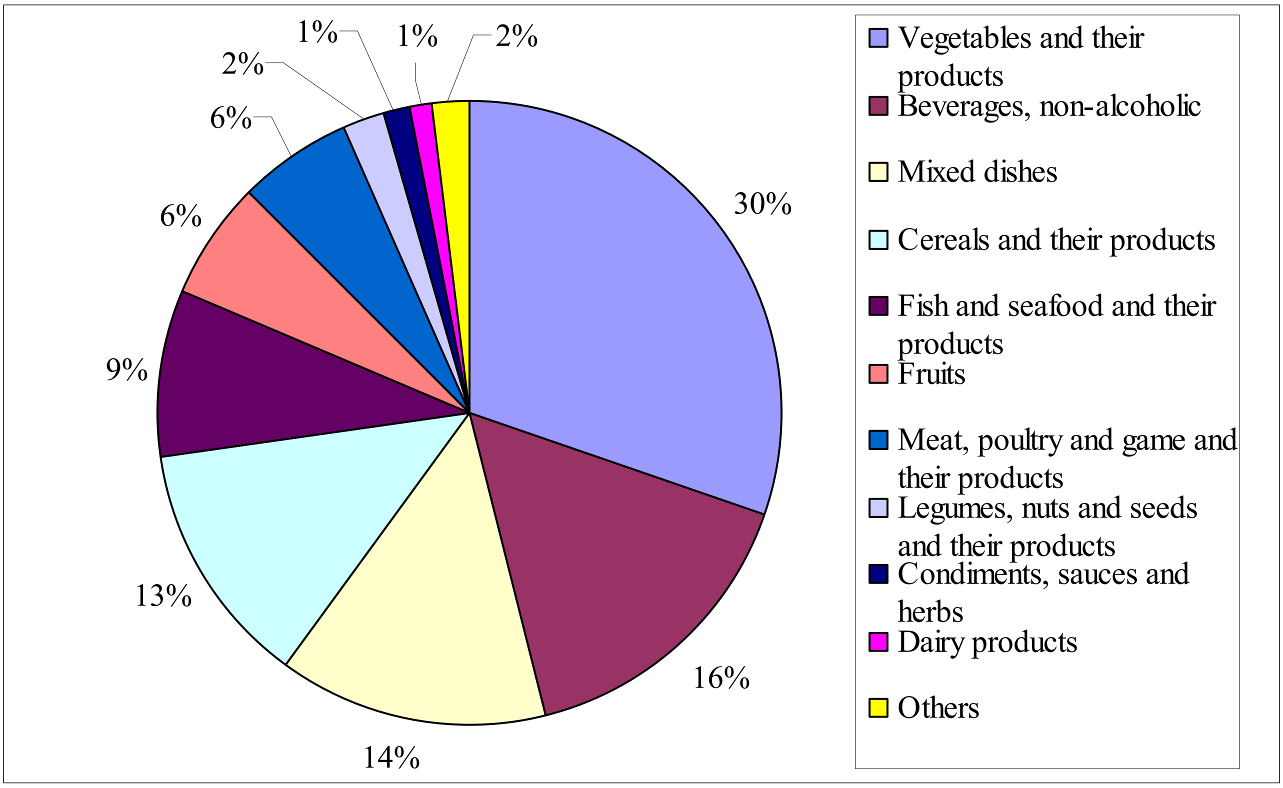

Figure 6.2. Percentage Contribution to Dietary Exposure to Lead by Food Groups

International Comparison

6.12 The dietary exposures to lead found in current study were compared to those obtained from other places and are summarised in Table 6.2. It can be seen that the dietary exposure estimates in our study are comparable with those obtained from other places. However, direct comparison of the data has to be done with caution due to the difference in time when the studies were carried out, research methodology, methods of collection of consumption data, methods of contaminants analysis and methods of treating results below detection limits.

Table 6.2. A Comparison of Dietary Exposures to Lead

Places	Dietary Exposure of Adult (μg/kg bw/day)	
	Average Consumers	High Consumers
Ireland 2011[11]	0.04-0.15	0.11-0.27(97.5th percentile)
USA 2002[32]	0.047-0.28[a]	-
UK 2006[12]	0.09-0.10	0.17-0.18 (97.5th percentile)
Canada 2007[13]	0.10-0.13	-
New Zealand 2009[28]	0.11-0.13[b]	-
Australia 2011[10]	0.13-0.14[c]	0.23-0.24 (90th percentile)
Hong Kong (current study)	0.21	0.38 (95th percentile)
South Korea 2006[29]	0.44[d]	-
Europe 2012[38]	0.50	0.83 (95th percentile)
China 2012[39]	0.81-1.9[e]	-

Notes:

[a] The dietary exposures of male and female of age-groups (25->70) were 3.3-19.5 μg/person/day (i.e. about 0.047-0.28 μg/kg bw/day for a 70-kg adult).

[b] The dietary exposures of the average consumer were 0.8-0.9 μg/kg bw/week (i.e. about 0.11-0.13 μg/kg bw/day).

[c] The dietary exposures of the average consumer were 0.0092-0.0098 mg/person/day (i.e. about 0.13-0.14 μg/kg bw/day for a 70-kg adult).

[d] The dietary exposure is for consumer >1 yrs was 3.1μg/kg bw/week ((i.e. about 0.44 μg/kg bw/day)

[e] The dietary exposures of the consumer of 10 age-gender groups were 48.7-116.7 μg/person/day (i.e. about 0.81-1.9 μg/kg bw/day for a 60-kg adult).

Summary

6.13 Dietary exposures to lead of average and high consumers of the population were 0.21 μg/kg bw/day and 0.38 μg/kg bw/day, respectively. The MOEs of average and high consumers were 6 and 3, respectively. The estimated dietary exposures to lead were below the level of 1.2 μg/kg bw/day considered by JECFA to have a low risk of increasing the systolic blood pressure in adults.

Chapter 7

Methylmercury

7.1 Mercury is a naturally occurring element that exists in several forms: elemental or metallic mercury, inorganic mercury compounds and organic mercury compounds.[40] Most of the mercury in the environment results from human activity, particularly from coal-fired power stations, residential heating systems and waste incinerators.[41]

Sources of Exposure

7.2 Possible routes of exposure to mercury including contamination of food from natural sources and human activities, dental amalgam and occupational exposure in agriculture and manufacturing sectors.[42] However, dietary intake is the main source of human exposure to mercury. Eating contaminated fish and shellfish is the main source of methylmercury exposure, especially in populations that rely heavily on consumption of predatory fish.[41]

Methylmercury in Fish

7.3 Local studies have reported that methylmercury percentages with respect to total mercury in different types of fish ranged from 46 to 99.[43] In fact, in most fish methylmercury can contribute more than 90% of the total mercury content. Fish that are more likely to accumulate higher levels of methylmercury are larger, longerliving, and predatory species. Examples of varieties found to contain high levels include shark, swordfish, marlin, orange roughy, pike, tilefish and king mackerel. Some species of tuna can also contain high levels, such as big eye, blue fin and albacore tuna, although the average concentrations tend to be significantly lower than in the fish varieties listed above. Mercury levels in canned tuna are often lower than in fresh tuna, largely due to the species or because smaller-sized fish are used. Skipjack tuna is often canned and this variety tends to contain lower levels of mercury. However, species with higher levels may also be canned, such as albacore tuna (known as canned 'white' tuna in the US).[44]

Toxicity

7.4 Methylmercury is more toxic than inorganic mercury. For foetuses, infants and children, the primary health effect of methylmercury is impaired neurological development. Methylmercury exposure in the womb, which can result from a mother's consumption of fish and shellfish that contain methylmercury, can adversely affect a baby's growing brain and nervous system. Impacts on cognitive thinking, memory, attention, language, and fine motor and visual spatial skills have been seen in children exposed to methylmercury in the womb.[40] In 2003, JECFA established a provisional tolerable weekly intake (PTWI) of 1.6 μg/kg bw for methylmercury in order to protect the developing foetus from neurotoxic effects.[45] In 2006, JECFA clarified that life-stages other than the embryo and foetus may be less sensitive to the adverse effects of methylmercury. For adults, up to about twice the tolerable intake per week (i.e. the previous PTWI of 3.3μg/kg bw established by JECFA in 2000) would not pose any risk of neurotoxicity. However, in the case of women of childbearing age, it should be borne in mind that intake should not exceed the PTWI, in order to protect the embryo and foetus. In addition, available data did not allow firm conclusions to be drawn for children (up to about 17 years), as they may be more sensitive than adults. Hence the tolerable intake established in 2003 applies also to children.[46]

7.5 The Committee on Toxicity of Chemicals in Food, Consumer Products and the Environment (COT) of the UK issued a statement in 2003 and commented that a methylmercury intake of 3.3 µg/kg bw/week may be used as a guideline to protect against non developmental adverse effects in general population. The committee considered that the JECFA PTWI of 1.6 µg/kg bw is sufficient to protect against neurodevelopmental effects in the foetus. This PTWI should be used in assessing the dietary exposure to methylmercury of women who are pregnant, and who may become pregnant within the following year.[47]

Previous Study

7.6 In 2008, the CFS conducted a risk assessment study "Mercury in Fish and Food Safety". Using together the methylmercury levels in fish collected in 2007 and data used for the risk assessment study "Dietary exposure to Mercury of Secondary School Students" in 2004, dietary exposure of secondary school students to methylmercury was estimated, and was below the PTWI for the average consumer (0.50-0.66 µg/kg bw/week, 31-41% of PTWI). However, the estimated dietary exposure for the high consumer (95th percentile exposure level) may exceed the PTWI (1.51-1.69 µg/kg bw/week, 94% - 106% of PTWI). Among 280 samples tested, only 3 samples of imported alfonsino were detected with mercury and methylmercury levels higher than 500 μg/kg.[43]

Results and Discussion

Concentrations of Methylmercury in TDS Foods

7.7 A total 51 TDS food items (204 composite samples on four occasions) which were mainly food of animal origin and seafood were tested for methylmercury. It was because food sources other than fish and seafood products may contain mercury, but mostly in the form of inorganic mercury. Based on the available data the contribution to methylmercury exposure from these foods is considered to be insignificant.[48] The results in TDS food groups are summarised in Table 7.1 and the results in 51 TDS food items are shown in Table E of Appendix I.

Table 7.1. Methylmercury Content (μg/kg) in TDS Food Groups of the 1st HKTDS

TDS Group	Number of composite samples	% of composite samples < LOD	Mean (μg/kg) [range]	
Cereals and their products	16	25	0.7	ND-1.6
Meat, poultry and game and their products	48	54	0.7	ND-3.4
Eggs and their products	12	0	1.0	0.3-2.4
Fish and seafood and their products	76	0	68	3.7-450
Mixed dishes	48	40	1.1	ND-6.0
Condiments, sauces and herbs	4	100	0.15	ND
Total	204	26		

Notes: ND denotes non-detected, i.e. results less than LOD.

7.8 In this study, only 26% of the composite samples were not detected with methylmercury. The highest methylmercury level was detected in food group "fish and seafood and their products" (mean: 68 μg/kg). All other food groups contained relatively low levels of methylmercury (mean: about or less than 1 μg/kg). At present, Codex guideline levels for methylmercury are set at 1 mg/kg (1000 μg/kg) for large predatory fish and 0.5 mg/kg (500 μg/kg) for all other fish.[49] In our study, all methylmercury levels in fish were below the Codex guideline levels and the highest methylmercury level was found in tuna (mean: 330 μg/kg).

Dietary Exposure to Methylmercury

7.9 Dietary exposures to methylmercury of average and high consumers of the population were 0.74 and 2.7 μg/kg bw/week which account for 22% and 82% of the previous JECFA PTWI of 3.3 μg/kg bw, respectively. The exposure estimates of the current study were higher than those of our previous study on secondary school students (0.50-0.66 μg/kg bw/week and 1.51-1.69 μg/kg bw/week for average and high consumers, respectively). This may be caused by different methodologies used in the estimation of exposures. In the previous study, the exposure estimates were obtained by combining the median concentration of methylmercury of different fish species and the consumption data of "fish" as a group (consumption data on individual type of fish were not available at that time). In current study, consumption data of a variety of fish of the adult population were available. Therefore, the dietary estimates were more precisely calculated by using the mean concentrations of methylmercury of each food items including fish and seafood samples and their corresponding consumption data.

7.10 The breakdowns of dietary exposures of the individual age-gender population subgroups are shown in Figure 7.1 and Table E of Appendix II. Since methylmercury can cause adverse effect to the nervous system, especially the developing brain, the methylmercury exposure among women of childbearing age (15-49 years)[ii] is of particular concern. Our study showed that the dietary methymercury exposure of average women aged 20-49 was well below the PTWI of 1.6 μg/kg bw. However, the exposures of high consumers of women aged 20-29, 30-39 and 40-49, the exposures were 2.1, 2.5 and 2.4 μg/kg bw/week which account for 131%, 146%, and 150% the PTWI, respectively. About 11% of them had exposure exceeded the PTWI. Hence, there are potential health concerns over women of childbearing age with dietary exposures to methylmercury.

[ii] According to WHO, the childbearing age of women is defined as ages of 15-49 years.

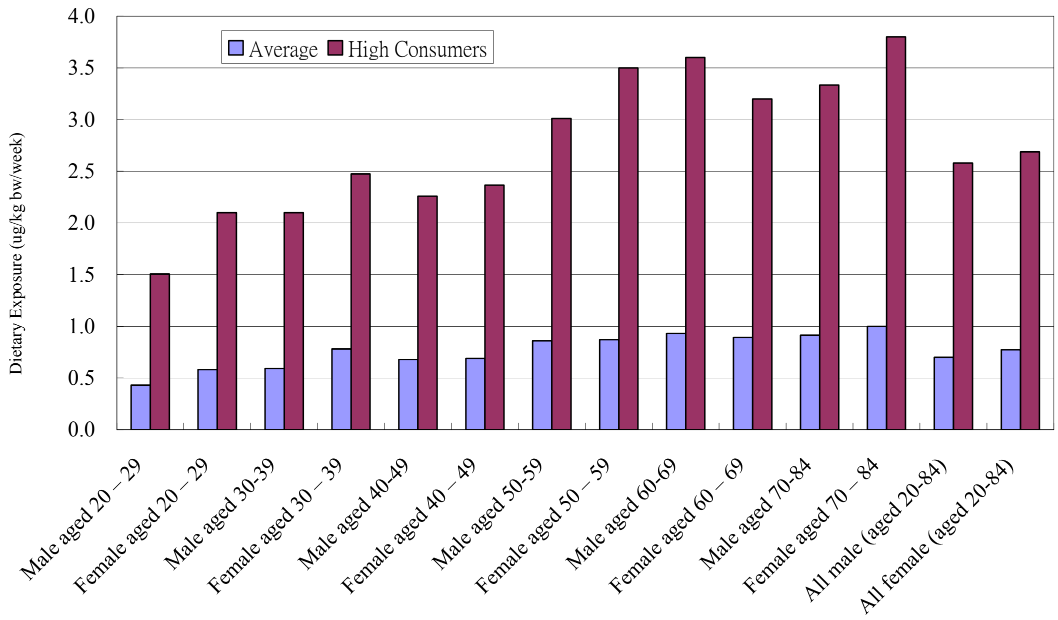

Figure 7.1. Dietary Exposures to Methylmercury of Average and High Consumers by Individual Age-gender Groups

International Comparison

7.11 The dietary exposures to methylmercury found in current study are in the same order of magnitude when compared to exposure estimates obtained from overseas studies in general (Table 7.2). It is expected that a population that has high consumption of fish would have relatively higher exposure to methylmercury and this can been seen by the exposure data from our study as well as from Portugal, Greece, Norway and Japan.[48,50] However, direct comparison of the data has to be done with caution due to the difference in time when the studies were carried out, research methodology, methods of collection of consumption data, methods of contaminants analysis and methods of treating results below detection limits.

Table 7.2. A Comparison of Dietary Exposures to Methylmercury

Places	Dietary Exposure of Adult (μg/kg bw/week)	
	Average Consumers	High Consumers
China 2010[51]	0.003 to 0.138[a]	-
USA 2002 [32]	0.097-0.26[b,c]	-
The Netherlands 2004[48]	<0.1[c]	0.4[c]
UK 2006[12]	0.14-0.35[d]	0.70-0.91 (97.5th percentile)[c,d]
Ireland 2011[11]	0.14-2.0[c]	0.7-3.3 (97.5th percentile)[c]
Korea 2006[29]	0.21 [c,e]	-
New Zealand 2009[28]	0.27-0.33[f]	-
Australia 2011[10]	0.45[g]	1.1 (90th percentile)
France 2004[48]	0.30 [c]	-
Norway 2004[48]	0.40 [c]	1.8 [c]
Greece 2004[48]	0.50 [c]	2.2 [c]
Hong Kong (current study)	0.74	2.7 (95th percentile)
Japan 2005[50]	1.1 [c]	-
Portugal 2004[48]	1.6 [c]	-

Notes:

[a] The result was the dietary exposure of 18-45 years adult males.

[b] Dietary exposures of male and female of age-groups (25->70) of were 0.97-2.59 μg/person/day (i.e. about 0.097-0.26 μg/kg bw/week for a 70-kg adult).

[c] Total mercury was tested.

[d] Dietary exposures of the average adult consumer were 0.02-0.05 μg/kg bw/day (i.e. about 4.3-5.2 μg/kg bw/week) and of the high adult consumer were 0.10-0.13μg/kg bw/day (i.e. about 0.70-0.91 μg/kg bw/week).

[e] The dietary exposure estimation included consumer of 1 yrs and older.

[f] Medium bound dietary exposure to methylmercury from fish and shellfish of males, 25+ yrs male and 25+ yrs female were presented in range.

[g] The dietary exposure of the average consumer (17 yrs & above) was 0.0045 mg/day (i.e. about 0.45 μg/kg bw/week for a 70-kg adult) and of the high consumer was 0.15 μg/kg bw/day (i.e. 1.1 μg/kg bw.week).

Summary

7.12 Dietary exposures to methylmercury of average and high consumers of the population account for 22% and 82% of the PTWI of 3.3 μg/kg bw for general population, respectively. Therefore, the general adult population was unlikely to experience major undesirable health effects of methylmercury. However, about 11% of women aged 20-49 (childbearing age) had dietary exposure to methylmercury exceeded the PTWI of 1.6 μg/kg bw that applied to children up to 17 years and pregnant women. Methylmercury exposure during pregnancy of is a public health concern due to potential health risks to the foetus.

Chapter 8

Nickel

8.1 Nickel combined with other elements occurs naturally in the Earth's crust. It is found in all soil, and is also emitted from volcanoes. The Earth's core is composed of 6% nickel. Nickel is released into the atmosphere during nickel mining and by industries that make or use nickel, nickel alloys, or nickel compounds. These industries also might discharge nickel in waste water. Nickel is also released into the atmosphere by oil-burning power plants, coal-burning power plants and trash incinerators.[52]

Sources of Exposure

8.2 Nickel is used mainly in the production of stainless steel and nickel alloys. Food is the dominant source of nickel exposure in the non-smoking, non-occupationally exposed population; water is generally a minor contributor to the total daily oral intake. Foods naturally high in nickel include chocolate, soybeans, nuts and oatmeal. However, where there is heavy pollution, where there are areas in which nickel that naturally occurs in groundwater is mobilized, or where there is use of certain types of kettles, of non-resistant material in wells or of water that has come into contact with nickel- or chromium-plated taps, the nickel contribution from water may be significant.[53]

Toxicity

8.3 Accidental oral exposure to nickel compounds might lead to the development of symptoms such as nausea, vomiting, headache and weakness. Transient nephrotoxicity, acute haemorrhagic gastritis and cardiac arrest have also been reported. Chronic excessive exposure to nickel compounds was found to affect the reproduction, white blood cells and spleen of the experimental animals.[53,54] The evidence for genotoxicity for nickel compunds is inconclusive. IARC classified nickel compounds as Group 1 agents, i.e. carcinogenic to humans and metallic nickel as Group 2B agent, i.e. possibley carcinogenic to humans (Group 2B).[55] During the establishment of the Drinking Water Guideline in 2004, WHO has considered a TDI of 12 μg/kg bw for nickel.[53]

Results and Discussion

Concentrations of Nickel in TDS Foods

8.4 A total of 600 composite samples on four occasions were tested for nickel and the results in 15 TDS food groups are summarised in Table 8.1 and the results in 150 TDS food items are shown in Table F of Appendix I.

Table 8.1. Nickel Contents (μg/kg) in TDS Food Groups of the 1st HKTDS

Food Group	Number of composite samples	% of composite samples < LOD	Mean (μg/kg) [range]	
Cereals and their products	76	4	120	ND-630
Vegetables and their products	140	1	91	ND-720
Legumes, nuts and seeds and their products	24	0	1800	20-8700
Fruits	68	3	120	ND-300
Meat, poultry and game and their products	48	0	72	200-80
Eggs and their products	12	25	32	ND-71
Fish and seafood and their products	76	26	58	ND-280
Dairy products	20	35	61	ND-420
Fats and oils	8	38	41	ND-85
Beverages, alcoholic	8	13	67	ND-200
Beverages, non-alcoholic	40	28	83	ND-560
Mixed dishes	48	4	89	ND-290
Snack foods	4	0	260	160-400
Sugars and confectionery	8	38	700	ND-1800
Condiments, sauces and herbs	20	50	170	ND-780
Total	600	10		

Notes: ND denotes non-detected, i.e. results less than LOD.

8.5 In this study, only 10% of the composite samples were not detected with nickel. The highest nickel level was detected in food group "legumes, nuts and seeds and their products" (mean: 1800 μg/kg), followed by "sugars and confectionery" (mean: 700 μg/kg) and "snack foods" (mean: 260 μg/kg). Among 150 TDS foods, the highest levels of nickel where found in peanut (mean: 5300 μg/kg), peanut butter, (mean: 3800 μg/kg), chocolate (mean: 1400 μg/kg) and fermented bean products (mean 890 μg/kg). These results agree with those reported by literature that chocolates, soybeans, peanuts, and nuts are naturally high in nickel.[52,56,57]

Dietary Exposure to Nickel

8.6 The dietary exposures to nickel of average and high consumers of the population were 3.1 μg/kg bw/day and 5.7 μg/kg bw/day which accounted for 26% and 48% of the TDI of 12 μg/kg bw established by WHO, respectively.

8.7 The breakdowns of dietary exposures of the individual age-gender population subgroups are shown in Figure 8.1 and Table F of Appendix II. All individual age-gender population subgroups were well below the TDI. Therefore, the general population was unlikely to experience major undesirable health effects of nickel.

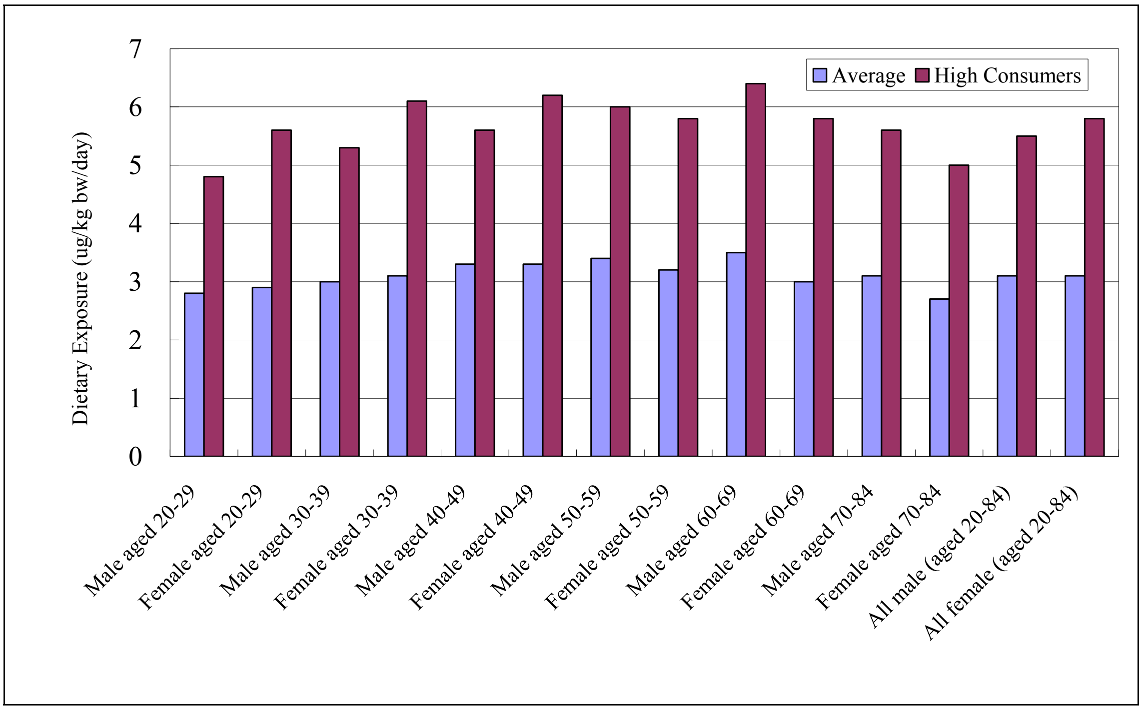

Figure 8.1. Dietary Exposures to Nickel of Average and High Consumers by Individual Age-gender Groups

Major Food Contributors

8.8 The percentage contribution to dietary exposures to nickel of an average consumer by food groups is shown in Figure 8.2. The main dietary sources of nickel were "cereals and their products" and "beverages, non-alcoholic". Each group contributed to 25% of the total exposure.

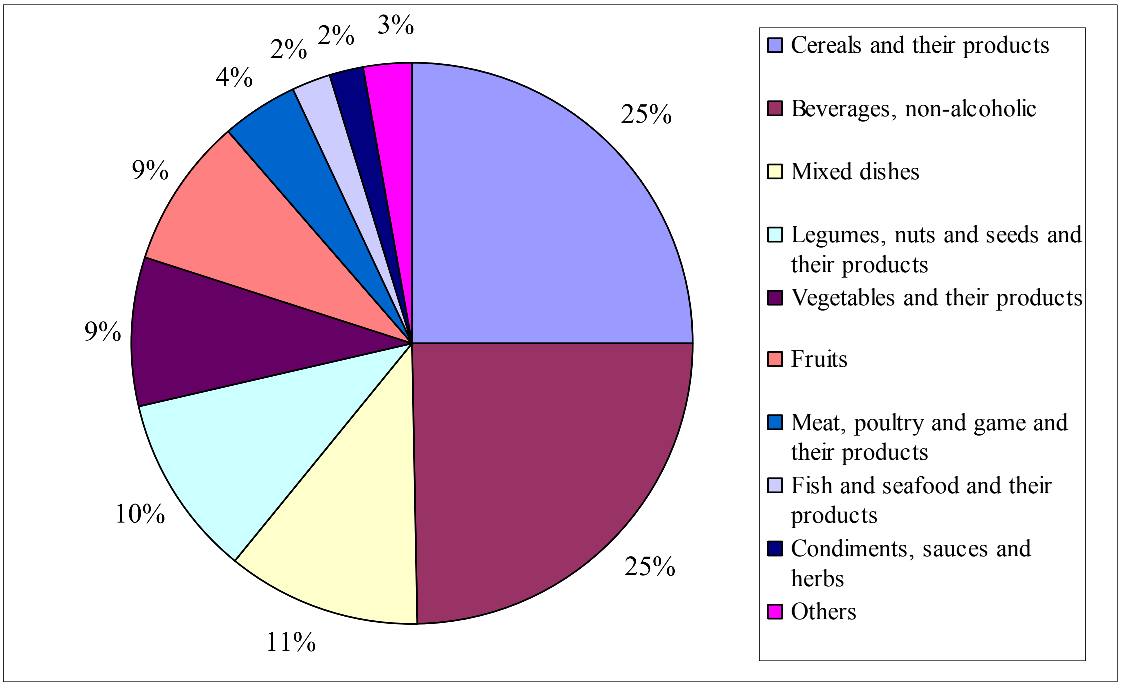

Figure 8.2. Percentage Contribution to Dietary Exposure to Nickel by Food Groups

International Comparison

8.9 The dietary exposures to nickel found in current study were also compared to those obtained from other places and are summarised in Table 8.3. It can be seen that the dietary exposure estimates in our study are comparable with those obtained from other places. However, direct comparison of the data has to be done with caution due to the difference in time when the studies were carried out, research methodology, methods of collection of consumption data, methods of contaminants analysis and methods of treating results below detection limits.

Table 8.2. A Comparison of Dietary Exposures to Nickel

Places	Dietary Exposure of Adult (μg/kg bw/day)	
	Average Consumers	High Consumers
UK 2009[12]	1.5-1.6	3.0-3.1 (97.5th percentile)
USA 2002[52]	2.2-2.3[a]	-
Hong Kong (current study)	3.1	5.7 (95th percentile)
Canada 2007[13]	3.1-5.0	-

Notes:

[a]The mean exposure female and male of 18+yrs of age were 157 to 163 μg/day (i.e. 2.2-2.3 μg/kg bw/day for 70 kg adults)

Summary

8.10 The dietary exposures to nickel for average and high consumers of the population accounted for 26% and 48% of the TDI of 12 μg/kg bw respectively. On this basis, the general population was unlikely to experience major undesirable health effects of nickel.

Chapter 9

Tin

9.1 Tin is a metal that can combine with other chemicals to form various compounds. When tin is combined with chlorine, sulfur, or oxygen, it is called an inorganic tin compound. Inorganic tin compounds are found in small amounts in the Earth's crust. They are also present in toothpaste, perfumes, soaps, coloring agents and dyes. Tin also can combine with carbon to form organotin compounds. These compounds are used in making plastics, food packages, plastic pipes, pesticides, paints, wood preservatives and rodent (rats and mice) repellants. There can be tin metal as well as inorganic and organic tin compounds in the air, water, and soil near places where they are naturally present in the rocks, mined, manufactured, or used.[58]

<u>Sources of Exposure</u>

9.2 Tin is present in the air, water, soil, and landfills and is a normal part of many plants and animals that live on land and in water.[58] The natural concentration of tin in plant and animal tissues is low and that the main dietary source of this mineral is foods that have been in contact with metallic tin from the tinplate of cans used to preserve them. Population groups with higher intakes of canned foods may have higher intakes of inorganic tin. Little contamination of food comes from tin in air, water, or soil. Organic tin-containing plasticisers, fungicides, and stannous chloride which are used as a colouring or decolouring agents, preservatives, and sequestrants, contribute negligible amounts of tin to the diet.[59,60] Tin is present in some multi-vitamin and mineral food supplements (levels up to 10 μg tin/tablet).[61]

Toxicity

9.3 The absorption of inorganic compounds of tin from the gastrointestinal tract in humans and animals is very low with as much as 98% being excreted directly in the faeces. Because of their limited absorption, orally ingested inorganic tin compounds have low systemic toxicity in man and animals. Occasional high intakes of tin are associated with high consumption of canned foods, and regulatory limits of tin content in canned foods (200 mg/kg) and beverages (100 mg/kg) have been established to protect against possible local acute effects on the gastrointestinal tract. Short-term human studies indicate that high intakes of tin (about 30-50 mg tin/day or per meal) may reduce the absorption of zinc, but not other minerals such as iron, copper, manganese, or magnesium. However, the possible long-term effects, if any, of such intake levels on status of zinc or other minerals have not been investigated.[61] JECFA in 1988 established the PTWI of 14 mg/kg bw for tin, expressed as Sn, includes tin from food additive use.[62]

Results and Discussion

Concentrations of Tin in TDS Foods

9.4 A total of 600 composite samples on four occasions were tested for tin and the results in 15 TDS food groups are summarised in Table 9.1 and the results in 150 TDS food items are shown in Table G of Appendix I.

Table 9.1. Tin Contents (mg/kg) in TDS Food Groups of the 1st HKTDS

Food Group	Number of composite samples	% of composite samples < LOD	Mean (mg/kg)) [range]	
Cereals and their products	76	83	0.009	ND-0.054
Vegetables and their products	140	78	0.92	ND-64
Legumes, nuts and seeds and their products	24	75	0.049	ND-0.94
Fruits	68	76	4.0	ND-48
Meat, poultry and game and their products	48	88	0.015	ND-0.15
Eggs and their products	12	100	0.005	ND
Fish and seafood and their products	76	54	0.022	ND-0.18
Dairy products	20	95	0.048	ND-0.47
Fats and oils	8	100	0.005	ND
Beverages, alcoholic	8	100	0.005	ND
Beverages, non-alcoholic	40	90	0.007	ND-0.059
Mixed dishes	48	65	0.13	ND-2.7
Snack foods	4	50	0.015	ND-0.039
Sugars and confectionery	8	100	0.005	ND
Condiments, sauces and herbs	20	75	0.61	ND-0.53
Total	600	77		

Notes: ND denotes non-detected, i.e. results less than LOD.

9.5 In this study, 77% of the composite samples were not detected with Tin. The highest tin level was detected in food group "fruits" (mean: 4 mg/kg), followed by "vegetables and their products" (mean: 0.92 mg/kg) and “mixed dishes” (mean: 0.13 mg/kg). Among 150 TDS foods, the highest levels of tin where found in pineapple (mean: 37 mg/kg), mushroom (mean: 32 mg/kg), and peach (mean 31 mg/kg). Some samples of these three food items were canned products so their relatively high tin levels could be due to the can coatings.

Dietary Exposure to Tin

9.6 The dietary exposures to tin of average and high consumers of the population were 0.029-0.031 mg/kg bw/week and 0.16-0.17 mg/kg bw/week which accounted for only 0.2% and 1.1-1.2 % of the PTWI of 14 mg/kg bw /day established by JECFA, respectively.

Major Food Contributors

9.7 As the dietary exposure to tin of an average consumer from all food groups contributed to less than 1% of the PTWI, none of the food groups should be considered as a significant food contributor of tin.

International Comparison

9.8 The dietary exposures to tin found in current study were also compared to those obtained from other places and are summarised in Table 9.2. It can be seen that the dietary exposure estimated in our study are lower than those reported by Ireland and UK. Part of the reasons may due to lower consumption of canned foods (especially canned vegetables and fruits) of Hong Kong adult population compare to adults from Ireland and UK. However, direct comparison of the data has to be done with caution due to the difference in time when the studies were carried out, research methodology, methods of collection of consumption data, methods of contaminants analysis, and methods of treating results below detection limits.

Table 9.2. A Comparison of Dietary Exposures to Tin

Places	Dietary exposure of adult (mg/kg bw/week)	
	Average Consumers	High Consumers
Hong Kong (current study)	0.029-0.031	0.16-0.17 (95th percentile)
Ireland 2011[11]	0.11	0.43 (97.5th percentile)
UK 2006[12]	0.16[a]	0.57-0.58 (97.5th percentile)[a]

[a]The of dietary exposure of average adult consumers were 23.3-23.4 µg/kg bw/day (i.e. 0.16 mg/kg bw/week) and of high consumers were 82.1-82.2 µg/kg bw/day (i.e. 0.57-0.58 mg/kg bw/week).

Summary

9.9 The dietary exposures to tin for average and high consumers of the population accounted for 0.2% and 1.1-1.2 % of the PTWI, respectively. On this basis, the general population was unlikely to experience major undesirable health effects of tin.

Chapter 10

Vanadium

10.1 Vanadium is an abundant element with a very wide distribution and is mined in South Africa, Russia and China. The most abundant source of vanadium in the environment is from the combustion of oil and coal, in which vanadium pentoxide is produced. Vanadium pentoxide is used in the manufacture of alloys, pigments, and inks.[63]

Sources of Exposure

10.2 Food is the primary source of vanadium exposure. Other minor sources include water and air. Most foods have naturally occurring low concentrations of vanadium. Seafood generally contains higher concentrations of vanadium than meat from land animals. Vanadium also may be found in various commercial nutritional supplements and multivitamins in amounts ranging from 0.0004 to 12.5 mg, depending on the serving size recommended by the manufacturer. Consumption of some vanadium-containing supplements may result in intakes of vanadium that would exceed intakes from food and water. Populations in areas with high levels of residual fuel oil consumption may also be exposed to above-background levels of vanadium, both from increased particulate deposition upon food crops and soil in the vicinity of power plants.[64]

Toxicity

10.3 In humans, nausea, mild diarrhea, and stomach cramps have been reported in people taking sodium metavanadate or vanadyl sulfate for the experimental treatment of diabetes. Stomach cramps were also reported in a study of people taking about 13 mg vanadium/day. A number of effects have been found in rats and mice ingesting several vanadium compounds. The effects include decreases in number of red blood cells, increased blood pressure and mild neurological effects.[64] The IARC in 2006 has classified vanadium pentoxide into Group 2B, i.e. possibly carcinogenic to humans.[65] Furthermore, vanadium compounds have been reported to be genotoxic in several *in vitro* systems and in some *in vivo* studies.[66] JECFA has not established any safety reference dose for vanadium as there is no safe level of exposure that can be established.[63]

Results and Discussion

Concentrations of Vanadium in TDS Foods

10.4 A total of 600 composite samples on four occasions were tested for vanadium and the results in 15 TDS food groups are summarised in Table 10.1 and the results in 150 TDS food items are shown in Table H of Appendix I.

Table 10.1. Vanadium Content (μg/kg) in TDS Food Groups of the 1st HKTDS

TDS Group	Number of composite samples	% of composite samples < LOD	Mean (μg/kg) [range]	
Cereals and their products	76	30	10	ND-260
Vegetables and their products	140	50	9	ND-66
Legumes, nuts and seeds and their products	24	42	11	ND-82
Fruits	68	97	1.5	ND-3
Meat, poultry and game and their products	48	67	4	ND-20
Eggs and their products	12	25	13	ND-35
Fish and seafood and their products	76	42	20	ND-270
Dairy products	20	75	5	ND-57
Fats and oils	8	100	1.5	ND
Beverages, alcoholic	8	0	43	8-94
Beverages, non-alcoholic	40	75	2	ND-9
Mixed dishes	48	8	6	ND-15
Snack foods	4	0	20	14-39
Sugars and confectionery	8	50	21	ND-71
Condiments, sauces and herbs	20	20	22	ND-83
Total	600	50		

Notes: ND denotes non-detected, i.e., results less than LOD.

Summary

10.5 In this study, half (50%) of the composite samples were not detected with vanadium. Among different food groups, the highest vanadium level was detected in "alcoholic beverage" (mean: 43 μg/kg). For individual samples, the highest vanadium level was detected in oyster (mean: 190 μg/kg).

Chapter 11

Conclusions and Recommendations

11.1 The dietary exposures of average and high consumers of the population to aluminium accounted for 30% and 77% of the PTWI of 2 mg/kg bw, to antimony accounted for 0.3-0.7% and 0.5-1.1% of the TDI of 6 µg/kg bw, to cadmium accounted for 33% and 75% of the PTMI of 25 µg/kg bw, to nickel accounted for 26% and 48% of the TDI of 12 µg/kg bw, and to tin accounted for 0.2% and 1.1-1.2% of the PTWI of 14 mg/kg bw. All dietary exposure estimates were below their respective health-based guidance values.

11.2 For lead, the dietary exposures of average and high consumers of the population were 0.21 µg/kg bw/day and 0.38 µg/kg bw/day, respectively which were below the level of 1.2 µg/kg bw/day considered by JECFA to have a low risk of increasing the systolic blood pressure in adults. For methylmercury, the estimated dietary exposures of average and high consumers of the population account for 22% and 82% of the PTWI of 3.3 µg/kg bw for general population, respectively. The findings suggested that the general adult population was unlikely to experience major undesirable health effects of the seven metallic contaminants.

11.3 The average consumers of women aged 20-49 (childbearing age) had dietary methymercury exposure well below the PTWI of 1.6 µg/kg bw that applies to pregnant women. However, about 11% of this group had dietary exposure to methylmercury exceeded the PTWI. This indicated that methylmercury exposure during pregnancy is a public health concern due to potential health risks to the foetus.

Recommendations

11.4 Based on the findings of this study advice to the public and trade were formulated for reducing the potential risks associated with dietary exposure to metallic contaminants:

Advice to the Public

- Maintain a balanced and varied diet so as to avoid excessive exposure to metallic contaminants from a small range of food items.
- Pregnant women, women planning pregnancy, and young children should avoid eating large or predatory fish and the types of fish which may contain high levels of methylmercury (e.g. tuna, alfonsino, shark, swordfish, marlin, orange roughy and king mackerel.)
- Fish contain many essential nutrients, such as omega-3 fatty acids and high quality proteins. Moderate consumption of a variety of fish is recommended.

Advice to the Trade

- Observe good agricultural and manufacturing practices to minimize metallic contamination of foods.
- Obtain food supplies from reliable sources.
- Maintain proper records to enable source tracing when required.

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Appendices

Appendix I

Table A: Aluminium Contents (mg/kg) in TDS Foods of the 1st HKTDS

TDS Food Item	Number of composite samples	% of composite samples < LOD	Mean (mg/kg)	range
Cereals and their products:	**76**	**13**	**20**	**ND-450**
Rice, white			0.050	ND
Rice, unpolished			0.60	0.36-0.84
Corn			0.050	ND
Noodles, Chinese or Japanese style			2.7	2.4-3.2
Pasta, Western style			2.1	1.1-3.3
Instant noodles			1.8	1.5-2.4
Noodles, rice			0.51	0.40-0.65
Bread, plain			4.5	1.8-7.3
Bread, raisin			4.9	2.5-6.4
"Pineapple" bun			9.7	2.6-28
Sausage/ham/luncheon meat bun			3.3	1.9-5.6
Chinese steamed bread			38	13-59
Biscuits			9.6	5.5-15
Cakes			19	2.0-51
Pastries			35	1.8-50
Pastries, Chinese			6.5	1.7-15
Oatmeal			0.12	ND-0.24
Breakfast cereals			1.9	0.44-3.6
Deep-fried dough			250	50-450
Vegetables and their products:	**140**	**19**	**4.1**	**ND-45**
Carrot/ Radish			0.51	0.16-1.2
Potato			0.52	0.35-0.60
Potato, fried			2.3	0.43-6.2
Broccoli			1.1	0.85-1.5
Cabbage, Chinese			0.20	0.13-0.35
Cabbage, Chinese flowering			4.9	2.6-6.8
Cabbage, European variety			0.32	0.19-0.57
Cabbage, Petiole Chinese			6.7	4.7-10
Celery			0.34	0.25-0.37
Chinese kale			1.6	1.2-2.0
Chinese spinach			35	25-45
Leaf mustard			5.5	0.68-13
Lettuce, Chinese			2.4	1.7-3.6
Lettuce, European			0.32	0.11-0.50
Mung bean sprout			0.083	ND-0.18
Spinach			13	11-15
Water spinach			5.0	3.5-7.8
Watercress			8.7	5.8-13

TDS Food Item	Number of composite samples	% of composite samples < LOD	Mean (mg/kg)	range
Bitter melon			0.63	0.15-1.8
Cucumber			0.21	ND-0.42
Hairy gourd			0.050	ND
Pumpkin			0.083	ND-0.18
Sponge gourd			2.4	0.22-8.7
Wax gourd			0.050	ND
Zucchini			0.35	0.26-0.48
Eggplant			0.22	ND-0.35
Sweet pepper			0.11	ND-0.17
Tomato			0.05	ND
Garlic			0.27	0.16-0.48
Onion			0.050	ND
Spring onion			13.5	12-15
Preserved vegetables			8.3	4.2-12
Mushroom, dried shiitake			2.5	1.8-3.3
Mushrooms			3.1	1.4-4.4
Ear fungus			23	14-36
Legumes, nuts and seeds and their products:	**24**	**0**	**5.5**	**0.11-31**
Green string beans, with pod			1.2	0.77-1.7
Mung bean vermicelli			3.9	0.11-9.9
Beancurd			3.2	1.5-4.0
Fermented bean products			18	3.3-31
Peanut			3.0	1.3-4.7
Peanut butter			3.4	1.8-4.6
Fruits:	**68**	**68**	**0.25**	**ND-2.8**
Apple			0.38	0.22-0.60
Banana			0.050	ND
Dragon fruit			0.26	ND-0.70
Grapes			0.72	0.31-1.1
Kiwi fruit			1.6	0.34-2.8
Longan/ Lychee			0.21	ND-0.41
Mango			0.050	ND
Melons			0.14	ND-0.41
Orange			0.26	ND-0.88
Papaya			0.065	ND-0.11
Peach			0.050	ND
Pear			0.050	ND
Persimmon			0.068	ND-0.12
Pineapple			0.050	ND
Plum			0.050	ND
Pummelo /Grapefruit			0.050	ND
Watermelon			0.26	ND-0.66

TDS Food Item	Number of composite samples	% of composite samples < LOD	Mean (mg/kg)	range
Meat, poultry and game and their products:	**48**	**19**	**2.5**	**ND-19**
Beef			0.15	0.12-0.18
Mutton			3.1	0.25-11
Pork			0.083	ND-0.18
Ham			3.7	2.6-5.3
Luncheon meat			9.8	1.3-19
Barbecued pork			1.0	0.54-1.4
Roasted pork			0.80	0.45-1.3
Pig liver			0.050	ND
Chicken meat			0.17	ND-0.36
Chicken, soy sauce			0.47	0.22-0.73
Roasted duck/goose			0.71	0.49-0.98
Meat sausage			11	8.5-12
Eggs and their products:	**12**	**67**	**0.23**	**ND-0.91**
Egg, chicken			0.050	ND
Egg, lime preserved			0.58	0.34-0.91
Egg, salted			0.050	ND
Fish and seafood and their products:	**76**	**50**	**4.9**	**ND-110**
Fish, Big head			0.050	ND
Fish, Mandarin fish			0.050	ND
Fish, Grass carp			0.050	ND
Fish, Golden thread			0.21	0.14-0.28
Fish, Grouper			0.050	ND
Fish, Horse head			0.21	ND-0.41
Fish, Pomfret			0.093	ND-0.22
Fish, Sole			0.050	ND
Fish, Tuna			0.050	ND
Fish, Grey mullet			0.76	0.53-1.1
Fish, Salmon			0.050	ND
Fish, Yellow croaker			0.050	ND
Fish, Dace, minced			1.4	0.69-2.5
Fish ball/fish cake			3.5	2.7-5.2
Shrimp/ Prawn			12	1.3-22
Crab			7.8	5.3-9.8
Oyster			62	20-110
Scallop			4.8	2.6-7.5
Squid			0.11	ND-0.23
Dairy products:	**20**	**45**	**1.2**	**ND-12**
Milk, whole			0.050	ND
Milk, skim			0.050	ND
Cheese			1.4	0.57-2.4
Yoghurt			0.18	ND-0.3

TDS Food Item	Number of composite samples	% of composite samples < LOD	Mean (mg/kg)	range
Ice-cream			4.1	0.11-12
Fats and oils:	**8**	**100**	**0.050**	**ND**
Butter			0.050	ND
Oil, vegetable			0.050	ND
Beverages, alcoholic:	**8**	**50**	**0.21**	**ND-0.47**
Beer			0.050	ND
Red wine			0.37	0.34-0.47
Beverages, non-alcoholic:	**40**	**40**	**1.9**	**ND-14**
Tea, Chinese			3.2	1.4-5.5
Tea, Milk tea			11	8.0-14
Coffee			1.4	ND-2.8
Malt drink			3.2	3.0-3.4
Soybean drink			0.44	0.25-0.59
Fruit and vegetable juice			0.090	ND-0.21
Carbonated drink			0.050	ND
Tea, chrysanthemum			0.30	0.18-0.54
Water, bottled, distilled			0.010	ND
Water, drinking			0.010	ND
Mixed dishes:	**48**	**2**	**16**	**ND-240**
Siu Mai			2.3	1.5-3.1
Dumpling, steamed			3.1	1.6-4.5
Dumpling, pan-fried			3.6	1.5-6.8
Dumpling, including wonton			4.6	3.1-6.9
Steamed barbecued pork bun			170	110-240
Turnip cake			3.9	2.7-5.7
Steamed minced beef ball			2.0	1.3-3.2
Glutinous rice dumpling			2.4	1.5-3.5
Steamed rice-rolls with filling			1.1	0.53-1.4
Steamed rice-rolls, plain			0.89	0.61-1.3
Chinese soup			1.0	ND-3.4
Hamburger			3.2	2.8-3.4
Snack foods:	**4**	**0**	**6.4**	**3.1-15**
Potato chips			6.4	3.1-15
Sugars and confectionery:	**8**	**50**	**5.6**	**ND-19**
Chocolate			11	4.0-19
Granulated white sugar			0.050	ND
Condiments, sauces and herbs:	**20**	**20**	**4.3**	**ND-11**
Table salt			0.050	ND
Soya sauce			1.8	0.22-5.3
Oyster sauce			4.6	2.7-6.1
Tomato paste/ ketchup			5.1	2.7-11
Cornstarch			10	7.8-11

Table B: Antimony Contents (µg/kg) in TDS Foods of the 1st HKTDS

TDS Food Item	Number of composite samples	% of composite samples < LOD	Mean (µg/kg)	range
<u>Cereals and their products:</u>	**76**	**46**	**2**	**ND-8**
Rice, white			0.5	ND
Rice, unpolished			0.6	ND-1
Corn			0.5	ND
Noodles, Chinese or Japanese style			1	ND-3
Pasta, Western style			0.6	ND-1
Instant noodles			1	ND-3
Noodles, rice			0.5	ND
Bread, plain			1	1-2
Bread, raisin			1	1-1
"Pineapple" bun			0.9	ND-1
Sausage/ham/luncheon meat bun			4	2-8
Chinese steamed bread			3	ND-8
Biscuits			4	2-7
Cakes			4	3-5
Pastries			0.9	ND-2
Pastries, Chinese			2	ND-4
Oatmeal			0.5	ND
Breakfast cereals			3	ND-8
Deep-fried dough			3	2-4
<u>Vegetables and their products:</u>	**140**	**76**	**0.9**	**ND-5**
Carrot/ Radish			0.5	ND
Potato			0.5	ND
Potato, fried			0.5	ND
Broccoli			0.5	ND
Cabbage, Chinese			0.5	ND
Cabbage, Chinese flowering			0.9	ND-2
Cabbage, European variety			0.5	ND
Cabbage, Petiole Chinese			1	ND-4
Celery			0.5	ND
Chinese kale			0.5	ND
Chinese spinach			2	ND-3
Leaf mustard			1	ND-2
Lettuce, Chinese			0.5	ND
Lettuce, European			0.5	ND
Mung bean sprout			0.5	ND
Spinach			0.8	ND-1
Water spinach			2	1-3
Watercress			2	ND-5
Bitter melon			0.5	ND

TDS Food Item	Number of composite samples	% of composite samples < LOD	Mean (µg/kg)	range
Cucumber			0.5	ND
Hairy gourd			0.5	ND
Pumpkin			0.6	ND-1
Sponge gourd			0.5	ND
Wax gourd			0.5	ND
Zucchini			0.5	ND
Eggplant			0.5	ND
Sweet pepper			0.5	ND
Tomato			0.6	ND-1
Garlic			0.5	ND
Onion			0.5	ND
Spring onion			2	1-3
Preserved vegetables			2	1-3
Mushroom, dried shiitake			0.5	ND
Mushrooms			2	1-2
Ear fungus			3	3-4
Legumes, nuts and seeds and their products:	**24**	**33**	**1**	**ND-7**
Green string beans, with pod			0.6	ND-1
Mung bean vermicelli			1	ND-2
Beancurd			0.6	ND-1
Fermented bean products			4	2-7
Peanut			1	1-2
Peanut butter			1	1-1
Fruits:	**68**	**85**	**0.7**	**ND-5**
Apple			2	ND-5
Banana			0.6	ND-1
Dragon fruit			0.5	ND
Grapes			0.5	ND
Kiwi fruit			0.5	ND
Longan/ Lychee			0.5	ND
Mango			0.5	ND
Melons			0.6	ND-1
Orange			0.5	ND
Papaya			0.5	ND
Peach			1	ND-2
Pear			0.5	ND
Persimmon			0.5	ND
Pineapple			0.8	ND-1
Plum			0.5	ND
Pummelo /Grapefruit			0.9	ND-2
Watermelon			0.5	ND
Meat, poultry and game and their products:	**48**	**42**	**3**	**ND-13**

TDS Food Item	Number of composite samples	% of composite samples < LOD	Mean (µg/kg)	range
Beef			0.6	ND-1
Mutton			6	2-11
Pork			1	1-2
Ham			7	1-13
Luncheon meat			8	2-11
Barbecued pork			1	ND-2
Roasted pork			0.9	ND-1
Pig liver			0.6	ND-1
Chicken meat			0.5	ND
Chicken, soy sauce			0.5	ND
Roasted duck/goose			0.5	ND
Meat sausage			5	2-6
Eggs and their products:	**12**	**75**	**0.7**	**ND-2**
Egg, chicken			0.5	ND
Egg, lime preserved			1	ND-2
Egg, salted			0.6	ND-1
Fish and seafood and their products:	**76**	**66**	**2**	**ND-18**
Fish, Big head			0.5	ND
Fish, Mandarin fish			0.5	ND
Fish, Grass carp			0.9	ND-2
Fish, Golden thread			2	ND-3
Fish, Grouper			0.5	ND
Fish, Horse head			0.6	ND-1
Fish, Pomfret			0.5	ND
Fish, Sole			2	ND-6
Fish, Tuna			0.6	ND-1
Fish, Grey mullet			0.5	ND
Fish, Salmon			0.5	ND
Fish, Yellow croaker			0.5	ND
Fish, Dace, minced			0.6	ND-1
Fish ball/fish cake			3	2-6
Shrimp/ Prawn			5	1-13
Crab			2	1-2
Oyster			4	3-5
Scallop			5	ND-18
Squid			0.5	ND
Dairy products:	**20**	**80**	**1**	**ND-6**
Milk, whole			0.5	ND
Milk, skim			0.5	ND
Cheese			4	ND-6
Yoghurt			0.5	ND
Ice-cream			0.9	ND-2

TDS Food Item	Number of composite samples	% of composite samples < LOD	Mean (µg/kg)	range
Fats and oils:	**8**	**88**	**0.6**	**ND-1**
Butter			0.5	ND
Oil, vegetable			0.6	ND-1
Beverages, alcoholic:	**8**	**63**	**1**	**ND-4**
Beer			0.5	ND
Red wine			2	ND-4
Beverages, non-alcoholic:	**40**	**73**	**0.7**	**ND-3**
Tea, Chinese			0.1	ND
Tea, Milk tea			0.9	ND-2
Coffee			1	ND-2
Malt drink			0.5	ND
Soybean drink			0.5	ND
Fruit and vegetable juice			0.5	ND
Carbonated drink			2	2-3
Tea, chrysanthemum			0.5	ND
Water, bottled, distilled			0.1	ND-0.2
Water, drinking			0.2	ND-0.3
Mixed dishes:	**48**	**54**	**1**	**ND-5**
Siu Mai			1	ND-3
Dumpling, steamed			2	ND-3
Dumpling, pan-fried			0.8	ND-1
Dumpling, including wonton			2	ND-2
Steamed barbecued pork bun			2	ND-5
Turnip cake			2	1-2
Steamed minced beef ball			0.5	ND
Glutinous rice dumpling			0.5	ND
Steamed rice-rolls with filling			0.5	ND
Steamed rice-rolls, plain			0.6	ND-1
Chinese soup			0.5	ND
Hamburger			2	1-3
Snack foods:	**4**	**50**	**1**	**ND-2**
Potato chips			1	ND-2
Sugars and confectionery:	**8**	**13**	**4**	**ND-14**
Chocolate			6	3-14
Granulated white sugar			2	ND-4
Condiments, sauces and herbs:	**20**	**40**	**1**	**ND-7**
Table salt			1	ND-2
Soya sauce			3	1-7
Oyster sauce			1	ND-2
Tomato paste/ ketchup			0.8	ND-1
Cornstarch			1	ND-3

Table C: Cadmium Contents (μg/kg) in TDS Foods of the 1st HKTDS

TDS Food Item	Number of composite samples	% of composite samples < LOD	Mean (μg/kg)	range
Cereals and their products:	**76**	**9**	**12**	**ND-70**
Rice, white			4	2-5
Rice, unpolished			3	ND-9
Corn			4	ND-6
Noodles, Chinese or Japanese style			5	3-6
Pasta, Western style			19	16-22
Instant noodles			4	4-5
Noodles, rice			20	4-31
Bread, plain			14	12-17
Bread, raisin			13	11-14
"Pineapple" bun			14	13-15
Sausage/ham/luncheon meat bun			13	12-13
Chinese steamed bread			13	11-14
Biscuits			28	19-41
Cakes			8	3-12
Pastries			6	4-8
Pastries, Chinese			36	12-70
Oatmeal			1	ND
Breakfast cereals			17	3-41
Deep-fried dough			17	15-18
Vegetables and their products:	**140**	**7**	**33**	**ND-310**
Carrot/ Radish			14	7-21
Potato			26	19-33
Potato, fried			61	56-68
Broccoli			6	ND-8
Cabbage, Chinese			73	48-96
Cabbage, Chinese flowering			34	28-40
Cabbage, European variety			9	4-13
Cabbage, Petiole Chinese			66	39-130
Celery			54	33-76
Chinese kale			24	11-49
Chinese spinach			72	38-140
Leaf mustard			68	30-160
Lettuce, Chinese			37	30-46
Lettuce, European			17	6-32
Mung bean sprout			4	3-5
Spinach			92	56-130
Water spinach			33	17-44
Watercress			73	29-180
Bitter melon			2	ND-3

TDS Food Item	Number of composite samples	% of composite samples < LOD	Mean (µg/kg)	range
Cucumber			2	ND-3
Hairy gourd			3	ND-5
Pumpkin			3	ND-4
Sponge gourd			9	7-11
Wax gourd			3	ND-5
Zucchini			3	ND-4
Eggplant			34	14-43
Sweet pepper			8	6-11
Tomato			8	4-13
Garlic			19	16-21
Onion			8	2-14
Spring onion			25	14-49
Preserved vegetables			10	7-12
Mushroom, dried shiitake			240	190-310
Mushrooms			8	6-13
Ear fungus			14	9-18
Legumes, nuts and seeds and their products:	**24**	**25**	**53**	**ND-290**
Green string beans, with pod			5	ND-14
Mung bean vermicelli			1	ND
Beancurd			10	6-14
Fermented bean products			23	16-37
Peanut			140	110-160
Peanut butter			150	57-290
Fruits:	**68**	**88**	**1**	**ND-7**
Apple			1	ND
Banana			3	ND-7
Dragon fruit			1	ND
Grapes			1	ND
Kiwi fruit			1	ND
Longan/ Lychee			1	ND-2
Mango			1	ND
Melons			4	ND-6
Orange			1	ND
Papaya			1	ND
Peach			1	ND
Pear			1	ND-2
Persimmon			1	ND
Pineapple			1	ND
Plum			1	ND
Pummelo /Grapefruit			1	ND
Watermelon			2	ND-3
Meat, poultry and game and their products:	**48**	**63**	**5**	**ND-46**

TDS Food Item	Number of composite samples	% of composite samples < LOD	Mean (µg/kg)	range
Beef			1	ND
Mutton			1	ND
Pork			1	ND
Ham			5	3-6
Luncheon meat			4	1-6
Barbecued pork			1	ND
Roasted pork			1	ND
Pig liver			34	23-46
Chicken meat			1	ND
Chicken, soy sauce			1	ND
Roasted duck/goose			3	ND-6
Meat sausage			4	4-4
Eggs and their products:	**12**	**100**	**1**	**ND**
Egg, chicken			1	ND
Egg, lime preserved			1	ND
Egg, salted			1	ND
Fish and seafood and their products:	**76**	**51**	**150**	**ND-1800**
Fish, Big head			1	ND
Fish, Mandarin fish			1	ND
Fish, Grass carp			1	ND
Fish, Golden thread			8	5-11
Fish, Grouper			1	ND
Fish, Horse head			3	ND-7
Fish, Pomfret			2	ND-4
Fish, Sole			1	ND
Fish, Tuna			21	13-30
Fish, Grey mullet			1	ND
Fish, Salmon			1	ND
Fish, Yellow croaker			1	ND
Fish, Dace, minced			1	ND
Fish ball/fish cake			2	ND-4
Shrimp/ Prawn			97	5-340
Crab			540	260-890
Oyster			1300	1000-1800
Scallop			730	340-1200
Squid			140	40-300
Dairy products:	**20**	**85**	**1**	**ND-6**
Milk, whole			1	ND
Milk, skim			1	ND
Cheese			1	ND-2
Yoghurt			1	ND
Ice-cream			3	ND-6

TDS Food Item	Number of composite samples	% of composite samples < LOD	Mean (µg/kg)	range
Fats and oils:	**8**	**100**	**1**	**ND**
Butter			1	ND
Oil, vegetable			1	ND
Beverages, alcoholic:	**8**	**100**	**1**	**ND**
Beer			1	ND
Red wine			1	ND
Beverages, non-alcoholic:	**40**	**80**	**1**	**ND-7**
Tea, Chinese			0.2	ND
Tea, Milk tea			1	ND
Coffee			1	ND
Malt drink			3	3-3
Soybean drink			4	2-7
Fruit and vegetable juice			1	ND
Carbonated drink			1	ND
Tea, chrysanthemum			1	ND
Water, bottled, distilled			0.2	ND
Water, drinking			0.2	ND
Mixed dishes:	**48**	**8**	**8**	**ND-22**
Siu Mai			12	7-17
Dumpling, steamed			8	5-10
Dumpling, pan-fried			10	6-16
Dumpling, including wonton			11	5-18
Steamed barbecued pork bun			9	7-12
Turnip cake			15	10-22
Steamed minced beef ball			5	3-6
Glutinous rice dumpling			10	8-15
Steamed rice-rolls with filling			6	3-11
Steamed rice-rolls, plain			7	ND-19
Chinese soup			2	ND-3
Hamburger			9	8-10
Snack foods:	**4**	**0**	**120**	**80-150**
Potato chips			120	80-150
Sugars and confectionery:	**8**	**50**	**39**	**ND-120**
Chocolate			78	16-120
Granulated white sugar			1	ND
Condiments, sauces and herbs:	**20**	**40**	**14**	**ND-58**
Table salt			1	ND
Soya sauce			9	8-11
Oyster sauce			36	25-58
Tomato paste/ ketchup			23	20-28
Cornstarch			1	ND

Table D: Lead Contents (μg/kg) in TDS Foods of the 1st HKTDS

TDS Food Item	Number of composite samples	% of composite samples < LOD	Mean (μg/kg)	range
Cereals and their products:	**76**	**17**	**7**	**ND-40**
Rice, white			2	ND-5
Rice, unpolished			3	ND-4
Corn			1	ND
Noodles, Chinese or Japanese style			6	4-6
Pasta, Western style			2	ND-5
Instant noodles			4	3-5
Noodles, rice			4	2-6
Bread, plain			7	4-9
Bread, raisin			8	5-10
"Pineapple" bun			5	4-7
Sausage/ham/luncheon meat bun			6	5-8
Chinese steamed bread			6	3-9
Biscuits			19	9-30
Cakes			8	3-15
Pastries			15	4-40
Pastries, Chinese			18	10-34
Oatmeal			2	ND-3
Breakfast cereals			8	5-13
Deep-fried dough			11	8-14
Vegetables and their products:	**140**	**10**	**21**	**ND-280**
Carrot/ Radish			4	2-6
Potato			1	ND
Potato, fried			3	ND-4
Broccoli			8	4-11
Cabbage, Chinese			1	ND-2
Cabbage, Chinese flowering			41	14-73
Cabbage, European variety			1	ND
Cabbage, Petiole Chinese			14	10-21
Celery			3	ND-6
Chinese kale			13	6-21
Chinese spinach			59	32-79
Leaf mustard			34	6-98
Lettuce, Chinese			11	9-13
Lettuce, European			5	3-7
Mung bean sprout			7	5-9
Spinach			25	14-41
Water spinach			47	27-71
Watercress			96	14-280
Bitter melon			12	6-19

TDS Food Item	Number of composite samples	% of composite samples < LOD	Mean (µg/kg)	range
Cucumber			6	3-8
Hairy gourd			6	3-12
Pumpkin			4	3-6
Sponge gourd			11	8-14
Wax gourd			6	4-7
Zucchini			6	5-8
Eggplant			9	4-20
Sweet pepper			6	5-6
Tomato			17	3-57
Garlic			6	4-7
Onion			4	3-6
Spring onion			30	22-38
Preserved vegetables			88	65-100
Mushroom, dried shiitake			20	18-23
Mushrooms			20	8-40
Ear fungus			100	74-140
Legumes, nuts and seeds and their products:	**24**	**0**	**19**	**4-120**
Green string beans, with pod			14	6-31
Mung bean vermicelli			6	4-9
Beancurd			14	7-20
Fermented bean products			60	20-120
Peanut			10	7-16
Peanut butter			7	5-9
Fruits:	**68**	**15**	**5**	**ND-32**
Apple			11	4-32
Banana			3	2-3
Dragon fruit			3	ND-5
Grapes			5	3-9
Kiwi fruit			5	2-7
Longan/ Lychee			3	ND-4
Mango			3	ND-6
Melons			2	ND-3
Orange			5	2-11
Papaya			7	ND-10
Peach			17	7-25
Pear			3	ND-5
Persimmon			5	3-7
Pineapple			11	6-17
Plum			3	2-4
Pummelo /Grapefruit			3	2-4
Watermelon			2	ND-3
Meat, poultry and game and their products:	**48**	**0**	**9**	**3-50**

TDS Food Item	Number of composite samples	% of composite samples < LOD	Mean (μg/kg)	range
Beef			7	7-8
Mutton			8	6-9
Pork			6	3-9
Ham			8	6-9
Luncheon meat			18	6-50
Barbecued pork			6	6-7
Roasted pork			10	7-12
Pig liver			16	9-29
Chicken meat			3	3-4
Chicken, soy sauce			9	5-17
Roasted duck/goose			7	7-8
Meat sausage			10	7-15
Eggs and their products:	**12**	**0**	**6**	**3-9**
Egg, chicken			6	3-9
Egg, lime preserved			6	5-6
Egg, salted			7	6-7
Fish and seafood and their products:	**76**	**1**	**24**	**ND-300**
Fish, Big head			6	4-10
Fish, Mandarin fish			5	ND-8
Fish, Grass carp			7	3-17
Fish, Golden thread			14	7-18
Fish, Grouper			6	5-7
Fish, Horse head			7	4-10
Fish, Pomfret			7	6-8
Fish, Sole			6	4-8
Fish, Tuna			5	4-5
Fish, Grey mullet			16	11-26
Fish, Salmon			4	3-5
Fish, Yellow croaker			5	3-7
Fish, Dace, minced			13	9-15
Fish ball/fish cake			33	16-78
Shrimp/ Prawn			12	4-17
Crab			30	19-42
Oyster			230	190-300
Scallop			34	24-51
Squid			16	14-17
Dairy products:	**20**	**25**	**4**	**ND-7**
Milk, whole			2	ND-4
Milk, skim			2	ND-5
Cheese			6	4-7
Yoghurt			3	ND-4
Ice-cream			5	3-6

TDS Food Item	Number of composite samples	% of composite samples < LOD	Mean (µg/kg)	range
Fats and oils:	**8**	**0**	**5**	**2-7**
Butter			5	2-7
Oil, vegetable			5	3-6
Beverages, alcoholic:	**8**	**25**	**6**	**ND-14**
Beer			2	ND-3
Red wine			10	7-14
Beverages, non-alcoholic:	**40**	**23**	**4**	**ND-19**
Tea, Chinese			2	1.6-2.3
Tea, Milk tea			4	3-6
Coffee			5	2-9
Malt drink			8	7-9
Soybean drink			4	ND-8
Fruit and vegetable juice			5	4-7
Carbonated drink			3	ND-5
Tea, chrysanthemum			9	3-19
Water, bottled, distilled			0.2	ND
Water, drinking			0.3	ND-0.6
Mixed dishes:	**48**	**0**	**11**	**4-27**
Siu Mai			9	7-11
Dumpling, steamed			14	11-19
Dumpling, pan-fried			13	8-16
Dumpling, including wonton			16	13-19
Steamed barbecued pork bun			8	6-9
Turnip cake			20	17-27
Steamed minced beef ball			9	8-10
Glutinous rice dumpling			13	7-18
Steamed rice-rolls with filling			7	6-7
Steamed rice-rolls, plain			7	5-10
Chinese soup			7	4-14
Hamburger			7	6-8
Snack foods:	**4**	**0**	**7**	**6-7**
Potato chips			7	6-7
Sugars and confectionery:	**8**	**0**	**9**	**ND-29**
Chocolate			17	7-29
Granulated white sugar			2	ND-3
Condiments, sauces and herbs:	**20**	**10**	**12**	**ND-32**
Table salt			9	ND-26
Soya sauce			17	3-26
Oyster sauce			18	12-32
Tomato paste/ ketchup			8	5-12
Cornstarch			7	6-9

Table E: Methylmercury Contents (μg/kg) in TDS Foods of the 1st HKTDS

TDS Food Item	Number of composite samples	% of composite samples < LOD	Mean (μg/kg)	range
Cereals and their products:	**16**	**25**	**0.7**	**ND-1.6**
Rice, white			0.9	0.5-1.5
Rice, unpolished			1.1	0.7-1.6
Noodles, rice			0.7	0.6-0.8
Sausage/ham/luncheon meat bun			0.15	ND
Meat, poultry and game and their products:	**48**	**54**	**0.7**	**ND-3.4**
Beef			0.3	ND -0.9
Mutton			0.15	ND
Pork			0.5	ND-0.8
Ham			0.2	ND-0.3
Luncheon meat			0.6	0.4-0.9
Barbecued pork			1.3	0.7-2.1
Roasted pork			0.3	ND-0.5
Pig liver			1.3	ND-3.4
Chicken meat			0.15	ND
Chicken, soy sauce			0.15	ND
Roasted duck/goose			2.7	2.5-2.9
Meat sausage			0.2	ND-0.3
Eggs and their products:	**12**	**0**	**1.0**	**0.3-2.4**
Egg, chicken			0.7	0.5-1.0
Egg, lime preserved			1.6	0.7-2.4
Egg, salted			0.6	0.3-0.9
Fish and seafood and their products:	**76**	**0**	**68**	**3.7-450**
Fish, Big head			49	33-79
Fish, Mandarin fish			100	80-140
Fish, Grass carp			4.5	4.0-5.0
Fish, Golden thread			130	87-160
Fish, Grouper			160	100-240
Fish, Horse head			160	63-250
Fish, Pomfret			36	26-42
Fish, Sole			7.9	4.8-11
Fish, Tuna			330	150-450
Fish, Grey mullet			21	16-24
Fish, Salmon			29	26-30
Fish, Yellow croaker			66	49-100
Fish, Dace, minced			34	30-37
Fish ball/fish cake			28	23-32
Shrimp/ Prawn			25	9.5-33
Crab			48	32-72
Oyster			7	4.5-7.9

TDS Food Item	Number of composite samples	% of composite samples < LOD	Mean (μg/kg)	range
Scallop			11	3.7-18
Squid			46	34-56
Mixed dishes:	**48**	**40**	**1.1**	**ND-6.0**
Siu Mai			4.7	3.7-6.0
Dumpling, steamed			1.9	1.0-3.1
Dumpling, pan-fried			0.15	ND
Dumpling, including wonton			1.2	ND-2.2
Steamed barbecued pork bun			0.15	ND
Turnip cake			1.1	0.7-1.7
Steamed minced beef ball			0.8	ND-2.1
Glutinous rice dumpling			0.7	0.4-0.9
Steamed rice-rolls with filling			0.2	ND-0.5
Steamed rice-rolls, plain			0.5	ND-0.8
Chinese soup			0.15	ND
Hamburger			1.0	0.5-1.7
Condiments, sauces and herbs:	**4**	**100**	**0.15**	**ND**
Oyster sauce			0.15	ND

Table F: Nickel Contents (μg/kg) in TDS Foods of the 1st HKTDS

TDS Food Item	Number of composite samples	% of composite samples < LOD	Mean (μg/kg)	range
Cereals and their products:	**76**	**4**	**120**	**ND-630**
Rice, white			120	57-250
Rice, unpolished			100	98-110
Corn			85	71-110
Noodles, Chinese or Japanese style			29	ND-43
Pasta, Western style			44	32-71
Instant noodles			33	22-49
Noodles, rice			25	ND-49
Bread, plain			87	85-90
Bread, raisin			67	54-90
"Pineapple" bun			58	45-71
Sausage/ham/luncheon meat bun			71	51-93
Chinese steamed bread			57	42-74
Biscuits			230	100-280
Cakes			180	49-260
Pastries			140	82-200
Pastries, Chinese			370	120-630
Oatmeal			150	87-250
Breakfast cereals			290	120-620
Deep-fried dough			120	72-220
Vegetables and their products:	**140**	**1**	**91**	**ND-720**
Carrot/ Radish			60	41-75
Potato			200	80-300
Potato, fried			170	150-190
Broccoli			98	56-170
Cabbage, Chinese			31	22-40
Cabbage, Chinese flowering			110	67-180
Cabbage, European variety			44	27-71
Cabbage, Petiole Chinese			77	36-110
Celery			63	54-68
Chinese kale			240	51-720
Chinese spinach			160	56-330
Leaf mustard			73	54-120
Lettuce, Chinese			43	26-67
Lettuce, European			37	25-52
Mung bean sprout			170	120-200
Spinach			74	39-160
Water spinach			54	37-76
Watercress			88	70-130
Bitter melon			110	63-210

TDS Food Item	Number of composite samples	% of composite samples < LOD	Mean (μg/kg)	range
Cucumber			85	41-130
Hairy gourd			117	77-160
Pumpkin			71	43-100
Sponge gourd			120	77-190
Wax gourd			44	27-70
Zucchini			90	64-110
Eggplant			100	55-210
Sweet pepper			150	99-210
Tomato			41	20-67
Garlic			100	94-110
Onion			59	31-72
Spring onion			98	63-120
Preserved vegetables			59	41-83
Mushroom, dried shiitake			49	30-75
Mushrooms			51	ND-81
Ear fungus			51	32-74
Legumes, nuts and seeds and their products:	**24**	**0**	**1800**	**20-8700**
Green string beans, with pod			190	120-290
Mung bean vermicelli			36	24-49
Beancurd			380	250-600
Fermented bean products			890	520-1700
Peanut			5300	2900-7600
Peanut butter			3800	480-8700
Fruits:	**68**	**3**	**120**	**ND-300**
Apple			63	20-130
Banana			270	230-300
Dragon fruit			160	130-190
Grapes			41	ND-68
Kiwi fruit			62	47-72
Longan/ Lychee			230	110-290
Mango			110	54-190
Melons			83	65-110
Orange			75	52-100
Papaya			57	34-75
Peach			97	64-140
Pear			65	30-92
Persimmon			200	180-210
Pineapple			120	64-230
Plum			44	ND-99
Pummelo /Grapefruit			91	21-220
Watermelon			210	150-260
Meat, poultry and game and their products:	**48**	**0**	**72**	**20-180**

TDS Food Item	Number of composite samples	% of composite samples < LOD	Mean (μg/kg)	range
Beef			55	39-83
Mutton			57	38-68
Pork			70	21-120
Ham			90	82-100
Luncheon meat			130	68-170
Barbecued pork			64	50-79
Roasted pork			50	30-92
Pig liver			38	20-49
Chicken meat			77	51-130
Chicken, soy sauce			61	32-120
Roasted duck/goose			55	37-70
Meat sausage			120	61-180
Eggs and their products:	**12**	**25**	**32**	**ND-71**
Egg, chicken			30	24-34
Egg, lime preserved			49	24-71
Egg, salted			16	ND-34
Fish and seafood and their products:	**76**	**26**	**58**	**ND-280**
Fish, Big head			38	23-47
Fish, Mandarin fish			33	ND-63
Fish, Grass carp			36	ND-73
Fish, Golden thread			57	28-110
Fish, Grouper			14	ND-27
Fish, Horse head			10	ND
Fish, Pomfret			38	ND-63
Fish, Sole			59	ND-110
Fish, Tuna			10	ND
Fish, Grey mullet			32	ND-61
Fish, Salmon			33	ND-62
Fish, Yellow croaker			43	ND-81
Fish, Dace, minced			90	39-160
Fish ball/fish cake			110	29-150
Shrimp/ Prawn			71	29-130
Crab			73	47-100
Oyster			130	74-180
Scallop			180	55-280
Squid			44	22-76
Dairy products:	**20**	**35**	**61**	**ND-420**
Milk, whole			22	ND-38
Milk, skim			10	ND
Cheese			54	ND-85
Yoghurt			41	23-66
Ice-cream			180	30-420

TDS Food Item	Number of composite samples	% of composite samples < LOD	Mean (µg/kg)	range
Fats and oils:	**8**	**38**	**41**	**ND-85**
Butter			29	ND-85
Oil, vegetable			53	28-85
Beverages, alcoholic:	**8**	**13**	**67**	**ND-200**
Beer			46	ND-84
Red wine			87	23-200
Beverages, non-alcoholic:	**40**	**28**	**83**	**ND-560**
Tea, Chinese			71	54-79
Tea, Milk tea			110	71-140
Coffee			63	31-100
Malt drink			100	89-120
Soybean drink			310	170-560
Fruit and vegetable juice			76	32-110
Carbonated drink			18	ND-43
Tea, chrysanthemum			75	32-110
Water, bottled, distilled			2	ND
Water, drinking			2	ND
Mixed dishes:	**48**	**4**	**89**	**ND-290**
Siu Mai			79	24-190
Dumpling, steamed			67	55-83
Dumpling, pan-fried			130	69-200
Dumpling, including wonton			72	40-130
Steamed barbecued pork bun			78	52-100
Turnip cake			84	53-130
Steamed minced beef ball			83	54-130
Glutinous rice dumpling			170	89-290
Steamed rice-rolls with filling			44	ND-100
Steamed rice-rolls, plain			82	21-200
Chinese soup			97	ND-220
Hamburger			77	46-150
Snack foods:	**4**	**0**	**260**	**160-400**
Potato chips			260	160-400
Sugars and confectionery:	**8**	**38**	**700**	**ND-1800**
Chocolate			1400	510-1800
Granulated white sugar			13	ND-22
Condiments, sauces and herbs:	**20**	**20**	**170**	**ND-780**
Table salt			10	ND
Soya sauce			500	210-780
Oyster sauce			75	40-100
Tomato paste/ ketchup			130	95-160
Cornstarch			150	31-480

Table G: Tin Contents (mg/kg) in TDS Foods of the 1st HKTDS

TDS Food Item	Number of composite samples	% of composite samples < LOD	Mean (mg/kg) [range]	
Cereals and their products:	**76**	**83**	**0.009**	**ND-0.054**
Rice, white			0.005	ND
Rice, unpolished			0.005	ND
Corn			0.039	0.019-0.054
Noodles, Chinese or Japanese style			0.005	ND
Pasta, Western style			0.005	ND
Instant noodles			0.005	ND
Noodles, rice			0.005	ND
Bread, plain			0.005	ND
Bread, raisin			0.009	ND-0.015
"Pineapple" bun			0.005	ND
Sausage/ham/luncheon meat bun			0.013	ND-0.022
Chinese steamed bread			0.005	ND
Biscuits			0.005	ND
Cakes			0.005	ND
Pastries			0.027	ND-0.047
Pastries, Chinese			0.005	ND
Oatmeal			0.005	ND
Breakfast cereals			0.005	ND
Deep-fried dough			0.007	ND-0.012
Vegetables and their products:	**140**	**78**	**0.92**	**ND-64**
Carrot/ Radish			0.005	ND
Potato			0.005	ND
Potato, fried			0.005	ND
Broccoli			0.005	ND
Cabbage, Chinese			0.005	ND
Cabbage, Chinese flowering			0.005	ND
Cabbage, European variety			0.005	ND
Cabbage, Petiole Chinese			0.012	ND-0.033
Celery			0.005	ND
Chinese kale			0.007	ND-0.011
Chinese spinach			0.017	ND-0.031
Leaf mustard			0.008	ND-0.018
Lettuce, Chinese			0.007	ND-0.012
Lettuce, European			0.010	ND-0.026
Mung bean sprout			0.007	ND-0.014
Spinach			0.015	ND-0.045
Water spinach			0.026	ND-0.034
Watercress			0.021	ND-0.053
Bitter melon			0.005	ND

TDS Food Item	Number of composite samples	% of composite samples < LOD	Mean (mg/kg) [range]	
Cucumber			0.005	ND
Hairy gourd			0.005	ND
Pumpkin			0.015	ND-0.045
Sponge gourd			0.015	ND-0.026
Wax gourd			0.005	ND
Zucchini			0.007	ND-0.012
Eggplant			0.007	ND-0.013
Sweet pepper			0.005	ND
Tomato			0.007	ND-0.012
Garlic			0.005	ND
Onion			0.008	ND-0.016
Spring onion			0.007	ND-0.012
Preserved vegetables			0.006	ND-0.010
Mushroom, dried shiitake			0.005	ND
Mushrooms			32	0.058-64
Ear fungus			0.005	ND
Legumes, nuts and seeds and their products:	**24**	**75**	**0.049**	**ND-0.94**
Green string beans, with pod			0.005	ND
Mung bean vermicelli			0.005	ND
Beancurd			0.017	ND-0.054
Fermented bean products			0.25	0.017-0.94
Peanut			0.007	ND-0.014
Peanut butter			0.005	ND
Fruits:	**68**	**76**	**4**	**ND-48**
Apple			0.007	ND-0.012
Banana			0.005	ND
Dragon fruit			0.005	ND
Grapes			0.005	ND
Kiwi fruit			0.005	ND
Longan/ Lychee			0.005	ND
Mango			0.005	ND
Melons			0.005	ND
Orange			0.005	ND
Papaya			0.005	ND
Peach			31	16-48
Pear			0.008	ND-0.012
Persimmon			0.019	ND-0.049
Pineapple			37	20-43
Plum			0.007	ND-0.014
Pummelo /Grapefruit			0.005	ND
Watermelon			0.009	ND-0.013
Meat, poultry and game and their products:	**48**	**88**	**0.015**	**ND-0.15**

TDS Food Item	Number of composite samples	% of composite samples < LOD	Mean (mg/kg) [range]	
Beef			0.005	ND
Mutton			0.034	ND-0.12
Pork			0.005	ND
Ham			0.005	ND
Luncheon meat			0.087	0.035-0.15
Barbecued pork			0.005	ND
Roasted pork			0.005	ND
Pig liver			0.005	ND
Chicken meat			0.005	ND
Chicken, soy sauce			0.005	ND
Roasted duck/goose			0.005	ND
Meat sausage			0.010	ND-0.024
Eggs and their products:	**12**	**100**	**0.005**	**ND**
Egg, chicken			0.005	ND
Egg, lime preserved			0.005	ND
Egg, salted			0.005	ND
Fish and seafood and their products:	**76**	**54**	**0.022**	**ND-0.18**
Fish, Big head			0.005	ND
Fish, Mandarin fish			0.005	ND
Fish, Grass carp			0.005	ND
Fish, Golden thread			0.027	0.025-0.033
Fish, Grouper			0.050	ND-0.11
Fish, Horse head			0.023	0.016-0.030
Fish, Pomfret			0.050	0.013-0.082
Fish, Sole			0.005	ND
Fish, Tuna			0.018	ND-0.057
Fish, Grey mullet			0.005	ND
Fish, Salmon			0.005	ND
Fish, Yellow croaker			0.046	0.017-0.13
Fish, Dace, minced			0.005	ND
Fish ball/fish cake			0.025	0.016-0.044
Shrimp/ Prawn			0.005	ND
Crab			0.036	ND-0.075
Oyster			0.082	0.023-0.18
Scallop			0.005	ND
Squid			0.025	0.015-0.038
Dairy products:	**20**	**95**	**0.028**	**ND-0.47**
Milk, whole			0.005	ND
Milk, skim			0.005	ND
Cheese			0.005	ND
Yoghurt			0.005	ND
Ice-cream			0.12	ND-0.47

TDS Food Item	Number of composite samples	% of composite samples < LOD	Mean (mg/kg) [range]	
Fats and oils:	**8**	**100**	**0.005**	**ND**
Butter			0.005	ND
Oil, vegetable			0.005	ND
Beverages, alcoholic:	**8**	**100**	**0.005**	**ND**
Beer			0.005	ND
Red wine			0.005	ND
Beverages, non-alcoholic:	**40**	**90**	**0.007**	**ND-0.059**
Tea, Chinese			0.001	ND
Tea, Milk tea			0.039	ND-0.059
Coffee			0.007	ND-0.014
Malt drink			0.005	ND
Soybean drink			0.005	ND
Fruit and vegetable juice			0.005	ND
Carbonated drink			0.005	ND
Tea, chrysanthemum			0.005	ND
Water, bottled, distilled			0.001	ND
Water, drinking			0.001	ND
Mixed dishes:	**48**	**65**	**0.13**	**ND-2.7**
Siu Mai			0.012	ND-0.027
Dumpling, steamed			0.098	ND-0.30
Dumpling, pan-fried			0.018	ND-0.058
Dumpling, including wonton			0.014	ND-0.031
Steamed barbecued pork bun			0.005	ND
Turnip cake			0.009	ND-0.013
Steamed minced beef ball			0.034	0.017-0.076
Glutinous rice dumpling			0.016	ND-0.047
Steamed rice-rolls with filling			1.3	ND-2.7
Steamed rice-rolls, plain			0.005	ND
Chinese soup			0.005	ND
Hamburger			0.005	ND
Snack foods:	**4**	**50**	**0.015**	**ND-0.039**
Potato chips			0.015	ND-0.039
Sugars and confectionery:	**8**	**100**	**0.005**	**ND**
Chocolate			0.005	ND
Granulated white sugar			0.005	ND
Condiments, sauces and herbs:	**20**	**75**	**0.061**	**ND-0.53**
Table salt			0.005	ND
Soya sauce			0.005	ND
Oyster sauce			0.008	ND-0.018
Tomato paste/ ketchup			0.28	0.014-0.53
Cornstarch			0.005	ND

Table H: Vanadium Contents (μg/kg) in TDS Foods of the 1st HKTDS

TDS Food Item	Number of composite samples	% of composite samples < LOD	Mean (μg/kg) [range]	
Cereals and their products:	**76**	**30**	**10**	**ND-260**
Rice, white			1.5	ND
Rice, unpolished			1.5	ND
Corn			3	ND-5
Noodles, Chinese or Japanese style			3	ND-7
Pasta, Western style			1.5	ND
Instant noodles			7	5-9
Noodles, rice			3	ND-6
Bread, plain			10	7-13
Bread, raisin			9	7-13
"Pineapple" bun			3	ND-5
Sausage/ham/luncheon meat bun			6	4-9
Chinese steamed bread			4	3-5
Biscuits			23	9-40
Cakes			73	8-260
Pastries			7	6-7
Pastries, Chinese			7	5-8
Oatmeal			2	ND-4
Breakfast cereals			13	4-21
Deep-fried dough			8	5-11
Vegetables and their products:	**140**	**50**	**9**	**ND-66**
Carrot/ Radish			1.5	ND
Potato			1.5	ND
Potato, fried			28	12-64
Broccoli			5	4-6
Cabbage, Chinese			2	ND-3
Cabbage, Chinese flowering			11	8-16
Cabbage, European variety			3	ND-4
Cabbage, Petiole Chinese			11	10-12
Celery			1.5	ND
Chinese kale			3	ND-4
Chinese spinach			31	15-49
Leaf mustard			10	ND-19
Lettuce, Chinese			7	6-8
Lettuce, European			2	ND-3
Mung bean sprout			2	ND-4
Spinach			48	36-66
Water spinach			14	11-18
Watercress			19	13-25
Bitter melon			1.5	ND

TDS Food Item	Number of composite samples	% of composite samples < LOD	Mean (µg/kg)	[range]
Cucumber			1.5	ND
Hairy gourd			1.5	ND
Pumpkin			1.5	ND
Sponge gourd			3	ND-6
Wax gourd			1.5	ND
Zucchini			1.5	ND
Eggplant			2	ND-4
Sweet pepper			1.5	ND
Tomato			1.5	ND
Garlic			1.5	ND
Onion			1.5	ND
Spring onion			14	9-16
Preserved vegetables			24	15-34
Mushroom, dried shiitake			6	4-8
Mushrooms			25	3-58
Ear fungus			47	31-63
Legumes, nuts and seeds and their products:	**24**	**42**	**11**	**ND-82**
Green string beans, with pod			2	ND-4
Mung bean vermicelli			1.5	ND
Beancurd			6	ND-9
Fermented bean products			51	10-82
Peanut			4	ND-7
Peanut butter			5	ND-6
Fruits:	**68**	**97**	**1.5**	**ND-3**
Apple			1.5	ND
Banana			1.5	ND
Dragon fruit			1.5	ND
Grapes			2	ND-3
Kiwi fruit			1.5	ND
Longan/ Lychee			1.5	ND
Mango			1.5	ND
Melons			1.5	ND
Orange			1.5	ND
Papaya			1.5	ND
Peach			1.5	ND
Pear			1.5	ND
Persimmon			1.5	ND
Pineapple			2	ND-3
Plum			1.5	ND
Pummelo /Grapefruit			1.5	ND
Watermelon			1.5	ND
Meat, poultry and game and their products:	**48**	**67**	**4**	**ND-20**

TDS Food Item	Number of composite samples	% of composite samples < LOD	Mean (µg/kg) [range]	
Beef			1.5	ND
Mutton			1.5	ND
Pork			1.5	ND
Ham			6	5-8
Luncheon meat			6	5-7
Barbecued pork			1.5	ND
Roasted pork			1.5	ND
Pig liver			13	8-16
Chicken meat			1.5	ND
Chicken, soy sauce			1.5	ND
Roasted duck/goose			1.5	ND
Meat sausage			13	6-20
Eggs and their products:	**12**	**25**	**13**	**ND-35**
Egg, chicken			2	ND-3
Egg, lime preserved			8	6-10
Egg, salted			30	24-35
Fish and seafood and their products:	**76**	**42**	**20**	**ND-270**
Fish, Big head			7	5-9
Fish, Mandarin fish			3	ND-5
Fish, Grass carp			3	ND-6
Fish, Golden thread			1.5	ND
Fish, Grouper			1.5	ND
Fish, Horse head			1.5	ND
Fish, Pomfret			1.5	ND
Fish, Sole			5	ND-7
Fish, Tuna			1.5	ND
Fish, Grey mullet			10	4-17
Fish, Salmon			3	ND-5
Fish, Yellow croaker			2	ND-4
Fish, Dace, minced			20	11-36
Fish ball/fish cake			11	8-16
Shrimp/ Prawn			34	7-64
Crab			47	35-56
Oyster			190	130-270
Scallop			38	17-54
Squid			3	ND-6
Dairy products:	**20**	**75**	**5**	**ND-57**
Milk, whole			1.5	ND
Milk, skim			1.5	ND
Cheese			18	ND-57
Yoghurt			1.5	ND
Ice-cream			5	ND-9

TDS Food Item	Number of composite samples	% of composite samples < LOD	Mean (μg/kg) [range]	
Fats and oils:	**8**	**100**	**1.5**	**ND**
Butter			1.5	ND
Oil, vegetable			1.5	ND
Beverages, alcoholic:	**8**	**0**	**43**	**8-94**
Beer			21	8-42
Red wine			65	30-94
Beverages, non-alcoholic:	**40**	**75**	**2**	**ND-9**
Tea, Chinese			0.3	ND
Tea, Milk tea			1.5	ND
Coffee			2	ND-4
Malt drink			6	5-7
Soybean drink			1.5	ND
Fruit and vegetable juice			2	ND-5
Carbonated drink			1.5	ND
Tea, chrysanthemum			3	ND-9
Water, bottled, distilled			0.3	ND
Water, drinking			0.6	ND-0.8
Mixed dishes:	**48**	**8**	**6**	**ND-15**
Siu Mai			5	3-7
Dumpling, steamed			7	4-8
Dumpling, pan-fried			6	4-8
Dumpling, including wonton			9	7-12
Steamed barbecued pork bun			5	4-6
Turnip cake			10	6-15
Steamed minced beef ball			4	3-5
Glutinous rice dumpling			5	4-7
Steamed rice-rolls with filling			4	ND-5
Steamed rice-rolls, plain			4	3-5
Chinese soup			3	ND-6
Hamburger			7	5-9
Snack foods:	**4**	**0**	**20**	**14-39**
Potato chips			20	14-39
Sugars and confectionery:	**8**	**50**	**21**	**ND-71**
Chocolate			40	15-71
Granulated white sugar			1.5	ND
Condiments, sauces and herbs:	**20**	**20**	**22**	**ND-83**
Table salt			1.5	ND
Soya sauce			49	27-83
Oyster sauce			22	18-27
Tomato paste/ ketchup			19	11-34
Cornstarch			20	12-31

Appendix II

Table A. Dietary Exposures to Aluminium by Age-gender Groups (Average and High Consumers of the Population)

Age-gender groups	Dietary Exposure # (mg/kg bw/week)	
	Average Consumers	High Consumers@
Male aged 20 – 29	0.48	1.2
Female aged 20 – 29	0.50	1.1
Male aged 30-39	0.52	1.2
Female aged 30 – 39	0.62	1.7
Male aged 40-49	0.66	1.7
Female aged 40 – 49	0.64	1.6
Male aged 50-59	0.69	1.9
Female aged 50 – 59	0.60	1.4
Male aged 60-69	0.66	1.9
Female aged 60 – 69	0.61	1.5
Male aged 70-84	0.71	2.1
Female aged 70 – 84	0.52	1.6
Male aged 20-84	0.61	1.6
Female aged 20 – 84	0.59	1.5
Adult aged 20 – 84	**0.60**	**1.5**

Half of LOD is used for all results less than LOD in calculating the exposure estimates.

@ Exposures of high consumers refer to the exposures at 95th percentile.

Table B. Dietary Exposures to Antimony by Age-gender Groups (Average and High Consumers of the Population)

Age-gender groups	Dietary Exposure # (µg/kg bw/day)	
	Average Consumers	High Consumers@
Male aged 20 – 29	0.020-0.041	0.039-0.064
Female aged 20 – 29	0.019-0.041	0.035-0.066
Male aged 30-39	0.019-0.040	0.034-0.065
Female aged 30 – 39	0.019-0.042	0.034-0.069
Male aged 40-49	0.017-0.040	0.030-0.063
Female aged 40 – 49	0.016-0.040	0.028-0.061
Male aged 50-59	0.016-0.040	0.030-0.064
Female aged 50 – 59	0.015-0.038	0.027-0.058
Male aged 60-69	0.013-0.037	0.025-0.059
Female aged 60 – 69	0.012-0.035	0.023-0.057
Male aged 70-84	0.011-0.034	0.022-0.054
Female aged 70 – 84	0.011-0.033	0.022-0.053
Male aged 20-84	0.017-0.039	0.032-0.063
Female aged 20 – 84	0.016-0.039	0.031-0.062
Adult aged 20 – 84	**0.016-0.039**	**0.031-0.063**

0 and LOD are used for all results less than LOD in calculating the exposure estimates.

@ Exposures of high consumers refer to the exposures at 95th percentile.

Table C. Dietary Exposures to Cadmium by Age-gender Groups (Average and High Consumers of the Population)

Age-gender groups	Dietary Exposure # (μg/kg bw/month)	
	Average Consumers	High Consumers@
Male aged 20 – 29	7.5	18
Female aged 20 – 29	8.9	21
Male aged 30-39	8.6	25
Female aged 30 – 39	9.4	21
Male aged 40-49	8.0	18
Female aged 40 – 49	9.3	20
Male aged 50-59	8.0	20
Female aged 50 – 59	8.2	16
Male aged 60-69	8.0	17
Female aged 60 – 69	7.6	18
Male aged 70-84	6.8	16
Female aged 70 – 84	7.1	15
Male aged 20-84	7.9	19
Female aged 20 – 84	8.7	19
Adult aged 20 – 84	**8.3**	**19**

\# Half of LOD is used for all results less than LOD in calculating the exposure estimates.

@ Exposures of high consumers refer to the exposures at 95th percentile.

Table D. Dietary Exposures to Lead by Age-gender Groups (Average and High Consumers of the Population)

Age-gender groups	Dietary Exposure # (μg/kg bw/day) Average Consumers	High Consumers@
Male aged 20 – 29	0.17	0.32
Female aged 20 – 29	0.20	0.37
Male aged 30-39	0.19	0.35
Female aged 30 – 39	0.22	0.40
Male aged 40-49	0.20	0.33
Female aged 40 – 49	0.23	0.40
Male aged 50-59	0.21	0.38
Female aged 50 – 59	0.22	0.41
Male aged 60-69	0.22	0.41
Female aged 60 – 69	0.22	0.43
Male aged 70-84	0.21	0.41
Female aged 70 – 84	0.20	0.39
Male aged 20-84	0.20	0.36
Female aged 20 – 84	0.22	0.40
Adult aged 20 – 84	**0.21**	**0.38**

Half of LOD is used for all results less than LOD in calculating the exposure estimates.

@ Exposures of high consumers refer to the exposures at 95th percentile.

Table E. Dietary Exposures to Methylmercury by Age-gender Groups (Average and High Consumers of the Population)

Age-gender groups	Dietary Exposure # (µg/kg bw/week)	
	Average Consumers	High Consumers@
Male aged 20 – 29	0.43	1.5
Female aged 20 – 29	0.58	2.1
Male aged 30-39	0.59	2.1
Female aged 30 – 39	0.78	2.5
Male aged 40-49	0.67	2.3
Female aged 40 – 49	0.69	2.4
Male aged 50-59	0.86	3.0
Female aged 50 – 59	0.87	3.5
Male aged 60-69	0.93	3.6
Female aged 60 – 69	0.89	3.2
Male aged 70-84	0.91	3.3
Female aged 70 – 84	1.0	3.8
Male aged 20-84	0.70	2.6
Female aged 20 – 84	0.77	2.7
Adult aged 20 – 84	**0.74**	**2.7**

Half of LOD is used for all results less than LOD in calculating the exposure estimates.

@ Exposures of high consumers refer to the exposures at 95th percentile.

Table F. Dietary Exposures to Nickel by Age-gender Groups (Average and High Consumers of the Population)

Age-gender groups	Dietary Exposure # (µg/kg bw/day) Average Consumers	High Consumers@
Male aged 20 – 29	2.8	4.8
Female aged 20 – 29	2.9	5.6
Male aged 30-39	3.0	5.3
Female aged 30 – 39	3.1	6.1
Male aged 40-49	3.3	5.6
Female aged 40 – 49	3.3	6.2
Male aged 50-59	3.4	6.0
Female aged 50 – 59	3.2	5.8
Male aged 60-69	3.5	6.4
Female aged 60 – 69	3.0	5.8
Male aged 70-84	3.1	5.6
Female aged 70 – 84	2.7	5.0
Male aged 20-84	3.1	5.5
Female aged 20 – 84	3.1	5.8
Adult aged 20 – 84	**3.1**	**5.7**

\# Half of LOD is used for all results less than LOD in calculating the exposure estimates.

@ Exposures of high consumers refer to the exposures at 95th percentile.

Table G. Dietary Exposures to Tin by Age-gender Groups (Average and High Consumers of the Population)

Age-gender groups	Dietary Exposure # (mg/kg bw/week)	
	Average consumers	High Consumers@
Male aged 20 – 29	0.022-0.024	0.096-0.098
Female aged 20 – 29	0.032-0.034	0.18
Male aged 30-39	0.019-0.020	0.088-0.089
Female aged 30 – 39	0.044-0.046	0.23
Male aged 40-49	0.028-0.030	0.15
Female aged 40 – 49	0.049-0.051	0.27-0.28
Male aged 50-59	0.019-0.021	0.090-0.092
Female aged 50 – 59	0.032-0.033	0.16
Male aged 60-69	0.018-0.020	0.052-0.056
Female aged 60 – 69	0.027-0.029	0.14-0.15
Male aged 70-84	0.014-0.016	0.043-0.046
Female aged 70 – 84	0.013-0.015	0.042-0.044
Male aged 20-84	0.021-0.023	0.10-0.11
Female aged 20 – 84	0.037-0.039	0.21
Adult aged 20 – 84	**0.029-0.031**	**0.16-0.17**

0 and LOD are used for all results less than LOD in calculating the exposure estimates.

@ Exposures of high consumers refer to the exposures at 95th percentile.

Appendix III

A Summary of Estimated Dietary Exposures to Metallic Contaminants of the HK Adult Population

Contaminant	Health-based Guidance Value	Estimated Dietary Exposures (% Contribution to Health-based Guidance Value)	
		Average Consumers	High Consumers (95th percentile)
Aluminium	PTWI: 2 mg/kg bw	0.6 mg/kg bw/week (30% PTWI)	1.5 mg/kg/bw week (77% PTWI)
Antimony	TDI: 6 µg/kg bw	0.016-0.039 µg/kg bw/day (0.3-0.7% TDI)	0.031-0.063 µg/kg bw/day (0.5-1.1% TDI)
Cadmium	PTMI: 25 µg/kg bw	8.3 µg/kg bw/month (33% PTMI)	19 µg/kg bw/month (75% PTMI)
Lead	1.2 µg/kg bw/day[1]	0.21 µg/kg bw/day (MOE=6)	0.38 µg/kg bw/day (MOE=3)
Methylmercury	PTWI: 3.3 µg/kg bw[2]	0.74 µg/kg bw/week (22% PTWI)	2.7 µg/kg bw/week (82% PTWI)
Nickel	TDI: 12 µg/kg bw	3.1 µg/kg bw/day (26% TDI)	5.7 µg/kg bw/day (48% TDI)
Tin	PTWI: 14 mg/kg bw	0.029-0.031 mg/kg bw/week (0.2% PTWI)	0.16-0.17 mg/kg bw/week (1.1-1.2% PTWI)

Notes: Dietary exposure data were rounded to 2 significant figures while percentage data were rounded to whole number for figures >10 and to one decimal place for figures<10.

[1] JECFA in 2011 opined that for adults, an exposure of 1.2 µg/kg bw/day may result in a population increase in systolic blood pressure of 1 mmHg. This dose estimate is not a health-based guidance value but an approximate estimate of where the risk of an adverse effect is considered to be acceptably low (i.e. MOE>1).

[2] The PTWI of 3.3 µg/kg bw (~twice the PTWI of 1.6 µg/kg bw established by JECFA in 2003) applied to general population while the PTWI of 1.6 µg/kg bw applied to pregnant women and children up to 17 years.