# Report of the Second Hong Kong Total Diet Study: Cadmium and Lead

July 2026
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# Executive Summary
# The Second Hong Kong Total Diet Study: Cadmium and Lead

The Centre for Food Safety is conducting the Second Hong Kong Total Diet Study (2nd HKTDS) to estimate the latest dietary exposure of the Hong Kong population and various population subgroups to a range of chemical substances of potential food safety concern, and to assess the associated health risks. This report presents an analysis of the levels of two metallic contaminants, namely cadmium and lead, in foods and the dietary exposure assessment in the local population.

2. Cadmium and lead are metallic elements that are found at low concentrations in the Earth's crust. They can be released into the environment (including soil, water and air) through natural activities as well as human activities including industrial and agricultural activities. Once released into the environment, they persist and can travel long distances from the source of emission via atmospheric transport, deposit on soils and water surfaces, and then be taken up by plants and animals and enter the human food chain. Cadmium and lead enter the human body mainly via ingestion and inhalation.

3. Due to the long half-life of cadmium and lead in the human body which could persist for decades, chronic toxicity is of the most concern when considering their potential risks to human health. Cadmium is classified as a human carcinogen, and chronic excessive exposure can impair renal function and is associated with decreased bone mineral density. The Joint Food and Agriculture Organization of the United Nations / World Health Organization Expert Committee on Food Additives (JECFA) in 2010 established a Provisional Tolerable Monthly Intake (PTMI) of 25 μg/kg body weight (bw) for cadmium. As for lead, chronic exposure is associated with a wide range of effects, including

various neurological and behavioural effects, mortality (mainly due to cardiovascular diseases), impaired renal function, hypertension, impaired fertility and adverse pregnancy outcomes, delayed sexual maturation and impaired dental health. JECFA in 2010 identified that a dietary exposure level of 0.6 μg/kg bw/day to lead would associate with a population decrease of 1 intelligence quotient (IQ) point in children, whereas a dietary exposure level of 1.2 μg/kg bw/day to lead would associate with a population increase in systolic blood pressure of 1 mmHg (0.1 kPa) in adults.

## Results

4. Out of the 187 TDS food items covering 15 TDS food groups tested, cadmium was detected in 125 (67%) of food items, while lead was detected in 176 (94%) of food items.

5. For the adult population, the estimated dietary exposure to cadmium for average consumers was 5.3-6.1 μg/kg bw/month (LB-UB), which accounted for 21-24% (LB-UB) of the PTMI allocated to cadmium by JECFA (i.e. 25 μg/kg bw/month). Among high consumers ($90^{th}$ percentile) of the adult population, the estimated dietary exposure to cadmium was 9.3-10 μg/kg bw/month (LB-UB), which accounted for 37-41% (LB-UB) of the PTMI. For the younger population, the estimated dietary exposure to cadmium for average consumers was 8.8-9.9 μg/kg bw/month (LB-UB), which accounted for 35-40% (LB-UB) of the PTMI. Among high consumers ($90^{th}$ percentile) of the younger population, the estimated dietary exposure to cadmium was 15-17 μg/kg bw/month (LB-UB), which accounted for 61-67% (LB-UB) of the PTMI.

6. In regard to lead, for the adult population, the dietary exposure estimates of lead for average and high consumers ($90^{th}$ percentile) were 0.089-0.092 μg/kg bw/day (LB-UB) and 0.15-0.15 μg/kg bw/day (LB-UB), respectively, which were well below the dietary exposure level (i.e. 1.2 μg/kg bw/day) associated with a

population increase of 1 mmHg in systolic blood pressure in adults. For the younger population, the dietary exposure estimates of lead for average and high consumers (90th percentile) were 0.13-0.14 μg/kg bw/day (LB-UB) and 0.23-0.24 μg/kg bw/day (LB-UB), respectively, which also fell below the dietary exposure level (i.e. 0.6 μg/kg bw/day) associated with a population decrease of 1 IQ point in children.

Conclusion and Recommendations

7. Regarding cadmium, the dietary exposure estimates for average and high consumers of the overall local adult and younger populations all fell below the PTMI allocated to cadmium. Thus, dietary exposure to cadmium would be unlikely to pose health risks to the local population.

8. As for lead, the dietary exposure estimates for average and high consumers of the overall local adult and younger populations all fell below the respective dietary exposure levels that would associate with an increase of blood pressure in adults and a decrease of 1 IQ point in children. Thus, it is considered that the health impact on the local population due to dietary exposure to lead is low.

9. Compared to the 1st HKTDS conducted in 2010-2014, it is noted that the dietary exposure estimates of cadmium and lead for both average and high consumers of the overall adult population appeared to be lower in this round of HKTDS.

10. The public is advised to maintain a balanced and varied diet to avoid excessive exposure to metallic contaminants from a small range of food items. Additional food preparation steps, such as washing vegetables and fruits thoroughly to remove dust and soil, removing outer leaves from leafy greens and peeling root crops, may be adopted to reduce cadmium and lead levels therein.

# Chapter 1
# Background

1.1 Total Diet Study (TDS) is a tool for estimating population chronic dietary exposure to a wide range of chemicals across the whole diet within one study, which is an internationally well-recognised approach for quantifying the presence of chemical substances in the food supply and for estimating dietary exposure. The Food and Agriculture Organization of the United Nations (FAO) and the World Health Organization (WHO) have been promoting and supporting the TDS approach since the 1970's. The Centre for Food Safety (CFS) conducted the First Hong Kong Total Diet Study (1st HKTDS) in 2010-2014.[1]

## Introduction of the Second Hong Kong Total Diet Study (2nd HKTDS)

1.2 With the availability of an updated set of food consumption data from the Second Population-based Food Consumption Survey (2nd FCS) (2018-2020), the CFS has taken the opportunity to conduct the Second Hong Kong Total Diet Study (2nd HKTDS). The 2nd HKTDS aims to estimate the latest dietary exposure of the Hong Kong population and various population subgroups to a range of chemical substances of potential food safety concern, and to assess the associated health risks.

1.3 Similar to the 1st HKTDS, the 2nd HKTDS comprises selection of chemical substances, development of a TDS food list, food sampling, sample preparation, laboratory analysis, dietary exposure estimation and publication of results. The 2nd HKTDS covers the majority of foods normally consumed by the Hong Kong population, with laboratory analysis conducted for some 130 chemical substances in total, covering mainly contaminants and pesticide residues in food and some food additives of local concern.

Metallic contaminants in the 2nd HKTDS

1.4 Metallic contaminants exist in foods in trace amounts. They can enter the food supply from the environment through air, soil and water, or during food processing, handling and packaging. For the general population, diet is the main source of exposure to some common metallic contaminants such as arsenic (As), cadmium (Cd), lead (Pb) and mercury (Hg). Potential health risks associated with dietary exposure to metallic contaminants are of public health concern.

1.5 As agreed at the Fifth International Workshop on Total Diet Studies organised by the WHO Regional Office for the Western Pacific, four metallic contaminants, namely inorganic arsenic (iAs), cadmium, lead and mercury, were included in the lists of chemicals recommended for inclusion in TDS.[2] Taking into consideration that these metallic contaminants are present in the food supply and are commonly included in national TDSs, with some results raising health concerns, these metallic contaminants have been accorded high priority for inclusion in HKTDS.

1.6 In the 2nd HKTDS, the above-mentioned four metallic contaminants, i.e. arsenic (in various forms including iAs), cadmium, lead and mercury (in various forms including methylmercury) have been included as selected chemical substances for continuous monitoring. This report focuses on the analysis of the levels of cadmium and lead in foods, and the relevant dietary exposure assessment in the local population.

**Cadmium**

1.7 Cadmium (Cd) is a metallic element that is found at low concentrations in the Earth's crust. It can be released into the environment (including soil, water and air) through natural activities such as volcanic activity, weathering and erosion. Nowadays, the principal industrial uses of cadmium are in nickelcadmium batteries, pigments, coatings and plating, plastics stabilisers, non-ferrous alloys and solar cells. Human activities, such as mining, smelting and refining of non-ferrous metals, fossil fuel combustion, disposal and recycling of waste (including electronic waste), manufacture and application of phosphate fertilizers, have increased to a large extent the levels of cadmium exist in the environment. Cadmium persists in the environment, and can travel long distances from the source of emission via atmospheric transport and deposit on soils and water surfaces.[3,4]

1.8 Cadmium that exists in soil and water can be taken up by crops, pasture and aquatic organisms and enter the human food chain. Highest cadmium levels have been reported in the kidney and liver of animals and in certain species of molluscs (e.g. oysters, scallops, mussels) and crustaceans, whereas lower cadmium levels have been reported in fruits, vegetables, cereals and muscle meat of animals.[3,5,6] In addition, cadmium that exists in certain equipment (e.g. cadmium glazed ceramics, certain brightly coloured plastic tableware) may leach into foods during food preparation and storage/packaging.

*Sources of exposure*

1.9 The pathways of human exposure to cadmium include food, air, water and tobacco smoking. For the non-smoking general population, the major route of exposure to cadmium is via food. For smokers, smoking tobacco is an important source of cadmium uptake whilst in the case of heavy smokers, daily intake may equal or even exceed that from food.[3,4,7] Cadmium exposure from drinking-water is much less in proportion as compared with exposure from diet. However, impurities in water pipes, solders and some metal fittings may result in increased cadmium levels in drinking-water.[6] According to the monitoring results of the Water Supplies Department (WSD), the average concentration of cadmium in drinking water samples collected in Hong Kong was <0.001 mg/L for the past three consecutive 12-month periods (i.e. from October 2022 to September

2025)[8], which was lower than the guideline value for cadmium in drinking water (i.e. 0.003 mg/L) established by the WHO.[9] In terms of occupational exposure, higher risk of exposure through inhalation of dust and fumes occurs in operations involving heating cadmium-containing products such as smelting, welding, soldering, or electroplating, and also in operations associated with producing cadmium powders.[4]

*Kinetics and metabolism*

1.10 The absorption of cadmium via the gastrointestinal tract is influenced by the solubility of the cadmium compound concerned, composition of the diet and nutrition status of the individuals. Higher absorption of cadmium is observed in iron-deficient individuals.[5,6] Absorbed cadmium enters the bloodstream and is retained in the liver and kidney where tissue concentrations increase with age. Only a small part of the cadmium absorbed will be excreted mainly in the urine.[6] The biological half-life in humans is in the range of 10 to 35 years. Cadmium levels in urine are widely accepted as a measure of the body burden and the cumulative amount in the kidneys.[10]

*Toxicity*

1.11 Cadmium compounds have a moderate acute oral toxicity. Major acute effects include necrosis of the gastric and intestinal mucosa and dystrophic changes of liver, heart and kidneys.[6] The kidney is the critical target organ following long-term exposure to cadmium. Cadmium accumulation in the kidneys may lead to renal tubular dysfunction, resulting in increased excretion of low molecular weight proteins in the urine which can progress to overt nephropathy.[3] In addition, high intake of cadmium can cause disturbances in calcium metabolism and is associated with a decrease in bone mineral density.[3,5]

1.12 The International Agency for Research on Cancer (IARC) last evaluated cadmium compounds in 2009. Cadmium and cadmium compounds were classified as carcinogenic agents to humans (Group 1) on the basis of sufficient evidence in humans for lung cancer while limited evidence in humans for kidney and prostate cancers.[11]

*Health-based guidance value*

1.13 Having considered the exceptionally long half-life of cadmium in humans, the Joint FAO / WHO Expert Committee on Food Additives (JECFA) in 2010 established a Provisional Tolerable Monthly Intake (PTMI) of 25 μg/kg bw for cadmium.[5]

**Lead**

1.14 Lead (Pb) occurs at low concentrations in the Earth's crust and the environment naturally, but to a greater extent it enters the environment as a result of past or current human activities such as mining, smelting, refining and recycling of lead, use of leaded petrol (gasoline) and aviation fuel, use of lead or lead-containing materials in manufacturing batteries, ammunition, water pipes and plumbing fittings, solder, paints, ceramic glazes and crystal tableware, etc.[12] Lead occurs in both inorganic and organic forms. In the environment, lead is present primarily in the inorganic form.[13] Once lead is released into the environment, it persists and has a potential for global atmospheric transport.[12,14,15] Due to the health concerns on chronic exposure to lead, international concerted efforts have been made to reduce the use and environmental releases of lead over the past decades. Year 2021 has marked the end of leaded petrol worldwide.[16] Additionally, the use of leaded paints, lead-containing water pipes and fittings, and leaded solder in food and beverage cans has been or is being phased out, particularly in developed countries.[12,13]

1.15 Lead contamination of food arises mainly from the environment but also during food processing, handling and packaging.[15] Lead may be taken up in edible plants from soil, and through atmospheric deposition of particulate matter on plant surfaces. Uptake of lead in animals may occur as a result of inhalation of contaminated ambient air or ingestion of contaminated plants.[14] In addition, lead that exists in certain food processing equipment (e.g. cookware made from aluminium or certain alloys, and ceramics with leaded glaze) may leach into foods during food preparation and storage/packaging.[12,17,18] Lead is widely distributed in food, and is most frequently detected in shellfish (especially bivalves), cocoa products, organ meats, tea, roots and tubers, seaweed and mushrooms/fungi.[15]

*Sources of exposure*

1.16 Lead enters the human body mainly via ingestion and inhalation. For the general adults, diet (including food and water) is the main source of lead exposure whereas diet, dust and 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 smokers, tobacco and e-cigarettes are additional sources of lead exposure.[14] For those people who are involved in occupations such as lead smelting and refining, battery manufacturing and recycling, steel welding or cutting operations, construction and painting, they may be exposed to higher levels of lead from their work environment mainly through inhalation of lead fumes or lead dust.[19]

1.17 Regarding drinking water, lead can be present in tap water primarily from corrosive water effects on household plumbing systems containing lead in pipes, solder or fittings (including alloy fittings with high lead content). The WHO has established a provisional guideline value for lead in drinking water at 0.01 mg/L.[20] In Hong Kong, there were incidents of excess lead found in drinking water in 2015. Since 2017, the WSD has implemented an Enhanced Water Quality Monitoring Programme, which extends the collection of drinking water samples to cover consumers' taps of randomly selected premises for testing of metallic contaminants (including lead) that could be present in internal plumbing systems. According to the monitoring results of the WSD, the average concentration of lead in drinking water samples collected in Hong Kong was <0.001 mg/L for the past three consecutive 12-month periods (i.e. from October 2022 to September 2025).[8]

*Kinetics and metabolism*

1.18 Gastrointestinal absorption of ingested lead varies depending on physiological factors (e.g. age, fasting, calcium and iron status) of the individuals and on the physicochemical properties (e.g. particle size and solubility) of the ingested material. Absorption from the gastrointestinal tract is higher in children than in adults, and is lower in the presence of food.[13,15] Absorbed lead is transported in the blood mainly through the red blood cells, and then transferred to soft tissues (including liver and kidneys), and to bone tissue where it accumulates with age. Blood is the tissue used most frequently to estimate exposure to lead. Maternal transfer of lead occurs through the placenta and during breast feeding. Enhanced mobilisation of lead from bones occurs during pregnancy. Half-lives for inorganic lead in blood and bone are approximately 30 days and between 10 and 30 years, respectively, and excretion primarily is in urine and faeces.[13,15]

*Toxicity*

1.19 The acute toxicity of lead is low.[15] Due to its long half-life in the body, chronic toxicity of lead is of the most concern when considering the potential risk to human health.[13] Chronic exposure to lead is associated with a wide range of effects, including various neurological and behavioural effects, mortality (mainly due to cardiovascular diseases), impaired renal function, hypertension, impaired fertility and adverse pregnancy outcomes, delayed sexual maturation and impaired dental health.[15] There is considerable evidence demonstrating that the developing brain is more vulnerable to the neurotoxic effect of lead than the mature brain and this is of particular concern even at relatively low levels of lead exposure.[13] According to the last evaluation on lead conducted by JECFA in 2010, for children, the weight of evidence was the greatest and the evidence across studies was the most consistent for an association of blood lead levels with impaired neurodevelopment, specifically a reduction of intelligence quotient (IQ). For adults, the adverse effect associated with the lowest blood lead concentrations for which the weight of evidence was the greatest and the most consistent was a lead-associated increase in systolic blood pressure.[15]

1.20 In 2004, IARC classified inorganic lead compounds as probably carcinogenic to humans (Group 2A) and organic lead compounds as not classifiable as to their carcinogenicity to humans (Group 3).[19]

*Health-based guidance value*

1.21 In 2010, JECFA withdrew the previous Provisional Tolerable Weekly Intake (PTWI) established for lead and concluded that it was not possible to establish a PTWI for lead that would be considered to be health protective, because the dose-response analyses did not provide any indication of a threshold for the key effects of lead. Notwithstanding this, JECFA identified that a dietary exposure of 0.6 μg/kg bw/day to lead would associate with a population decrease of 1 IQ point in children, whereas a dietary exposure of 1.2 μg/kg bw/day to lead would associate with a population increase in systolic blood pressure of 1 mmHg (0.1 kPa) in adults.[15] For the purposes of risk characterisation, this study would assess the health impact of dietary exposure to lead with reference to these toxicological reference points determined by JECFA for children and adults respectively.

## Regulatory control

1.22 In Hong Kong, the control on metallic contaminants in food is governed by the Food Adulteration (Metallic Contamination) Regulations (Cap. 132V) ("the Regulations"). The Regulations stipulate the maximum levels (MLs) for various specified metallic contaminants, including cadmium and lead, in specified foods. In the past decade, the Regulations have gone through two amendment exercises with a view to better protecting public health, facilitating effective regulation and promoting harmonisation between local and international standards. The Amendment Regulation 2018 had taken full effect from November 2020, while the Amendment Regulation 2025 provides a grace period of 18 months, and will take full effect from March 2027.[21]

## Previous HKTDS

1.23 Cadmium and lead were included in the 1st HKTDS.[22] The results indicated that the estimated dietary exposure to cadmium among high consumers (95th percentile) for one particular age-gender subgroup (i.e. male aged 30-39) slightly exceeded the PTMI for cadmium, while the dietary exposure estimates for all other age-gender subgroups were below the PTMI. As for lead, dietary exposure to lead and the risk of increase in systolic blood pressure was examined in the adult population in the 1st HKTDS, as local food consumption data was only available for the adult population when the 1st HKTDS was conducted. The results indicated that dietary exposure to lead for all adult population age-gender subgroups fell below the dietary exposure level associated with an increase in systolic blood pressure. With the availability of local food consumption data for the younger population, dietary exposure to lead and the risk of reduction of IQ in children was also examined in the 2nd HKTDS.

# Chapter 2
# Methodology and Laboratory Analysis

## Methodology of the 2nd HKTDS

2.1 Based on the 2nd FCS, 187 TDS food items (involving 15 food groups) were selected for the study as representative foods to represent the majority of foods consumed by the local population. Six individual samples of each TDS food item were collected throughout Hong Kong and prepared individually to "as consumed" status on each of the two sampling occasions from February 2023 to January 2024. A total of 2,244 individual food samples were collected, prepared, and combined into 374 composite samples for laboratory chemical analysis.

2.2 The analytical results were integrated with food consumption data of the local population to estimate dietary exposure to the selected chemical substances included in this study. Dietary exposure estimation was performed using an in-house web-based computer system, the Exposure Assessment System 2 (EASY2), which involved food mapping and weighting of data. The mean and 90th percentile exposure levels were used to represent the dietary exposure of average and high consumers of the local population, respectively. In this report, the estimated dietary exposure to cadmium and lead for average and high consumers were compared against the health-based guidance value (HBGV), or other toxicological reference points, as appropriate, to evaluate the associated health risks.

2.3 Details of the methodology are given in the same series of reports on Methodology.[23]

**Laboratory analysis**

2.4 All samples collected during the two sampling occasions were tested for cadmium and lead. In other words, 187 TDS food items were processed to form 374 composite samples (two composite samples for each TDS food item), which were then tested for cadmium and lead contents.

2.5 Laboratory analysis of cadmium and lead were conducted by the Food Research Laboratory (FRL) of the CFS. Samples were weighed and followed by microwave-assisted digestion with concentrated nitric acid in an enclosed system. Then, the resulting acidic solution was diluted and subsequently analysed by Inductively Coupled Plasma Mass Spectrometer (ICP-MS). The limits of detection (LODs) in food and water were tabulated as follows:

| | LOD in food (μg/kg) | LOD in water (μg/kg) |
|---|---|---|
| Cadmium | 1.8 | 0.18 |
| Lead | 0.70 | 0.070 |

Treatment of analytical results

2.6 In this study, data were treated with both lower bound (LB) and upper bound (UB) approaches. The approaches present the two extreme scenarios, considering that the true value for results below the LOD could lie anywhere between zero and the LOD. The LB scenario assumes the absence of the chemical, and assigns a value of zero to results reported as <LOD. Conversely, the UB scenario assumes the chemical is present at the level of the LOD, and assigns the corresponding LOD to results reported as <LOD.

# Chapter 3
# Results and Discussion

## Cadmium

Concentrations of cadmium in TDS foods

3.1 All 187 TDS food items, comprising 374 composite samples, were tested for cadmium. Two-thirds (125 out of 187) of the TDS food items tested, involving 12 out of a total of 15 TDS food groups, were found to contain detectable levels of cadmium in either one or both of the composite samples. Cadmium was not detected in three TDS food groups, namely “Egg and their products”, “Fats and oils” and “Beverages, alcoholic”. The results for the 15 TDS food groups are summarised in Table 1, while the detailed analytical results of all the 187 TDS food items tested are provided in Appendix.

3.2 The highest mean cadmium level was detected in the TDS food group “Fish, seafood and their products” (180-190 µg/kg (LB-UB)), followed by “Snack food” (95 µg/kg) and “Vegetables and their products” (29-29 µg/kg (LB-UB)). As for food items, lobster was found to contain the highest mean level (890 µg/kg), followed by oyster (780 µg/kg), and cuttlefish and mantis shrimp (both at 620 µg/kg) (see Appendix). In the TDS food group “Snack foods”, the mean cadmium level was represented by potato chips (95 µg/kg), the only TDS food item in this food group. The main ingredient of potato chips is potatoes. With the concentration effect during the processing of fresh potatoes to potato chips, the cadmium level of potato chips was found to be approximately triple that of boiled/stewed fresh potatoes (29 µg/kg) in this study.

## Table 1: Cadmium contents (μg/kg) in TDS food groups of the 2nd HKTDS

| | TDS food groups | TDS food items within food group | | Composite samples within food group [a] | | Mean concentration of food group (μg/kg) [b c] | Range within food group (μg/kg) [b] |
|---|---|---|---|---|---|---|---|
| | | Total number tested | Number with detectable levels | Total number tested | Number with detectable levels | | |
| 1 | Cereals and their products | 21 | 20 | 42 | 40 | 8.8-8.9 | ND-26 |
| 2 | Vegetables and their products | 42 | 41 | 84 | 80 | 29-29 | ND-490 |
| 3 | Legumes, nuts and seeds and their products | 9 | 8 | 18 | 15 | 26-27 | ND-110 |
| 4 | Fruits | 18 | 7 | 36 | 12 | 1.2-2.4 | ND-6.7 |
| 5 | Meat, poultry and game and their products | 17 | 5 | 34 | 9 | 2.8-4.2 | ND-36 |
| 6 | Egg and their products | 3 | 0 | 6 | 0 | – | ND-ND |
| 7 | Fish, seafood and their products | 24 | 17 | 48 | 33 | 180-190 | ND-890 |
| 8 | Dairy products | 8 | 1 | 16 | 2 | 0.79-2.4 | ND-9.1 |
| 9 | Fats and oils | 2 | 0 | 4 | 0 | – | ND-ND |
| 10 | Beverages, alcoholic | 2 | 0 | 4 | 0 | – | ND-ND |
| 11 | Beverages, non-alcoholic | 12 | 3 | 24 | 5 | 0.82-2.0 | ND-6.0 |
| 12 | Mixed dishes | 12 | 11 | 24 | 22 | 13-13 | ND-90 |
| 13 | Snack foods | 1 | 1 | 2 | 2 | 95 | 90-100 |
| 14 | Sugars and confectionery | 5 | 2 | 10 | 3 | 5.9-7.2 | ND-33 |
| 15 | Condiments, sauces and herbs | 11 | 9 | 22 | 16 | 15-16 | ND-90 |
| | Total | 187 | 125 | 374 | 239 | | |

Notes:

[a] Two composite samples were tested for each TDS food item.

[b] Concentration levels are rounded to 2 significant figures. ND denotes non-detected, i.e. results less than limit of detection (LOD).

[c] Mean concentrations for those food groups with detectable levels in all composite samples are presented as a single value. For those food groups with detectable levels in some of the composite samples, mean concentrations are presented as a range (lower bound-upper bound). For those food groups with non-detected results in all TDS food items, mean concentrations are not calculated and are marked as "–".

3.3 These results were in line with findings reported in literature that: (i) molluscs and crustaceans generally contained the highest levels of cadmium as compared with other foods; and (ii) animal livers, including pig liver and goose liver (29 μg/kg and 14 μg/kg respectively), were detected with higher mean levels of cadmium as compared with muscle meats (with non-detected results in most of the composite samples).[3,5] On the other hand, as cadmium can be taken up from the marine environment and accumulate in seaweed, which is high in polysaccharides, seaweed was detected in this study with a higher mean level of cadmium (370 μg/kg) as compared with other terrestrial vegetables. The detected level was similar to the levels, based on ready-to-eat status, as reported in literature.[24]

3.4 In this study, one composite sample of eggplant was detected with cadmium level at 55 μg/kg which exceeded the maximum level (ML) (i.e. 50 μg/kg) as stipulated in the Food Adulteration (Metallic Contamination) Regulations (Cap. 132V). The CFS has taken follow up actions, including tracing the sources of the individual samples in question and taking follow up samples for testing. All subsequent test results were found to be satisfactory.

<u>Dietary exposure to cadmium</u>

3.5 Table 2 shows the overall dietary exposure estimates of cadmium for the local adult and younger populations. For the adult population, the estimated dietary exposure for average consumers was 5.3-6.1 μg/kg bw/month (LB-UB), which accounted for 21-24% (LB-UB) of the PTMI allocated to cadmium by JECFA (i.e. 25 μg/kg bw/month). Among high consumers ($90^{th}$ percentile) of the adult population, the estimated dietary exposure was 9.3-10 μg/kg bw/month (LB-UB), which accounted for 37-41% (LB-UB) of the PTMI.

3.6 For the younger population, the estimated dietary exposure for average consumers was 8.8-9.9 μg/kg bw/month (LB-UB), which accounted for 35-40% (LB-UB) of the PTMI allocated to cadmium. Among high consumers ($90^{th}$ percentile) of the younger population, the estimated dietary exposure was 15-17 μg/kg bw/month (LB-UB), which accounted for 61-67% (LB-UB) of the PTMI (Table 2).

**Table 2: Estimates of overall dietary exposure to cadmium for average and high consumers of the local adult and younger populations and their contribution to Provisional Tolerable Monthly Intake (PTMI)**

| Population | Dietary Exposure Estimates (LB-UB) (µg/kg bw/month) | | % PTMI (LB-UB) | |
|---|---|---|---|---|
| | Average consumers | High consumers | Average consumers | High consumers |
| Adults aged 18+ | 5.3-6.1 | 9.3-10 | 21-24 | 37-41 |
| Younger population aged 6-17 | 8.8-9.9 | 15-17 | 35-40 | 61-67 |

Exposure estimates for high consumers refer to the exposure estimates at 90th percentile.
LB and UB denote lower bound and upper bound respectively.
Figures for dietary exposure estimates and contribution to PTMI are rounded to two significant figures.

3.7 Further details on age-gender subgroup analysis on dietary exposure to cadmium are presented in Table 3 and Figure 1. Among all individual age-gender subgroups, the dietary exposure estimates of cadmium for average and high consumers were below the PTMI allocated to cadmium. A relatively higher exposure estimate was noted among high consumers of children aged 6-11 (i.e. 19-20 µg/kg bw/month (LB-UB), accounting for 75-80% (LB-UB) of the PTMI), which was not an unexpected finding, considering the fact that children have a higher food intake on a per-kg body weight basis.

3.8 The study findings revealed that dietary exposure to cadmium would be unlikely to pose health risks to both average and high consumers of the local adult and younger populations, at both the population level and age-gender subgroup level.

**Table 3: Estimates of dietary exposure to cadmium for average and high consumers of age-gender subgroups and their contribution to the Provisional Tolerable Monthly Intake (PTMI)**

| Age-gender groups | Dietary exposure estimates (LB-UB) (μg/kg bw/month) | | % PTMI (LB-UB) | |
|---|---|---|---|---|
| | Average consumers | High consumers | Average consumers | High consumers |
| **Adults** | | | | |
| Adults aged 18-49 | 5.9-6.8 | 11-12 | 24-27 | 44-49 |
| ● Male | 5.4-6.2 | 9.3-10 | 21-25 | 37-42 |
| ● Female | 6.4-7.3 | 12-13 | 26-29 | 48-53 |
| Adults aged 50-64 | 4.9-5.8 | 8.2-9.1 | 19-23 | 33-36 |
| ● Male | 4.6-5.6 | 7.1-8.1 | 19-22 | 28-32 |
| ● Female | 5.1-5.9 | 9.1-10 | 20-24 | 36-40 |
| Adults aged 65+ | 4.2-5.1 | 7.0-8.4 | 17-20 | 28-33 |
| ● Male | 3.8-4.7 | 6.4-7.8 | 15-19 | 25-31 |
| ● Female | 4.6-5.4 | 8.0-9.0 | 18-21 | 32-36 |
| Adults aged 18+ | 5.3-6.1 | 9.3-10 | 21-24 | 37-41 |
| ● Male | 4.8-5.7 | 7.9-8.9 | 19-23 | 32-36 |
| ● Female | 5.7-6.5 | 10-11 | 23-26 | 42-46 |
| **Younger population** | | | | |
| Children aged 6-11 | 11-12 | 19-20 | 42-48 | 75-80 |
| Adolescents aged 12-17 | 7.0-7.9 | 12-14 | 28-32 | 49-54 |
| ● Male | 7.0-8.0 | 12-14 | 28-32 | 49-56 |
| ● Female | 6.9-7.8 | 12-13 | 28-31 | 49-53 |

Exposure estimates for high consumers refer to the exposure estimates at 90th percentile.
LB and UB denote lower bound and upper bound respectively.
Figures for dietary exposure estimates and contribution to PTMI are rounded to two significant figures.

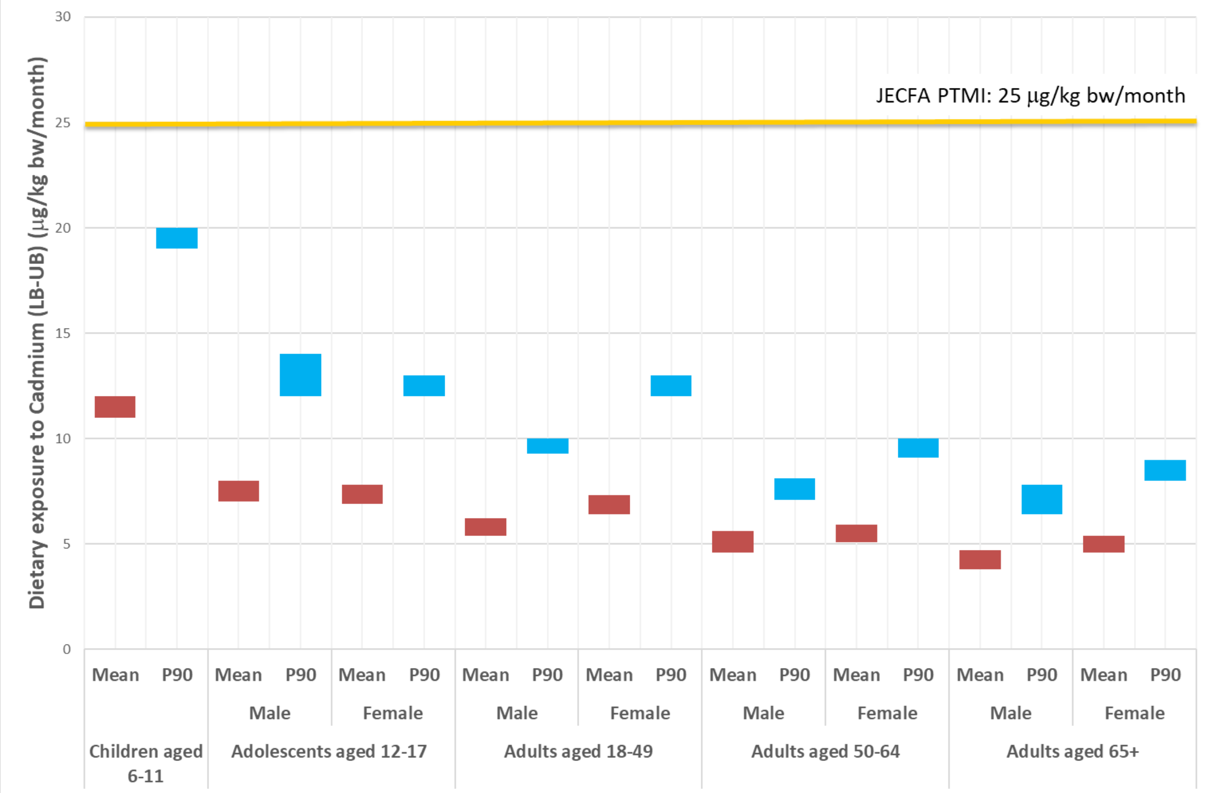


**Figure 1: Dietary exposure to cadmium in age-gender subgroups (LB-UB) (µg/kg bw/month)**

<u>Major food contributors</u>

3.9 Dietary exposure (based on LB exposure) to cadmium for average consumers from the 15 TDS food groups are shown in Table 4, and Figures 2 and 3.

**Table 4: Dietary exposure to cadmium for average consumers and percentage contribution from TDS food groups**

| TDS food groups | Adults aged 18+ | | Younger population aged 6-17 | |
|---|---|---|---|---|
| | Dietary exposure estimates (LB) (µg/kg bw/month) | % Contribution to total dietary exposure | Dietary exposure estimates (LB) (µg/kg bw/month) | % Contribution to total dietary exposure |
| Fish, seafood and their products | 1.6 | 30% | 2.4 | 27% |
| Vegetables and their products | 1.5 | 29% | 2.5 | 28% |
| Cereals and their products | 1.4 | 26% | 2.2 | 25% |
| Mixed dishes | 0.37 | 7.1% | 0.77 | 8.7% |
| Legumes, nuts and seeds and their products | 0.16 | 3.1% | 0.23 | 2.6% |
| Condiments, sauces and herbs | 0.081 | 1.5% | 0.18 | 2.1% |
| Snack foods | 0.064 | 1.2% | 0.27 | 3.0% |
| Beverages, non-alcoholic | 0.058 | 1.1% | 0.17 | 1.9% |
| Fruits | 0.026 | 0.49% | 0.044 | 0.50% |
| Meat, poultry and game and their products | 0.023 | 0.44% | 0.037 | 0.42% |
| Sugars and confectionery | 0.013 | 0.25% | 0.050 | 0.57% |
| Dairy products | 0.0057 | 0.11% | 0.040 | 0.46% |
| Others | 0.00010 | 0.0019% | 0.00027 | 0.0031% |

Figures for dietary exposure estimates and % contribution to overall dietary exposure are rounded to two significant figures.
Others included “Egg and their products”, “Beverages, alcoholic” and “Fats and oils”.

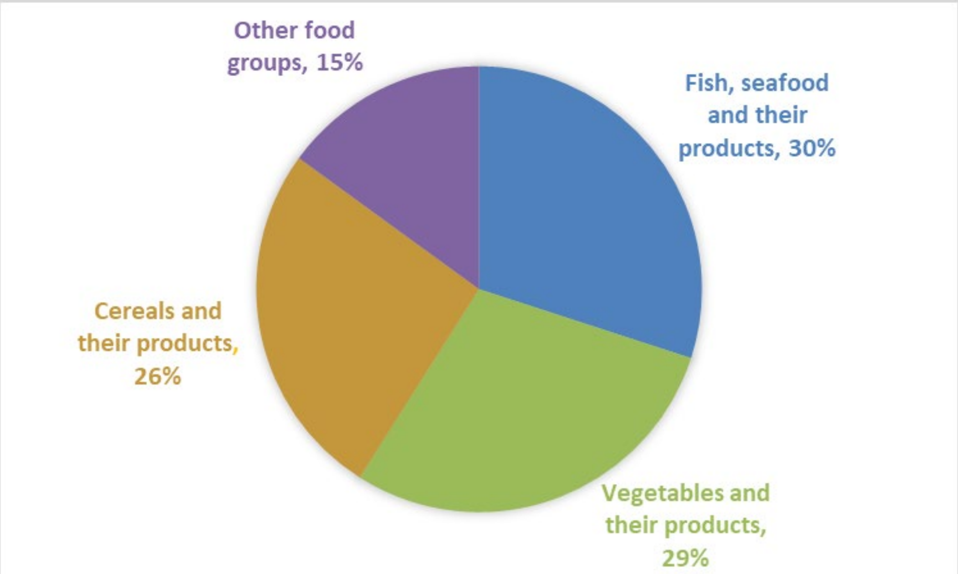


**Figure 2: Percentage contribution to dietary exposure to cadmium by TDS food group in the adult population**

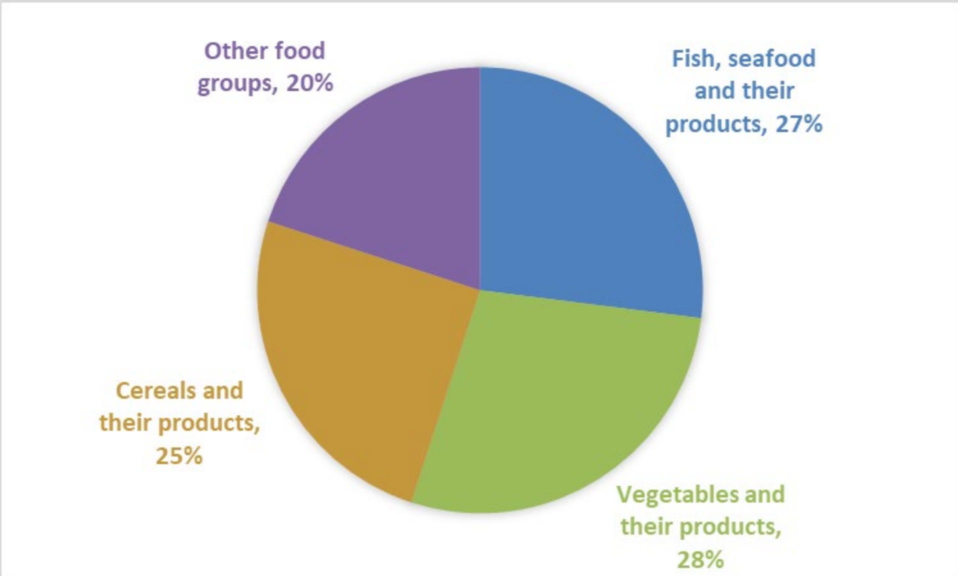


**Figure 3: Percentage contribution to dietary exposure to cadmium by TDS food group in the younger population**

3.10 For the adult population, the main dietary sources of cadmium found in this study were "Fish, seafood and their products" (30% of total dietary exposure), followed by "Vegetables and their products" (29%), and "Cereals and their products" (26%). For the younger population, the main dietary sources of cadmium found in this study were "Vegetables and their products" (28% of total dietary exposure), followed by "Fish, seafood and their products" (27%), and "Cereals and their products" (25%). This finding echoes the finding of the most recent dietary exposure assessment conducted by JECFA in 2021 that the main sources of dietary cadmium exposure were cereals and cereal-based products, vegetables, and fish and seafood.[25] These top three contributing food groups altogether accounted for 80% or above of the total dietary exposure to cadmium in the local population.

3.11 It is worthy to point out that within the food group "Fish, seafood and their products", the vast majority (over 90%) of the dietary exposure to cadmium actually came from non-fish sources (including molluscs and crustaceans), namely oyster, lobster, squid, octopus ball / cuttlefish ball / squid ball, abalone, etc., due to the relatively high content of cadmium detected in these food items.

On the other hand, although vegetables and cereals generally had much lower cadmium content than molluscs and crustaceans, when their relatively large consumption amounts were taken into account, these two food groups, namely "Vegetables and their products" (particularly leafy vegetables, root and tuber vegetables) and "Cereals and their products" (particularly rice, pasta and noodles), became important contributors of dietary exposure to cadmium in the local diet.

Comparison with results from 1st HKTDS

3.12 In terms of concentrations of cadmium in TDS foods, a large number of TDS food items were tested in both the 1st and 2nd HKTDS. Overall speaking, some variations in the detected levels of cadmium were noted between the two rounds of HKTDS, but the difference was not statistically significant.

3.13 In terms of dietary exposure estimation, Table 5 compares the dietary exposure estimates of cadmium for the local adult population obtained from the 1st and the 2nd HKTDS. Noting that there are differences in the data reporting format between the two rounds of HKTDS (i.e. lower bound - upper bound approach was adopted in the 2nd HKTDS vs middle bound approach was adopted in the 1st HKTDS; the 90th percentile was adopted in the 2nd HKTDS to represent high percentile exposure level vs the 95th percentile was adopted in the 1st HKTDS), the dietary exposure estimates of the 1st HKTDS have been adjusted to follow the same data reporting format of the 2nd HKTDS so as to facilitate a like-with-like comparison. Notably, the dietary exposure estimates obtained from this round of HKTDS appeared to be lower than those obtained from the 1st HKTDS.

3.14 However, caution should be exercised in making any direct comparison between the two studies due to the differences in the sampling plan, such as expanded number of TDS food items in the 2nd HKTDS, and variations in the sample preparation methods adopted in the 2nd HKTDS.

**Table 5: A comparison of dietary exposure estimates (μg/kg bw/month) of cadmium in the local adult population between the 1st and 2nd HKTDS**

| | Dietary exposure estimates (LB-UB) (μg/kg bw/month) | | % PTMI | |
|---|---|---|---|---|
| | Average consumers | High consumers | Average consumers | High consumers |
| 2nd HKTDS | 5.3-6.1 | 9.3-10 | 21-24 | 37-41 |
| 1st HKTDS | 7.8-8.8 | 13-15 | 31-35 | 53-58 |

LB and UB denote lower bound and upper bound respectively.
Figures for dietary exposure estimates and contribution to the Provisional Tolerable Monthly Intake (PTMI) are rounded to two significant figures.
Exposure estimates of high consumers refer to the exposure estimates at 90th percentile.

Comparison with other places

3.15 The data on estimates of dietary exposure to cadmium locally and those reported from other places (including Chinese Mainland, Japan, Australia, New Zealand, France, Ireland, Portugal, the United Kingdom (UK) and the United States of America (USA))[26,27,28,29,30,31,32,33,34] using TDS methodology were summarised in Table 6. The dietary exposure estimates in the current study are roughly in the mid-range as compared with those obtained from other places.

3.16 However, caution should be exercised in making any direct comparison of the data due to the differences in time when the reported studies were conducted, the approaches of capturing and handling food consumption data, the sampling strategies adopted, the analytical methods used and the methods of treating analytical results below detection limits, etc.

**Table 6: A comparison of dietary exposure to cadmium locally and reported in other places**

| Country / place | Population subgroups | Dietary exposure (µg/kg bw/month) (% contribution to PTMI) | | | Reference |
|---|---|---|---|---|---|
| | | Average consumers | High consumers | Percentile used | |
| Hong Kong (LB-UB) | 18+ yrs | 5.3-6.1 (21-24%) | 9.3-10 (37-41%) | 90th | 2nd HKTDS |
| | 6-17 yrs | 8.8-9.9 (35-40%) | 15-17 (61-67%) | | |
| Chinese Mainland (MB) | 18-45 yrs male | 8.26 (33%) | NA | NA | Zhao X et al (2022) |
| Japan (LB-MB)[a] | 1+ yrs | 10.5-10.5 | NA | NA | Watanabe T et al (2022) |
| Australia (LB-UB) | 19+ yrs | 2.0-5.8 (8-25%) | 3.7-8.8 (15-35%) | 90th | FSANZ (2019) |
| | 13-18 yrs | 2.9-6.3 (10-25%) | 5.6-9.6 (20-40%) | | |
| | 6-12 yrs | 4.3-9.5 (15-40%) | 8.2-15 (35-60%) | | |
| New Zealand (LB-UB) | 25+ yrs males | 6.47-6.69 (26%) | NA | NA | MPI (2016) |
| | 25+ yrs female | 5.06-5.26 (21%) | | | |
| | 19-24 yrs male | 6.77-6.99 (28%) | | | |
| | 11-14 yrs male | 7.69-7.89 (32%) | | | |
| | 11-14 yrs female | 6.89-7.07 (28%) | | | |
| France (LB-UB)[a] | 18-79 yrs | 4.2-4.5 | 7.8-8.1 | 95th | ANSES (2026) |
| | 3-17 yrs | 8.1-8.4 | 15.6-16.2 | | |
| Ireland (LB-UB)[a] | 18+ yrs | 4.8-6.6 | 9.9-12.6 | 97.5th | FSAI (2016) |
| | 5-12 yrs | 7.2-9.6 | 14.1-17.7 | | |
| Portugal (LB-UB)[b] | 18-74 yrs | 2.91-5.83 | 6.94-11.27 | 95th | Vasco E, Graca Dias M, Oliveira L (2025) |
| UK (LB-UB)[a] | 19+ yrs | 3.6-5.7 | 6.3-9.9 | 97.5th | FSA (2019) |
| | 11-18 yrs | 4.5-6.6 | 9.0-11.7 | | |
| | 4-10 yrs | NA | 14.7-21 | | |
| USA[b] | 70+ yrs | 1.8 | NA | NA | Kim K et al (2018) |
| | 51-70 yrs | 1.9 | | | |
| | 31-50 yrs | 2.1 | | | |
| | 20-30 yrs | 2.1 | | | |
| | 11-19 yrs | 2.1 | | | |
| | 2-10 yrs | 4.0 | | | |

Note:
a Exposure data presented in the original report were multiplied by 30 for converting data from daily basis into monthly basis.
b Exposure data presented in the original report were divided by 7 and then multiplied by 30 for converting data from weekly basis into monthly basis.
LB, MB and UB denote lower bound and middle bound and upper bound respectively.
"NA" denotes that data are not available.
PTMI denotes Provisional Tolerable Monthly Intake of 25 μg/kg bw/month.

## Lead

### Concentrations of lead in TDS foods

3.17 A total of 187 TDS food items, covering 374 composite samples, were tested for lead. Lead was detected in the vast majority (176 out of 187, 94%) of the TDS food items tested, and was detected across all 15 TDS food groups, indicating its ubiquitous presence in food. The results in 15 TDS food groups are summarised in Table 7 and the detailed analytical results of all the 187 TDS food items tested are shown in Appendix.

**Table 7: Lead contents (μg/kg) in TDS food groups of the 2nd HKTDS**

| | TDS food groups | TDS food items within food group | | Composite samples within food group [a] | | Mean concentration of food group (μg/kg) [b c] | Range within food group (μg/kg) [b] |
|---|---|---|---|---|---|---|---|
| | | Total number tested | Number with detectable levels | Total number tested | Number with detectable levels | | |
| 1 | Cereals and their products | 21 | 20 | 42 | 40 | 3.0-3.0 | ND-13 |
| 2 | Vegetables and their products | 42 | 42 | 84 | 82 | 13-13 | ND-120 |
| 3 | Legumes, nuts and seeds and their products | 9 | 9 | 18 | 18 | 16 | 1.3-200 |
| 4 | Fruits | 18 | 17 | 36 | 28 | 1.8-2.0 | ND-18 |
| 5 | Meat, poultry and game and their products | 17 | 17 | 34 | 33 | 3.4-3.4 | ND-26 |
| 6 | Egg and their products | 3 | 3 | 6 | 6 | 2.8 | 1.0-5.1 |
| 7 | Fish, seafood and their products | 24 | 24 | 48 | 46 | 28-28 | ND-190 |
| 8 | Dairy products | 8 | 5 | 16 | 9 | 1.2-1.5 | ND-5.4 |
| 9 | Fats and oils | 2 | 2 | 4 | 3 | 1.0-1.2 | ND-1.5 |
| 10 | Beverages, alcoholic | 2 | 1 | 4 | 2 | 3.1-3.5 | ND-7.4 |
| 11 | Beverages, non-alcoholic | 12 | 8 | 24 | 14 | 1.2-1.4 | ND-4.8 |
| 12 | Mixed dishes | 12 | 12 | 24 | 24 | 5.7 | 1.6-13 |
| 13 | Snack foods | 1 | 1 | 2 | 2 | 4.4 | 3.1-5.7 |
| 14 | Sugars and confectionery | 5 | 4 | 10 | 8 | 4.2-4.4 | ND-11 |
| 15 | Condiments, sauces and herbs | 11 | 11 | 22 | 22 | 18 | 1.2-70 |
| | Total | 187 | 176 | 374 | 337 | | |

Notes:

[a] Two composite samples were tested for each TDS food item.

[b] Concentration levels are rounded to two significant figures. ND denotes non-detected, i.e. results less than limit of detection (LOD).

[c] Mean concentrations for those food groups with detectable levels in all composite samples are presented as a single value. For those food groups with detectable levels in some of the composite samples, mean concentrations are presented as a range (lower bound-upper bound).

3.18 The highest mean lead level was detected in the TDS food group “Fish, seafood and their products” (28-28 μg/kg (LB-UB)), followed by “Condiments, sauces and herbs” (18 μg/kg) and “Legumes, nuts and seeds and their products” (16 μg/kg). As for food items, clam was found to contain the highest mean level (180 μg/kg), followed by mussel (130 μg/kg), oyster (120 μg/kg), and fermented soybean products (110 μg/kg) (see Appendix). The study results were generally in line with those reported internationally, in which lead was detected in a wide range of food categories, reflecting its ubiquitous presence in the environment.

3.19 In this study, one composite sample of sweet potato was detected with lead level at 110 μg/kg which exceeded the maximum level (ML) (i.e. 100 μg/kg) as stipulated in the Food Adulteration (Metallic Contamination) Regulations (Cap. 132V). The CFS has taken follow up actions, including tracing the sources of the individual samples in question and taking follow up samples for testing. All subsequent test results were found to be satisfactory.

Dietary exposure to lead

3.20 Table 8 shows the overall dietary exposure estimates of lead for the local adult and younger populations. For the adult population, the dietary exposure estimates for average and high consumers ($90^{th}$ percentile) were 0.089-0.092 μg/kg bw/day (LB-UB) and 0.15-0.15 μg/kg bw/day (LB-UB), respectively, which are far below the dietary exposure level (i.e. 1.2 μg/kg bw/day) associated with a population increase of 1 mmHg of systolic blood pressure in adults.

3.21 For the younger population, the dietary exposure estimates for average and high consumers ($90^{th}$ percentile) were 0.13-0.14 μg/kg bw/day (LB-UB) and 0.23-0.24 μg/kg bw/day (LB-UB), respectively (Table 8), which are below the dietary exposure level (i.e. 0.6 μg/kg bw/day) associated with a population decrease of 1 IQ point in children.

**Table 8: Estimates of overall dietary exposure to lead for average and high consumers of the local adult and younger populations**

| Population | Dietary exposure estimates (LB-UB) (μg/kg bw/day) | |
|---|---|---|
| | Average consumers | High consumers |
| Adults aged 18+ | 0.089-0.092 | 0.15-0.15 |
| Younger population aged 6-17 | 0.13-0.14 | 0.23-0.24 |

Exposure estimates for high consumers refer to the exposure estimates at $90^{th}$ percentile.
LB and UB denote lower bound and upper bound respectively.
Figures for dietary exposure estimates are rounded to two significant figures.

3.22 Further details on age-gender subgroup analysis on dietary exposure to lead are presented in Table 9, and Figures 4 and 5. Among all individual age-gender subgroups of the adult population, the dietary exposure estimates of lead for average and high consumers were below the dietary exposure level (i.e. 1.2 μg/kg bw/day) associated with a population increase of 1 mmHg of systolic blood pressure (Figure 4). As for the younger population, dietary exposure estimates of lead for average and high consumers in all individual age-gender subgroups were below the dietary exposure level (i.e. 0.6 μg/kg bw/day) associated with a population decrease of 1 IQ point (Figure 5). A relatively higher exposure estimate was again noted among children aged 6-11, as they have a higher food intake on a per-kg body weight basis.

3.23 Foetuses are one of the subgroups that are most sensitive to the neurodevelopmental effects of lead. Women of child-bearing age can be considered as a surrogate for pregnant women to estimate the risk of lead exposure in the womb on neurodevelopment in the foetuses.[13] In the current study, adult females aged 18-49 is used as a surrogate for pregnant women. The dietary exposure estimates for average and high consumers ($90^{th}$ percentile) of this particular age-gender subgroup were 0.098-0.10 μg/kg bw/day (LB-UB) and 0.17-0.17 μg/kg bw/day (LB-UB), respectively (Table 9), which were lower than those of the adolescent counterpart (i.e. females aged 12-17). Notably, both female population subgroups were found with dietary exposure estimates below the dietary exposure level (i.e. 0.6 μg/kg bw/day) associated with a population decrease of 1 IQ point in children.

3.24 The above dietary exposure estimates for average and high consumers of the overall local adult and younger populations and individual age-gender subgroups all fell below the respective dietary exposure levels that would associate with the key effects of lead. Thus, it is considered that the health impact on average and high consumers due to dietary exposure to lead is low. Nevertheless, given the absence of a threshold for the key effects of lead, continuous efforts should be made to reduce total exposure to lead from all sources.

**Table 9: Estimates of dietary exposure to lead for average and high consumers of age-gender subgroups**

| Age-gender groups | Dietary exposure estimates (LB-UB) (µg/kg bw/day) | | | |
|---|---|---|---|---|
| | Average consumers | | High consumers | |
| **Adults** | | | | |
| Adults aged 18-49 | 0.089-0.093 | | 0.15-0.15 | |
| ● Male | | 0.080-0.084 | | 0.13-0.13 |
| ● Female | | 0.098-0.10 | | 0.17-0.17 |
| Adults aged 50-64 | 0.090-0.093 | | 0.15-0.15 | |
| ● Male | | 0.083-0.086 | | 0.13-0.13 |
| ● Female | | 0.096-0.099 | | 0.16-0.16 |
| Adults aged 65+ | 0.087-0.089 | | 0.15-0.15 | |
| ● Male | | 0.083-0.085 | | 0.14-0.14 |
| ● Female | | 0.090-0.093 | | 0.16-0.16 |
| Adults aged 18+ | 0.089-0.092 | | 0.15-0.15 | |
| ● Male | | 0.082-0.085 | | 0.13-0.13 |
| ● Female | | 0.095-0.099 | | 0.16-0.17 |
| **Younger population** | | | | |
| Children aged 6-11 | 0.15-0.16 | | 0.27-0.28 | |
| Adolescents aged 12-17 | 0.11-0.12 | | 0.19-0.20 | |
| ● Male | | 0.10-0.11 | | 0.17-0.17 |
| ● Female | | 0.12-0.13 | | 0.21-0.22 |

Exposure estimates for high consumers refer to the exposure estimates at 90th percentile.
LB and UB denote lower bound and upper bound respectively.
Figures for dietary exposure estimates are rounded to two significant figures.

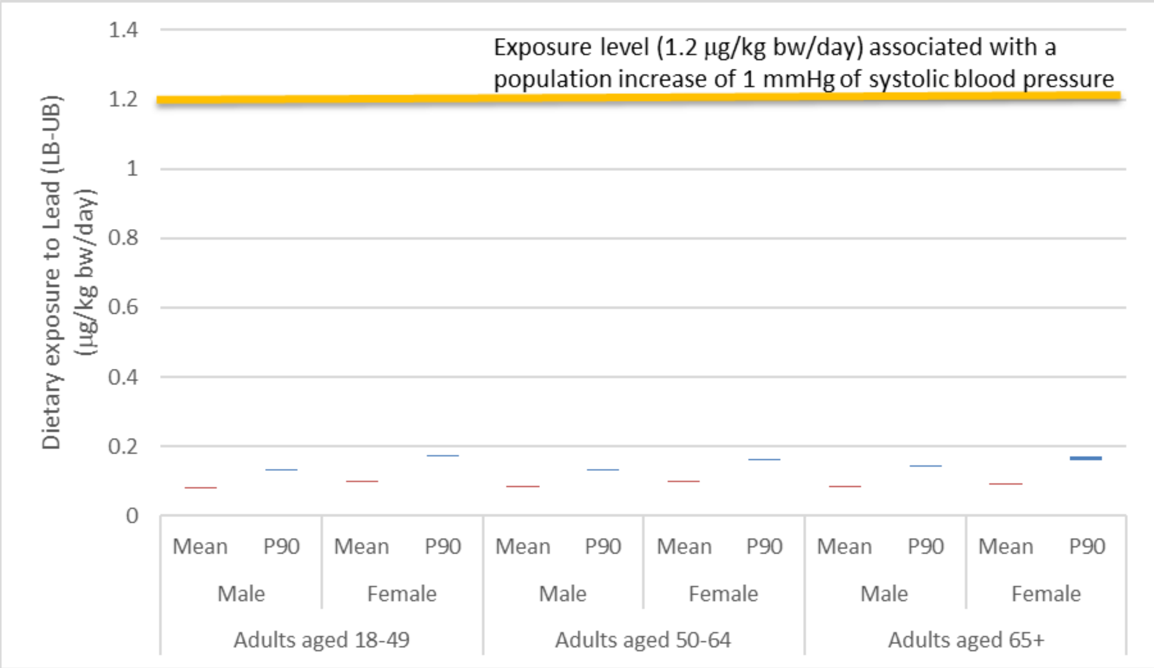


**Figure 4: Dietary exposure to lead in age-gender subgroups of adult population (LB-UB) (μg/kg bw/day)**

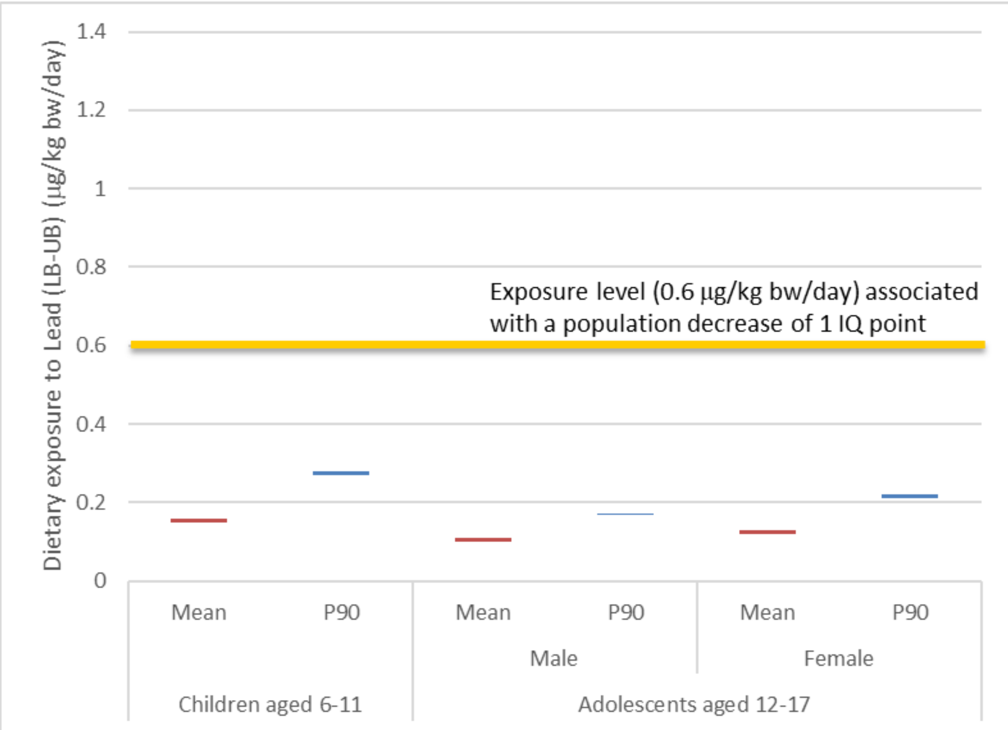


**Figure 5: Dietary exposure to lead in age-gender subgroups of younger population (LB-UB) (μg/kg bw/day)**

Major food contributors

3.25 Dietary exposure (based on LB exposure) to lead for average consumers from the 15 TDS food groups are shown in Table 10, and Figures 6 and 7.

**Table 10: Dietary exposure to lead for average consumers and percentage contribution from TDS food groups**

| TDS food groups | Adults aged 18+ | | Younger population aged 6-17 | |
|---|---|---|---|---|
| | Dietary Exposure Estimates (LB) (μg/kg bw/day) | % Contribution to total dietary exposure | Dietary Exposure Estimates (LB) (μg/kg bw/day) | % Contribution to total dietary exposure |
| Vegetables and their products | 0.025 | 28% | 0.032 | 25% |
| Mixed dishes | 0.018 | 20% | 0.027 | 21% |
| Cereals and their products | 0.013 | 15% | 0.026 | 20% |
| Fish, seafood and their products | 0.0086 | 9.7% | 0.013 | 10% |
| Beverages, non-alcoholic | 0.0086 | 9.6% | 0.0066 | 5.0% |
| Condiments, sauces and herbs | 0.0054 | 6.1% | 0.0081 | 6.2% |
| Meat, poultry and game and their products | 0.0033 | 3.7% | 0.0052 | 3.9% |
| Legumes, nuts and seeds and their products | 0.0027 | 3.1% | 0.0034 | 2.6% |
| Fruits | 0.0022 | 2.4% | 0.0029 | 2.2% |
| Egg and their products | 0.0011 | 1.2% | 0.0023 | 1.7% |
| Beverages, alcoholic | 0.00043 | 0.48% | 0.0000011 | 0.00084% |
| Dairy products | 0.00035 | 0.39% | 0.0020 | 1.5% |
| Fats and oils | 0.00024 | 0.27% | 0.00042 | 0.32% |
| Sugars and confectionery | 0.00017 | 0.20% | 0.00075 | 0.58% |
| Snack foods | 0.00013 | 0.14% | 0.00053 | 0.41% |

Figures for dietary exposure estimates and % contribution to overall dietary exposure are rounded to two significant figures.

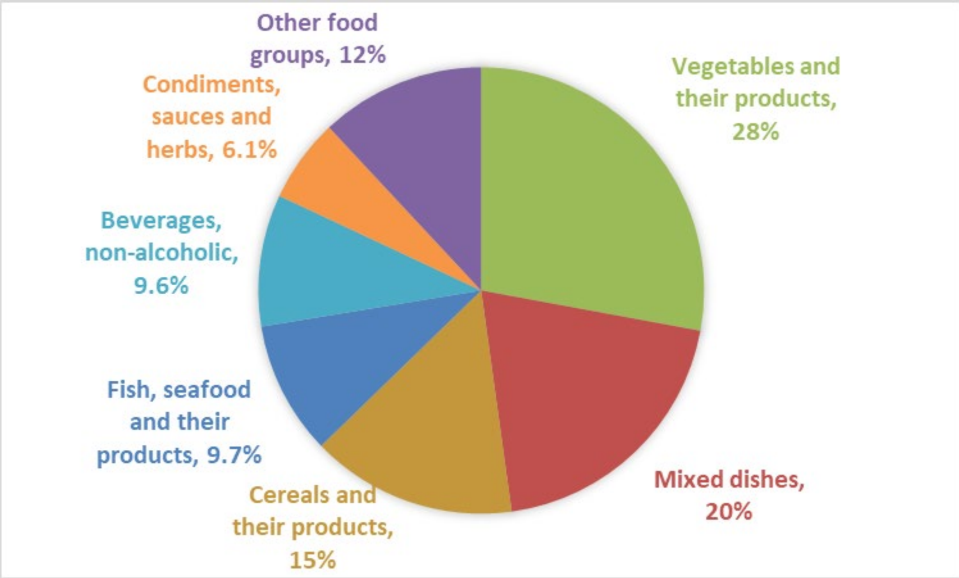


**Figure 6: Percentage contribution to dietary exposure to lead by TDS food group in the adult population**

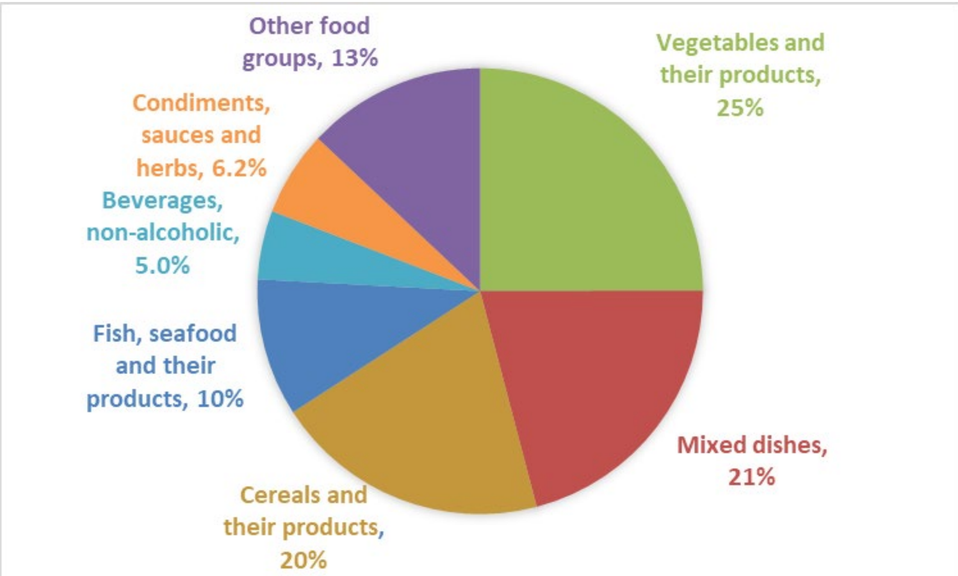


**Figure 7: Percentage contribution to dietary exposure to lead by TDS food group in the younger population**

3.26 For both adult and younger populations, the main dietary sources of lead found in this study were "Vegetables and their products" (28% and 25% of the total dietary exposure, respectively), followed by "Mixed dishes" (20% and 21% respectively), and "Cereals and their products" (15% and 20% respectively). These top three contributing food groups altogether accounted for over 60% of total dietary exposure to lead in the local population. In this study, vegetables (particularly leafy vegetables, root and tuber vegetables), cereals (particularly pasta and noodles, rice) and mixed dishes (which are composed of a variety of ingredients including cereals and vegetables) are important contributors of dietary lead exposure because they are consumed in large amounts in the local diet. This finding is generally in line with results of assessments conducted in other countries/regions, in which food groups with relatively large consumption amounts (such as cereals and cereals products, vegetables and vegetables products) have frequently been identified as major contributors of dietary sources of lead.[15]

Comparison with results from 1st HKTDS

3.27 In terms of concentrations of lead in TDS foods, a large number of TDS food items were tested in both the 1st and 2nd HKTDS. Overall speaking, among those TDS food items tested in both studies, the mean rank of detected lead concentrations in this round of HKTDS was found to be lower than that of the previous round, and the difference in the detected levels of lead was statistically significant ($p<0.05$).

3.28 In terms of dietary exposure estimation, Table 11 compares the dietary exposure estimates of lead for the local adult population obtained from the 1st and the 2nd HKTDS. The dietary exposure estimates of the 1st HKTDS have been adjusted to follow the same data reporting format of the 2nd HKTDS so as to facilitate a like-with-like comparison. Notably, the dietary exposure estimates of this round of HKTDS appeared to be lower (roughly by 50%) when compared with those of the 1st HKTDS.

3.29 However, caution should be exercised in making any direct comparison between the two studies due to the differences in the sampling plan, such as expanded number of TDS food items in the 2nd HKTDS, and variations in the sample preparation methods adopted in the 2nd HKTDS.

**Table 11: A comparison of dietary exposure estimates (μg/kg bw/day) of lead in the local adult population between the 1st and 2nd HKTDS**

| | Dietary exposure estimates (LB-UB) (μg/kg bw/day) | |
|---|---|---|
| | Average consumers | High consumers |
| 2nd HKTDS | 0.089-0.092 | 0.15-0.15 |
| 1st HKTDS | 0.20-0.22 | 0.31-0.33 |

LB and UB denote lower bound and upper bound respectively.
Figures for dietary exposure estimates are rounded to two significant figures.
Exposure estimates for high consumers refer to the exposure estimates at 90th percentile.

Comparison with other places

3.30 Internationally, there have been concerted efforts to reduce the industrial uses of lead and its release into the environment over the past decades. These efforts have resulted in declining lead levels detected in foods and in turn population dietary exposure estimates as observed in many countries/regions.[13,15] The data on estimates of dietary exposure to lead locally and those reported from other places (including Chinese Mainland, Japan, Australia, New Zealand, France, Germany, Ireland, Portugal, the UK and the USA)[26,27,28,29,30,31,32,33,35,36] using TDS methodology were summarised in Table 12. The dietary exposure estimates in the current study are roughly in the mid-range as compared those obtained from other places.

3.31 However, caution should be exercised in making any direct comparison of the data due to the differences in time when the reported studies were conducted, the approaches of capturing and handling food consumption data, the sampling strategies adopted, the analytical methods used and the methods of treating analytical results below detection limits, etc.

**Table 12: A comparison of dietary exposure to lead locally and reported in other places**

| Country / place | Population subgroups | Dietary exposure (µg/kg bw/day) | | | Reference |
|---|---|---|---|---|---|
| | | Average consumers | High consumers | Percentile used | |
| Hong Kong (LB-UB) | 18+ yrs | 0.089-0.092 | 0.15-0.15 | 90th | 2nd HKTDS |
| | 6-17 yrs | 0.13-0.14 | 0.23-0.24 | | |
| Chinese Mainland (MB) | 18-45 yrs male | 0.318 | NA | NA | Zhao X et al (2022) |
| Japan (LB-MB) | 1+ yrs | 0.14-0.15 | NA | NA | Watanabe T et al (2022) |
| Australia (LB-UB) | 19+ yrs | 0.018-0.16 | 0.036-0.24 | 90th | FSANZ (2019) |
| | 13-18 yrs | 0.016-0.16 | 0.032-0.23 | | |
| | 6-12 yrs | 0.029-0.24 | 0.057-0.39 | | |
| New Zealand (LB-UB)[a] | 25+ yrs males | 0.041-0.12 | NA | NA | MPI (2016) |
| | 25+ yrs female | 0.039-0.11 | | | |
| | 19-24 yrs male | 0.046-0.13 | | | |
| | 11-14 yrs male | 0.044-0.15 | | | |
| | 11-14 yrs female | 0.04-0.12 | | | |
| France (LB-UB) | 18-79 yrs | 0.12-0.13 | 0.23-0.25 | 95th | ANSES (2026) |
| | 3-17 yrs | 0.18-0.20 | 0.38-0.41 | | |
| Germany (LB-UB) | >65 yrs | 0.06-0.09 | 0.12-0.14 | 95th | BfR (2025) |
| | 51<65 yrs | 0.06-0.09 | 0.13-0.16 | | |
| | 35<51 yrs | 0.06-0.09 | 0.13-0.16 | | |
| | 25<35 yrs | 0.06-0.09 | 0.12-0.15 | | |
| | 19<25 yrs | 0.06-0.09 | 0.11-0.15 | | |
| | 14<19 yrs | 0.05-0.08 | 0.11-0.15 | | |
| | 10<12 yrs | 0.08-0.11 | 0.14-0.18 | | |
| | 6<10 yrs | 0.11-0.14 | 0.18-0.23 | | |
| Ireland (LB-UB) | 18+ yrs | 0.04-0.12 | 0.11-0.22 | 97.5th | FSAI (2016) |
| | 5-12 yrs | 0.04-0.17 | 0.09-0.27 | | |
| Portugal (LB-UB) | 18-74 yrs | 0.09-0.35 | 0.26-0.67 | 95th | Vasco E, Graca Dias M, Oliveira L (2025) |

| Country / place | Population subgroups | Dietary exposure (µg/kg bw/day) | | | Reference |
|---|---|---|---|---|---|
| | | Average consumers | High consumers | Percentile used | |
| UK (LB-UB) | 19+ yrs | 0.062-0.11 | 0.13-0.19 | 97.5th | FSA (2019) |
| | 11-18 yrs | 0.063-0.11 | 0.14-0.20 | | |
| | 4-10 yrs | NA | 0.22-0.34 | | |
| USA (LB-MB)[b] | 18+ yrs | 1.7-5.3 | 3.2-7.8 | 90th | Gavelek, A et al (2020) |
| | 16-49 yrs female | 1.6-4.6 | 2.8-6.7 | | |
| | 7-17 yrs | 1.4-4.0 | 2.3-5.8 | | |

Note:
a Exposure data presented in the original report were divided by 7 for converting data from weekly basis into daily basis.
b Exposure data presented in the original report and Table 12 were presented as µg/person/day, i.e. not presented on a per kg bw basis.
LB, MB and UB denote lower bound and middle bound and upper bound respectively.
"NA" denotes that data are not available.

## Limitations of the study

3.32 Foetuses, infants and young children are the subgroups that are most sensitive to the neurodevelopmental effects of lead. Nevertheless, dietary exposure assessment in the current study only covered the local population from 6 years old and above, whilst women of child-bearing age (females aged 18-49) were used as a surrogate for pregnant women to estimate the risk of lead exposure in the womb on neurodevelopment in the foetuses.

3.33 In the current study, the limited number of individual food samples, combined with the use of food mapping approach to assign cadmium and lead concentrations in applicable foods, introduced uncertainties in the dietary exposure assessment of cadmium and lead for the local population. Also, this exposure estimation only covered dietary sources of lead intake and was not a comprehensive estimation of total exposure to lead including all other sources (e.g. soil, dust, air, smoking) as this was outside the scope of this study.

3.34 Other limitations have been described in the Report on the 2nd HKTDS: Methodology.[23]

# Chapter 4
## Conclusion and Recommendations

4.1 Out of the 187 TDS food items tested, cadmium was detected in two-thirds (125) of the TDS food items, involving 12 out of a total 15 TDS food groups. The highest mean cadmium level was detected in the TDS food group "Fish, seafood and their products" (180-190 μg/kg (LB-UB)). Among all TDS food items tested, lobster was found to contain the highest mean level of cadmium (890 μg/kg), followed by oyster (780 μg/kg), and cuttlefish and mantis shrimp (both at 620 μg/kg).

4.2 For the adult population, the estimated dietary exposure for average consumers was 5.3-6.1 μg/kg bw/month (LB-UB), which accounted for 21-24% (LB-UB) of the PTMI allocated to cadmium by JECFA (i.e. 25 μg/kg bw/month). Among high consumers (90th percentile) of the adult population, the estimated dietary exposure was 9.3-10 μg/kg bw/month (LB-UB), which accounted for 37-41% (LB-UB) of the PTMI. For the younger population, the estimated dietary exposure for average consumers was 8.8-9.9 μg/kg bw/month (LB-UB), which accounted for 35-40% (LB-UB) of the PTMI. Among high consumers (90th percentile) of the younger population, the estimated dietary exposure was 15-17 μg/kg bw/month (LB-UB), which accounted for 61-67% (LB-UB) of the PTMI.

4.3 For both adult and younger populations, the main dietary sources of cadmium were identified as "Fish, seafood and their products" (27-30% of total dietary exposure), "Vegetables and their products" (28-29%), and "Cereals and their products" (25-26%). These top three contributing food groups altogether accounted for 80% or above of the total daily dietary exposure to cadmium in the local population.

4.4 The study findings revealed that dietary exposure to cadmium would be unlikely to pose health risks to both average and high consumers of the local adult and younger populations.

4.5 In regard to lead, it was detected in the vast majority (94%) of the TDS food items tested, and was detected across all 15 TDS food groups, indicating its ubiquitous presence in food. The highest mean lead level was detected in the TDS food group “Fish, seafood and their products” (28-28 μg/kg (LB-UB)). Among all TDS food items tested, clam was found to contain the highest mean level of lead (180 μg/kg), followed by mussel (130 μg/kg), and oyster (120 μg/kg).

4.6 For the adult population, the dietary exposure estimates of lead for average and high consumers ($90^{th}$ percentile) were 0.089-0.092 μg/kg bw/day (LB-UB) and 0.15-0.15 μg/kg bw/day (LB-UB), respectively, which were well below the dietary exposure level (i.e. 1.2 μg/kg bw/day) associated with a population increase of 1 mmHg in systolic blood pressure in adults. For the younger population, the dietary exposure estimates for average and high consumers ($90^{th}$ percentile) were 0.13-0.14 μg/kg bw/day (LB-UB) and 0.23-0.24 μg/kg bw/day (LB-UB), respectively, which also fell below the dietary exposure level (i.e. 0.6 μg/kg bw/day) associated with a population decrease of 1 IQ point in children.

4.7 For both adult and younger populations, the main dietary sources of lead were identified as “Vegetables and their products” (25-28% of total dietary exposure), “Mixed dishes” (20-21%), and “Cereals and their products” (15-20%). These top three contributing food groups altogether accounted for over 60% of total daily dietary exposure to lead in the local population.

4.8 The dietary exposure estimates of lead for average and high consumers of the overall local adult and younger populations all fell below the respective dietary exposure levels that would associate with an increase of blood pressure in adults and a decrease of IQ point in children. Thus, it is considered that the health impact on the local population due to dietary exposure to lead is low. Nevertheless, given the absence of a threshold for the key effects of lead, continuous efforts should be made to reduce total exposure to lead from all sources.

4.9 Compared to the 1st HKTDS conducted in 2010-2014, it is noted that the dietary exposure estimates of cadmium and lead for both average and high consumers of the overall adult population appeared to be lower in this round of HKTDS.

4.10 The public is advised to maintain a balanced and varied diet to avoid excessive exposure to metallic contaminants from a small range of food items, and to ensure a proper intake of micronutrients (e.g. iron, calcium) which help minimise absorption of cadmium and lead. Additional food preparation steps, such as washing vegetables and fruits thoroughly to remove dust and soil, removing outer leaves from leafy greens and peeling root crops, may be adopted to reduce cadmium and lead levels therein.

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**Appendix**

# Cadmium and lead contents (μg/kg) detected in TDS food items

| TDS Food Item [a] | Cadmium Contents (μg/kg) [b] | | | Lead Contents (μg/kg) [b] | | |
|---|---|---|---|---|---|---|
| | Mean [c] | 1st Sampling Occasion | 2nd Sampling Occasion | Mean [c] | 1st Sampling Occasion | 2nd Sampling Occasion |
| **Cereals and their products** | | | | | | |
| Biscuit / Cookie | 21 | 26 | 15 | 5.8 | 7.7 | 3.9 |
| Bread, plain | 19 | 20 | 17 | 2.9 | 3.8 | 1.9 |
| Bread, raisin | 15 | 14 | 15 | 2.8 | 3.6 | 1.9 |
| Breakfast cereals | 7.6 | 11 | 4.1 | 3.2 | 3.6 | 2.8 |
| Bun, with savoury filling, baked | 11 | 11 | 11 | 2.2 | 2.0 | 2.3 |
| Bun, with savoury filling, steamed | 8.2 | 8.1 | 8.3 | 3.6 | 3.0 | 4.2 |
| Bun, with sweet filling, steamed | 7.7 | 8.7 | 6.7 | 1.9 | 2.1 | 1.7 |
| Cake | 3.4 | 3.2 | 3.6 | 2.0 | 2.0 | 1.9 |
| Corn | 2.2 | 2.3 | 2.0 | – | ND | ND |
| Corn starch | – | ND | ND | 2.8 | 1.4 | 4.2 |
| Deep-fried dough, Chinese style | 14 | 14 | 13 | 2.4 | 2.2 | 2.5 |
| Noodles, Chinese / Japanese style | 5.6 | 6.5 | 4.7 | 5.3 | 2.7 | 7.9 |
| Noodles, instant | 4.7 | 4.5 | 4.8 | 1.8 | 1.8 | 1.8 |
| Noodles, rice | 8.1 | 10 | 6.1 | 1.9 | 1.9 | 1.8 |
| Oats / Oatmeal | 3.0 | 3.0 | 2.9 | 1.8 | 1.3 | 2.3 |
| Pasta, Western style | 15 | 16 | 13 | 1.6 | 1.8 | 1.4 |
| Pastries, Chinese style | 8.9 | 6.7 | 11 | 7.5 | 6.3 | 8.7 |
| Pie / Tart | 8.1 | 8.5 | 7.6 | 7.8 | 13 | 2.5 |
| Pineapple bun | 15 | 15 | 14 | 1.8 | 1.7 | 1.8 |
| Rice, unpolished | 6.1 | 7.9 | 4.2 | 3.2 | 3.1 | 3.2 |
| Rice, white | 4.1 | 4.8 | 3.3 | 0.84 | 0.77 | 0.90 |
| **Vegetables and their products** | | | | | | |
| Bamboo fungus | 88 | 100 | 76 | 17 | 19 | 14 |
| Bamboo shoot | 12 | 7.4 | 16 | 52 | 39 | 64 |

| TDS Food Item [a] | Cadmium Contents (μg/kg) [b] | | | Lead Contents (μg/kg) [b] | | |
|---|---|---|---|---|---|---|
| | Mean [c] | 1st Sampling Occasion | 2nd Sampling Occasion | Mean [c] | 1st Sampling Occasion | 2nd Sampling Occasion |
| Beet root | 19 | 21 | 17 | 1.5 | 1.6 | 1.4 |
| Bitter melon | 1.0-1.9 | 1.9 | ND | 3.3 | 3.3 | 3.2 |
| Blanching chives | 17 | 22 | 12 | 2.5 | 2.6 | 2.4 |
| Broccoli / Cauliflower | 5.1 | 3.1 | 7.1 | 1.4 | 1.4 | 1.4 |
| Cabbage, Chinese (including Pe-tsai / Celery cabbage) | 15 | 17 | 12 | 0.90 | 0.81 | 0.99 |
| Cabbage, Chinese flowering | 13 | 10 | 15 | 7.1 | 7.8 | 6.4 |
| Cabbage, European variety | 4.9 | 3.3 | 6.4 | 0.86 | 0.99 | 0.72 |
| Cabbage, Pak-choi Chinese | 16 | 17 | 15 | 6.4 | 6.4 | 6.4 |
| Cabbage, Pak-choi Chinese, dried | 43 | 47 | 39 | 61 | 68 | 53 |
| Carrot / Radish | 5.2 | 4.8 | 5.6 | 3.4 | 4.5 | 2.2 |
| Celery | 10 | 9.1 | 11 | 1.7 | 0.9 | 2.5 |
| Chinese amaranth (Chinese spinach) | 71 | 87 | 55 | 24 | 26 | 21 |
| Chinese kale | 11 | 8.1 | 14 | 5.8 | 4.3 | 7.3 |
| Cucumber | – | ND | ND | 0.99 | 0.97 | 1.0 |
| Ear fungus | 8.5 | 13 | 3.9 | 23 | 28 | 17 |
| Eggplant | 32 | 55 | 9.3 | 0.86 | 0.84 | 0.88 |
| Garlic | 15 | 16 | 14 | 1.4 | 1.6 | 1.1 |
| Ginger | 14 | 13 | 15 | 30 | 24 | 36 |
| Hairy gourd / wax gourd | 2.6 | 3.0 | 2.2 | 2.1 | 2.7 | 1.4 |
| Leaf mustard | 24 | 29 | 19 | 3.5 | 3.0 | 3.9 |
| Lettuce, Chinese / European / Indian | 22 | 20 | 24 | 3.4 | 1.9 | 4.8 |
| Mung bean sprout | 3.9 | 5.7 | 2.1 | 7.6 | 6.0 | 9.2 |
| Mushroom, button | 5.0 | 5.7 | 4.3 | 4.3 | 4.3 | 4.3 |
| Mushroom, shiitake, dried | 130 | 170 | 83 | 4.1 | 4.4 | 3.7 |
| Onion | 6.1 | 8.0 | 4.1 | 0.55-0.90 | ND | 1.1 |
| Pea shoots | 5.1 | 7.0 | 3.2 | 4.7 | 5.3 | 4.0 |
| Peppers (sweet pepper / chili pepper) | 28 | 41 | 14 | 2.4 | 1.4 | 3.3 |
| Potato | 29 | 38 | 20 | 0.94 | 1.1 | 0.77 |
| Potato, fried | 47 | 39 | 55 | 2.2 | 1.8 | 2.6 |
| Preserved vegetables | 20 | 21 | 19 | 95 | 120 | 69 |

| TDS Food Item [a] | Cadmium Contents (µg/kg) [b] | | | Lead Contents (µg/kg) [b] | | |
|---|---|---|---|---|---|---|
| | Mean [c] | 1st Sampling Occasion | 2nd Sampling Occasion | Mean [c] | 1st Sampling Occasion | 2nd Sampling Occasion |
| Pumpkin | 2.2-3.1 | ND | 4.4 | 1.3 | 1.3 | 1.2 |
| Seaweed | 370 | 490 | 240 | 40 | 50 | 30 |
| Spinach | 48 | 66 | 29 | 12 | 14 | 9.3 |
| Sponge gourd | 3.9 | 2.8 | 5.0 | 1.4-1.8 | ND | 2.8 |
| Spring onion | 9.2 | 8.4 | 10 | 6.0 | 5.5 | 6.4 |
| Sweet potato | 9.1 | 8.6 | 9.5 | 61 | 12 | 110 |
| Tomato | 6.1 | 5.0 | 7.2 | 1.9 | 2.0 | 1.7 |
| Water spinach | 4.4 | 4.8 | 3.9 | 9.7 | 10 | 9.3 |
| Watercress | 48 | 26 | 69 | 24 | 11 | 37 |
| Zucchini | 2.8 | 3.4 | 2.2 | 2.8 | 3.6 | 2.0 |
| **Legumes, nuts and seeds and their products** | | | | | | |
| Fermented soybean products | 20 | 19 | 20 | 110 | 25 | 200 |
| Green peas | 3.3 | 1.9 | 4.7 | 6.0 | 7.8 | 4.2 |
| Green string beans (with pod) | 1.1-2.0 | 2.1 | ND | 2.4 | 2.8 | 2.0 |
| Peanut | 110 | 100 | 110 | 3.9 | 4.4 | 3.3 |
| Peanut butter | 82 | 93 | 70 | 4.2 | 2.8 | 5.5 |
| Red bean | 2.1 | 1.9 | 2.2 | 2.0 | 1.6 | 2.4 |
| Soybean curd (Tofu) | 15 | 14 | 16 | 7.4 | 7.8 | 7.0 |
| Tree nuts | 11 | 12 | 10 | 1.5 | 1.3 | 1.7 |
| Vermicelli, mung bean | – | ND | ND | 2.2 | 1.4 | 3.0 |
| **Fruits** | | | | | | |
| Apple | – | ND | ND | 1.4 | 1.3 | 1.5 |
| Banana | – | ND | ND | 2.3 | 3.1 | 1.5 |
| Cherry | – | ND | ND | 0.65-1.0 | 1.3 | ND |
| Dragon fruit | – | ND | ND | 0.65-1.0 | 1.3 | ND |
| Dried fruits | 4.4 | 4.3 | 4.4 | 12 | 5.1 | 18 |
| Durian | 5.4 | 4.0 | 6.7 | 1.5 | 0.9 | 2.1 |
| Grapes | – | ND | ND | 1.7 | 2.2 | 1.1 |
| Kiwi | – | ND | ND | 0.65-1.0 | 1.3 | ND |
| Longan / Lychee | 2.4 | 2.2 | 2.6 | 1.4 | 1.8 | 1.0 |

| TDS Food Item [a] | Cadmium Contents (µg/kg) [b] | | | Lead Contents (µg/kg) [b] | | |
|---|---|---|---|---|---|---|
| | Mean [c] | 1st Sampling Occasion | 2nd Sampling Occasion | Mean [c] | 1st Sampling Occasion | 2nd Sampling Occasion |
| Mandarin / Tangerine | – | ND | ND | 1.1 | 1.5 | 0.7 |
| Mango | 1.4-2.3 | 2.7 | ND | 1.1 | 1.4 | 0.9 |
| Melon | 2.5 | 2.8 | 2.1 | – | ND | ND |
| Orange | – | ND | ND | 0.36-0.71 | ND | 0.72 |
| Papaya | – | ND | ND | 0.39-0.74 | 0.77 | ND |
| Peach | 0.9-1.8 | 1.8 | ND | 2.9 | 3.4 | 2.3 |
| Pear | 4.1 | 4.6 | 3.6 | 1.3 | 1.0 | 1.5 |
| Pineapple | – | ND | ND | 3.6 | 4.3 | 2.8 |
| Watermelon | – | ND | ND | 0.37-0.72 | ND | 0.73 |
| **Meat, poultry and game and their products** | | | | | | |
| Beef | – | ND | ND | 0.45-0.80 | 0.89 | ND |
| Beef tendon | – | ND | ND | 1.6 | 1.8 | 1.4 |
| Chicken meat, other than chicken wing | – | ND | ND | 1.0 | 1.0 | 1.1 |
| Chicken wing | – | ND | ND | 1.6 | 1.3 | 1.8 |
| Duck / goose, roasted | 2.1 | 2.1 | 2.0 | 5.1 | 7.7 | 2.4 |
| Ham, pork | – | ND | ND | 2.0 | 2.1 | 1.8 |
| Liver, goose | 14 | 18 | 10 | 14 | 2.8 | 26 |
| Liver, pig | 29 | 36 | 21 | 10 | 12 | 8.6 |
| Luncheon meat | 1.1-2.0 | ND | 2.2 | 3.4 | 3.0 | 3.8 |
| Meat ball | – | ND | ND | 4.0 | 3.2 | 4.8 |
| Meat sausage | 2.4 | 2.2 | 2.6 | 3.4 | 4.0 | 2.8 |
| Mutton | – | ND | ND | 1.5 | 1.5 | 1.4 |
| Pork chop | – | ND | ND | 1.1 | 1.4 | 0.8 |
| Pork ribs | – | ND | ND | 1.3 | 1.6 | 1.0 |
| Pork, barbequed | – | ND | ND | 2.6 | 2.9 | 2.3 |
| Pork, other than pork chop and pork ribs | – | ND | ND | 1.8 | 1.8 | 1.7 |
| Pork, roasted | – | ND | ND | 1.9 | 2.0 | 1.7 |

| TDS Food Item [a] | Cadmium Contents (μg/kg) [b] | | | Lead Contents (μg/kg) [b] | | |
|---|---|---|---|---|---|---|
| | Mean [c] | 1st Sampling Occasion | 2nd Sampling Occasion | Mean [c] | 1st Sampling Occasion | 2nd Sampling Occasion |
| **Egg and their products** | | | | | | |
| Egg, chicken | – | ND | ND | 2.4 | 3.9 | 1.0 |
| Egg, lime preserved | – | ND | ND | 2.0 | 2.1 | 1.9 |
| Egg, salted | – | ND | ND | 3.9 | 2.6 | 5.1 |
| **Fish, seafood and their products** | | | | | | |
| Clam | 220 | 130 | 310 | 180 | 160 | 190 |
| Crab | 220 | 280 | 150 | 18 | 27 | 9.9 |
| Cuttlefish | 620 | 640 | 600 | 28 | 26 | 30 |
| Fish ball / fish cake | 3.5 | 3.0 | 3.9 | 5.4 | 5.3 | 5.4 |
| Fish fillet | 1.2-2.1 | 2.4 | ND | 3.1 | 2.9 | 3.2 |
| Fish, Dace, minced | – | ND | ND | 5.1 | 5.1 | 5.1 |
| Fish, Golden thread | 5.8 | 7.4 | 4.2 | 0.93 | 0.76 | 1.1 |
| Fish, Grass carp | – | ND | ND | 0.38-0.73 | 0.75 | ND |
| Fish, Grouper | – | ND | ND | 1.5 | 1.0 | 2.0 |
| Fish, Mandarin fish | – | ND | ND | 1.4 | 1.3 | 1.5 |
| Fish, Mangrove red snapper | – | ND | ND | 0.38-0.73 | ND | 0.76 |
| Fish, Pomfret / Pompano | 6.0 | 5.0 | 7.0 | 1.8 | 2.2 | 1.3 |
| Fish, Salmon | – | ND | ND | 1.3 | 1.7 | 0.9 |
| Fish, Tuna | 27 | 30 | 24 | 1.9 | 2.5 | 1.3 |
| Fish, Yellow croaker | – | ND | ND | 0.85 | 0.77 | 0.93 |
| Lobster | 890 | 890 | 880 | 12 | 7.8 | 16 |
| Mantis shrimp | 620 | 450 | 790 | 32 | 49 | 14 |
| Mussel | 470 | 480 | 450 | 130 | 110 | 150 |
| Oyster | 780 | 670 | 880 | 120 | 120 | 110 |
| Salted fish | 5.7 | 5.5 | 5.9 | 51 | 60 | 42 |
| Scallop | 230 | 320 | 140 | 7.7 | 9.5 | 5.8 |
| Shrimp / Prawn | 7.6 | 5.5 | 9.6 | 6.8 | 7.8 | 5.8 |
| Shrimp / Prawn, dried | 87 | 98 | 76 | 56 | 74 | 37 |
| Squid | 260 | 320 | 200 | 9.5 | 10 | 9.0 |

| TDS Food Item [a] | Cadmium Contents (μg/kg) [b] | | | Lead Contents (μg/kg) [b] | | |
|---|---|---|---|---|---|---|
| | Mean [c] | 1st Sampling Occasion | 2nd Sampling Occasion | Mean [c] | 1st Sampling Occasion | 2nd Sampling Occasion |
| **Dairy products** | | | | | | |
| Cheese | – | ND | ND | 3.2 | 4.1 | 2.3 |
| Fermented / Cultured beverages, dairy based | – | ND | ND | – | ND | ND |
| Ice-cream | 6.3 | 9.1 | 3.5 | 3.6 | 5.4 | 1.7 |
| Milk beverages | – | ND | ND | 1.1 | 1.4 | 0.9 |
| Milk, condensed / evaporated | – | ND | ND | – | ND | ND |
| Milk, skim | – | ND | ND | 1.0-1.4 | ND | 2.0 |
| Milk, whole | – | ND | ND | – | ND | ND |
| Yoghurt | – | ND | ND | 1.0 | 1.0 | 1.1 |
| **Fats and oils** | | | | | | |
| Butter | – | ND | ND | 0.75-1.1 | ND | 1.5 |
| Vegetable oil | – | ND | ND | 1.3 | 1.3 | 1.2 |
| **Beverages, alcoholic** | | | | | | |
| Beer | – | ND | ND | – | ND | ND |
| Wine, red / white | – | ND | ND | 6.3 | 7.4 | 5.1 |
| **Beverages, non-alcoholic** | | | | | | |
| Carbonated drink (including diet version) | – | ND | ND | – | ND | ND |
| Coconut water | – | ND | ND | – | ND | ND |
| Coffee | – | ND | ND | 1.7 | 2.4 | 0.9 |
| Fruit and / or vegetable juice | 1.0-1.9 | 2.0 | ND | 0.47-0.82 | ND | 0.93 |
| Malt drink | 4.8 | 4.5 | 5.0 | 3.5 | 3.9 | 3.0 |
| Soybean drink | 4.1 | 2.2 | 6.0 | 1.4 | 0.7 | 2.0 |
| Tea (including lemon tea) | – | ND | ND | 0.94 | 0.96 | 0.91 |
| Tea, chrysanthemum | – | ND | ND | 2.4-2.8 | ND | 4.8 |
| Tea, with milk | – | ND | ND | 3.0 | 2.8 | 3.2 |
| Tea, with milk and tapioca pearls | – | ND | ND | 1.5 | 1.5 | 1.4 |
| Water, bottled, distilled / purified | – | ND | ND | – | ND | ND |
| Water, drinking | – | ND | ND | – | ND | ND |

| TDS Food Item [a] | Cadmium Contents (μg/kg) [b] | | | Lead Contents (μg/kg) [b] | | |
|---|---|---|---|---|---|---|
| | Mean [c] | 1st Sampling Occasion | 2nd Sampling Occasion | Mean [c] | 1st Sampling Occasion | 2nd Sampling Occasion |
| **Mixed dishes** | | | | | | |
| Dim sum, beef ball, steamed | 3.2 | 3.7 | 2.6 | 4.8 | 4.3 | 5.2 |
| Dim sum, Siu Mai, steamed | 9.3 | 11 | 7.5 | 3.8 | 4.2 | 3.3 |
| Dumpling / spring roll, fried | 10 | 14 | 6.9 | 6.3 | 10 | 2.6 |
| Dumpling, boiled (including wonton) | 9.1 | 6.1 | 12 | 7.3 | 8.2 | 6.3 |
| Dumpling, steamed | 8.5 | 8.4 | 8.5 | 8.3 | 11 | 5.5 |
| Glutinous rice dumpling | 15 | 22 | 8.8 | 8.5 | 5.9 | 11 |
| Hamburger | 7.4 | 6.8 | 7.9 | 3.7 | 4.6 | 2.7 |
| Pizza | 17 | 20 | 14 | 6.0 | 7.1 | 4.8 |
| Rice-roll, plain, steamed | 11 | 8.5 | 14 | 2.1 | 1.8 | 2.4 |
| Soup, Chinese style | – | ND | ND | 7.3 | 1.6 | 13 |
| Soup, Western style | 47 | 3.4 | 90 | 4.0 | 3.2 | 4.7 |
| Turnip cake | 14 | 15 | 13 | 6.5 | 3.9 | 9.1 |
| **Snack foods** | | | | | | |
| Potato chips | 95 | 90 | 100 | 4.4 | 3.1 | 5.7 |
| **Sugars and confectionery** | | | | | | |
| Chocolate | 29 | 24 | 33 | 11 | 10 | 11 |
| Honey | – | ND | ND | 4.5 | 4.3 | 4.6 |
| Jam | 1.2-2.1 | 2.3 | ND | 2.8 | 2.3 | 3.3 |
| Sugar, brown / rock | – | ND | ND | 3.3 | 2.8 | 3.8 |
| Sugar, white, granulated | – | ND | ND | – | ND | ND |
| **Condiments, sauces and herbs** | | | | | | |
| Chicken powder / cube | 2.8 | 3.8 | 1.8 | 14 | 4.3 | 23 |
| Chinese parsley | 72 | 53 | 90 | 10 | 10 | 10 |
| Curry sauce | 15 | 14 | 15 | 28 | 20 | 36 |
| Oyster sauce | 23 | 24 | 22 | 18 | 27 | 8.2 |
| Salad dressing | – | ND | ND | 2.6 | 1.2 | 3.9 |
| Sesame seed oil | – | ND | ND | 3.9 | 6.2 | 1.6 |
| Soya sauce | 5.6 | 5.1 | 6.0 | 13 | 12 | 13 |
| Table salt | 3.9-4.8 | ND | 7.8 | 47 | 23 | 70 |
| Tomato paste / ketchup | 33 | 20 | 45 | 9.2 | 4.4 | 14 |

| TDS Food Item [a] | Cadmium Contents (μg/kg) [b] | | | Lead Contents (μg/kg) [b] | | |
|---|---|---|---|---|---|---|
| | Mean [c] | 1st Sampling Occasion | 2nd Sampling Occasion | Mean [c] | 1st Sampling Occasion | 2nd Sampling Occasion |
| Vinegar | 2.7-3.6 | 5.4 | ND | 18 | 13 | 23 |
| White pepper | 12 | 10 | 13 | 32 | 35 | 28 |

Notes:

[a] Two composite samples were tested for each TDS food item.

[b] Concentration levels are rounded to 2 significant figures. ND denotes non-detected, i.e. results less than limit of detection (LOD).

[c] Mean concentrations for those TDS food items detected in both sampling occasions are presented as a single value, whereas those detected only in one of the two sampling occasions are presented as a range (lower bound-upper bound)