Executive Summary

Dietary Exposure To Heavy Metals of Secondary School Students

Purposes

1. This study aims to determine the dietary exposure to heavy metals of secondary school students in Hong Kong so as to assess whether there are any risks to their health. The potential for any risks to health are assessed by comparing the dietary exposure to heavy metals with the appropriate safe exposure levels - Provisional Tolerable Weekly Intakes (PTWIs) recommended by the Joint FAO/WHO Expert Committee on Food Additives (JECFA). PTWI is an estimate of the amount of a contaminant that can be ingested over a lifetime without appreciable risk.

Heavy Metals and Dietary Exposure

2. Three heavy metals, namely arsenic, cadmium and mercury, were chosen for this study, principally because of their toxicities. These heavy metals are environmental contaminants that are present naturally in the Earth's crust. They may also be discharged to the environment through industrial uses.

3. The possible health effects of heavy metals vary, depending on the unique features of the metals and the route of exposure. Human may be exposed to these metals through the food chain, after the food has been contaminated. Acute toxicity resulting from ingesting food contaminated with these heavy metals is uncommon, but chronic exposure to these metals may result in undesirable toxic effects. Of the three metals studied, mercury is a toxic chemical, particularly in its organic form, which is neurotoxic. Inorganic arsenic, a human carcinogen, is the more toxic form of arsenic. Cadmium is toxic to the kidney.

4. Dietary exposure to a chemical is determined by its concentrations in foods and the amounts of foods eaten. A food that contains high levels of a particular chemical can make a significant

contribution to dietary exposure even if it is eaten in small amounts. Conversely, a food that contains low concentrations but is eaten in large quantities can also make a large contribution to dietary exposure.

Scope and Method

5. In determining the dietary exposure of secondary school students to the heavy metals, two sets of data were used. The first set of data on concentrations of arsenic, cadmium and mercury in food was obtained from the food surveillance programme of the Department. Data on 2510 food samples collected between 1999 and 2001 were extracted from the food surveillance database. These food items were categorised under six target food groups, namely "cereals and cereal products", "vegetables", "meat, poultry and their products", "fish", "seafood other than fish" and "milk and dairy products".

6. The second set of data on food consumption of the above food groups of secondary school students was derived from the food consumption survey conducted by this Department in late 2000.

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7. Using the above two sets of data, dietary exposure to heavy metals was estimated. **For an average secondary school student in Hong Kong, the dietary exposures to inorganic arsenic, cadmium and mercury were 2.52, 2.49, and 2.98 μg/ kg bw/ week respectively.** They fell within the PTWIs of 15, 7 and 5 μg/ kg bw/ week for inorganic arsenic, cadmium and mercury respectively.

8. To estimate the heavy metals exposure of high consumers, those above 95th percentile exposure level were studied. **The dietary exposures to inorganic arsenic, cadmium and mercury were 6.77, 5.71, and 6.41μg/ kg bw/ week respectively.** The 95th percentile of exposure was approximately two to three times the average exposure.

9. An intake of these heavy metals above the PTWIs does not automatically mean that health is at risk. These PTWIs represent a tolerable weekly intake for life-time exposure and that occasional short-

term excursions above the PTWIs would have no major health consequences provided that the average intake over long periods is not exceeded.

10. The results of the study showed that predatory fish, such as shark, tuna and swordfish, had the highest concentration of mercury while "seafood other than fish", particularly shellfish, was identified as the main dietary source of cadmium and inorganic arsenic.

Implications and Limitations of the Study

11. Comparing the results of this study with other similar studies conducted in China, Australia, USA and the UK, it was found that the dietary exposures to arsenic and cadmium were similar. However, dietary exposure to mercury was slightly higher compared to these countries. This could be explained by different consumption patterns, analytical methods, and numerical values assigned to non-detected results.

12. From our study, **it could be concluded that the estimated dietary exposures to inorganic arsenic, cadmium and mercury for an average secondary school student were below the PTWI established by JECFA and an average secondary school student would not experience major toxicological effects of these heavy metals.**

13. Several limitations of this study were identified. This study used food surveillance data which might produce biased results in dietary exposure assessment, as they were examined chiefly for enforcement purpose and might contain higher levels of contaminants. The limits of detection (LOD) were relatively high, which might result in overestimating the heavy metal content, particularly among those food groups with the majority of food samples having metal concentrations below LOD. Although the number of food groups selected was considered sufficient to produce reasonable dietary exposure estimates, it fell short of representing the full range of food products consumed and might thus underestimate the exposure to heavy metals.

Recommendations

14. Dietary intake is one of the major routes of heavy metals exposure. Since heavy metals are products of environmental pollution resulting from various industrial activities, the ultimate goals of reducing heavy metals exposure are to control heavy metals emissions as well as interrupting their pathways into food.

15. The LOD for heavy metals for food surveillance and enforcement purpose were relatively high and would introduce uncertainties in exposure studies especially when a significant proportion of food samples had below LOD concentrations. We recommend the use of analytical methods with LOD set at level as low as practicable for dietary exposure studies. With the establishment of the Food Research Laboratory by this Department, lower reporting limits of contaminants in foods can be achieved which in turn provide more accurate dietary exposure assessment.

16. Consumption data used in this study were obtained from a

consumption survey conducted in secondary school children using food frequency questionnaires. To monitor the trend of the exposure and produce more accurate estimates, we will explore the possibility of conducing a population-based food consumption survey so that population-wide dietary exposure studies can be conducted in the future.

17. A balanced diet is essential to avoid excessive exposure to contaminants from a small range of food items. Vulnerable groups such as children and pregnant women should be careful in the selection of food, in particular, they are advised not to consume excessive amount of predatory fish such as shark, tuna and swordfish, which may contain higher concentrations of mercury. However, as fish are excellent sources of high-quality protein and low in saturated fat, moderate consumption is recommended. Food safety authority in countries like the UK, USA, Australia and Canada also shares the same view. Consumers are also advised not to overindulge in shellfish as they tend to contain higher concentrations of arsenic and cadmium, as well as other food hazards.