

Chapter 24

The First Total Diet Study in Hong Kong, China

Waiky W.K. Wong, Ying Xiao, Stephen W.C. Chung, and Y.Y. Ho

Introduction

Hong Kong is a special administrative region of China with a total area of about 1,000 km², and home to about seven million people. With few domestic agricultural activities, Hong Kong is in a unique situation that over 95 % of its food supply is imported, with Mainland China by far the major source. In recent years, Hong Kong has not been short of food incidents, such as Sudan Red in duck's eggs, malachite green in fish, and more recently melamine in dairy products, to name just a few. Understandably, consumers have been concerned about food safety. In addition, they are increasingly interested in diet, nutrition, and health. Accurate information on people's dietary exposures to chemicals is important for assessing possible risks and for setting priorities for public health action. To address these issues, the Food and Environmental Hygiene Department (FEHD) was formed in 2000. In 2006, the Centre for Food Safety (CFS) was set up under the FEHD responds to growing consumer concerns about the safety of food.

Road to a Total Diet Study

Hong Kong has been conducting risk assessment studies for some time. Initially, these studies focused on individual food hazards but were hampered, to a certain extent, by the lack of appropriate food consumption data. The only data on food consumption was from a survey conducted in 2000 on about 1,000 secondary school

W.W.K. Wong (✉) • Y. Xiao, M.B.B.S., Ph.D. • S.W.C. Chung, Ph.D. • Y.Y. Ho, M.B.B.S.
Food and Environmental Hygiene Department, Centre for Food Safety, 43/F, Queensway
Government Offices, 66 Queensway, Hong Kong, China
e-mail: wwkwong@feh.d.gov.hk

students by means of a self-administered food frequency questionnaire, which covered 93 commonly consumed food items. One of the aims of establishing the FEHD was to build up the capability and capacity of the food safety regulatory authority in Hong Kong. Political commitment and funding were secured early to attain these aims.

To strengthen the quantitative assessment of population exposure to chemicals, the FEHD conducted the first population-based food consumption survey in 2005. With the availability of food consumption data for the local population, dietary exposure studies could be expanded incorporating the total diet study (TDS) approach, which is considered to be one of the best ways for dietary exposure estimation for a population.

Capability and Capacity Building for a Total Diet Study

A TDS is a large and complex project with many components, which include purchasing foods commonly consumed, processing them as for consumption, combining the foods into food composites, homogenizing and analyzing them for chemical contaminants and selected nutrients. Finally, the dietary exposures of the contaminants and nutrients are estimated by combining the analytical results with food consumption information for the population.

A team approach is necessary when conducting TDS. A Task Force on TDS comprising professionals of different backgrounds, including public health, food science, nutrition, and laboratory analysis was formed to plan and monitor the progress of the TDS in 2007. All team members, including those responsible for food sampling, food preparation, laboratory analysis, and risk assessment, were acquainted with the TDS principles and methodology. Team members had attended International Workshops on TDS organized by World Health Organization (WHO) since 1999. Moreover, in December 2008, the CFS, in collaboration with the WHO, organized a workshop in Hong Kong to equip the members with the knowledge and skills required for conducting a TDS.

Laboratory Facilities

To have better exposure estimations, sensitive analytical methods are needed to obtain the lowest achievable limits of quantification for the chemicals of interest in the dietary exposure assessment. In addition, a comprehensive quality assurance and quality control program is required to assure the quality of the analyses. Since no commercial laboratories in Hong Kong could provide testing services with sufficiently low detection limits, the Food Research Laboratory (FRL) of the CFS and the Government Laboratory (GL) conducted the analytical work. The substances to be included in the TDS were linked to the capabilities and capacities of FRL and GL.

Other factors, including the stability of the chemicals and availability of long-term and reliable storage facilities, were also considered in prioritizing the chemicals to be tested. Furthermore, retention and storage of reserve samples was considered important, in case reanalysis was required.

Kitchen Facilities

A TDS is different from other food commodity-based surveys in that a TDS is characterized by measuring chemicals in foods as normally consumed and therefore, food preparation is a key step in conducting a TDS. Since the operations of FRL and GL mainly focus on laboratory analysis, it is not possible for them to perform extensive food preparation with their existing facilities. In view of infrequent use of kitchen facilities, the food preparation work was outsourced. To ensure consistency in the preparation of food samples, a single kitchen facility was used for the whole project.

Dietary Exposure Estimation

The fieldwork for the first population-based food consumption survey was completed in 2007. A total of 5,008 Hong Kong individuals aged 20–84 years were interviewed by using two independent, nonconsecutive 24-h dietary recall methodology supplemented by a food frequency questionnaire. More than 1,400 food items as consumed have been captured by the 24-h dietary recall of this survey and the average daily consumption of solid food and liquid food were about 1.1 kg and 1.9 l (including about 1.1 l of water), respectively. The top 10 solid foods identified by the survey are listed in Table 24.1.

Table 24.1 Top 10 solid foods identified by the first population-based food consumption survey in Hong Kong (g per person per day)

Solid food	Average consumption
Rice (including white rice, brown rice, and cognee)	297
Leafy/stalk/shoot vegetables and brassica	121
Pasta/noodles	120
Fish	57
Oranges	56
Pork	54
Bread/rolls/buns	44
Chicken	33
Apples	21
Squash/gourds	17

Given the complexity of the food consumption dataset and exposure estimation, development of an in-house computer program enabled the dietary exposure assessments to be conducted more efficiently and accurately and the data to be managed more systematically.

The First Total Diet Study in Hong Kong

The first TDS in Hong Kong aims to estimate the dietary exposures of the Hong Kong population to a range of substances including chemical contaminants and nutrients, and thus assess their potential health risks. The study plan was developed as follows.

More than 1,400 food items were contained in the food consumption data from the first population-based food consumption survey of the local people. It was not feasible to carry out laboratory analysis of every single food item due to time and resource constraints. Therefore, a TDS food list was developed to select representative food items out of the more than 1,400 survey foods, to represent the key components of the local diet.

Food items in the TDS food list were selected based on the following criteria: (i) food commonly consumed by the population; and (ii) food that is likely to contain high concentration of certain chemicals even it is consumed in a low amount. To this end, a TDS food list with 150 food items was developed, including drinking water and bottled water, and covered 88 % of food consumed by the Hong Kong population in terms of weight of food consumed.

Owing to its small size, three regions across the territory have been identified for sampling purposes as shown in Fig. 24.1. However, it is expected that in terms of food supply, the differences are likely to be relatively small. The 150 TDS food items will be sampled from each of the three regions over four seasons of a year. In the end, a total of 1,800 samples will be collected for the entire TDS project.

Following the food sampling, samples from the three regions will be prepared separately as food normally consumed, i.e. ready-to-eat, in a manner consistent with cultural habits in Hong Kong. Three prepared samples of the same food items will then be mixed and homogenized to obtain a composite sample for laboratory testing. A total of 600 composite samples will be tested in the Hong Kong TDS. The composite samples will be kept frozen prior to testing. Portions of the three separate prepared samples making up each composite will be kept frozen individually as backup reserve samples, should follow up investigations of any composite be needed. The food preparation work will be carried out by a single kitchen facility and completed in a year.

When selecting the substances for the TDS project, the following criteria were considered in prioritizing the substances to be analyzed: (i) recommendation from international authorities, (ii) public health significance, and (iii) public concern. However, the inclusion of substances in the TDS project also hinges on the laboratory capability and capacity, such as the number of analyses that can be handled and

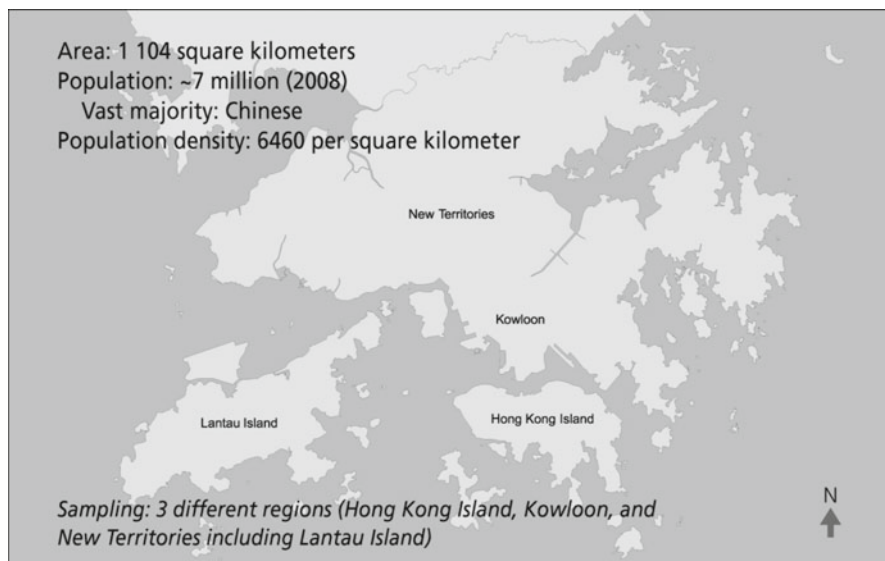


Fig. 24.1 Hong Kong total diet study sampling regions

the progress of analytical method development, which will be a key determinant in selecting substances for testing. To this end, over a hundred substances including persistent organic pollutants (POPs), pesticide residues, heavy metals, mycotoxins, processing contaminants and nutrients, will be analyzed.

Laboratory analysis will be mainly performed by FRL of the CFS. As some of the targeted substances may gradually decompose over time, become bound to the food matrix or change its oxidation state, such substances will be analyzed immediately upon delivery of the composite food sample to the laboratory. Other substances will then be analyzed in batches depending on the stability of substances. Substances, such as POPs and heavy metals, are relatively stable. Therefore, sufficient and reliable freezer storage space is necessary for keeping these composite samples.

Dietary exposures will be estimated by using a computer program for a point estimate approach, in which the TDS food items will be mapped with food consumption data, as far as possible, in estimating the dietary exposure. The resulting dietary exposure estimates will then be compared with the safety reference or nutritional reference values.

To ensure consistency of the procedures, sets of procedural manuals are being developed to explain the management structure and contact information, and detail the sampling and food preparation procedures. Prior to the fieldwork of food sampling and food preparation, a pilot run will be conducted for testing the workflow, which will be critical to the success of the fieldwork. Based on the experience obtained from the pilot run, the procedural manuals may need to be further modified.

Way Forward

It is anticipated that the fieldwork of food sampling and food preparation of the first Hong Kong TDS will be started in 2010, and that the laboratory analysis will take about 3 years to complete. Once the analytical results are available, the data analysis will be conducted, and a report will then be prepared and released in phases, as contaminant assessments are completed.