# Thematic Report on Iodine Status
## (Population Health Survey 2020–22)

Non-Communicable Disease Branch
Centre for Health Protection
Department of Health

2023

Produced and published by
Non-Communicable Disease Branch, Centre for Health Protection,
Department of Health, the Government of the Hong Kong Special Administrative Region
18/F, Wu Chung House, 213 Queen's Road East, Wan Chai, Hong Kong

This publication is available from the Centre for Health Protection's website at:
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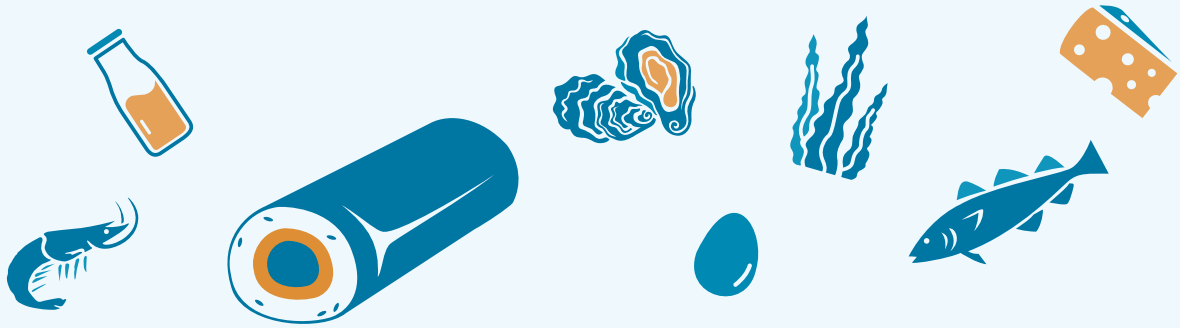
# EXECUTIVE SUMMARY



Iodine is an essential micronutrient required for thyroid hormone synthesis to support growth and development. Persistently low iodine intake will result in iodine deficiency or even damage to the developing brain and other harmful effects known collectively as iodine deficiency disorders (IDDs).

The Department of Health (DH) commissioned the Chinese University of Hong Kong to conduct an Iodine Survey in 2018, which assessed the iodine status of three vulnerable target groups including school-aged children, pregnant women, and lactating mothers in Hong Kong. Results showed that iodine intake of school-aged children was found to be sufficient while both pregnant and lactating women were found to be insufficient. The report with findings and recommendations has been published in August 2021 and is accessible at https://www.chp.gov.hk/files/pdf/iodine_survey_report_en.pdf.

Apart from vulnerable target groups, the spectrum of IDDs spread across all age-groups including adults. To understand more about the iodine status of Hong Kong's adult population, the third Population Health Survey (PHS) which targeted at the land-based non-institutional population aged 15 or above in Hong Kong (excluding foreign domestic helpers and visitors), assessed use of iodised salt at home, consumption of iodine rich food, iodine-containing supplement and included biochemical testing to assess the population iodine status.

## The Study

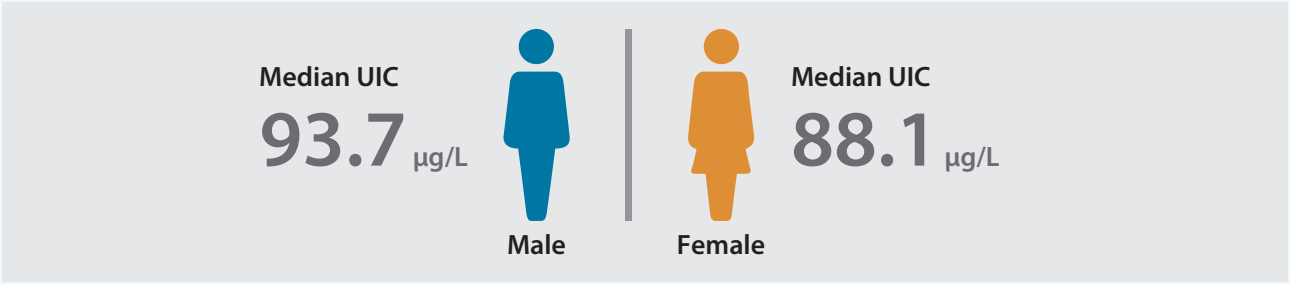
The fieldwork of PHS 2020–22 comprised two parts, namely (I) household survey; and (II) health examination. The fieldwork of the household survey was conducted between 2 November 2020 and 2 January 2022, with temporary suspension between 2 December 2020 and 22 February 2021 due to COVID-19 pandemic. It covered the land-based non-institutional population aged 15 or above in Hong Kong, excluding foreign domestic helpers and visitors. Health examination was conducted between 1 March 2021 and 19 February 2022. Age-gender stratified random subsample of respondents aged between 15 and 84, who were successfully enumerated in the household survey and had signed consent for health examination, were further invited to undergo health examination. A total of 16 655 individuals aged 15 or above were enumerated in the household interview (overall response rate: 73.3% at household level), 3 757 respondents out of 6 373 consented respondents were randomly-selected selected and invited to make appointment for health examination, including 2 072 respondents who completed physical measurements and blood tests. These represented a participation rate of 55.2%. 2 066 of the invited respondents completed spot urine test for iodine (participation rate: 55.0%). The survey data were adjusted for the differential participation rates by type of housing and grossed up to control for the age and gender profile of the study population for the second quarter (Q2) of 2021. PHS 2020–22 Part I and Part II Survey Report which presented findings on household survey and health examination has been published in December 2022 and April 2023 respectively. The details of survey method and characteristics of the sample could be referred to Chapter 1 of the Part I Report.

Questions from the household interview and the health examination covered various aspects including physical, psychosocial health and health-related lifestyle. The information on use of iodised salt at home, frequency of consumption of iodine-rich food including seaweeds (including kelp/laver but excluding ready-to-eat seaweed snack) and ready-to-eat seaweed (including pre-packed snack/nori sheet), consumption of iodine containing supplement were also collected. Spot urine samples from the 2 066 respondents aged between 15 and 84 were tested for the urinary iodine concentration (UIC; µg/L), which reflects their recent iodine intake. The median UIC values were compared to the World Health Organization (WHO) recommended cut-off values (100–199 µg/L for adequate iodine nutrition) to assess iodine status of the Hong Kong population. WHO's classification on iodine intake and status according to median UIC for school-age children aged 6 years or older including adults was set below –

| | UIC cutoff values for public health significance | | |
|---|---|---|---|
| | **Median UIC (µg/L)** | **Iodine intake** | **Iodine status** |
| **School-age children ≥6 years including adults (Excluding pregnant women and lactating women)** | <20 µg/L | Insufficient | Severe deficiency |
| | 20–49 µg/L | Insufficient | Moderate deficiency |
| | 50–99 µg/L | Insufficient | Mild deficiency |
| | 100–199 µg/L | Adequate | Adequate iodine nutrition |

## Key Findings

The median UIC of persons aged 15–84 was 91.3 µg/L which was classified as "insufficient iodine intake" with "mild iodine deficiency status" according to the epidemiological criteria set by the WHO.

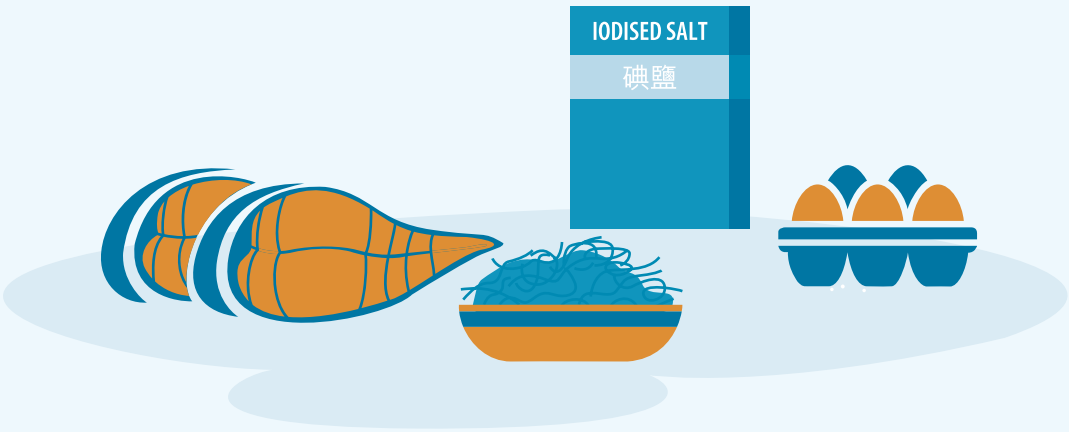



Median UIC for both female and male (88.1 µg/L for female; 93.7 µg/L for male) were also below the cut-off values for adequate iodine intake and the median UIC for female was lower than that of male. For breakdown by age groups, the median UIC was observed to be higher in younger age groups, with a consistent gradient from the highest in the group of 15–24 years (114.7 µg/L) to the lowest in the group of 65–84 years (77.7 µg/L). The median UIC for persons aged 15–34 was 107.5 µg/L, which indicated an "adequate" iodine intake; while the median UICs for persons aged 35 or above were lower than 100 µg/L, which indicated an "insufficient" iodine intake.

Majority (72.1%) of persons aged 15–84 were not aware of whether they were using iodised salt at home, only 21.0% reported using iodised salt at home. There was no difference found in the median UIC between iodised salt user and the others (p=0.400) and the result should be interpreted with cautions as the majority of respondents did not aware of whether they used iodised salt or not. Only 8.7% and 6.7% of persons aged 15–84 ate seaweed (including kelp/laver but excluding ready-to-eat seaweed snack) and ready-to-eat seaweed (including pre-packed snack/nori sheet) respectively at least once per week, and their median UIC (104.9 µg/L and 108.0 µg/L respectively) were higher than those who ate these iodine-rich food less than once per week (p = 0.038 for seaweeds including kelp/laver; p<0.001 for ready-to-eat seaweeds). Only 0.7% of persons aged 15–84 reported taking iodine-containing supplements in the 2 weeks preceding the health examination, but their median UIC (170.9 µg/L) indicated adequate iodine intake.

## Conclusion of Findings

PHS 2020–22 findings showed that the overall median UIC was below 100 µg/L which indicated insufficient iodine intake and mild iodine deficiency status among the general population aged 15 to 84. In general, median UIC was below 100 µg/L for both genders and across different age-groups except the younger people (those aged 15–34) which was "adequate" (median UIC: 107.5 µg/L) and with a decreasing gradient with age. Of note, in the previous iodine survey among school-aged children, pregnant women and lactating women, it showed "adequate" iodine nutrition among school-aged children (median UIC: 115 µg/L, total goitre rate: 'none' degree for iodine deficiency disorder) but the iodine intake was "insufficient" among the pregnant women and lactating women overall (median UIC: 134 µg/L & 65 µg/L respectively). Though subgroups reported taking iodine-containing supplement or frequent consumption of seaweed were found to have sufficient iodine intake, only minority of respondents took iodine-containing supplement or having frequent consumption of seaweed. The use of iodised salt was also not common among local domestic households. Only 21.0% of persons aged 15–84 reported the use of iodised salt at home. Overall, the iodine intake of local population is insufficient except breakdown among the younger age subgroup.



## Recommendations

The Working Group on Prevention of Iodine Deficiency Disorders which has been set up by the DH and Centre for Food Safety (CFS), Food and Environmental Hygiene Department (FEHD) with representatives from the Hospital Authority, the Hong Kong College of Community Medicine, the Hong Kong College of Family Physicians, the Hong Kong College of Obstetricians and Gynaecologists, the Hong Kong College of Paediatricians, and the Hong Kong College of Physicians, has reviewed the key findings of this study and the latest scientific evidence, and made the following recommendations:

Members of the public are advised to increase iodine intake to maintain adequate iodine nutrition.

### *1. Consume iodine-rich foods*

— Consume food with more iodine as part of a healthy balanced diet. Seaweed, kelp, seafood, marine fish, eggs, milk, dairy products are food rich in iodine.

— When choosing iodine-rich snacks, avoid those which are high in salt or fat content.

### *2. Use iodised salt*

— Use iodised salt instead of ordinary table salt, keeping total salt intake below 5 g (1 teaspoon) per day to lower the risk of raised blood pressure.

— As iodine content in iodised salt may be affected by humidity, heat and sunlight, iodised salt should be stored in a tight and coloured container and kept in a cool dry place.

— To minimise loss of iodine through the cooking process, in particular from prolonged boiling and pressure cooking, add iodised salt to food as close to the time of serving as possible.

— Persons with thyroid problems should seek medical advice regarding use of iodised salt.

### *3. Additional measures for pregnant and lactating women*

— Take iodine-containing supplements containing at least 150 µg iodine per day.

— Seek medical advice if in doubt.

— Persons with existing medical conditions or thyroid problems should consult healthcare professionals and take supplements as instructed.

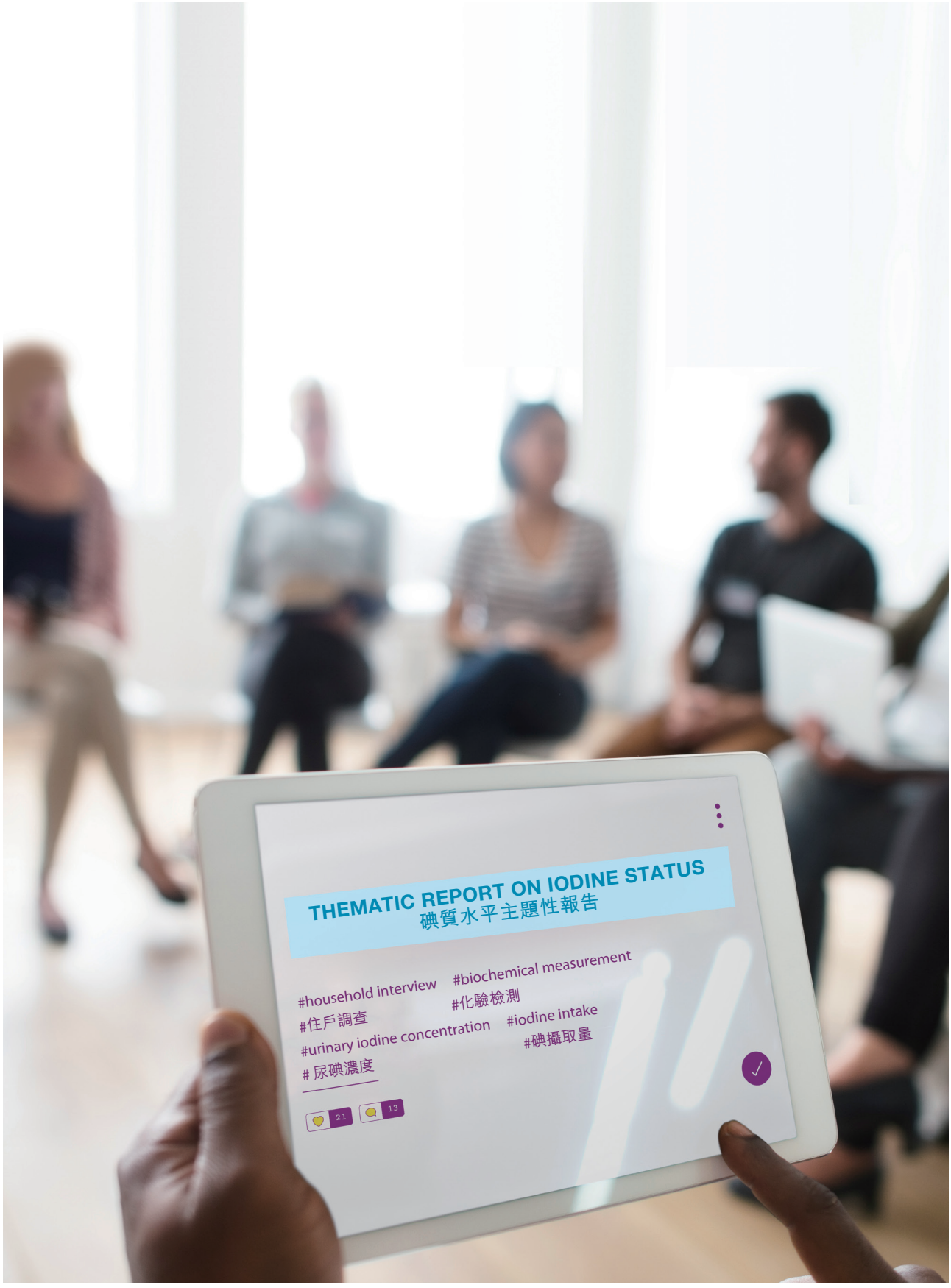
The DH will strengthen the surveillance and conduct regular surveys to collect information on the use of iodised salt, average salt intake and iodine status (median UIC) among local population.

The CFS of the FEHD will work with the trade to improve the availability of iodised salt

— Formulate and promulgate guidelines for traders to provide salt fortified with iodine. The CFS developed a set of guidelines making reference to WHO's and Codex's recommendations and in consultation with relevant local traders basing on the local situation. The guidelines entitled "*Salt Iodisation: A Practical Guide for Salt Importers, Wholesalers and Retailers*" is available at the CFS' website (https://www.cfs.gov.hk/english/programme/programme_fii/files/Food_Iodisation_e.pdf). Basing on the mean population intake of salt from PHS 2014/15 and PHS 2020–22 at 8.8 g/day and 8.4 g/day, respectively, salt can be fortified following WHO's recommendation, i.e. 15–40 mg iodine per kg of salt at household (consumer) level.

— Encourage traders to make more iodised salt available to general public in local market.

# CHAPTER 1 INTRODUCTION



## 1.1 Background

Iodine is an essential micronutrient required for thyroid hormone synthesis to support growth and development. Persistently low iodine intake will result in iodine deficiency or even damage to the developing brain and other harmful effects known collectively as iodine deficiency disorders (IDDs). According to the World Health Organization (WHO), the recommended daily iodine intake is 150 µg for adults and adolescents[1]; the cut-off values of 100–199 µg/L of median urinary iodine concentration (UIC) in a population reflect adequate iodine nutrition[2].

Iodine deficiency is a global public health issue, affecting around 40% of the world population[3]. With reference to the Iodine Survey conducted by the Department of Health (DH) in 2019, iodine intake of pregnant women and lactating mothers in Hong Kong were insufficient[4]. Earlier local studies including the first Hong Kong Population-based Food Consumption Survey conducted by the Centre for Food Safety (CFS) in 2011 suggested that median daily intake of the Hong Kong population might probably be below the recommendation made by the WHO[5].

As part of the Population Health Survey (PHS) 2020–22 conducted by the DH, assessment of iodine status of the Hong Kong population was conducted.

### *1.1.1 Objective*

To assess the iodine status of land-based non-institutional population aged 15–84 in Hong Kong, excluding foreign domestic helpers and visitors.

# CHAPTER 2 SURVEY METHOD

## 2.1 Survey Method

The fieldwork of PHS 2020–22 comprised two parts, namely (I) household survey; and (II) health examination, including physical measurements and biochemical testing. Among the biochemical testing, UIC of spot urine samples was performed to assess the iodine status. The DH commissioned a private research firm and a private healthcare organisation with laboratory service to conduct the fieldworks of household survey and health examination respectively. Data analysis and reporting of the PHS 2020–22 was commissioned to the Jockey Club School of Public Health and Primary Care, the Chinese University of Hong Kong. The DH was responsible for the overall planning of the survey including the study design and development of questionnaire as well as monitoring the quality of various part of the survey.

UIC is a sensitive marker of recent dietary iodine intake[3]. 24-hour urine collection is theoretically a more accurate measurement method considering the variable iodine intake and excretion during the day, but it is also more troublesome for subjects and may lead to low compliance[3]. Spot urine was selected for this study in view of the higher subject acceptability. Spot urine analysis was also used in the Iodine Survey conducted by DH in 2019[4].

### *2.1.1 Target Population Coverage*

The household survey covered the land-based non-institutional population aged 15 or above in Hong Kong, excluding foreign domestic helpers and visitors of Hong Kong. The health examination covered persons aged between 15 and 84 (both ages inclusive) who had been enumerated in the household survey.

### *2.1.2 Sampling Frame and Sample Selection*

The survey adopted the Frame of Quarters maintained by the Census and Statistics Department (C&SD) as the sampling frame. The Frame of Quarters consists of the Register of Quarters (RQ) and the Register of Segments (RS) which contain records of all addresses of permanent quarters in built-up areas and records of area segments in non-built-up areas respectively. Systematic replicated sampling was deployed for selecting a sample of replicates of living quarters in built-up areas from the RQ and a sample of area segments in non-built-up areas from the RS. Each replicate of living quarters is a representative sample of domestic households in Hong Kong.

### *2.1.3 Participants of Health Examination*

All domestic households in the selected living quarters and all members aged 15 or above, excluding foreign domestic helpers and visitors, were enumerated individually. All enumerated persons aged between 15 and 84 were invited to sign consent for health examination. For respondents under 18 years of age, their consents were signed by parents or guardians. Eligible and consented members of enumerated households, stratified into gender and age groups were randomly invited to undergo a follow-up health examination.

### *2.1.4 Data Collection Method*

Respondents who consented for health examination after completing the household interview were stratified into gender and age groups. For each group, the randomly selected respondents were contacted by telephone to make appointment at designated health examination centres. Appointment confirmation letters or SMS, a health examination pamphlet and instructions for biochemical test were sent to respondents who accepted the invitation. Another hotline was set up for enquiries and making appointments for health examination. Identities of respondents attending health examination were verified. Respondents were requested to complete a self-administered questionnaire on the day of the health examination. Spot urine collection for iodine were performed by trained staff supervised by medical practitioner in four designated health examination centres, one each in Central, Causeway Bay, Mong Kok and Tsuen Wan. The respondents were given a clean acid-washed trace element urine bottle and instructions for sample collection on the same day of the health examination.

All laboratory reports were reviewed by registered medical laboratory technologists before passing to the DH. Medical staff of DH further reviewed all laboratory results before sending to the respondents concerned. Health advice was provided to the respondents with results outside reference range.

Procedures of biochemical tests followed the WHO STEPS Surveillance Manual[6]. Procedures for handling biochemical specimens followed the Safety Guidelines on Transport of Clinical Specimens and Infectious Substances for Courier Team and the relevant Infection Control Guidelines issued by the Centre for Health Protection of the DH.

### *2.1.5 Survey Instrument*

Participants were requested to complete a self-administered questionnaire including the use of iodine-containing supplement in the 2 weeks preceding the health examination. Apart from physical measurements and blood test, participants were also asked to collect at least 10 mL of spot urine sample for biochemical testing.

**Assays of urinary iodine concentrations (UIC)**

Urinary iodine was assayed by an inductively coupled plasma mass spectrometer concentration (ICPMS). UIC was assayed in micromole of iodine content per litre of urine (μmol/L) and was converted in microgram per litre of urine (μg/L). Both the laboratory responsible for UIC measurement and the urinary iodine measurement test are accredited against ISO15189:2012 standard by the National Association of Testing Authorities, Australia (NATA).

### *2.1.6 Main Fieldwork*

The fieldwork of health examination was conducted between 1 March 2021 and 19 February 2022. A total of 3 757 respondents out of 6 373 consented respondents were selected according to age-gender stratified sampling and invited to make appointment for health examination. Among these 3 757 invited respondents, 2 072 respondents completed physical measurements and blood test (participation rate: 55.2%). 2 066 of the invited respondents completed spot urine test for iodine (participation rate: 55.0%).

### *2.1.7 Grossing-up Method*

The data collected from the study were adjusted by the differential participation rates for the three types of housing (i.e. public rental housing, subsidised sale flats and private housing), and grossed-up to the control for the age and gender profile of the target population for the second quarter (Q2) of 2021. One set of statistical weights each was derived for (i) household survey, (ii) health examination (exclude 24-hour urine tests), (iii) 24-hour urine tests, and (iv) spot urine iodine. After these adjustments, the survey estimates can represent those of the study population during the survey period.

### *2.1.8 Statistical Analysis*

Data are expressed as median or number (proportion). Between-group comparisons of UIC were performed by Kruskal-Wallis Test, for which a p-value <0.05 would indicate statistical significance. Statistical analysis was performed by R[7].

### *2.1.9 Confidentiality*

All questionnaires and data files were regarded as confidential documents, and the research team exercised due care in handling the records to avoid the leakage of information. At the beginning of the survey, all relevant staff of the private data collection firm commissioned for the survey were required to sign an undertaking not to disclose any confidential information related to the survey.

In accordance with the Personal Data (Privacy) Ordinance (Cap. 486) and the code of conduct of the research agency, all data collected from the survey were used only for research and statistical purposes. All worksheets filled with households' information would be destroyed within six months after completion of the survey.

### *2.1.10 Ethics Approval*

The study was approved by the Ethics Committee of the DH.

# CHAPTER 3 RESULTS

## 3.1 Demographic Characteristics

The proportion of male (47.4%) and female (52.6%) participants were similar. 20.3% of the participants were 55–64 years old, followed by 65–84 years old (19.8%). More than half of the participants (51.7%) had attained secondary education level, followed by post-secondary or above (35.1%). 27.2% of the participants had household income at $50,000 or above, followed by $20,000–$29,999 (19.9%) (Table 3.1).

**Table 3.1: Demographic characteristics (weighted) among persons aged 15 to 84 with valid spot urine iodine test result**

| | %[#] |
|---|---|
| Gender | |
| Male | 47.4% |
| Female | 52.6% |
| Age Group | |
| 15–24 | 9.7% |
| 25–34 | 15.0% |
| 35–44 | 17.0% |
| 45–54 | 18.2% |
| 55–64 | 20.3% |
| 65–84 | 19.8% |
| Education level | |
| No schooling/Pre-primary | 1.0% |
| Primary | 12.2% |
| Secondary | 51.7% |
| Post-secondary or above | 35.1% |
| Monthly household income | |
| Below $5,000 | 5.6% |
| $5,000–$9,999 | 6.7% |
| $10,000–$19,999 | 14.5% |
| $20,000–$29,999 | 19.9% |
| $30,000–$39,999 | 14.6% |
| $40,000–$49,999 | 11.5% |
| $50,000 or above | 27.2% |
| Total | 100.0% |

Notes: Figures may not add up to the total due to rounding.

[#] It refers to weighted percentage among all respondents who had participated in health examination with valid urine iodine test results.

## 3.2 Iodine Status Evaluation

According to the WHO, the median Urinary Iodine Concentration (UIC) of school-age children and adults (excluding pregnant women and lactating women) of 100–199 µg/L indicates adequate iodine nutrition in a population[2]. WHO's classification on iodine intake and status according to median UIC for school-age children ≥6 years old or older including adults was set below.

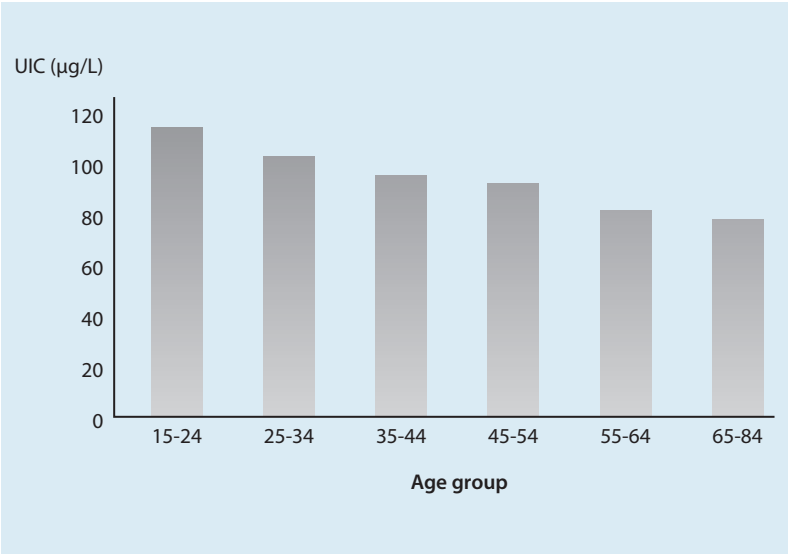
| | UIC cutoff values for public health significance | | |
|---|---|---|---|
| | **Median UIC (µg/L)** | **Iodine intake** | **Iodine status** |
| **School-age children ≥6 years including adults (Excluding pregnant women and lactating women)** | <20 µg/L | Insufficient | Severe deficiency |
| | 20–49 µg/L | Insufficient | Moderate deficiency |
| | 50–99 µg/L | Insufficient | Mild deficiency |
| | 100–199 µg/L | Adequate | Adequate iodine nutrition |

### *3.2.1 Median UIC*

The median UIC of persons aged 15–84 was 91.3 µg/L. Analysed by age group, the median UIC decreased as age increased, from 114.7 µg/L among those aged 15–24 to 77.7 µg/L among those aged 65–84. Median UICs were also significantly different by age groups ($p<0.001$) (Table 3.2.1a).

**Table 3.2.1a: Median UIC by age group**

| Age group | %[#] | Median UIC (µg/L) |
|---|---|---|
| 15–24 | 9.7% | 114.7 |
| 25–34 | 15.0% | 102.6 |
| 35–44 | 17.0% | 94.9 |
| 45–54 | 18.2% | 91.6 |
| 55–64 | 20.3% | 81.3 |
| 65–84 | 19.8% | 77.7 |
| **15–84** | 100.0% | 91.3 |



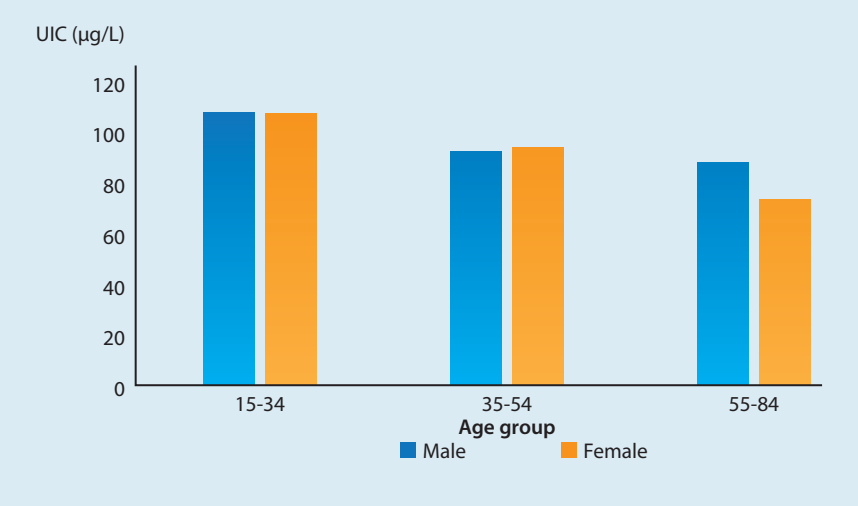

Notes: Figures may not add up to the total due to rounding.
Statistical differences were tested by Kruskal-Wallis test.
[#] It refers to weighted percentage among all respondents who had participated in health examination with valid urine iodine test results.

The overall median UICs for both genders were below 100 µg/L, which indicated an "insufficient" iodine intake. Median UICs by gender (88.1 µg/L for female; 93.7 µg/L for male) were significantly different (p = 0.003). Analysed by age groups, the median UIC for persons aged 15–34 was 107.5 µg/L, which indicated an "adequate" iodine intake; while the median UICs for persons aged 35 or above were lower than 100 µg/L, which indicated an "insufficient" iodine intake (Table 3.2.1b).

**Table 3.2.1b: Median UIC by age group and gender**

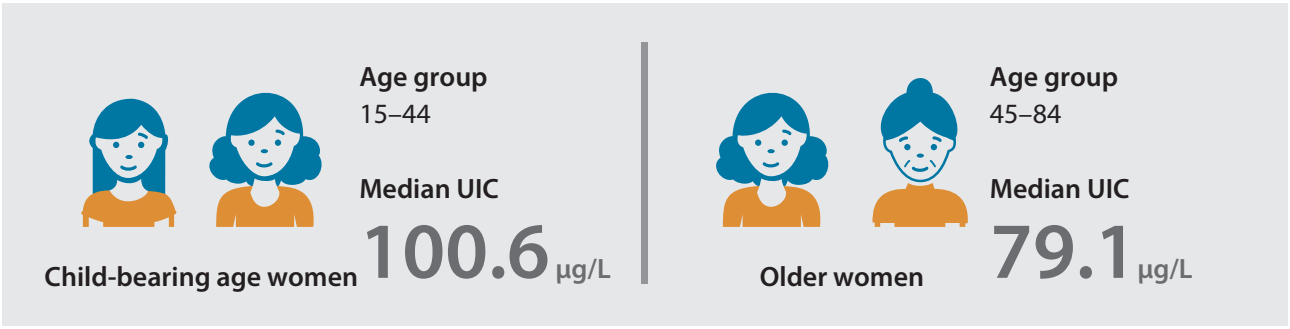
| | Male | Female | Both genders |
|---|---|---|---|
| **Age group** | **Median UIC (µg/L)** | **Median UIC (µg/L)** | **Median UIC (µg/L)** |
| 15–34 | 107.5 | 107.2 | 107.5 |
| 35–54 | 92.1 | 93.9 | 92.7 |
| 55–84 | 88.0 | 73.3 | 79.8 |
| **15–84** | 93.7 | 88.1 | 91.3 |

Note: Figures may not add up to the total due to rounding. Statistical differences were tested by Kruskal-Wallis test.



The median UIC of child-bearing age woman (aged 15–44) was 100.6 μg/L, compared to 79.1 μg/L among those aged 45–84 (Table 3.2.1c). The difference between median UIC of the two age groups was statistically significant (p<0.001). The median UIC of child-bearing age woman indicated "adequate" iodine intake.

**Table 3.2.1c: Median UIC among female by age group**




| Age group | %[#] | Median UIC (μg/L) |
|---|---|---|
| 15–44 | 41.1% | 100.6 |
| 45–84 | 58.9% | 79.1 |
| **15–84** | 100.0% | 88.1 |

Notes: Figures may not add up to the total due to rounding.
Statistical differences were tested by Kruskal-Wallis test.
[#] It refers to weighted percentage among all respondents who had participated in health examination with valid urine iodine test results.

### *3.2.2 Proportions of Population with UIC at or above 100 µg/L and below 50 µg/L*

According to the WHO's recommended criteria in monitoring progress towards the goal of eliminating IDD, the proportion of population with UIC at or above 100 µg/L (i.e. adequate iodine nutrition) should be higher than or equal to 50%. On the other hand, the proportion of population with UIC below 50 µg/L should be below 20%[8]. In this section, the proportions were also presented with 95% confidence intervals (CI).

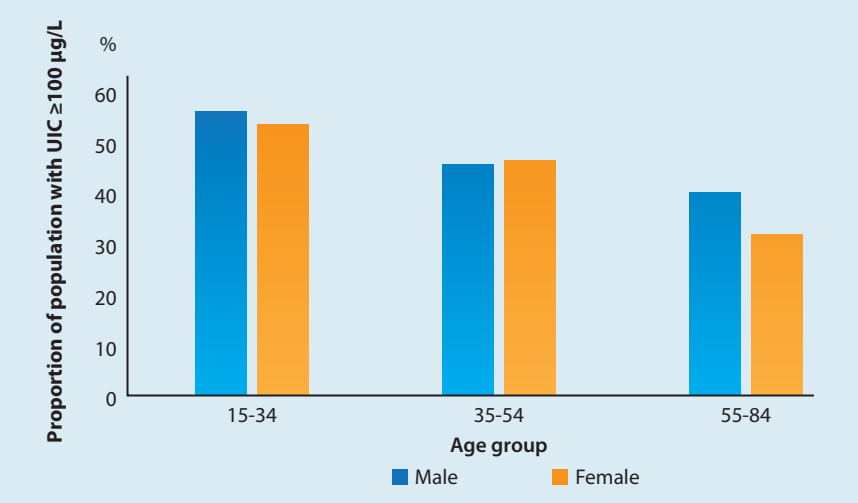
The overall proportion of persons with UIC ≥100 µg/L was 44.0% (CI: 41.7%–46.3%). Analysed by gender, the proportion of persons with UIC ≥100 µg/L for male (46.0% (CI: 42.9%–49.2%)) is higher than that in female (42.2% (CI: 39.1%–45.3%)). The proportions and their CIs of both genders with UIC ≥100 µg/L were below 50% (Table 3.2.2a).

Analysed by age group, the proportion of persons with UIC ≥100 µg/L decreased as age increased, from 54.7% (CI: 50.8%–58.5%) among persons aged 15–34 to 35.8% (CI: 32.2%–39.5%) among persons aged 55–84 (Table 3.2.2a).

**Table 3.2.2a: Proportion of population with UIC ≥100 µg/L by age group and gender**

| | Male | | | Female | | | Both genders | | |
|---|---|---|---|---|---|---|---|---|---|
| Age group | % | 95% CI (Lower limit) | 95% CI (Upper limit) | % | 95% CI (Lower limit) | 95% CI (Upper limit) | % | 95% CI (Lower limit) | 95% CI (Upper limit) |
| 15–34 | 56.0% | 50.5% | 61.3% | 53.4% | 47.7% | 59.0% | 54.7% | 50.8% | 58.5% |
| 35–54 | 45.5% | 40.3% | 50.9% | 46.3% | 41.2% | 51.5% | 45.9% | 42.1% | 49.8% |
| 55–84 | 40.1% | 35.2% | 45.3% | 31.7% | 27.1% | 36.7% | 35.8% | 32.2% | 39.5% |
| **15–84** | 46.0% | 42.9% | 49.2% | 42.2% | 39.1% | 45.3% | 44.0% | 41.7% | 46.3% |

Note: Figures may not add up to the total due to rounding. CI: Confidence Interval



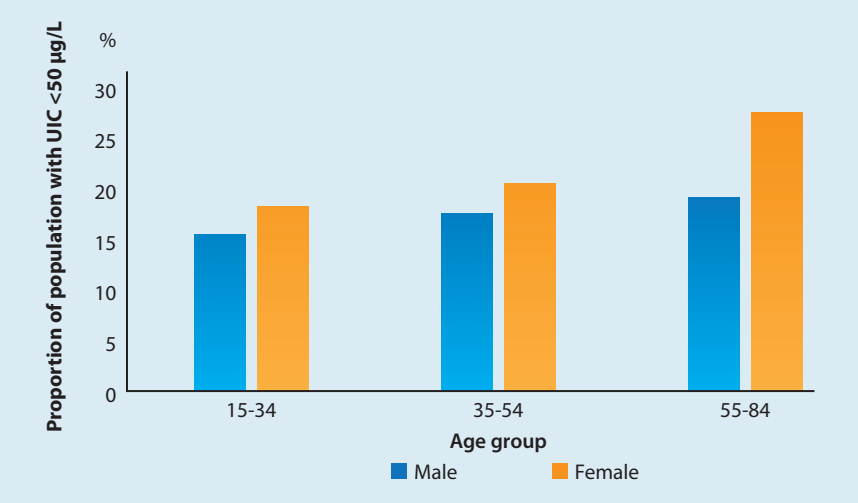
The overall proportion of persons with UIC <50 µg/L was 20.3% (CI: 18.5%–22.3%). Analysed by gender, the proportion of persons with UIC <50 µg/L for male (17.6% (CI: 15.3%–20.2%)) is lower than that for female (22.7% (CI: 20.2%–25.5%)) (Table 3.2.2b).

Analysed by age group, the proportion of persons with UIC <50 µg/L increased as age increased, from 16.8% (CI: 14.0%–20.1%) among persons aged 15–34 to 23.5% (CI: 20.4%–26.9%) among persons aged 55–84 (Table 3.2.2b).

**Table 3.2.2b: Proportion of population with UIC <50 µg/L by age group and gender**

| | Male | | | Female | | | Both genders | | |
|---|---|---|---|---|---|---|---|---|---|
| **Age group** | **%** | **95% CI (Lower limit)** | **95% CI (Upper limit)** | **%** | **95% CI (Lower limit)** | **95% CI (Upper limit)** | **%** | **95% CI (Lower limit)** | **95% CI (Upper limit)** |
| 15–34 | 15.4% | 11.8% | 19.9% | 18.2% | 14.2% | 23.1% | 16.8% | 14.0% | 20.1% |
| 35–54 | 17.5% | 13.8% | 21.9% | 20.5% | 16.7% | 24.9% | 19.1% | 16.4% | 22.2% |
| 55–84 | 19.1% | 15.3% | 23.6% | 27.5% | 23.2% | 32.3% | 23.5% | 20.4% | 26.9% |
| **15–84** | 17.6% | 15.3% | 20.2% | 22.7% | 20.2% | 25.5% | 20.3% | 18.5% | 22.3% |

Note: Figures may not add up to the total due to rounding. CI: Confidence Interval



## 3.3 The Use of Iodised salt, Consumption of Iodine-rich Food and Iodine-containing Supplement and their association with Median Urinary Concentration

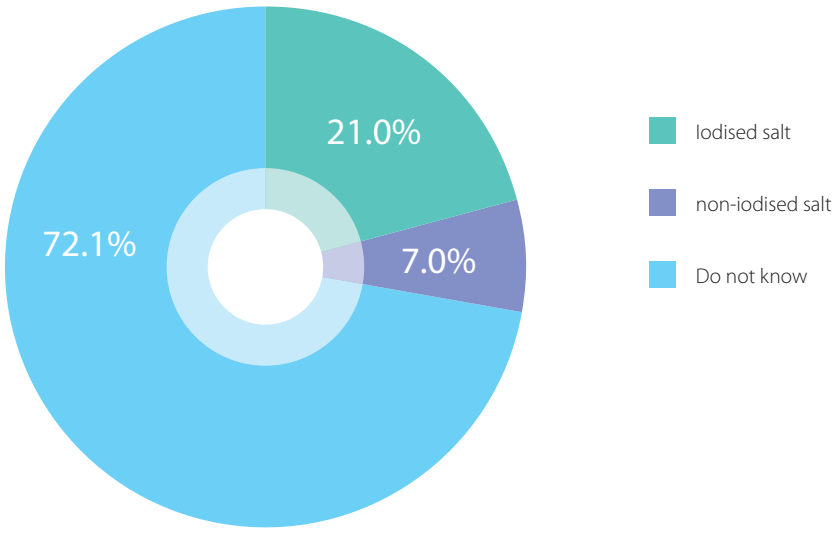
### *3.3.1 Use of Iodised Salt*

Overall, majority of the population (72.1%) reported that they were not aware of whether iodised salt was used at home. 21.0% reported using iodised salt. The median UIC was below 100 µg/L regardless of the use of iodised salt (p = 0.400) (Table 3.3.1).

**Table 3.3.1: Median UIC by types of salt used**

| Types of salt used | %[#] | Median UIC (µg/L) |
|---|---|---|
| Iodised | 21.0% | 85.7 |
| Iodised salt only | 19.3% | 85.9 |
| Both iodised and non-iodised | 1.7% | 82.0 |
| Non-iodised | 7.0% | 88.4 |
| Non-iodised salt only | 6.2% | 87.9 |
| Did not use salt | 0.8% | 93.0 |
| Do not know | 72.1% | 93.4 |
| **Total** | 100.0% | 91.3 |

Notes: Figures may not add up to the total due to rounding.
Statistical differences were tested by Kruskal-Wallis test.
[#] It refers to weighted percentage among all respondents who had participated in health examination with valid urine iodine test results.



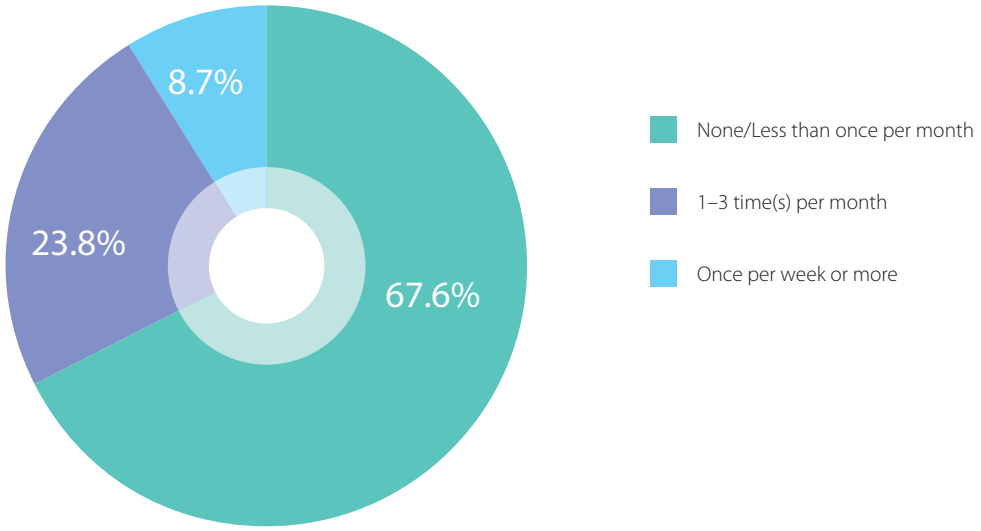
### *3.3.2 Seaweed Consumption (including kelp/laver, but excluding ready-to-eat seaweed snack)*

More than two-thirds of population (67.6%) reported consuming seaweed (including kelp/laver, but excluding ready-to-eat seaweed snack) with a frequency of none/less than once per month. Only 8.7% reported consumption once per week or more. In general, median UIC increased as seaweed consumption frequency increased, from 90.4 µg/L among those who consumed seaweed none/less than once per month to 104.9 µg/L among those who consumed seaweed once per week or more (p = 0.038) (Table 3.3.2).

**Table 3.3.2: Median urinary iodine concentration by frequency of seaweeds consumption (including kelp/laver, but excluding ready-to-eat seaweed snack)**

| Frequency of seaweed consumption (including kelp/laver, but excluding ready-to-eat seaweed snack) | %[#] | Median UIC (µg/L) |
|---|---|---|
| None/Less than once per month | 67.6% | 90.4 |
| 1–3 time(s) per month | 23.8% | 91.4 |
| Once per week or more | 8.7% | 104.9 |
| **Total** | 100.0% | 91.3 |

Notes: Figures may not add up to the total due to rounding.
Statistical differences were tested by Kruskal-Wallis test.
[#] It refers to weighted percentage among all respondents who had participated in health examination with valid urine iodine test results.



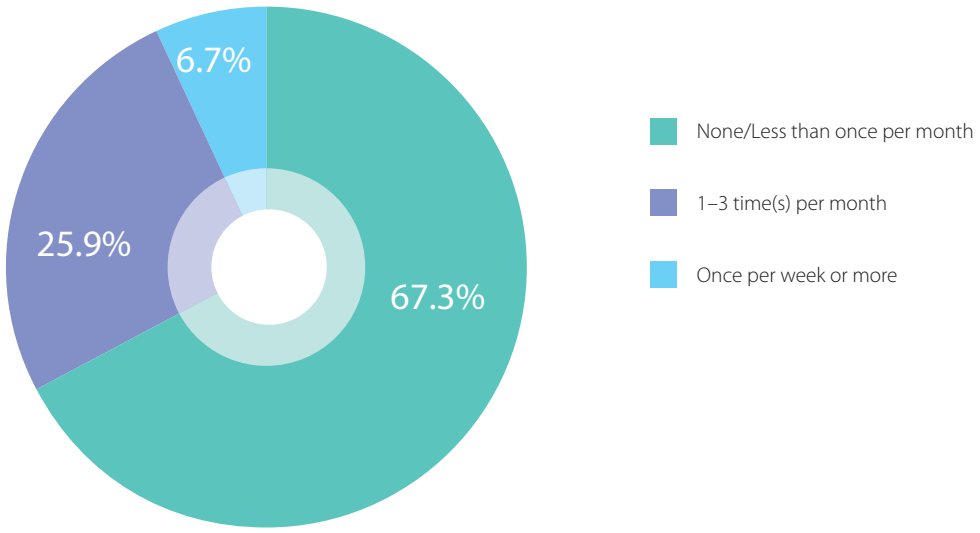
### *3.3.3 Ready-to-eat Seaweed Consumption (including pre-packed snack/nori sheet)*

More than two-thirds of population (67.3%) reported consuming ready-to-eat seaweed (including pre-packed snack/nori sheet) with a frequency of none/less than once per month. Only 6.7% reported consumption once per week or more. In general, median UIC increased as ready-to-eat seaweed consumption frequency increased, from 87.8 µg/L among those who consumed ready-to-eat seaweed in none/less than once per month to 108.0 µg/L among those who consumed ready-to-eat seaweed once per week or more ($p < 0.001$) (Table 3.3.3).

**Table 3.3.3: Median urinary iodine concentration by frequency of ready-to-eat seaweed consumption (including pre-packed snack/nori sheet)**

| Frequency of ready-to-eat seaweed consumption (including pre-packed snack/nori sheet) | %[#] | Median UIC (µg/L) |
|---|---|---|
| None/Less than once per month | 67.3% | 87.8 |
| 1–3 time(s) per month | 25.9% | 96.9 |
| Once per week or more | 6.7% | 108.0 |
| **Total** | 100.0% | 91.3 |

Note: Figures may not add up to the total due to rounding.
Statistical differences were tested by Kruskal-Wallis test.
[#] It refers to weighted percentage among all respondents who had participated in health examination with valid urine iodine test results.



### *3.3.4 Iodine-containing supplement*

Majority of the population (93.3%) reported that they did not take any iodine-containing supplement, only 0.7% reported taking iodine-containing supplement in the 2 weeks preceding the health examination. The median UIC among those who reported taking iodine-containing supplement was 170.9 μg/L, which was significantly higher than that for those who did not take any iodine-containing supplement (91.3 μg/L) and those who did not know (84.8 μg/L) (p = 0.014) (Table 3.3.4).

**Table 3.3.4: Median urinary iodine concentration by taking any iodine-containing supplement in the 2 weeks preceding the health examination**

| Whether had taken any iodine-containing supplement | %[#] | Median UIC (μg/L) |
|---|---|---|
| Yes | 0.7% | 170.9 |
| No | 93.3% | 91.3 |
| Do not know | 6.0% | 84.8 |
| **Total** | 100.0% | 91.3 |

Notes: Figures may not add up to the total due to rounding.
Statistical differences were tested by Kruskal-Wallis test.
[#] It refers to weighted percentage among all respondents who had participated in health examination with valid urine iodine test results.

# CHAPTER 4 DISCUSSION

This is the first territory-wide study on iodine status of the general population in Hong Kong. Results of this study provides valuable information of overall iodine status of the local population and the baseline for on-going monitoring and surveillance. It also provides evidence that informs food and health policies on tackling iodine deficiency and future evaluations of the effectiveness of public health measures.

This study showed "mild deficiency" with regard to iodine status of persons aged 15–84 in Hong Kong according to the WHO epidemiological criteria (median UIC 50–99 µg/L for mild deficiency)[1]. The overall median UIC was 91.3 µg/L which was below the cutoff value for adequate iodine nutrition (100–199 µg/L). The mild deficient iodine status was also reflected by the less than 50% of persons with a UIC higher than 100 µg/L, and a higher than 20% of persons with a UIC below 50 µg/L. Both males and females had median UICs below 100 µg/L although males were found to have a higher median UIC. The gender difference was also reflected by respective proportions with UIC <50 µg/L with less than 20% of males having UIC <50 µg/L compared to over 20% for female[1]. Some overseas studies have also found similar difference on median UIC between males and females[9,10], and a lower average energy as well as iodine intake in females might be one of the reasons[11,12].

There was also an age gradient on iodine status. This study showed that median UIC decreased with age, and this trend was observed in both males and females. The iodine intake changed from "adequate" (median UIC 107.5 µg/L) in persons aged 15–34 to "insufficient" in persons aged 35–54 and 55–84. The trend was also reflected by the proportions of persons among the age groups with UIC≥100 µg/L and UIC <50 µg/L, which are the other epidemiological criteria proposed by the WHO. Over 50% of the younger persons (aged 15–34) had a UIC higher than 100 µg/L (54.7%, 95% CI 50.8%–58.5%), while less than 50% of the older age groups achieved that status (45.9%, 95% CI 42.1%–49.8% for those aged 35–54; 35.8%, 95% CI 32.2%–39.5% for those aged 55–84, respectively). Similarly, the proportion with a UIC lower than 50 µg/L was below 20% (16.8%, 95% CI 14.0%–20.1%) for persons aged 15–34, compared to 19.1% (95% CI 16.4%–22.2%) among those aged 35–54, and 23.5%, (95% CI 20.4%–26.9%) among those aged 55–84. Meanwhile, females of the child-bearing age (i.e. 15–44 years) was found to have an "adequate" median UIC (100.6 µg/L). The findings on iodine status among the general population was in line with findings of previous Iodine Survey on school-aged children, pregnant and lactating women conducted by the DH in 2019[4]. Previous Iodine Survey showed that median UIC among school-aged children was 115 µg/L which was classified as "adequate iodine intake" while PHS 2020–22 also showed adequate iodine intake among younger population (aged 15–34). The total goiter rate among school-aged children measured in previous iodine survey also indicated "none" degree for iodine deficiency disorder according to WHO's classification. Though women of child-bearing age was found to have an adequate iodine intake in PHS 2020–22, requirement for iodine daily intake are increased during pregnancy and lactation. The increase in thyroid hormone synthesis, the need to transfer of iodine to the fetus, and the increased glomerular filtration leading to increased urinary losses result in increase in the requirement[13]. The WHO's epidemiological criteria for assessing iodine nutrition classified median UIC 150–249 µg/L and ≥100 µg/L as "adequate iodine intake" for pregnant women and lactating women respectively. Previous Iodine Survey also showed that median UIC for pregnant women with iodine containing supplement at average daily intake at least 150 µg/day, with iodine-containing at average daily intake less than 150 µg/day over the two weeks before interview and those did not consume any supplement or consumed supplement without iodine were 156 µg/L ("adequate"), 132 µg/L ("insufficient") and 97 µg/L ("insufficient") respectively. Median UIC for lactating women was 65 µg/L ("insufficient") only. In addition to consumption of iodine rich food and use of iodised salt, iodine containing supplement (at least 150 µg/day iodine) was recommended for pregnant and lactating women as required for the thyroid hormone synthesis and normal neurodevelopment of the developing fetus in utero and in the breastfed infant.

Further analysis by frequency of consumption of iodine-rich food showed that persons taking seaweed (including kelp/laver but excluding ready-to-eat seaweed snack) and read-to-eat seaweed (including pre-packed snack/nori sheet) once a week or more had an "adequate" median UIC (104.9 µg/L and 108.0 µg/L respectively), that were significantly higher than persons consuming these iodine-rich food less frequently (less than once per week). Edible seaweed accumulates iodine from seawater and can be rich source of iodine. Iodine content of different seaweed products can range from 29.3–4921 mg/kg[14]. The consumption of seaweed or its products is common is the East-Asian diet[15], however, less than 10% of our respondents reported consuming them once a week or more. Health education to raise awareness of iodine intake and consuming food with more iodine as part of a healthy balanced diet would be needed.

Persons taking iodine-containing supplement were also found to have an "adequate" iodine intake and significantly higher median UIC (170.9 µg/L) than their counterparts. However, this was an uncommon practice with less than 1% respondents reported taking iodine-containing supplement. Considering the small number of persons reported taking the supplement, this result needs to be interpreted with cautions.

Using iodised salt to replace non-iodised salt is a cost-effective and widely implemented strategy to prevent iodine deficiency disorders in populations[16]. However, the study revealed that majority (72.1%) of the local population were not aware or had no knowledge whether they were using iodised salt at household level. The median UIC of iodised salt-user was similar to non-user, and both were below 100 µg/L ($p = 0.400$). However, the results have to be interpreted with cautions considering i) the large proportion of population not knowing whether they were using iodised salt, ii) the lack of data on the frequency of use and iodine level in the iodised salt, and iii) the very different proportions reported using iodised salt in this study (21.0%) compared to the corresponding findings in the Iodine Survey (11.9% school-aged children, 4.7% pregnant women and 5.0% lactating mothers reported using iodised salt).

## 4.1 Limitations

### *Recruitment of participants for spot urine test*

Although sampling of the household interview was performed by a relatively robust systematic replicated method using Frame of Quarters maintained by the C&SD, which would produce a representative sample of the local population, the recruitment of participants for subsequent spot urine iodine test might be subject to consent bias. Respondents who were more health conscientious might be more likely to consent and participate in the health examinations and spot urine test. This could have resulted in bias in the survey result.

### *Iodine intake assessment*

The study collected information on the use of iodised salt at home, consumption frequency of a few iodine-rich food items (seaweeds and ready-to-eat seaweed), and use of iodine-containing supplement. Nevertheless, information other than consumption frequency such as the amount or serving size and consumption of other iodine-rich food were not collected. There was also no information collected on preparation and cooking methods of the covered iodine-rich food that would affect iodine content of the food products[17]. The self-reported nature of information on use of iodised salt and consumption of iodine-rich food was also subject to recall bias. Although there was limitation on information collected, the findings of overall insufficient iodine intake as reflected by median UIC, in general, were consistent with low prevalence of use of iodised salt and consumption of iodine-rich food.

### *Use of spot urine iodine in assessing iodine status*

Though spot urine samples only reflect iodine intake over a short period of time that can vary greatly between or even within days, these variations tend to even out over a population and the use of spot urine iodine was recommended by WHO in assessing population iodine status.

## 4.2 Conclusion

The overall median UIC was below 100 µg/L which indicated insufficient iodine intake and mild iodine deficiency status among the general population aged 15 to 84. In general, median UIC was below 100 µg/L for both genders and across different age-groups except the younger people (those aged 15–34) which was "adequate" (median UIC: 107.5 µg/L) and with a decreasing gradient with age. Of note, in the previous iodine survey among school-aged children, pregnant women and lactating women, it showed "adequate" iodine nutrition among school-aged children (median UIC: 115 µg/L, total goitre rate: 'none' degree for iodine deficiency disorder) but the iodine intake was "insufficient" among the pregnant women and lactating women overall (median UIC: 134 µg/L & 65 µg/L respectively). Though subgroups reported taking iodine-containing supplement or frequent consumption of seaweed were found to have sufficient iodine intake, only minority of respondents took iodine-containing supplement or having frequent consumption of seaweed. The use of iodised salt was also not common among local domestic households. Only 21.0% of persons aged 15–84 reported the use of iodised salt at home. Overall, the iodine intake of local population is insufficient except breakdown among the younger age subgroup.

## 4.3 Ways Forward

The Working Group on Prevention of Iodine Deficiency Disorders which has been set up by the DH and CFS, FEHD with representatives from the Hospital Authority, the Hong Kong College of Community Medicine, the Hong Kong College of Family Physicians, the Hong Kong College of Obstetricians and Gynaecologists, the Hong Kong College of Paediatricians, and the Hong Kong College of Physicians, has reviewed the key findings of this study and the latest scientific evidence, and made the following recommendations:

Members of the public are advised to increase iodine intake to maintain adequate iodine nutrition.

### *1. Consume iodine-rich foods*

— Consume food with more iodine as part of a healthy balanced diet. Seaweed, kelp, seafood, marine fish, eggs, milk, dairy products are food rich in iodine.

— When choosing iodine-rich snacks, avoid those which are high in salt or fat content.

### *2. Use iodised salt*

— Use iodised salt instead of ordinary table salt, keeping total salt intake below 5 g (1 teaspoon) per day to lower the risk of raised blood pressure.

— As iodine content in iodised salt may be affected by humidity, heat and sunlight, iodised salt should be stored in a tight and coloured container and kept in a cool dry place.

— To minimise loss of iodine through the cooking process, in particular from prolonged boiling and pressure cooking, add iodised salt to food as close to the time of serving as possible.

— Persons with thyroid problems should seek medical advice regarding use of iodised salt.

### *3. Additional measures for pregnant and lactating women*

— Take iodine-containing supplements containing at least 150 µg iodine per day.

— Seek medical advice if in doubt.

— Persons with existing medical conditions or thyroid problems should consult healthcare professionals and take supplements as instructed.

The DH will strengthen the surveillance and conduct regular surveys to collect information on the use of iodised salt, average salt intake and iodine status (median UIC) among local population.

The CFS of the FEHD will work with the trade to improve the availability of iodised salt

— Formulate and promulgate guidelines for traders to provide salt fortified with iodine. The CFS developed a set of guidelines making reference to WHO's and Codex's recommendations[16, 18–22] and in consultation with relevant local traders basing on the local situation. The guidelines entitled "*Salt Iodisation: A Practical Guide for Salt Importers, Wholesalers and Retailers*" is available at the CFS' website (https://www.cfs.gov.hk/english/programme/programme_fii/files/Food_Iodisation_e.pdf). Basing on the mean population intake of salt from PHS 2014/15 and PHS 2020–22 at 8.8g/day and 8.4g/day, respectively, salt can be fortified following WHO's recommendation, i.e. 15–40 mg iodine per kg of salt at household (consumer) level.

— Encourage traders to make more iodised salt available to general public in local market.

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