香港中文大學
The Chinese University of Hong Kong

Faculty of Medicine
The Chinese University of Hong Kong

Local Iodine Status – Findings of Population Health Survey 2020-22

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Introduction

- The Iodine Survey was conducted by DH in 2019-2021
  - Focused on 3 groups i) school-aged children, ii) pregnant women, and iii) lactating mothers
- Iodine status of the Hong Kong general population is not thoroughly studied
- As part of the Population Health Survey 2020-22, data on iodine intake and urinary iodine concentration (15-84 y.o.) were collected
- JC School of Public Health and Primary Care of CUHK is commissioned by the Department of Health to conduct data analysis

Methods

- Cross-sectional study with two components
  - Household survey
  - Test for iodine concentration on spot urine sample by ICPMS
- Subjects
  - Land-based non-institutional individuals aged 15-84 in Hong Kong (exclude foreign domestic helpers and visitors)
- Two-stage sampling
  - Systematic replicated sampling method based on Frame of Quarters maintained by C&SD for the household survey
  - Second stage – household survey participants aged 15-84 selected for urine iodine test by age-sex stratified random subsampling
- Sample size
  - 16,655 persons from 7,448 domestic households participated in household survey
  - **2,066** survey respondents invited and completed spot urine iodine test

Methods

- Questions on iodine intake
  - Seaweed (including kelp/ laver) consumption
  - Ready-to-eat seaweed consumption
  - Intake of iodine-containing supplement in past 2 weeks
  - Use of iodised salt
- The urinary iodine test and the laboratory accredited against ISO15189:2012 standard by the National Association of Testing Authorities, Australia (NATA)
- Fieldwork between Nov 2020 and Feb 2022

Population iodine status evaluation

- Assessed by median UIC based on WHO epidemiological criteria

	UIC cutoff values for public health significance		
	Median UIC (μg/L)	**Iodine intake**	**Iodine status**
≥6 years including adults (exclude pregnant 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**

World Health Organization. (2013). Urinary iodine concentrations for determining iodine status in populations.

Data analysis

- Weighting
  - Adjusted by the differential response rates or participation rates for the housing types (i.e. public rental housing, subsidised sale flats and private housing)
  - grossed-up to the control for the age and gender profile of the target population for Q2 of 2021
- Descriptive statistics
  - Median UIC
  - Proportions with 95% confidence intervals
    - "adequate" iodine nutrition (UIC ≥100ug/L)
    - "moderate to severe deficiency" (UIC <50ug/L)
- Associations between UIC and
  1) Seaweed (including kelp/laver) consumption;
  2) Ready-to-eat seaweed consumption;
  3) Iodine-containing supplement consumption in past 2 weeks;
  4) Use of iodised salt

Demographics

	No. of persons ('000)	%
Sex		
Male	2 824.7	47.4%
Female	3 135.0	52.6%
Age Group		
15-24	579.5	9.7%
25-34	892.9	15.0%
35-44	1 010.7	17.0%
45-54	1 083.0	18.2%
55-64	1 212.3	20.3%
65-84	1 181.3	19.8%
Education level		
No schooling/Pre-primary	61.7	1.0%
Primary	727.8	12.2%
Secondary	3 078.8	51.7%
Post-secondary or above	2 091.3	35.1%
Monthly household income		
Below $5,000	332.2	5.6%
$5,000 - $9,999	400.6	6.7%
$10,000 - $19,999	862.1	14.5%
$20,000 - $29,999	1 185.3	19.9%
$30,000 - $39,999	870.7	14.6%
$40,000 - $49,999	685.4	11.5%
$50,000 or above	1 623.4	27.2%
Total	5 959.7	100.0%

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Median UIC by age and sex

Age	Male Median UIC (μg/L)	Female Median UIC (μg/L)	Both * Median UIC (μg/L)
15 - 34	107.47	107.21	**107.47**
35 - 54	92.08	93.86	**92.66**
55 - 84	87.96	73.33	**79.84**
15 – 84 #	93.68	88.10	**91.26**

Statistical differences tested by Kruskal-Wallis Test.
* $p < 0.0001$ (by age group)
# $p = 0.003$ (by sex)

Overall median UIC <100 μg/L and median UIC decreased with age
The age gradient was seen in both sexes though males had a slightly higher median UIC than females

Median UIC of child-bearing age women

	Female#	
Age	Median UIC (μg/L)	Percentage
15 - 44	100.57	41.1%
45 - 84	79.06	58.9%
15 – 84	88.10	100%

Statistical differences tested by Kruskal-Wallis Test.
# p < 0.001 (by age group)

Child-bearing age women had a median UIC ≥100 μg/L

Proportions with UIC ≥100ug/L by age and sex

	Male			Female			Both		
Age	%	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%**

CI: Confidence Interval

According to the WHO, the proportion of population with UIC ≥100μg/L should be **>50%** to indicate adequate iodine nutrition

Overall <50% population had UIC ≥100μg/L and the proportion decreased with age

Reference: De Benoist, Bruno, et al. "Iodine status worldwide." *WHO Global Database on Iodine Deficiency. Geneva: World Health Organization* 83 (2004): 518-525

Proportions with UIC <50ug/L by age and sex

	Male			Female			Both		
Age	%	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%**

CI: Confidence Interval

According to the WHO, the proportion of population with UIC <50μg/L should be **<20%** to indicate adequate iodine nutrition

Overall >20% population had UIC <50μg/L (95% CI 18.5-22.3%)
The proportion increased with age

Reference: De Benoist, Bruno, et al. "Iodine status worldwide." *WHO Global Database on Iodine Deficiency. Geneva: World Health Organization* 83 (2004): 518-525

Association of seaweeds (including kelp/laver) consumption with UIC

Consumption frequency	No. of person ('000)	%	Median UIC (μg/L)
None / Less than once per month	4025.96	67.6%	90.35
1-3 time(s) per month	1417.60	23.8%	91.39
Once per week or more	516.13	8.7%	**104.93**
Total	5959.70	100.0%	91.26

Differences of median UICs among groups with different seaweed consumption frequencies (**p = 0.0381**)

Statistical differences tested by Kruskal-Wallis Test.

Respondents consuming seaweeds (including kelp/laver) once/week or more had a higher median UIC than others and it was ≥100 μg/L

Association of ready-to-eat seaweeds consumption with UIC

Consumption frequency	No. of person ('000)	%	Median UIC (μg/L)
None / Less than once per month	4012.53	67.3%	87.77
1-3 time(s) per month	1545.78	25.9%	96.86
Once per week or more	401.39	6.7%	107.97
Total	5959.70	100.0%	91.26

Differences of median UICs among groups with different ready-to-eat seaweed consumption frequencies (**p = 0.0002**)

Statistical differences tested by Kruskal-Wallis Test.

Respondents consuming ready-to-eat seaweeds once/week or more had a higher median UIC than others and it was ≥100 μg/L

Association of using iodine supplement in past 2 weeks with UIC

Whether taking iodine supplement	No. of person ('000)	%	Median UIC (μg/L)
Yes	41.20	0.7%	170.89
No	5559.79	93.3%	91.26
Do not know	358.71	6.0%	84.81
Total	5959.70	100.0%	91.26

Differences between median UICs between iodine supplement users and non-users (**p = 0.0137**)

Statistical differences tested by Kruskal-Wallis Test.

Respondents using iodine supplement in past 2 weeks had a much higher median UIC than others and it was >100 μg/L

Association of iodised salt use with UIC

Whether using iodised salt	No. of person ('000)	%	Median UIC (μg/L)
Yes	1249.79	21.0%	**85.70**
No	415.74	7.0%	88.43
Do not know	4294.17	**72.1%**	93.42
Total	5959.70	100.0%	91.26

Differences of median UIC between iodised salt users and non-users (p = 0.3996)

Statistical differences tested by Kruskal-Wallis Test.

72.1% of respondents did not know the type of salt they were using
Median UIC <100 μg/L regardless of iodised salt use (p = 0.3996)

Discussion

- Iodine status of the Hong Kong general population is "**mild deficiency**" based on median UIC (91.26 μg/L)
- The deficient status is also reflected by the proportions with UIC ≥100 μg/L (44.0%), and <50 μg/L (20.3%)

	UIC cutoff values for public health significance		
	Median UIC (μg/L)	**Iodine intake**	**Iodine status**
≥6 years including adults (exclude pregnant and lactating women)	<20 μg/L	Insufficient	Severe deficiency
	20-49 μg/L	Insufficient	Moderate deficiency
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	100-199 μg/L	Adequate	Adequate iodine nutrition

World Health Organization. (2013). Urinary iodine concentrations for determining iodine status in populations.

Discussion

- In PHS, median UIC decreased with age; UIC of female < male
- Overseas studies found similar age and sex differences (Madar et al., 2020; Rasmussen et al., 2014; Tang et al., 2016; Haldimann et al., 2015)
- In 2019 Iodine Survey, school-age children were found to have adequate UIC (115 μg/L) but not lactating (65 μg/L) and pregnant women (134 μg/L, cut-off for adequate UIC 150 μg/L)
- Whereas, in PHS, child-bearing age women had a "marginally adequate" UIC (100.57 μg/L)

Discussion

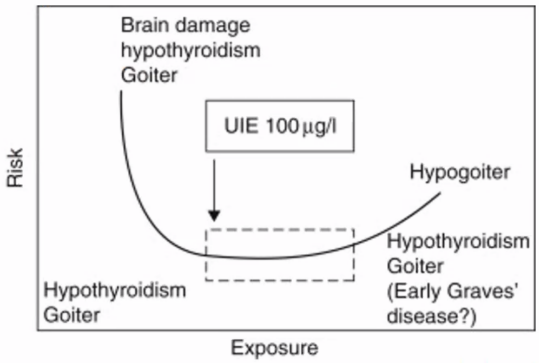
- Positive correlations between UIC and i) frequent seaweed (different types) consumption, ii) taking iodine supplement in past 2 weeks
- Seaweed consumption is common in East-Asia (Aakre I et al., 2021), but <10% of our respondents reported consuming seaweed ≥ once/week
- <1% reported taking iodine-containing supplement, the major reason of taking supplement "to maintain/improve health" (self-prescribed) (80.7%)
  - 8.0% took the supplement because of doctor's prescription

Discussion

- The lack of association detected (p=0.3996) between iodised salt use and UIC should be interpreted with caution
- 72.1% of respondents did not know whether they were using iodised salt or not. No data on iodine content in salt and frequency of salt use
- Besides, the prevalence (21.0%) is different from Iodine Survey (11.9% school-aged children, 4.7% pregnant women and 5.0% lactating mothers)

Discussion

- Iodine intake has a "U-shaped" effect on thyroid function



Laurberg P., Andersen S., Pedersen I.B., Carlé A. Hot Thyroidology, 4 (2007)

Table 3. Health effects of iodine deficiency.

Life-stage group	Effects of iodine deficiency
All	Hypothyroidism Goiter Susceptibility of thyroid gland to radioactive fall-out
Pregnancy	Miscarriage and stillbirth Physical abnormalities of the fetus Cretinism in infant Perinatal infant morbidity and mortality
Infants	Neurocognitive impairment Impaired physical development Mortality
Children and adolescents	Impaired cognitive function Impaired physical development
Adults	Impaired cognitive function Toxic nodular goiter Iodine-induced hyperthyroidism

Bertinato, J. (2021). Chapter Ten - Iodine nutrition: Disorders, monitoring and policies. In N. A. M. Eskin (Ed.), *Advances in Food and Nutrition Research* (Vol. 96, pp. 365-415). Academic Press. https://doi.org/https://doi.org/10.1016/bs.afnr.2021.01.004

Table 4. Health effects of chronic exposure to excess iodine.

Effects of excess iodine	Proposed mechanisms	Risk factors
Iodine-induced hypothyroidism and goiter	Inhibition of thyroid function (Wolff and Chaikoff effect) and iodine-induced thyroid autoimmunity	Thyroid autoimmune disease or partial thyroidectomy
Iodine-induced hyperthyroidism (Jöd-Basedow phenomenon)	Iodine-deficiency causes thyrocyte proliferation and mutations resulting in multifocal autonomous growth that predisposes individuals to hyperthyroidism when iodine intakes are increased	Iodine-deficiency and thyroid disease (e.g., toxic multinodular goiter, Graves' disease, thyroid adenoma, thyroid autoimmune disease)
Autoimmune thyroiditis	Increased thyroid immunoreactivity from (1) increased thyroglobulin immunogenicity or (2) thyroid injury by free radicals	

Bertinato, J. (2021). Chapter Ten - Iodine nutrition: Disorders, monitoring and policies. In N. A. M. Eskin (Ed.), *Advances in Food and Nutrition Research* (Vol. 96, pp. 365-415). Academic Press. https://doi.org/https://doi.org/10.1016/bs.afnr.2021.01.004