

BMJ Open Should both iodised and non-iodised salt be made available in Chinese cities? A cross-sectional survey

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ABSTRACT

Objective: To contribute evidence relevant to the policy of supplying iodised salt (IS), non-iodised salt (NIS) or both in Chinese cities.

Design: Subnational telephone interview survey.

Setting: China.

Participants: Totally, 24 557 telephone numbers were dialled and 4833 citizens accepted the telephone interview. The telephone numbers were randomly selected by random digit dialling and a Mitofsky-Waksberg two-stage sampling method in 17 capital cities and 6 coastal cities from 17 iodine deficiency disorder (IDD)-eliminated provinces (municipalities).

Results: The 4833 citizens finished the telephone interview. Among them, 3738 (77.3%) citizens chose IS, 481 (10%) citizens chose NIS, and the others chose both IS and NIS. The citizens' awareness rates of IDD and IDD preventive measures were 68.7% and 62.5%, respectively.

Conclusions: It is not a suitable time to supply IS and NIS simultaneously in the developed cities of China, but a pilot project may be conducted in the cities where IDD has been sustainably eliminated, there is strong awareness of IDD and the population can make informed decisions regarding IS. IDD health education should be further strengthened, especially regarding the potential for IQ damage.

INTRODUCTION

Approximately 20% of the total global population resides in China, which has one of the most severe iodine deficiency epidemics, in part due to the external environment. Iodine deficiency disorders (IDD) were once widespread and caused great damages. Universal salt iodization (USI) has been adopted for IDD prevention and control and has proven to be an effective measure since 1994. By 2000, 17 provinces (municipalities) in China achieved the goal of eliminating IDD and have sustained this outcome for 10 years based on the WHO criteria for IDD elimination.¹

However, an excess of iodine has been discovered, and new issues,^{2–4} including the increasing rate of thyroid disease and the

Strengths and limitations of this study

- The article initially describes the residents' preferences on salt type (iodised (IS) or non-iodised salt (NIS)) and their awareness of iodine deficiency disorders and its prevention measures.
- The telephone interview method is biased towards those residents with a fixed-line telephone. The pencil-and-paper interview method, rather than computer-aided telephone interviews, was used.
- Options for explaining the IS/NIS choice should have been more detailed.

elevated health awareness of the Chinese population, have started a debate about the ability of the population to make informed choices to use iodised salt (IS) or non-iodised salt (NIS). As we know, some developed European countries, such as Belgium, Finland, France, Germany, Greece, Ireland, Italy and the Netherlands, supply IS and NIS simultaneously in the market.⁵ Residents of these countries can purchase IS or NIS voluntarily. In developed cities in provinces that have demonstrated the sustainable elimination of IDD, is it the right time to supply IS and NIS simultaneously? If so, can these populations remain free of IDD? Finally, is there a proper method to demarcate cities to which IS and NIS is supplied simultaneously or to which only IS is supplied? To answer these questions, the subjective preference of the residents about choosing IS or NIS and the relevant influencing factors should be examined.

Door-to-door interviewing is usually used to conduct such investigations. Considering the associated time and money expenditures, a cross-sectional telephone interview is a feasible alternative and is a widespread method that was adopted earlier and used by different countries all over the world.⁶ Successful cases of the use of cross-sectional telephone interviewing in China include Knowledge-Attitude-Practice (KAP) surveys on influenza, smoking and pollinosis.^{7–10}



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The application of cross-sectional telephone interviewing is based on educational and economic levels, in addition to the telephone popularisation rate. In China, by the end of 2009, the national average Urban Per Capita Disposable Income was 17 175 RMBY, and some developed cities (municipalities) in the IDD-eliminated provinces were most at or beyond the national average (table 1).¹¹ Additionally, the national fixed line penetration had increased to 314 million people (23.5 telephones/100 persons) and 212 million people in the cities (34.1 telephones/100 persons). These facts made telephone interview a representative and feasible way to research the residents' KAP towards IDD.

As far as we know, there were no such records about the residents' subjective preferences between IS and NIS, and no research on the residents' awareness of IDD in developed cities (municipalities) has been conducted in recent years. Hence, the National Centre for Endemic Disease Control (CEDC) launched this project in April 2010, with the aim of obtaining data on the above aspects to decide whether supplying IS and NIS simultaneously is feasible in developed cities in IDD-eliminated provinces. The methods and results may provide evidence or references for similar regions in the world.

METHODS

City sites to be investigated

The 17 capital cities of the 17 provinces (3 municipalities, 6 coastal provinces and 8 inland provinces) that had achieved the goal of IDD elimination in 2000 were selected (table 1). One coastal city was also selected in each of the above coastal provinces. A total of 23 cities were included in the study.

Target population

Citizens who had fixed telephones in the 23 selected cities.

The main contents of the questionnaire

- ▶ If IS and NIS are supplied simultaneously, which will you choose? And why?
- ▶ Have you heard of IDD? If so, what are the effects? How is IDD prevented?
- ▶ Can you tell us your occupation and age group?

Sampling method and sampling size

Random digit dialling and the Mitofsky-Waksberg two-stage sampling method were used in this study.¹² In each city, only the main urban zones were investigated, and two districts were selected randomly from each main urban zone. At least 200 effective samples were sampled in each city included in the survey. The sample quota was divided evenly between each district. The sample size was calculated according to formula 1; the positive response rate (π) was approximately 70% according to the pilot survey and the allowable error (δ) was 0.5.

Thus, the calculated sample size was 170 responses per city; therefore, 200 responses per city were considered adequate:

$$n = \left\{ \frac{\mu_{\alpha}^2 \times \pi(1 - \pi)}{\delta} \right\} \quad (1)$$

where π is the positive rate and δ is the allowable error.

Telephone number acquisition

If the fixed telephone of the neighbourhood offices in the selected district was seven-digit or eight-digit numbers, the first three or four digits were deemed to be the direction code. The last four digits were obtained by the Random function ($=\text{Rand}() \times 10\,000$) in Microsoft Office Excel. If the function produced randomised numbers less than four digits, and '0' was supplemented in front of the generated numbers. The number of telephone numbers created randomly should be at least five times the effective sample size, that is, at least 1000 telephone numbers should be created per city.

Quality control

The research was approved by the review board of the Harbin Medical University. Participant consent was acquired when they answered the telephone. The survey programme and survey result database were designed and delivered to the project cities by the national CEDC. The survey programme was improved based on a pilot survey, and the questionnaire had clear questions that prompted simple answers and avoided providing hints to the residents. Sensitive questions, such as age, were designed as "Which age group do you belong to? <20, 20–30, 30–40...".

In the programme, the investigation was carried out in a unified manner, including the order and pattern of the questions, the dialling time (18:30–21:00), and instructions for making notes of the answers and filling the database.

To avoid investigation and report biases and to improve the research participants' cooperation, the interviewers were trained on their attitude, mood and countermeasures in case of emergency by the project provinces themselves according to the rules of the survey programme. For example, some related questions put forward by residents could be answered only after the interview was finished to avoid bias.

To guarantee the reliability of the research information, a return visit was conducted after a project city finished the telephone interviews. The quality control officer of the provincial Centre for Disease Control (CDC) or CEDC visited the citizens who had accepted the interview. At least 10% of the respondents were randomly sampled to complete the return visit questionnaire. When the coincidence rate of survey information was greater than 80%, the investigation results of the city

Table 1 Provinces and cities surveyed

Category	Provinces	Provincial capital			Coastal cities		
		Name	Telephone*	Income**	Name	Telephone*	Income**
Coastal province	Hebei	Shijiazhuang	–	16 607	Tangshan	24.58	18 053
	Shandong	Ji'nan	39.28	22 272	Yantai	28.27	21 125
	Jiangsu	Nanjing	38.91	25 504	Nantong	35.80	21 001
	Zhejiang	Hangzhou	48.23	26 864	Zhoushan	53.45	24 082
	Guangdong	Guangzhou	61.28	27 610	Shenzhen	52.64	29 244
	Guangxi	Nanning	16.61	16 254	Beihai	–	15 134
Inland province	Heilongjiang	Harbin	21.66	15 887			
	Jilin	Changchun	–	16 277			
	Shanxi	Taiyuan	44.31	15 607			
	He'nan	Zhengzhou	29.28	17 117			
	Anhui	Hefei	32.47	17 158			
	Hubei	Wuhan	40.57	18 385			
	Jiangxi	Nanchang	32.37	16 472			
	Hu'nan	Changsha	33.28	20 238			
Municipalities	Beijing	Beijing	50.89	26 738			
	Shanghai				Shanghai	48.70	28 838
	Tianjin				Tianjin	31.36	21 430

All data marked with '*' and '**' were obtained from the Statistics Bulletin of the Cities' Economic and Social Development of 2009: '*' fix telephones/100 persons, '**' Urban per capita disposable income (RMBY). The national fixed line penetration was 23.50 telephones/100 persons, and the urban per capita disposable income was 17 175 RMBY in 2009.

can be regarded as qualified, and otherwise, the city should be reinvestigated.

Definition of telephone number

Success: respondent finished the entire questionnaire; *Rejection*: respondent refused to answer or did not finish the questionnaire; *No answer*: the phone was busy both the first time and when redialling after 5 min; *Invalid number*: the phone number was vacant, fax, switchboard or phone quit.

Data processing and statistical analysis

Epi info 3.5.1 (CDC, Atlanta, Georgia, USA) was used for the database design, and SPSS V.17.0 was utilised for analysis. The level of significance was set at 0.05.

RESULTS

Response situation

The flow chart is presented in figure 1. The survey included 235 districts of 120 main urban zones in 23 cities. In total, 446 direction numbers were chosen, and 24 557 telephone numbers were dialled, of which 13 215 (53.8%) were valid and 11 342 were invalid numbers. An invalid number was a number that was not used as a telephone number. Among the 13 215 valid telephone numbers, 4833 successfully finished the questionnaire, 1949 answered the phone but refused to answer the questions and 6433 telephones were not answered. The answered numbers (successes and rejections) were 6782 and accounted for 51.3% of the valid numbers. The total response rate $(4833/(4833+1949) \times 100\%)$ was 71.3% (figure 2).

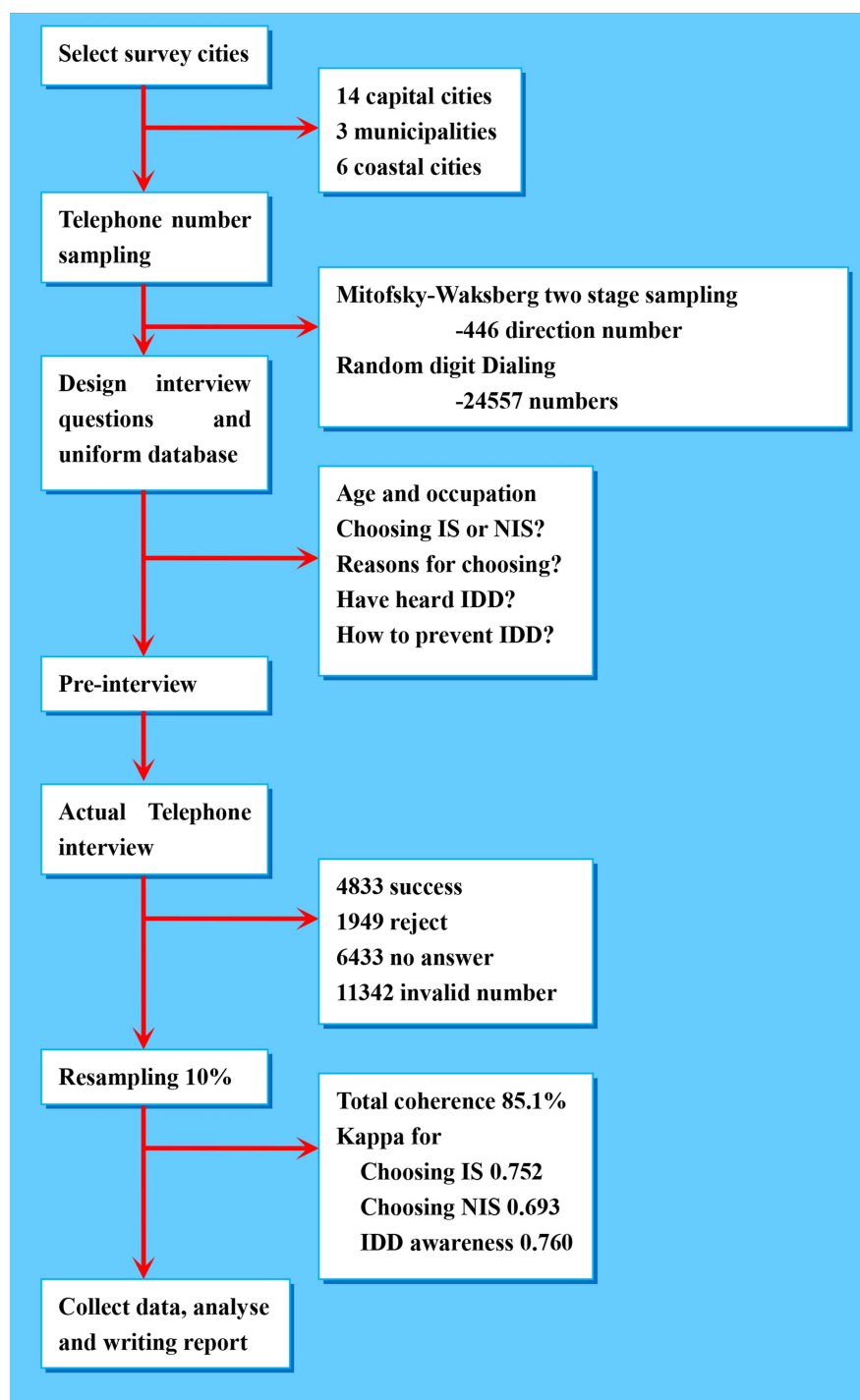
Basic information about the interviewee

The age and occupation questions were answered by 4861 and 4857 residents, respectively. The age and occupation proportion were similar between the capital city (including Beijing) and the coastal city (including Tianjin and Shanghai) residents. The residents' age were mainly distributed between 20 and 60 years, and this range accounted for 80% of the respondents. However, compared with the population composition from the '2009 China Health Statistical Yearbook'¹³ and the Chinese population pyramid,¹⁴ the 10–20 age group had a smaller constituent ratio. This may lead to a non-representative sample of the Chinese population, although this may be acceptable in this study because children rarely buy salt. The residents were evenly distributed in each profession (accounting for approximately 10%), except for the professions of servicemen, students and irregular professions, which had small sample sizes.

Proportion of respondents choosing IS or NIS

Of the residents investigated, 4865 answered the question 'If IS and NIS are supplied simultaneously, which will you choose?' The total percentage of respondents 'choosing IS' was 76.8%, 'choosing NIS' was 9.9%, 'both' was 3.9% and 'does not matter' was 9.3%. The respondents from the capital cities chose IS at a higher rate (79.5%) than those from the coastal cities (72%). The percentages of respondents choosing NIS was opposite between the city and coastal residents (6.7% and 15.7%, respectively), and the ratio of respondents who chose 'both' (<5%) and 'does not matter' (<10%) were nearly the same in the two areas. Of the 23 cities,

Figure 1 Flow chart (IDD, iodine deficiency disorder; IS, iodised salt; NIS, non-iodised salt).



there were 12 cities whose IS selection rate was higher than 80%, 8 cities in which the IS selection rate was between 60% and 80%, and 3 cities (Shanghai: 49.3%, Zhoushan: 42.8% and Hangzhou: 32.8%) in which the IS selection rate was lower than 50% (tables 2 and 3).

Reasons for 'choosing IS'

Of the 3738 residents who chose IS, their reasons were as follows: 61.9% of them accurately understood the benefits of IS, that is, preventing IDD and increasing

children's IQ, 14.7% of them merely chose IS for superior-quality reasons and knew little about the relationship between IS and IDD prevention, and 27.7% had no clear reason (most explained that it was the custom) (table 2).

Reasons for 'choosing NIS'

Most of the 481 residents who chose NIS lived in Shanghai, Hangzhou, Zhoushan and Beihai. The majority thought that they had received an adequate amount

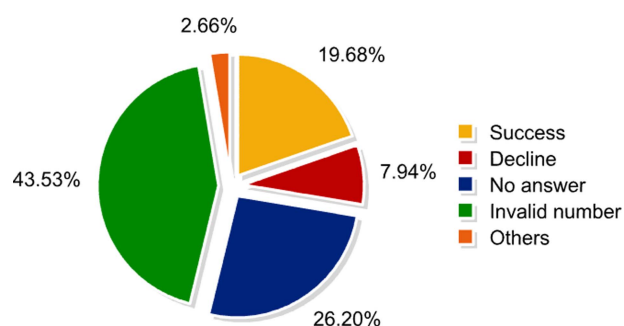


Figure 2 The answer status of the sampled telephone numbers.

of iodine from food or that they did not live in an IDD area. Unexpectedly, 9% of the respondents who chose NIS thought IS was harmful. Nearly 27% chose NIS because of reasons that cannot be classified, such as habit, parent's decision or changing taste (table 3).

Reasons for 'choosing both'

Most of the 192 residents who chose 'both IS and NIS' were from Hangzhou, Guangzhou and Shanghai. The two major reasons were to maintain an appropriate iodine intake and to avoid the harmful effect of excess

iodine, accounting for 27.6% and 30.7% of the responses, respectively.

Reasons for 'does not matter'

The 454 residents who chose 'does not matter' mainly resided in Nanjing, Wuhan, Hangzhou, Changsha, Guangzhou, Nanning, Tianjin, Shanghai and Zhoushan. They tended to choose IS or NIS based on which was most convenient to buy (52% of the respondents who had no preference).

Awareness rates of IDD

Of the residents who responded to our phone calls, 4865 answered the question "Have you heard of IDD?". Among those, 68.7% (3344) had heard and 31.3% (1521) had never heard of IDD. There was little difference in having heard of IDD between the capital cities (68.2%) and the coastal cities (69.8%). The awareness rate in Yantai (94.5%) was the highest, and in four cities (Shijiazhuang, Jinan, Hangzhou and Tangshan), the awareness rates were greater than 80%. Beihai and Taiyuan had the lowest awareness rates (46.2% and 44.7%, respectively). There were no significant differences in the levels of awareness between age groups or occupation groups.

Table 2 Respondents' reasons for buying iodised salt (IS) (%)

Province	City	Number of choosing IS	IS choosing rate	Reasons			
				Prevent IDD	Benefit for children's IQ	Good quality	Others
Heilongjiang	Harbin	183	91.5	36.6	3.8	1.6	60.1
Jilin	Changchun	175	86.6	48.6	9.7	6.3	0
Beijing	—	202	86.7	61.4	12.9	9.4	28.2
Hebei	Shijiazhuang	174	87.0	67.8	7.5	12.1	14.4
Shanxi	Taiyuan	189	95.0	13.8	0	14.3	70.9
Shandong	Ji'nan	187	93.5	73.3	27.3	20.3	11.2
He'nan	Zhengzhou	177	88.5	54.8	15.3	26.6	27.7
Jiangsu	Nanjing	180	72.6	64.4	25.0	23.9	7.8
Anhui	Hefei	178	84.8	32.0	0.6	5.6	61.8
Hubei	Wuhan	163	75.1	41.7	8.0	24.5	29.4
Zhejiang	Hangzhou	66	32.8	57.6	16.7	21.2	0
Jiangxi	Nanchang	184	86.8	52.2	7.6	13.6	8.7
Hu'nan	Changsha	146	72.3	56.2	6.8	5.5	39.7
Guangdong	Guangzhou	124	61.7	39.5	1.6	46.0	3.2
Guangxi	Nanning	170	78.0	38.8	4.1	6.5	46.5
Capital city total		2498	79.5	79.5	9.8	15.0	29.0
Hebei	Tangshan	208	94.1	81.7	17.3	9.6	5.8
Tianjin	—	200	83.7	75.5	28.5	27.0	6.5
Shandong	Yantai	186	93.0	90.3	3.2	8.1	4.8
Jiangsu	Nantong	153	73.9	46.4	5.9	2.6	47.7
Shanghai	—	108	49.3	25.9	6.5	29.6	48.1
Zhejiang	Zhoushan	86	42.8	68.6	12.8	18.6	0
Guangdong	Shenzhen	144	71.6	22.9	0.7	3.5	42.4
Guangxi	Beihai	155	66.2	21.9	2.6	18.7	58.1
Coastal city total		1240	72.0	72.0	10.6	14.1	25.0
Total		3738	76.8	51.9	10.0	14.7	27.7

Note: The reason for choosing IS was a multiple choice question.

Table 3 Respondents' reasons for choosing NIS (%)

City	n	Percent	Reasons						
			Iodine sufficient	Not IDD endemicia	Patient*	IS is harmful	IS bad taste	Cheap	Others
Capital city Total	211	6.7	40.0	13.3	9.0	10.5	2.9	1.4	23.3
Coastal city Total	270	15.7	27.7	17.7	5.2	8.1	4.0	1.5	29.9
Total	481	9.9	33.1	16.6	7.3	9.1	3.5	1.5	27.0

*Patients with thyroid disease for whom it is not feasible to take IS.

Some provinces had small sample sizes; the proportions refer to large ones; n: number that chose NIS; %: NIS choosing rate, the reason for choosing NIS was a multiple choice question. IDD, iodine deficiency disorder; IS, Iodised salt; NIS, non-iodised salt.

Among the 3344 residents who had heard of IDD, up to 77.1% of them knew that iodine deficiency could lead to goitre, but only 11.8% knew that it could also cause intelligence damage to children, and 16.9% of them knew nothing about its hazard.

Awareness rates of IDD preventive measures

Of the 3344 residents who had heard of IDD, 62.5% of them knew IS could prevent IDD, 43.2% of them knew that kelp and purple seaweed could prevent IDD, and nearly 18.7% of the residents knew nothing about how to prevent IDD.

The IS preference rates and IDD awareness rates in each city

All cities could be divided into four groups according to their relationship between the IS preference rate and IDD awareness rate: (1) high IS preference rate and high IDD awareness rate, such as Yantai, Shijiazhuang, Beijing, Tianjin, Nanjing, Changsha and Guangzhou; (2) high IS preference rate and low IDD awareness rate, such as Taiyuan, Harbin, Nanchang, Hefei, Wuhan and Beihai; (3) approximately or equal to the choosing rate and the awareness rate, such as Tangshan, Ji'nan, Zhengzhou, Changchun, Nanning, Nantong and Shenzhen and (4) low IS choosing rate and high IDD awareness rate, such as Shanghai, Zhoushan and Hangzhou. Only in Yantai and Nanjing were the IDD awareness rates a little higher than the IS preference rates. The IS choosing rates in Harbin and Taiyuan were greater than 90%, but their IDD awareness rates were only 57% and 44.7%, respectively. There were only four cities whose IS rates and awareness rates were all greater than 80% (table 4).

The χ^2 test was used to analyse the influence of IDD awareness on the IS preference rate. The results showed no difference between the capital cities' IS and NIS groups but significant difference between the coastal cities' IS and NIS groups. This could explain the weak relations between the IS preference rates and the IDD awareness rates in the cities, whereas for coastal cities, there were associations between the IS preferences and IDD awareness; specifically, part coastal residents who chose NIS had lower IDD awareness rates.

Results of the return visits

The total coherence rate of all questions was 85.1%. The κ values of the coherence analysis for choosing IS, choosing NIS and IDD awareness were 0.752, 0.693 and 0.76, respectively, and were all above the required 0.4, describing good coherence.¹⁵

DISCUSSIONS

Telephone interview has the advantages.¹⁶ However, if the response rate <30%,¹⁷ the representation of the random samples will be questioned. In our study, the response rate was 71.3%, and the coherence rate of resurvey was above 80%. One limitation was that it was the first telephone survey on the KAP towards IDD in China; the traditional Pencil-And-Paper-Interview (PAPI) method was taken rather than Computer-Aided-Telephone Interview (CATI). The other, some 'other reason' should be recorded more carefully.

Table 4 The iodine deficiency disorder (IDD) awareness rates and iodised salt (IS) preference rates (%)

City	IS rate (%)	Acknowledge rate (%)
Taiyuan	95.0	44.7
Tangshan	94.1	85.1
Jinan	93.5	81.0
Yantai	93.0	94.5
Harbin	91.5	57.0
Zhengzhou	88.5	74.0
Shijiazhuang	87.0	85.0
Nanchang	86.8	67.5
Beijing	86.7	79.8
Changchun	86.6	65.8
Hefei	84.8	52.9
Tianjin	83.7	76.6
Nanning	78.0	63.8
Wuhan	75.1	59.0
Nantong	73.9	62.8
Nanjing	72.6	74.2
Changsha	72.3	69.8
Shenzhen	71.6	60.7
Beihai	66.2	46.2
Guangzhou	61.7	65.2
Shanghai	49.3	57.5
Zhoushan	42.8	77.6
Hangzhou	32.8	81.1

The 6 coastal cities and 14 capital cities in 14 provinces and 3 municipalities had IDD elimination for nearly 10 years. A phenomenon that emerged in this study was that most residents had lower IDD awareness rates than IS selection rates, as was observed in Taiyuan, Hefei, Harbin and Changchun. Although IDD health education activities, such as the 5.15 IDD day, have been carried out widely and continuously by the relevant departments, it is still not enough or exhaustive, and the current propaganda strength and methods need further improving.

Considering that the supply system of IS is divided by province in China, the KAP towards IDD of the city residents is more important. Although these provinces all attained the goal of IDD elimination and their capital cities and coastal cities are all developed cities, their IS choosing and IDD awareness rates were different, and they should be treated differently according to these results. The result shows that the IS preference rates of southern city residents were lower than those of northern city residents. The main reason was that the people in the southern coastal areas think that they have received adequate iodine from food other than IS, and another reason was that they thought they did not live in an iodine-deficient area, as was the case with the residents of Hangzhou, Zhoushan and Shanghai. Their IDD awareness rates were greater than their IS preference rates, and some residents chose NIS despite knowing about the potential damage caused by IDD. In fact, these districts had no apparent IDD prevalence, which is likely attributable to the widespread IS supply. The survey "Iodine nutritional status of coastal districts residents in 2009" conducted by the MOH¹⁸ found that under the condition of consumption rates of qualified IS greater than 90%, the median urinary iodine (MUI) of Shanghai residents was merely between 100 and 200 µg/L, that is, just at the iodine intake appropriate level, and the MUI of pregnant women was lower than 150 µg/L, which corresponds to an insufficient iodine intake level. Among the residents of the Xiacheng district of Hangzhou city, Zhejiang province, the consumption rate of qualified IS was 96.7%, and the MUI of 8–10-year-old children was between 100 and 200 µg/L, which is at the iodine intake appropriate level.¹⁸ If allowing these cities' residents to freely choose IS or NIS, the residents may choose NIS blindly, and the achievement of controlled IDD that has been obtained will be destroyed.

From the society and economic development aspects, supplying IS and NIS simultaneously to some cities or persons is an inevitable trend. In the public health domain, if a disease has a prevalence rate below 5%, it will not become a public health problem. Hence, we deem that if the IDD awareness rates and the correct selection rates are above 95%, IS and NIS can both be made available. According to this telephone interview study, it is not a suitable time to supply IS and NIS simultaneously, even in the developed cities of China. The

intake of NIS should be performed with caution in China. The next step is to conduct a trial in which IS and NIS is simultaneously supplied in appropriate cities. The selected experimental city should be a developed city with no IDD prevalence in recent years, and the residents' awareness rate of IDD and selection rate of IS should be high. According to our study, Yantai, Tangshan and Ji'nan may be appropriate cities for this experiment. Before the experiment, emergency planning should be performed, and extensive IDD education should be conducted. If abnormal situations emerge, the emergency programme will be started, or the trial will even be stopped. Currently, USI was carried out as a mandatory effective strategy to prevent IDD in China since 1996. However, no documentation was found about the residents' preferences on salt type (IS or NIS) based on their awareness of IDD and its prevention measure knowledge. Hence, the study tried to find out the reason why people choose IS or NIS. Reasons enlisted including preventing IDD, improving children's IQ, good quality and convenience, etc, were possible main reasons people would purchase IS, while, the potential harm and having thyroid disorders were the reasons for choosing NIS. These results were important for further research and prevention measures and policy decision.

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Contributors YJ wrote the project report, LP analysed the data and wrote the manuscript, LY and SL designed the study and managed the project and DS was responsible for the project and the publication.

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