PJN
ISSN 1680-5194

PAKISTAN JOURNAL OF NUTRITION

ANSInet
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan
Mob: +92 300 3008585, Fax: +92 41 8815544
E-mail: editorpjn@gmail.com

Pakistan Journal of Nutrition 12 (7): 688-691, 2013
ISSN 1680-5194

Dietary Iodine from Interview-Based Semi-Quantitative Food Frequency Questionnaire: Correlation with 24h Dietary Recall

Salina Md. Taib and Zaleha Md. Isa
Department of Community Health, Faculty of Medicine, Universiti Kebangsaan Malaysia Medical Centre, Cheras, Kuala Lumpur, Malaysia

Abstract: Iodine deficiency is a major public health problem throughout the world. Malaysia's latest IDD survey in 2008 showed that 12.5% of the school children had urinary iodine above adequate requirement (≥200 µg/L), where 7.6% were above the adequate value (200-299 µg/L) and 4.9% were excessive (≥300 µ/L) particularly in the Federal Territory of Putrajaya (19.9%) and Sabah (16.6%). Socio-demography, environment and dietary are three main factors contributing to an increase in the prevalence of high urinary iodine in a population. Therefore, this study was conducted to validate an interview-based semi-quantitative Food Frequency Questionnaire (FFQ) with 24h dietary recall method on iodine nutrition for use in future studies in Malaysia particularly among school children. A total of 35 healthy euthyroid consented school children in the Federal Territory of Putrajaya were enrolled in the study. Each subject completed 24h dietary recall, followed by an interview-based food frequency questionnaire to assess dietary iodine intake. A standardized coloured book containing photos of food high in iodine and household measuring tools were used to help the respondents in answering the questions. Daily iodine intake was calculated for each participant in both FFQ and 24h dietary recall. Median daily iodine intake was 423.95±225.49 µg/L from the interview-based FFQ and 436.45±217.37 µg/L in the 24h dietary recall. The iodine content from the 24h dietary recall was strongly correlated with the iodine content from the interview-based FFQ where r = 0.954. It is concluded that the semi-quantitative FFQ is sufficiently reliable to inquire the daily iodine intake of school children.

Key words: Daily iodine intake, public health, urinary iodine, school children

INTRODUCTION

Iodine deficiency is still a major public health problem throughout the world, particularly for pregnant women and young children. It is the greatest cause of preventable brain damage in childhood which is the primary motivation behind the current worldwide drive to eliminate it. This leads to several interventions of iodine fortification in staple food, drinking water, even as supplements to the high risk group. These consequently lead to an increase of iodine intake in the world whereby 27 countries were known to have median urinary iodine between 200-299 µg/L while 7 others with more than 300 µg/l (Benoist *et al*., 2008). Malaysia on the other hand was known to have Iodine Deficiency Disorders (IDD) problem (particularly in Sabah and remote inland area of Sarawak and West Malaysia). National IDD survey in 1996 showed that IDD in Peninsular Malaysia was not a major problem where IDD prevalence was less than 5% with median urinary iodine of 82.2 µg/l (Institute for Medical Research, 1996). However, there have been contradictory findings from other studies and from the IDD monitoring by States Health Departments. A study conducted among aborigines women in an urban fringe area of Hulu Langat district had recorded IDD prevalence of 32.3% (Osman *et al*., 2005). Meanwhile, the IDD monitoring programme instituted by the Ministry of Health Malaysia showed that the median urinary iodine (UI, in µg/l) in several states such as Perak was 70.5 µg/l and Pahang was 90.9 µg/l (Rusidah, 2005; State Health Department of Perak, 2006). This leads to the Universal Salt Iodization (USI) which was first introduced to Sabah in 1999 (IDD prevalence >10%, Total Goitre Rate (TGR) 18% and median urinary iodine was 65 µg/l) (Ijab *et al*., 1996). The USI intervention was then introduced to other IDD gazetted areas in Malaysia. Regular monitoring was done to ensure the effectiveness of this intervention programme. Latest nationwide cross-sectional school-based survey among school children aged 8-10 years old was carried out in 2008. Median urinary iodine in Peninsular Malaysia has increased from 82.2-104.1 µg/l and 65.0-150.0 µg/l in Sabah but the level was reducing in Sarawak from 126.0-101.9 µg/l (Institute for Medical Research, 1996; Ijab *et al*., 1996; Rusidah *et al*., 2010; Kementerian Kesihatan Malaysia, 2009; Yahaya *et al*., 1996). A total of 39.3% has optimum median urinary iodine while 12.5% showed above normal range (≥200 µg/l where 7.6% was above normal range (200-299 µg/l) and 4.9% showed high range (≥300 µg/l) particularly in the Federal Territory of Putrajaya (19.9%) and Sabah

Corresponding Author: Salina Md. Taib, Department of Community Health, Faculty of Medicine, UKM Medical Centre, Cheras, Kuala Lumpur, Malaysia

(16.6%) (Yahaya *et al*., 1996). World Health Organization *et al*. (2007) recommended iodine intake of 120 µg per day for children aged 6-12 years with median urinary iodine concentrations of 100-99 µg/L as their adequate intake (World Health Organization, 2007) (Table 1). They also define iodine intake of 200-300 µg/L as more than adequate and ≥300 µg/L as excessive (World Health Organization, 2007) (Table 2). Socio-demography, environment and dietary are three main factors contributing to an increased prevalence of high urinary iodine in a population. Many studies concluded that gender and ethnicity (Kementerian Kesihatan Malaysia, 2009; Camargo *et al*., 2008; Gur *et al*., 2003), parents' occupations (Kementerian Kesihatan Malaysia, 2009), parents' education level (Camargo *et al*., 2008) were significantly associated with children urinary iodine level. This is also true with intervention programme for elimination of IDD whereby children who lived in the IDD gazetted area whom undergone IDD intervention programme have higher risk of developing high urinary iodine (Yahaya *et al*., 1996; Delange *et al*., 2002; Bulow *et al*., 2007; Katamine *et al*., 1986). Furthermore, those who consumed higher amount of iodine-containing diet especially fish, seafood, seaweed and its products are at greater risk of developing high urinary iodine (Katamine *et al*., 1986; Kim *et al*., 1998; Dahl *et al*., 2004; Leung *et al*., 2007; Jane *et al*., 2007; Rasmussen *et al*., 2001). These are well established in many studies particularly in population that consumed food based on those items (Katamine *et al*., 1986; Kim *et al*., 1998). In the present study, we constructed an interview-based semi-quantitative food frequency questionnaire to ascertain the types and quantity of iodine-containing foods and supplements in the diet and to correlate the results with a 24h dietary recall. We validate this questionnaire so that it can be used in future studies of iodine nutrition in Malaysia particularly among school children.

MATERIALS AND METHODS

Subjects: In August 2011, a total of 35 healthy, euthyroid school children aged 9 and 10 years old without known recent exposure to high iodine loads volunteered to be enrolled in the study. Each subject completed 24h dietary recall, followed by an interview based semi-quantitative food frequency questionnaire to assess dietary iodine intake. Informed consent was obtained from parents and/or guardians of all participants. All procedures followed were in accordance with the ethical consideration of UKM Medical Centre.

Questionnaire information: The interview was carried out by the researcher based on the prepared semi-quantitative Food Frequency Questionnaire (FFQ). A standardized coloured atlas containing photos of food high in iodine and household measuring tools were used to help the respondents in answering the questions. Daily iodine intake was calculated for each participant in both FFQ and 24h dietary recall. Other information regarding personal or family medical history of thyroid disease and participants' use of iodine-containing substances, such as multivitamins, dietary supplements, thyroid hormone, intravenous contrast dye, amiodarone and antiseptic skin cleaner were asked from each respondent's parents.

We used the 24h dietary recall to correlate subjects' intake of iodine-containing foods with their reported intake from the FFQ. Anthropometric measurement (height and weight) were taken as well.

Table 1: Recommended nutrient intakes for iodine by age or population group and epidemiological criteria for assessing adequate iodine intake based on median urinary iodine concentrations of populations[10]

WHO recommendations	Iodine intake (µg per day)	UI concentration for adequate intake (µg/L)
Children 0-5 years	90	≥100
Children 6-12 years	120	100-199
Children 12 years and adults	150	100-199
Pregnancy	250	150-249
Lactation	250	≥100

Statistical analysis: We tested concurrent validity of the questionnaire by determining whether data from the semi-quantitative interview-based FFQ correlated with the data from 24h dietary recall by using intra class correlation coefficient. Value of p less than 0.05 was considered significant.

RESULTS

Among the 35 participants, 48.6% were girls and 51.4% were boys. A total of 65.7% participants were 10 years of age and 34.3% were 9 years of age. Majority (97.1%) were Malays. None of the participants were originally from any IDD gazetted area in Malaysia. A total of 62.9% were having normal body mass index for their age, 11.4% were overweight, 11.4% obese, 5.7% underweight and 5.7% in severe thinness category.

Mean daily iodine intake were 423.95±225.49 µg/L in the interview-based FFQ and 436.45±217.37 µg/L in the 24h dietary recall. The iodine content from the 24h dietary recall is almost perfectly correlated with the iodine content from the interview-based FFQ where r = 0.954 and Cronbach's alpha = 0.953.

A total of 24% of subjects reported using vitamins but none contained iodine. No subject used any other iodine-containing dietary supplements. There was a wide range in the amount of potential iodine-containing foods consumed and reported in the interview-based FFQ. All 35 respondents reported regular intake of rice and chicken, 97.1% chicken egg, dried anchovy and canned sardines while 94.3% consumed cow's meat and banana. 85.7% consumed prawns, 82.86%

Table 2: Epidemiological criteria for assessment of urinary iodine nutrition in a population based on median or range of urinary iodine concentrations, or both UI cut offs[10]

School age children	Iodine intake	Iodine nutrition
<20 µg/L	Insufficient	Severe iodine deficiency
20-49 mg	Insufficient	Moderate iodine deficiency
50-99 mg	Insufficient	Mild iodine deficiency
100-199	Adequate	Optimum
200-299	More than adequate	Risk of iodine induced hyperthyroidism in susceptible group
>300	Excessive	Risk of adverse health consequences (iodine-induced hyperthyroidism, autoimmune thyroid disease)

consumed fresh milk and cuttlefish while 80% consumed short body mackerel and 54.3% reported ingestion of dried ready-to-eat seaweed.

DISCUSSION

IDD is one of the nutritional deficiency disorders and is the single most common cause of preventable mental retardation and brain damage (Camargo *et al*., 2008). Although iodine supplementation has reduced the IDD prevalence and endemic goiter in Malaysia, latest assessments suggested that median urinary iodine has increased dramatically among school children especially in the urban area (State Health Department of Perak, 2006).

Several previous studies have used 24h dietary recall method to assess the validity of questionnaires regarding iodine content in food. Leung *et al*. (2007) and Rasmussen *et al*. (2001) reported significant correlation between a semi-quantitative FFQ and 24h dietary recall in classifying levels of iodine intake (Katamine *et al*., 1986; Dahl *et al*., 2004). A Korean study found a significant correlation between dietary iodine intake, primarily from seaweed and urinary iodine excretion (Kim *et al*., 1998).

We constructed a Malay-language interview-based semi-quantitative FFQ to assess dietary iodine intake in 35 healthy school children in the Federal Territory of Putrajaya. The iodine content from the 24h dietary recall correlated well with the iodine content from the interview-based FFQ.

Majority of the respondents have daily dietary iodine intake way above the normal requirement for children, where mean daily iodine intake in both interview-based FFQ and the 24h dietary recall were 423.95±225.49 and 436.45±217.37 µg/L, respectively. These findings suggest that the volunteers in this study have excessive iodine intake which is mainly associated with their dietary intake of iodine-containing food.

We conclude that the questionnaire is sufficiently reliable to be used to inquire the daily iodine intake for school children.

ACKNOWLEDGMENTS

This study was supported by National University of Malaysia's grant FF-215-2011.

REFERENCES

Benoist, B.D., E. McLean, M. Anderson and L. Rogers, 2008. Iodine deficiency in 2007: Global progress since 2003. Food Nutr. Bull., 29: 195-202.

Bulow, I.P., P. Laurberg, N. Knudsen, T. Jorsen, H. Perrild, L. Ovesen and L.B. Rasmussen, 2007. An increase incidence of overt hypothyroid after iodine fortification of salt in Denmark: A prospective study. J. Clin. Endocrinol. Metab., 92: 3122-3127.

Camargo, R.Y.A., E.K. Tomimori, S.C. Neves, I.G.S. Rubio, A.L. Galra, M. Knobel and G. Medeiros-Neto, 2008. Thyroid and the environment: exposure to excessive nutritional iodine increases the prevalence of thyroid disorders in Sa˜o Paulo, Brazil. Eur. J. Endocrinol., 159: 293-299.

Dahl, L., L. Johnson, K. Julshamn and H.M. Meltzer, 2004. The iodine content of foods and diets: Norwegian perspectives. PH Nutr., 7: 569-576.

Delange, F., H. Burgi, Z.P. Chen and J.T. Dunn, 2002. World status of mnitoring of IDD control programs. Thyroid, 12: 915-924.

Gur, E., O. Ercan, G. Can, S. Ak kus, S. Guzeloz, S. Cifteli, A. Arvas and O. Ilter, 2003. Prevalence and risk factors of high iodine among school children. J. Trop. Peadiatries, 49: 168-171.

Ijab, T., J. Menon, A.N. Aziz and C.P. Singh, 1996. A survey of iodine deficiency disorders in Sabah, Malaysia. Kota Kinabalu: State Health Department of Sabah.

Institute for Medical Research, 1996. Ministry of Health, Malaysia. Survey of iodine deficiency disorders in Peninsular Malaysia. Kuala Lumpur, Ministry of Health.

Jane, T., L.E. Braveman, M.S. Kurzer, S. Pins, T.G. Hurley and J.R. Herbert, 2007. Seaweed and soy: companion foods in Asian Cuisine and their effects on thyroid function in American women. J. Med. Food, 10: 90-100.

Katamine, S., Y. Mamiya, K. Sekimoto, N. Hoshino, K. Totsuka, U. Naruse, A. Watabe, R. Sugiyama and M. Suzuki, 1986. Iodine content of various meals currently consumed by urban Japanese. J. Nutr. Sci. Vitaminol. (Tokyo), 32: 487-495.

Kementerian Kesihatan Malaysia, 2009. National IDD Survey 2008 Report. Nutrition Research Division, Institute of Public Health, Ministry of Health Malaysia.

Kim, J.Y., S.J. Moon, K.R. Kim, C.Y. Sohn and J.J. Oh, 1998. Dietary iodine intake and urinary iodine excretion in normal Korean adults. Yonsei Med. J., 39: 355-362.

Leung, A.M., L.E. Braveman and E.N. Pearce, 2007. A dietary iodine questionnaire: correlation with urinary iodine and food diaries. Thyroid, 17: 755-762.

Osman, A., M.I. Zaleha, Kehidupan dan kesihatan Orang, 2005. Asli di Malaysia (The life and health of the Orang Asli in Malaysia). Kota Kinabalu, Sabah: The Publisher of University Malaysia Sabah.

Rasmussen, L.B., L. Ovesen, I. Bulow, T. Jorgensen, N. Knudsen, P. Laurberg and H. Perrild, 2001. Evaluation of a semi-quantitative food frequency questionnaire to estimate iodine intake. Eur. J. Clin. Nutr., 55: 287-292.

Rusidah, S., 2005. Report on the monitoring of iodine deficiency in Pahang, Malaysia. Kuantan: State Health Department of Pahang, Malaysia.

Rusidah Selamat, Wan Nazaimoon Wan Mohamud, Ahmad Ali Zainuddin, Nor Syamlina Che Abdul Rahim, Suhaila Abdul Ghaffar and Tahir Aris, 2010. Iodine deficiency status and iodized salt consumption in Malaysia: Findings from a national iodine deficiency disorders survey. Asia Pac. J. Clin. Nutr., 19: 578-585.

State Health Department of Perak, 2006. Report on the monitoring of urinary iodine in Perak, Malaysia. Ipoh: State Health Department of Perak, Malaysia.

World Health Organization, 2007. United Nations Children's Fund and International Council for the Control of Iodine Deficiency Disorders. Assessment of iodine deficiency disorders and monitoring their elimination. A guide for program managers. 3rd edition. Geneva: World Health Organization.

Yahaya, A., Z.E. Fauziah, T. Zainab, K.B. Lau and G.L. Lim, 1996. Survey on the prevalence of iodine deficiency disorders among school children in Sarawak. Kuching: State Health Department of Sarawak, Malaysia.