นิพนธ์ต้นฉบับ

การประเมินภาวะไอโอดีนในปัสสาวะของนักเรียนชั้นประถมศึกษา จังหวัดมหาสารคาม

ธิดารัตน์ สมดี[1] *สุวิมล สงกลาง*[2] *อุดมศักดิ์ มหาวีรวัฒน์*[3] *สุณีรัตน์ ยั่งยืน*[2] *และตันติกร ขุนาพรม*[4]

วันที่ได้รับต้นฉบับ : *11 เมษายน 2555*
วันที่ตอบรับการตีพิมพ์ : *27 มิถุนายน 2555*

[1] **ผู้รับผิดชอบบทความ :** *อาจารย์ประจำคณะสาธารณสุขศาสตร์ มหาวิทยาลัยมหาสารคาม (โทรศัพท์ :089-4192512, E-mail address: ttoxic@windowslive.com)*
[2] *อาจารย์ประจำคณะสาธารณสุขศาสตร์ มหาวิทยาลัยมหาสารคาม*
[3] *รองศาสตราจารย์ประจำคณะสาธารณสุขศาสตร์ มหาวิทยาลัยมหาสารคาม*
[4] *นักวิทยาศาสตร์ประจำคณะสาธารณสุขศาสตร์ มหาวิทยาลัยมหาสารคาม*

บทคัดย่อ

การศึกษานี้เป็นการประเมินภาวะสารไอโอดีน กลุ่มเด็กนักเรียนชั้นประถมศึกษาปีที่ 1-6 อายุ 6 - 12 ปี ในพื้นที่เสี่ยงของประชากร จังหวัดมหาสารคาม จำนวน 114 คน ซึ่งทำการตรวจหาปริมาณสารไอโอดีนในปัสสาวะด้วยวิธี colorimetric method (the ammonium per-sulphate technique) ผลการศึกษา พบว่ากลุ่มตัวอย่างส่วนใหญ่มีระดับสารไอโอดีนในปัสสาวะต่ำกว่า 100 ไมโครกรัมต่อลิตร คิดเป็นร้อยละ 69.3 ซึ่งแสดงว่ามีภาวะขาดสารไอโอดีน เมื่อพิจารณาแยกเพศ พบว่าเด็กเพศชายและเพศหญิง อายุ 7-9 ปี มีภาวะขาดสารไอโอดีนเล็กน้อย ร้อยละ 40.7 และ 70 ตามลำดับ และที่น่าสนใจคือทั้งเด็กเพศชายและเพศหญิงกลุ่มอายุ 10-12 ปี มีภาวะที่ได้รับไอโอดีนจากอาหาร มากเกินไป หรือ มีภาวะความเสี่ยงต่อภาวะได้รับสารไอโอดีนมากเกินพอ โดยเมื่อวิเคราะห์ความสัมพันธ์ระหว่างอายุและระดับสารไอโอดีนในปัสสาวะ พบว่ามีความสัมพันธ์กันอย่างมีนัยสำคัญทางสถิติ ($p<0.001$) โดยสัดส่วนผู้ที่ได้รับสารไอโอดีนในระดับมากเกินพอมีแนวโน้มเพิ่มขึ้นตามอายุที่เพิ่มขึ้น ในทางตรงกันข้ามเมื่ออายุลดลงแนวโน้มของสัดส่วนผู้ขาดสารไอโอดีนจะเพิ่มขึ้น ดังนั้นควรให้ความสำคัญในการแก้ปัญหาภาวะสารไอโอดีนบกพร่องในเด็กทุกกลุ่มอายุที่มีปัญหาภาวะโภชนาการของสารไอโอดีนทั้งในด้านได้รับสารไอโอดีนไม่เพียงพอ หรือได้รับสารไอโอดีนมากเกินไป

คำสำคัญ: *ปริมาณไอโอดีนในปัสสาวะ, นักเรียนประถมศึกษา, สภาวะไอโอดีน*

Original Article

The evaluation of urinary iodine among primary school children in Mahasarakham province

Thidarat Somdee [1]. *Suvimol Sungkamanee* [2] *Udomsak Mahaweerawat* [3] *Suneerat Yangyuen* [2] *and Tantikorn kunapong* [4]

Received Date : *April 11, 2012*
Accepted Date : *June 27, 2012*

[1] **Corresponding author :**
Lecturer of Faculty of Public Health, Mahasarakham University
(Tel. 089-4192512, E-mail address: ttoxic@windowslive.com)
[2] *Lecturer of Faculty of Public Health, Mahasarakham University*
[3] *Associate Professor of Faculty of Public Health, Mahasarakham University*
[4] *Scientist of Faculty of Public Health, Mahasarakham University*

Abstract

The aimed of this study is urinary Iodine (UI) level assessment among 114 school children age between 6-12 year old at primary school grade 1-6 in an area of iodine deficiency risk in Mahasarakham Province. The colorimetric method (the ammonium persulphate technique) was used to assay for urine iodine.The result found that: most of subjects (69.3%) have UI level lower than 100 μg/L, which seemed to have inadequate iodine intake, whereas distribution among male and female age 7-9 year old was found mild adequate iodine intake as 40.7% and 70% respectively. Nevertheless more interesting. The subjects, of age 10-12 year old had high UI level or risk of iodine-induced hyperthyroidism. It indicated that the students received higher level of iodine with their increasing ages, on the otherhand, lower level of intake with their reducing ages, where the statistical significant relationship between age and urine iodine level. ($p<0.001$) The understanding of this study should be encouragement of proper Iodine implementation project for all age group of iodine deficiency children and nutritional problem both receiving under and over Iodine intake. This study signified that mild iodine deficiency (low intake) is prevalent among younger students and presents to excess iodine intake in a higher age group, consequently, action to solve the problems are continuously and sustainably needed.

Keyword: *urinary iodine, school children, iodine status*

Introduction

Iodine deficiency is a major public health problem of population throughout the world, emphasized particularly of pregnant women and young children. There are a threat to the social and economic development of countries. The most devastating outcomes of iodine deficiency are increased perinatal mortality and mental retardation iodine deficiency is the greatest cause of preventable brain damage during childhood which is the primary motivation behind the current worldwide drive to eliminate (Bruno et al., 2004). An adequate amount of dietary iodine intake is an essential for the production of thyroid hormones. Recent studies have shown that even a mild degree of iodine deficiency has repercussions on cognitive function and school performance in clinically euthyroid during school-aged children (Santiago et al., 2004; Vermiglio et al., 2004). Epidemiologic criteria for assessing iodine nutrition based on median urinary iodine (UI) concentrations of school-age children and adults are: iodine deficiency status, which determine as urine Iodine secretion level <100 μg/L; adequate iodine nutrition status UI range 100-199 μg/L; above requirements range as 200-299 μg/L; and excessive >=300 μg/L (WHO, 2007).

In Thailand, although ~66% of households use iodized salt consumption (Rajatanavin, 2007). And fortification of a suitable food vehicle with iodine for use in preexisting lunch programs in day care centers and schools has the potential to combat co-existing micronutrient deficiencies among children (Winichagoon et al., 2006). But the average intelligence Quotient (IQ) among Thai children has dropped to just 91 point compared to the international average score of 90-110.

Objective

The aims of this study was to cross-sectionally investigate the iodine concentration in urine among primary school children in Mahasarakham Province.

Materials and Methods

One hundred fourteen subjects were multistage random sampling from schools which are indicated by Mahasarakham provincial health office yearly reported as a mild endemic area of iodine deficiency in Mahasarakham Province selected by urinary. All those selected subjects are health with no history or biochemical marker suggestive of renal failure, 6 and 12 years of age, and both males and females. The morning mid-stream urine specimens of 114 subjects were collected and 40 ml were kept in clean specimen containers, fixation with 1 drop of 10% formalin solution and kept in ice boxes before being transferred to the laboratory and kept frozen at -2 ºC until be assayed. The standard colorimetric method (the ammonium per-sulphate technique) was used to assay urine iodine level (Dunn et al., 1993). The urine is digested by ammonium persulphate, iodine present in the urine acts like a catalyst in the reduction of ceric ammonium sulphate (yellow) to cerous ammonium sulphate (colourless). The degree of disappearance of the yellow colour is a measure of iodine content in the urine. A standard curve was plotted whereas the analysis was used to extrapolate the concentration of iodine in the urine samples.

The frequency, per-centage, mean, median, and standard deviation was applied for data analysis.The UI of students above 6 year old assessment used criteria of WHO/UNICEF/ICCIDD (4) as Table 1.

Result

This study was performed in August 2011 which shoulded the median urinary iodine (UI) among 114 school children, as mostly of subjects as 69.3% were UI level lower than 100 μg/L which were indicated as iodine deficiency, 21.1% of students have UI level between 100-199 μg/L, and 9.6% above 199 μg/L (WHO have given as normal and excess UI level as 100-199 μg/L and above 199 μg/L respectively) as illustrate in Table 2.

The results in Table 3 showed that boys age between 7-9 year old mostly (40.7%) had moderate and mild iodine deficiency and age between10-12 year old mostly (36.4%) had mild iodine deficiency, girls age 7-9 year old mostly (70%) had mild iodine deficiency and age 10-12 year old mostly (26.5%) had optimal iodine nutrition. And most important finding are both boys and girls, majority had insufficient iodine intake or moderate to mild iodine deficiency (UI level <100 μg/L) and age between 10-12 year old had more than adequate or risk of iodine-induced hyper-thyroidism in susceptible.

The Table 4 show that the trend of both boys and girls proportion gave more than adequate iodine intake (UI= 200-299 μg/L) and excess iodine intake (UI level >=300 μg/L) had increased with increasing of age but in another way the number of younger age both insufficient iodine intake (UI level <100 μg/L) were seemed to be increased.

The Table 5 show that the students received higher level of iodine with their increasing ages, on the otherhand, lower level of intake with their reducing ages, where the statistical significant relationship between age and urine iodine level. ($p<0.001$)

Discussion

Urinary iodine excretion is a good marker of the dietary intake of iodine, and an the index for evaluating the degree of iodine deficiency, correction and toxicity. Iodine deficiency is considered to be a public health problems in countries in which the median UI is below 100 μg/L. Regional and global populations with insufficient iodine intake were estimated on the basis of the proportion of the population with UI level lower than 100 μg/L in each

country. The proportion of the population with iodine deficiency was subsequently used to estimated the total proportion with iodine deficiency in the regional population of school-age children and the general population. The results of this study showed most (69.3%) subjects had UI level <100 μg/L as agree with the findings of Mu et al. (2001),who reported mild to moderate iodine deficiency across the populations they studied including school children. And Balaji et al. (2010) study revealed that out of 100 samples (8-10 years school children), 60 from rural area in that mild iodine deficiency (49), moderate iodine deficiency (5), and optimal iodine levels (6). Remaining 40 from urban area mild iodine deficiency (14) and optimal iodine levels (26). They present study revealed that 65% of the children residing in urban areas school are consuming salt with stipulated level of iodine. So they are having optimum iodine levels in their urine and 35% of the school children of urban areas are having mild deficiency which indicates that they are consuming Iodine below the required quantity. And 82% of children from rural areas are with mild deficiency and 8% with moderate deficiency. Only 10% of children are having optimum iodine levels. Contrast with Gowachirapant et al. (2009), who reported optimal iodine status in the children (median urinary iodine was 200 (25-835) μg/L). Both boys and girls mostly had moderate and mild iodine deficiency which might be implied that inadequate circumstance of iodine surveillance program implementation and consumption promotion of iodized salt fortification under responsibility of ministry of health. And Onyeaghala et al. (2010) studied that urinary iodine was measured in 300 primary school children in Ibadan. They found that 15 (5%) had moderate iodine deficiency, 15 (5%) had mild iodine deficiency, 69 (23%) fell into the sufficient group and 201 (67%) fell into the excess group, with urinary iodine level greater than 300 μg/L. This study infers that if this trend continues unmonitored, the entire population could be prone to developing iodine induced hyperthyroidism (IIH) with the associated toxicity. The problem of excess intake might cause consequence in the future, even though this study shown result UI level as more than adequate or risk of iodine-induced hyperthyroidism in susceptible groups complied with the World Health Organization report as the population have excess concentrations of urinary iodine could be prone to developing Iodine induced Hyperthyroidism (IIH) and autoimmune thyroid disorders (Dunn et al., 1993). Our findings could be implied that in the area of Mahasarakham Province Thailand, as the median of UI in school-aged children may indicate irregular of iodine intake and inadequate monitoring of iodine deficiency disorders (IDD), might be cause of not only usage of non iodized salt but also be presumed that these people will not be enough awareness for the level concentration of iodine fortified food intake as importance of iodine is highly helpful for their brain development.

Suggestion

The significant of this study should be emphasized on iodine and excessive intake in all each group of children continuously and sustainably solving problem were needed.

Acknowledgement

The researchers wish to give our deep gratitude to the Faculty of Public health, Mahasarakham University for provisioning of the supportive. Our heartfelt thanks also go to all primary school children representatives for their cooperation. Finally, we would like to thanks all of the leaders of the primary school children in Mahasarakham Province.

Reference

Balaji, K., Narayana, G., Sudheer, M., Hima, K.V., & Padma, A. (2010). Assessment of iodine deficiency by analysing urinary iodine levels. **International Journal of PharmTech Research, 2**(4), 2357-2363.

Bruno, D.B., Andersson, M., Egli, I., Takkouche, B., & Allen, H. (2004). **Iodine status worldwide: WHO global database on iodine deficiency.** Geneva: World Health Organization.

Dunn, J.T., Crutchfield, H.E., & Dunn, A. (1993). **Methode de dosage de l'iode dans les urines.** [n.p.]: ICCIDD/UNICEF/OMS.

Gowachirapant, S., Winichagoon, P., Wyss, L., Tong, B., Baumgartner, J., Melse-Boonstra, A. et al. (2009). Urinary iodine concentrations indicate iodine deficiency in pregnant Thai women but iodine sufficiency in their school-aged children. **Journal of Nutrition, 139**(6), 1169-1172.

Mu, L., Gary, M., Karmala, G., Steven, C.B., & Creswell, J.E. (2001). Reemergence of iodine deficiency in Australia. **Asia Pacific Journal of Clinical Nutrition, 10**(3), 200-203.

Onyeaghala, A.A., Anetor, J.I., Nurudeen, A., & Oyewole, O.E. (2010). High urinary iodine content (UIC) among primary school children in Ibadan, Nigeria, a public health concern. **Journal of Toxicology and Environmental Health Sciences, 2**(7), 93-96.

Rajatanavin, R. (2007). Iodine deficiency in pregnant women and neonates in Thailand. **Public Health Nutrition, 10**(12A), 1602-1605.

Santiago, F.P., Torres, B.R., Muela, J.A., Rojo, M.G., García, F.E., Garriga, M.J. et al. (2004). Intelligence quotient and iodine intake: A cross-sectional study in children. **Journal of Clinical Endocrinology and Metabolism, 89**(8), 3851-3857.

Vermiglio, F., Lo Presti, V.P., Moleti, M., Sidoti, M., Tortorella, G., Scaffidi, G. et al. (2004). Attention deficit and hyperactivity disorders in the offspring of mothers exposed to mild-moderate iodine deficiency: A possible novel iodine deficiencydisorder in developed countries. **Journal of Clinical Endocrinology and Metabolism, 89**(12), 6054-6060.

Winichagoon, P., McKenzie, J.E., Chavasit, V., Pongcharoen, T., Gowachirapant, S., Boonpraderm, A. et al. (2006). A multimicronutrient-fortified seasoning powder enhances the hemoglobin, zinc, and iodine status of primary school children in North East Thailand: A randomized controlled trial of efficacy. **Journal of Nutrition, 136**(6), 1617-1623.

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 programme managers.** 3rd ed. Geneva: World Health Organization.

Table 1 Epidemiological cut of point level criteria for assessing iodine nutrition in a population based on median and/or range of urinary iodine concentrations (WHO, 1996).

Median urinary iodine (μg/L)	Iodine intake	Iodine nutrition
School-aged children		
<20	Insufficient	Severe iodine deficiency
20-49	Insufficient	Moderate iodine deficiency
50-99	Insufficient	Mild iodine deficiency
100-199	Adequate	Optimal
200-299	More than adequate	Risk of iodine-induced hyperthyroidism in susceptible groups
>300	Excessive	Risk of adverse health consequences

Table 2 Number of students, per-centage and median of Urinary Iodine (n=114)

Median urinary iodine (μg/L)	Number	(%)
< 100 μg/L	79	(69.3)
100 – 199 μg/L	24	(21.1)
> 199 μg/L	11	(9.6)

Table 3 Number of students, mean, standard deviation, median of UI, sex and age

Age	Boy				Girl			
	Number	Mean (μg/L)	S.D.	Median (μg/L)	Number	Mean (μg/L)	S.D.	Median (μg/L)
7-9 years	27	64.07	39.19	55.00	20	61.50	32.24	67.50
10-12 years	33	116.28	80.62	95.00	34	91.32	74.77	77.50
Total	60	92.79	69.91	70.00	54	80.28	63.76	70.00

Table 4 Number and per-centage of students with age, sex, and UI level categorized

Median urinary iodine (Ug/L)	Age 7-9 years		Age 10-12 years	
	Boy	Girl	Boy	Girl
	Number (%)	Number (%)	Number (%)	Number (%)
<20	1 (3.7)	2 (10.0)	1 (3.0)	6 (17.6)
20-49	11(40.7)	3 (15.0)	4 (12.1)	8 (23.5)
50-99	11 (40.7)	14 (70.0)	12 (36.4)	6 (17.6)
100-199	4 (14.8)	1 (5.0)	10 (30.3)	9 (26.5)
200-299	0 (0.0)	0 (0.0)	6 (18.2)	5 (14.7)
>=300	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Total	**27**	**20**	**33**	**34**

Table 5 The association of age and median of urinary iodine concentrations

Median urinary iodine (μg/L)	Age 7-9 years	Age 10-12 years
< 100 μg/L	42	37
100-199 μg/L	5	19
> 199 μg/L	0	11
Chi-square = 16.482, df = 2, p-value < 0.001		