Difference in Goiter Rates Between Two Areas in Mae Hong Son Province Despite an Equally Sufficient Iodine Supply

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Abstract

The study was designed to investigate the problem of endemic goiter and iodine supplementation in Mae Hong Son, Thailand. Routine school data still showed high goiter rates in many areas. Six such schools and five schools with declining prevalence of goiter were selected. A single examiner examined all the children. Their weight, height, body mass index, ethnicity, history of iodine intake and migration were recorded. Urine samples were collected for measuring iodine and thiocyanate levels. From 653 children, 105 and 13 were found to have grade 1 and 2 goiter status, respectively. Median values of urine iodine level in children from all schools suggested sufficient iodine supplementation. Multivariate analysis showed that hilltribe minorities had a 2.09 times higher risk of endemic goiter than Thai children. Urine thiocyanate levels among children from high prevalence schools were significantly higher than those from low prevalence schools. No other significant correlation was found. Possible roles of other known and unknown goitrogens should also be investigated.

Key word : Endemic Goiter, Urine Iodine, Urine Thiocyanate, School Children

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Endemic goiters are common in northern Thailand[1]. In 1960, Nondasuta et al[2] reported the characteristics of 'Goitre Villages' in the northern areas of Thailand. They were located in mountainous areas. Most of them were not accessible and had a low socioeconomic status. Several iodine supplementation programs were implemented throughout the areas in the early 1990s. Goiter prevalence among school children of lower than 10 per cent is considered to be a level of sufficient iodine supplementation according to the WHO guideline[3]. After several years of implementation from several sectors, goiter rates in most schools in the north have been declining to the normal level except in Meuang District, Mae Hong Son province. Mae Hong Son is located in a mountainous area. Many schools cannot be accessed by road. The majority of the population are from the Karen hilltribe. Several other ethnic minorities are also scattered around the province. Meuang District is located at the Thai-Myanmar border. Travelling across the border is common. In 1997, the goiter rate in Meuang District was still high despite the declining trends observed in all other districts of the province (Fig. 1). The reliability of routine examination, consistency of iodine supplement activities at the schools and villages were questioned. Possible roles of goitrogens were also suspected. These included thiocyanate in various foods, several goitrogens in water such as bacterial contamination, lithium, fluoride, some organic materials in natural water sources, as well as malnutrition[4,5].

To explore the problems, 3 study phases were designed. During the first phase, the high prevalence of goiter and sufficiency of iodine supply needed to be verified. If these were confirmed, the second phase field surveys for epidemiological clues to the cause(s) of the problem would follow. In the final phase, laboratory studies on suspected specimens from the field would be tried to confirm the plausibility of the results from the field surveys.

This is the first study in Thailand aimed at verifying the high prevalence of goiter despite sufficient iodine supplementation as well as exploring other goiter related factors including, demographic factors, nutritional status and thiocyanate intakes among school children in those areas.

METHOD

Routine goiter examination data among primary schools in Meuang District, Mae Hong Son Province from 1993 to 1997 were used to identify schools having sustained a high prevalence and declining prevalence approaching the normal level (<10%). Eleven accessible and communicable schools were selected, 6 from the first and 5 from the second groups as shown in Table 1. In June 1998, goiter status of all children in classes 1-6 in those schools were examined by a single experienced examiner. Thyroid glands were palpated and assessed using the standard criteria by the World Health Organization [3]. The ethnicity, age, sex, school class, weight, height, body mass index, history of migration and iodine intakes were recorded. Urine samples were collected from those children and some adult villagers for the measurement of iodine and thiocyanate levels. Urine iodine was measured by Sandell-Kolthoff

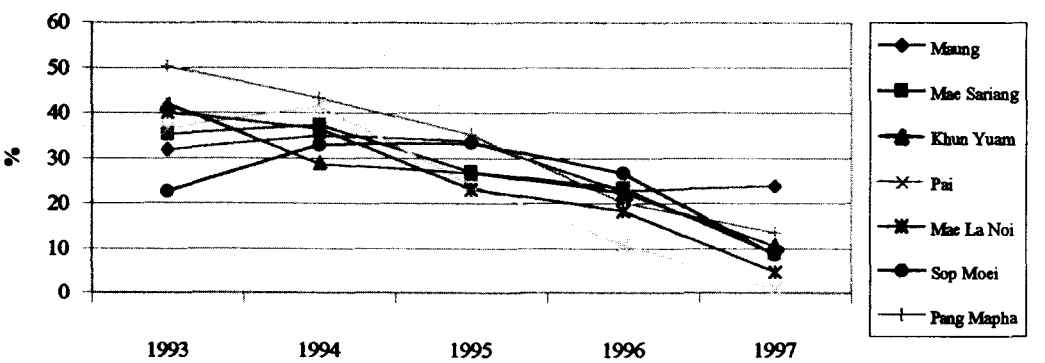


Fig. 1. Prevalence of school children in all districts, Mae Hong Son, 1993-1997.

Table 1. Number of schools in Meuang District, Mae Hong Son, having high (>20%), intermediate (10-20%) and low (<10%) prevalence of goiter in 1997.

Prevalence of goiter (%)	Total schools	Number of schools selected
>20% (high)	36	6
10-20% (intermediate)	13	1
<10% (low)	7	4
Total schools	56	11

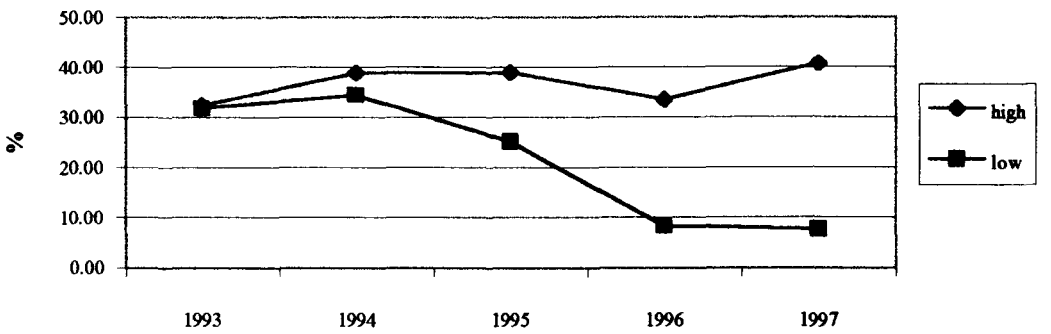


Fig. 2. Trends of average prevalence among samples from high and low prevalence schools.

reaction. Urine thiocyanate was measured by a simple kit method, based on its quantitative oxidation with permanganate to cyanide, which was then determined by picrate method[6]. Iodized oil capsule supplement was discontinued before the survey. Goiter data from the surveys were used to select urine samples from the pools to compare urine thiocyanate levels between high and low prevalence areas. Data were analyzed by the EPIINFO program for simple description and comparison purposes. Multivariate analysis was performed by the STATA program. Goiter rates were reported as percentage proportion. Paired *t*-test and kappa statistics[7] were used for assessing agreement between survey and routine data. Median values of urine iodine and thiocyanate levels were reported and non-parametric tests were used to compare them.

RESULTS

The comparison of trends of average prevalence between high and low prevalence school samples from 1993 to 1997 is demonstrated in Fig. 2. During the survey in June 1998, only 13 out of 653 children were found to have grade-2 goiter status. They were pooled with grade-1 status for detailed analyses. Table 2 shows the goiter prevalence from 1993 to 1997 from routine data, numbers and goiter prevalence from the survey in each selected school. Comparison of the prevalence in 1998 with that of 1997 revealed an average rate reduction of 7.2 per cent (S.E.M 4.7%) without statistical significance ($p=0.146$ by paired *t*-test). The small discrepancy was further explored using kappa statistics to assess a level of agreement as shown in Table 3. Weighted kappa value was calculated to be 0.555 (95% confidence interval 0.388-0.722, $p<0.00001$) which suggested a fair to good agreement of those rates. Median values of urine iodine levels among all school children and village samples were shown to be well above 10 μg/dl (Table 4), indicating sufficient iodine intakes among these school children and adult villagers. Table 5 shows that ethnic hilltribe children have a

Table 2. Goiter prevalence (%) among 11 schools selected from Meuang District, Mae Hong Son, Thailand, 1993-1998.

Prevalence	School	Goiter prevalence (%)									
		1993	1994	1995	1996	1997	1998				Rate '98-'97 difference
							n	Gr.1	Gr.2 (%)	Rate	
Low	A	26.7	26.0	7.8	5.0	7.1	78	10	-	12.8	5.7
Low	B	54.5	35.3	36.7	12.5	12.7	30	1	-	3.33	-9.37
Low	C	20.6	28.1	41.4	8.0	6.7	109	8	1	8.3	1.6
Low	D	36.5	34.4	33.7	16.8	5.9	31	9	-	3.2	-2.7
Low	E	20.7	48.6	6.3	0.0	6.7	55	16	4	36.4	29.7
High	F	29.7	54.2	18.0	52.1	52.9	84	22	2	28.6	- 24.3
High	G	70.0	35.5	41.5	21.8	35.9	56	13	5	32.1	-3.8
High	H	34.4	43.3	64.0	35.7	27.6	43	5	-	11.6	- 16.0
High	I	6.6	4.8	33.9	27.9	35.8	78	12	-	15.4	- 20.4
High	J	40.0	54.5	60.0	38.5	56.1	33	15	1	48.5	- 7.6
High	K	13.3	41.4	16.9	25.0	36.1	56	2	-	3.6	- 32.5
Total							653	105	13		* - 7.2

* - p value = 0.326 by paired *t*-test

Table 3. Agreement between 3 goiter prevalence levels of the years 1997 and 1998.

		1998			Total
		High	Intermediate	Low	
1997	High (>20%)	3	2	1	6
	Intermediate (10-20%)	1	-	-	1
	Low (<10%)	-	1	3	4
Total		4	3	4	11

Total agreement = 3 + 3 = 6 ; Partial agreement = 2 + 1 + 1 = 4 ; Disagreement = 1
Weighted kappa = 0.555 (95% confidence interval 0.388-0.722, p<0.00001)

2.09 times higher risk of thyroid enlargement than the Thais (95% confidence interval 1.34-3.26, p= 0.008 by Mantel-Haenszel stratified analysis). Multivariate analyses of age, sex, school class, weight, height, body mass index, history of iodine intake and migration from the villages revealed no significant correlation with individual goiter status.

Goiter status data from the survey were used to divide the children into 3 groups, first, all children from low prevalence schools (schools A, B, C and D), second, normal children in high prevalence schools (schools F, G and J), and third, children having goiter in those high prevalence schools. About 50 urine samples from each group were randomly selected for measuring thiocyanate levels. Fig. 3 shows the comparison of those levels. Median value of urine thiocyanate levels among children from group 2 and 3 (0.20 and 0.14 mg/dl, respectively), were significantly higher than that among samples from group 1 (0.03 mg/dl) ($p<0.00005$ and <0.0005, respectively). The results remained the same after adjusting for urinary creatinine level.

DISCUSSION

The goiter prevalence of the majority of schools in Meuang District was high. In 1997, only 12.5 per cent of all schools in the district had achieved the target of iodine supplementation programs, (prevalence<10%) according to the WHO guideline[3]. The longitudinal change in goiter rate in Meuang District was in contrast to declining prevalence in other districts. The effectiveness and con-

Table 4. Median values and range of urine iodine levels among school children and adult villagers in the study areas, Meuang District, Mae Hong Son, 1998.

Prevalence	School	Urine iodine levels (μg/dl)					
		School children			Adult villagers		
		Median	Range	N	Median	Range	N
Low	A	93.36	7.40 - 498.00	78	71.28	8.44 - 342.00	35
Low	B	45.68	9.05 - 558.90	30	37.13	9.03 - 236.70	30
Low	C	44.36	22.04 - 436.20	109	23.82	1.57 - 77.95	30
Low	D	64.00	4.65 - 209.60	31	25.80	0.00 - 134.49	41
Low	E	73.68	8.79 - 418.20	55	51.64	1.36 - 253.65	30
High	F	62.82	1.62 - 428.60	84	44.84	0.52 - 146.16	10
High	G	105.03	10.48 - 648.60	56	52.20	7.72 - 317.10	30
High	H	71.32	12.55 - 210.90	43	112.08	24.20 - 239.00	13
High	I	108.35	10.10 - 432.00	78	42.03	3.64 - 264.60	25
High	J	184.31	19.49 - 1349.60	33	32.50	5.29 - 101.29	29
High	K	35.50	3.64 - 261.75	56	24.42	3.57 - 138.60	40

Table 5. Stratified analysis of relationship between goiter rates and ethnic background of school children, Meuang District, Mae Hong Son, 1998.

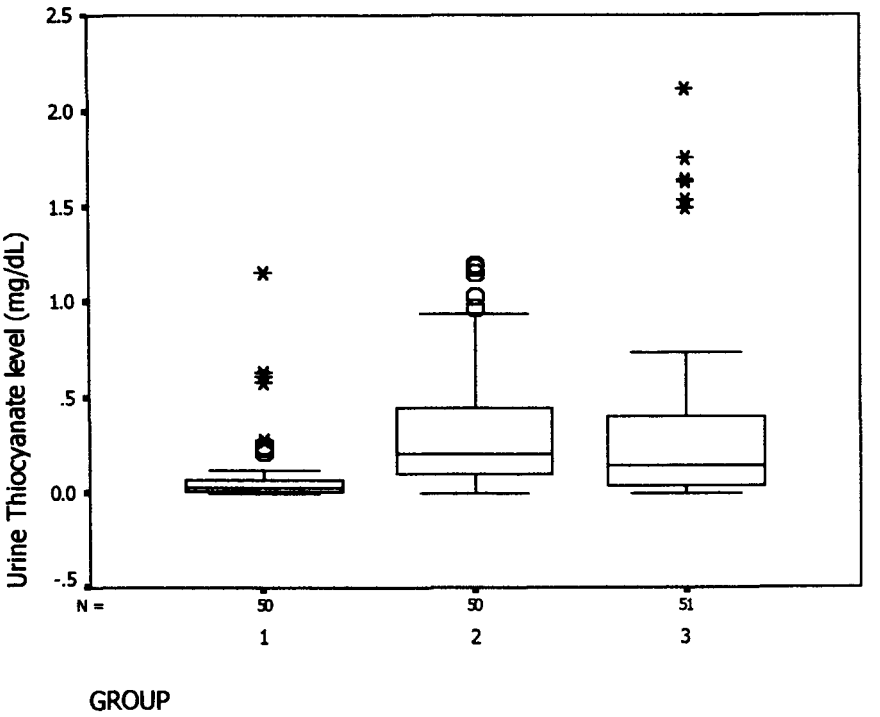
Area	School	Numbers of children		Goiter prevalence (%)		Risk Ratio (RR) (Hilltribe/Thai)
		Hilltribe	Thai	Hilltribe	Thai	
Low	A	17	56	23.5	10.7	2.56
Low	B	0	30	0.0	3.3	-
Low	C	32	77	18.8	3.9	4.81
Low	D	11	20	0.0	5.0	0
Low	E	11	44	36.4	36.4	1.00
High	F	59	25	37.3	8.0	4.66
High	G	44	12	34.1	25.0	1.36
High	H	6	36	16.7	8.3	2.00
High	I	53	25	17.0	12.0	1.42
High	J	30	3	53.3	0.0	-
High	K	22	33	4.5	3.0	1.50

Mantel-Haenzel Summary of Risk Ratio = 2.09 ; 95% confidence interval 1.34-3.26 ; p=0.008

sistency of various iodine supplementation activities as well as the reliability of goiter examination were questioned. Roles of many reported goitrogens such as thiocyanate in foods, bacterial contamination in water, etc were also considered. The language and travelling barriers were considered when selecting schools in Meuang District that were accessible and communicable. Results from this study may not be generalized to the more remote villages in the district.

The selection process resulted in 2 contrast groups of different school goiter trends. This was aimed at increasing the sensitivity of the study to detect any possible factors associated with the sustained high prevalence. Kappa analysis suggested that the reliability of routine examination was fair to good. Hence, the high rate should not be due to poor goiter examination quality. School children and adult villagers had adequate iodine intakes (median urine iodine>10 μg/dl) according to the WHO guidelines (3), which led to the conclusion that endemic goiter in Meuang District may have some other co-factors that contribute to goiter endemia.

Attempts to find important epidemiological clue(s) to the cause(s) of the problem revealed that an ethnic factor showed a significant association with goiter status. Why the ethnic minorities had a higher risk of endemic goiter even in an iodine sufficient situation was the question to be answered. The significant difference of urine thiocyanate levels among samples from high and low prevalence schools also suggested a possible role of thiocyanate from



Group 1. Samples from children in low prevalence schools, median = 0.03 mg/dl.
Group 2. Samples from normal children in high prevalence schools, median = 0.20 mg/dl.
Group 3. Samples from children with goiter in high prevalence schools, median = 0.14 mg/dl.
1 *vs* 2 p-value<0.00005; 1 *vs* 3 p-value<0.0005; 2 *vs* 3 p-value = 0.241 by Kruskal-Wallis test.

Fig. 3. Box plots comparing urine thiocyanate levels (mg/dl) among samples from low prevalence schools, high prevalence schools without and with goiter, Meuang District, Mae Hong Son, 1998.

food. However, the levels reported in this study were far too low when compared with other reports. The mean urine thiocyanate levels in various endemic areas in Vietnam and Ubangi were at least 0.6-0.9 mg/dl[8-10].

In conclusion, Meuang District, Mae Hong Son still has a high prevalence of endemic goiter after many years of iodine prophylaxis and adequate iodine supplementation. The ethnic minorities tended to have a higher risk of goiter than Thais. Thiocyanate level in high rate areas was higher than in low rate areas. However, the median values of thiocyanate found in this study were low and the role of other goitrogens could not be ruled out.

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รายงานการสำรวจเบื้องต้นถึงสาเหตุที่บางพื้นที่ในจังหวัดแม่ฮ่องสอนยังมีอัตราคอพอกสูง ทั้งที่ได้รับสารไอโอดีนเพียงพอแล้ว

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การศึกษานี้มีวัตถุประสงค์เพื่อศึกษาภาวะคอพอกชุกชุมในจังหวัดแม่ฮ่องสอน ข้อมูลจากรายงานการเฝ้าระวังภาวะคอพอกในโรงเรียนประถมชี้ว่า ยังมีภาวะคอพอกสูงอยู่มาก โรงเรียนประถมที่ยังมีภาวะดังกล่าว 6 โรง และโรงเรียนที่ภาวะคอพอกลดลงมาแล้ว 5 โรง ถูกคัดเลือกมาทำการศึกษาเปรียบเทียบ โดยใช้ผู้ตรวจคนเดียวตรวจคลำคอเด็กนักเรียนทุกคน ได้บันทึกอายุ, เพศ, ชั้นการศึกษา, เผ่าพันธุ์, น้ำหนัก, ส่วนสูง, ดัชนีมวลกาย ประวัติการรับประทานไอโอดีนจากแหล่งต่าง ๆ และประวัติการเคลื่อนย้ายที่อยู่ตามผู้ปกครองไม้การเก็บตัวอย่างปัสสาวะไว้สำหรับตรวจหาปริมาณไอโอดีนและสารไธโอซัยยาเนต พบว่า เด็กนักเรียน 653 คนมีภาวะคอพอกระดับ 1 และ 2 จำนวน 105 และ 13 คน ตามลำดับ ทุกโรงเรียนมีระดับไอโอดีนในปัสสาวะสูงเพียงพอ (median urine iodine >10 μg/dl) Multivariate analysis พบว่าเด็กชาวเขามีความเสี่ยงต่อภาวะคอพอกมากกว่าเด็กชาวไทย 2.09 เท่า เด็กในโรงเรียนที่มีความชุกชุมสูงมีระดับไธโอซัยยาเนตในปัสสาวะสูงกว่าเด็กในโรงเรียนที่มีความชุกชุมต่ำ ไม่พบความสัมพันธ์ระหว่างภาวะคอพอกกับตัวแปรอื่น ๆ อีก สาเหตุจากสารก่อคอพอกอื่น ๆ ในพื้นที่ ควรจะได้รับการศึกษาค้นหาต่อไป

คำสำคัญ : คอพอก, ไอโอดีน, สารไธโอซัยยาเนต, เด็กนักเรียน

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