

THIAMINE DEFICIENCY AND PARASITIC INFECTION IN RURAL THAI CHILDREN

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Abstract. A study was carried out to determine whether thiamine deficiency in northeast Thailand is linked with parasitic infection. We assessed the thiamine status and tested for parasitic infections in 231 children between 6 and 12 years of age in Nam Phong District of Khon Kaen Province, Thailand. Thiamine deficiency [thiamine pyrophosphate effect (TPPE) > 20%] and parasitic infections (mostly *Strongyloides stercoralis*) were identified in 16 and 45% of the children, respectively. No association between thiamine deficiency and parasitic infection was found. The general health of the children, according to Thai standard anthropometric curves, was within the normal range. The suboptimal thiamine status and the high prevalence of parasitic infection require attention.

INTRODUCTION

The prevalence of protein energy malnutrition has been dramatically reduced over the last two decades because of improvements in the health and nutritional status of Thais that is coincident with social and economic development (Kosulwat, 2002). Nevertheless, Egger *et al* (1991) reported that nutrient intake among northeast Thai children was still well below recommended levels.

The current prevalence of severe and moderate under-nutrition among pre-schoolchildren is >1% (World Health Organization, 2000). In addition, micronutrient deficiencies (*ie*, iron, iodine and vitamin A) and urinary bladder stone disease have declined among pregnant women, school- and pre-school-aged children (Tontisirin and Yongyout, 1992). However, while clinical nutritional disorders have virtually disappeared over the last decade, the suboptimal status of some micronutrients persists (Udomkesmalee *et al*, 1990; Ongroongruang, 1991; Puetpaiboon and Junjana, 1993).

Previous studies have indicated deficiencies

of thiamine (vitamin B1), riboflavin (vitamin B2), pyridoxine (vitamin B6) and retinol (vitamin A) (Thurnham *et al*, 1971; Schreurs *et al*, 1976; Charoenlarp *et al*, 1980; Changbumrung *et al*, 1985; Bloem *et al*, 1989a, b; Tanphaichitr *et al*, 1990). Although the inadequacy of many micronutrients may not be sufficient to cause clinical symptoms or to prompt a person to seek medical help, suboptimal micronutrient status was nevertheless prevalent among hospitalized patients and may complicate the treatment of an illness (Tienboon, 2002).

The main etiologies of micronutrient deficiencies are inadequate dietary supply and parasitic infection. We therefore aimed to assess the general health, thiamine status and parasitic infection rate among schoolchildren in Nam Phong District of Khon Kaen Province, northeast Thailand. We measured the anthropometric, hematological, nutritional parameters, and the intestinal parasitic infection rate.

MATERIALS AND METHODS

Subjects

The children investigated for their nutritional status and intestinal parasite infection numbered 231, between six and twelve years of age. They came from four neighboring villages, and all of them attended school in Na Kham Noi, Nam

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The clinical nutritional status was assessed by calculating the weight-for-age and height-for-age of children, and examining each child for any symptoms of nutritional deficiencies.

Blood sample collection

Blood samples were collected from schoolchildren in October 1994, at the end of the rainy season (*ie*, pre-treatment, Visit #1) and in March 1995, the beginning of the hot/dry season, after treatment with parasitic drugs (*ie*, post-treatment, Visit #2) to obtain baseline data and to assess for any seasonal variation in thiamine status.

The heparinized fraction was centrifuged; the red blood cells washed three times then diluted 1:1 (v/v) with 10% (v/v) Sterox solution, before storing at -70°C.

Thiamine assessment

Thiamine was assessed by determination of erythrocyte transketolase activity (ETKA), both with and without the addition of thiamine pyrophosphate (TPP). The results were expressed as the percent stimulation resulting from the added TPP, namely, the thiamine pyrophosphate effect, or TPPE. A TPPE > 15% indicated a low thiamine status; > 20% indicated thiamine deficiency.

Parasitic examination

Intestinal parasitic infections were measured using fecal samples collected from the children and stored on ice. The formalin-ether

concentration fecal examination technique was used to detect: hookworm (HW), *Strongyloides stercoralis* (SS), *Giardia lamblia* (GL), *Opisthorchis viverrini* (OV) and minute intestinal flukes (MIF) (Elkins *et al*, 1986). In addition, a culture technique was used to determine the presence of hookworm and *Strongyloides stercoralis* in the feces (Koga *et al*, 1991).

RESULTS

Nutritional assessments according to anthropometric measures (such as weight and height) among the schoolchildren (both boys and girls) of different ages were within the normal range. When these values were plotted as weight versus age and height versus age, they corresponded to the fiftieth percentile on Thai standard growth curves (Division of Nutrition, 2000).

The physical examinations revealed cheilosis (6.2%), pale conjunctiva (1.9%), follicular hyperkeratosis (1.7%), glossitis (1.2%), koilonychia (0.6%) and bleeding gums (0.6%). Tests for other clinical deficiencies were unremarkable.

Parasitic infections were found in 45.3% of the 212 children tested. The rankings of common parasitic infections were SS (25.2%), HW (18.9%), GL (13.0%), OV (5.6%) and MIF (4.6%). Boys were infected with parasites more frequently than girls (Table 1).

At Visit #1, 31 of the 196 children (15.8%) were diagnosed as having a thiamine deficiency

Table 1
The prevalence of parasitic infections.

Parasite	Boys infected/tested No. (%)	Girls infected/tested No. (%)	All infected/tested No. (%)	p-value χ^2 ^b
SS	37/105 (35.2)	18/107 (16.8)	55/212 (25.2)	0.003
HW	24/105 (22.9)	16/107 (15.0)	40/212 (18.9)	0.16
GL	17/108 (15.7)	11/107 (10.3)	28/215 (13.0)	0.31
OV	7/109 (6.4)	5/107 (4.7)	12/216 (5.6)	0.76
MIF	4/109 (3.7)	6/107 (5.6)	10/216 (4.6)	0.53
Total ^a	57/105 (54.3)	39/107 (36.4)	96/212 (45.3)	0.01

^aTotal number of children infected with one or more parasites

^b χ^2 -test to determine difference in infection frequency by gender

SS = *Strongyloides stercoralis*, HW = hookworm, GL = *Giardia lamblia*,
OV = *Opisthorchis viverrini*, MIF = minute intestinal flukes

(TPPE > 20%) (Table 2). When using TPPE > 15% as the cut-off point for a low thiamine status, 33 of the 196 children (16.8%) had a low status. No significant difference was found in the proportion of children with a low thiamine status between genders.

At Visit #2, thiamine deficiency had increased to 34 of 146 children (23.3%) and the low thiamine status had increased to 25.4%. There was no significant difference in the thiamine status of the parasitic infected versus the uninfected group (Table 3).

DISCUSSION

Thiamine status was assessed by measuring the percent stimulation of TPP, expressed as TPPE. The prevalence of thiamine deficiency (TPPE > 20%) was 15.8% of the children attend-

ing the surveyed primary school. The proportion, including those who had a low thiamine status (TPPE > 15%), was as high as 16.8%. All the children with a sub-optimal thiamine status had no clinical signs of a deficiency.

Previous reports of thiamine deficiency for the northeast Thailand indicated 18 and 40% of children and adults, respectively, were deficient (Tanphaichitr *et al*, 1990). In southern Thailand, a 'poor' thiamine status was found among 40.3% of the staff and students in a university (Puetpai-boon and Junjana, 1993), and among 35.5% of female hospital personnel (Ongroongruang, 1991).

The causes of thiamine deficiency among Thais are: 1) energy intake derived mainly from polished rice, 2) consumption of foods containing anti-thiamine factors, and, 3) insufficient intake of animal products (Tanphaichitr *et al*, 1990; Ongroongruang, 1991; Butterworth, 2001).

Thai children in rural areas proved to have an inadequate intake of thiamine according to the FAO/WHO Recommended Daily Allowances (Egger *et al*, 1991). Our study showed that the general health of these schoolchildren reflected adequate macronutrients and was in the normal range. This may indicate an improved nutritional status due to the better economics of the past decade. Notwithstanding, ~15% of children from rural areas may have a suboptimal thiamine status. Importantly, it may be that other micronutrient deficiencies prevail among these children.

Table 2
The prevalence of deficient thiamine status (TPPE > 20%).

	Thiamine deficiency (TPPE > 20%)	
	Visit #1 (Rainy season)	Visit #2 (Hot/dry season)
	Boys	17/103 (16.5%)
Girls	14/93 (15.1%)	16/69 (23.2%)
All	31/196 (15.8%)	34/146 (23.3%)

Table 3
Prevalence of parasitic infections and thiamine status among schoolchildren.

Parasite	Normal (TPPE ≤ 20%)	Deficient (TPPE > 20%)	Infected children	p-value χ^2 ^b
SS	32/149 (21.5%)	12/30 (40.0%)	44/179 (24.6%)	0.03
HW	30/149 (20.1%)	3/30 (10.0%)	33/179 (18.4%)	0.30
GL	19/151 (12.6%)	4/30 (13.3%)	23/181 (12.7%)	1.00
OV	6/152 (3.9%)	2/30 (6.7%)	8/182 (4.4%)	0.62
MIF	6/152 (3.9%)	2/30 (6.7%)	8/182 (4.4%)	0.62
Total ^a	61/149 (40.9%)	16/30 (53.3%)	77/179 (43.0%)	0.23

^aTotal number of children infected with one or more parasites

^b χ^2 -test to determine difference in infection frequency by gender

SS = *Strongyloides stercoralis*, HW = hookworm, GL = *Giardia lamblia*,

OV = *Opisthorchis viverrini*, MIF = minute intestinal flukes

Nearly half of the children we studied were infected with more than one type of parasite. SS was the most common infection (25.2%) followed by HW (18.9%). The prevalence of parasitic infection was comparable with other studies of rural northeast Thais: 23.5-28.9% with SS infection (Jongsuksuntigul *et al*, 2003; Sithithaworn *et al*, 2003) and 12.3% with HW (Sithithaworn *et al*, 2003).

OV infection, which is common in this region, was found in only 5.6% of the children. The low prevalence was likely due to the lower age of the subjects who would not have had lengthy enough exposure to this parasite. A study in adults in the same area indicated an OV infection rate of 14.3% (Sithithaworn *et al*, 2003).

Similarly, 57% of 343 urban and rural three- to eight-year-old children in Sakon Nakhon Province suffer from single or multiple helminthiasis [ancylostomiasis (AD), ascariasis (AL), opisthorchiasis (OV) and/or strongyloidiasis (SS)] and/or giardiasis (GL) infection (Egger *et al*, 1990).

In Chiang Mai, northern Thailand, 239 out of 491 (48.7%) children were positive for a parasitic infection (Kasuya *et al*, 1989). The most common types of parasite were soil-transmitted helminthes, such as hookworm (26.3%) or *Strongyloides stercoralis* (11.2%), while *Ascaris lumbricoides* was not so prevalent.

We found no association between thiamine deficiency and parasitic infection in the pre-treatment visit (Visit #1). At the end of the study, after parasitic treatment (Visit #2), a higher proportion of children was found with thiamine deficiency compared with Visit #1. No correlation between thiamine deficiency and parasitic infection was also found in a previous study (Nontasut *et al*, 1996).

In conclusion, the thiamine status and parasitic infection rate were studied in schoolchildren in a rural area of northeast Thailand. The results demonstrated that nearly 30% of the children had a low thiamine status. A higher proportion of children had inadequate thiamine status during the hot/dry season. A suboptimal thiamine status and parasitic infection were concurrent, but not interdependent. The improvement of di-

etary vitamin intake and hygiene are advised.

ACKNOWLEDGEMENTS

This project was supported by a research grant from the Faculty of Medicine, Khon Kaen University. The authors thank Mr Bryan Roderick Hamman for assistance with the English-language editing of the manuscript.

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