

Relationships between waist-to-hip circumference ratio and gender, age and nutritional status in Thai children in Mueang District, Chiang Mai Province

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Objectives To investigate the relationship between waist-hip circumference ratio (WHR) and demographic factors including gender, age and nutritional status and construct standard reference tables of WHR in Thai children and adolescents.

Methods This cross sectional study was carried out during 2001-2002 in Mueang district, Chiang Mai province, northern Thailand. The participants comprised 2,537 children (1,215 boys and 1,322 girls) aged between 6 and 15 years, who were selected randomly from public (n=13) and private (n=9) schools. Their weight, height, and waist and hip circumferences were measured. The nutritional status was categorized into 4 groups: under-nourished, normal, overweight and obese. The relationship between WHR and demographic factors was investigated by using ANOVA.

Results The standard reference tables of WHR were constructed to categorize 2,537 Thai children and adolescents by gender, age and nutritional status. The mean and standard deviation of WHR for all participants was 0.81 ± 0.06 . The WHR in the participants included associated factors such as gender, age and nutritional status, which were significantly smaller in girls than boys. WHR also decreased with age. Nutritional status was categorized into 4 groups, with all mean WHR having a statistically significant difference from one another. The under-nourished group had the lowest WHR, whereas the obesity group had the highest.

Conclusion This is the first study that provides tables of WHR by gender, age, and nutritional status in Thai children and adolescents. They show the standard for a subsequent surveillance study as well as research of abnormal body form in these participants. **Chiang Mai Medical Journal 2012;51(2):29-37.**

Keywords: WHR, demographic parameters, BMI, children, adolescents, Thai

Introduction

The waist-to-hip circumference ratio (WHR) is a simple parameter for distinguishing between fat in the lower trunk (hip and buttocks) and that in the upper trunk (waist and abdomen). The fat

depots assessed by the WHR are mainly subcutaneous (external or outer) and visceral (internal or deep), with the subcutaneous adipose tissue being found largely in the lower trunk [1]. Pouliot et al showed that total body fat mass correlates with the WHR [2]. Several prospective cohort studies have shown that an elevated WHR in adults associates with increased risk of coronary heart disease, stroke and type 2 diabetes mellitus both in men and women [3,4]. Several studies in adults have revealed that the WHR varies with race or ethnicity, age, gender, geographic region, and degree of being overweight [5,6]. WHR and its relation to age, gender, and ethnicity also have been studied in children of the USA [7]. and the mean WHR varied consistently with age, gender and ethnic group in children and adolescents aged 4-19 years. Some diseases/syndromes, which are characterized by mal-distribution of body fat, may be assessed by WHR. Standard references for WHR in Thai children and adolescents are lacking.

The aims of this study were to investigate the relationship between WHR and demographic factors including gender, age and nutritional status and to construct the standard reference tables of WHR for Thai children and adolescents.

Methods

This cross-sectional study was approved by the Ethical Committee of the Research Institute for Health Sciences, Chiang Mai University, Thailand. Written informed consent was obtained from parents of the participants. The study was carried out during 2001-2002 in Mueang district, Chiang Mai province, northern Thailand, with the children and adolescents selected from this area. To decrease any error in the sampling technique, three steps were taken as follows: Firstly, the sample size was calculated from the following formula [8]:

$$n = (Z_{1-\alpha/2} + Z_{1-\beta})^2 * p(1-p) / e^2$$

where α is the significance level (0.05) and β power of the test (80%). The expected value for the proportion of obesity in the population (p) was 25%, with the percentage error of p (e) being 10 %. The result of this calculation was 2,368 children and adolescents. As the population frame was known (47,657 children and adolescents), the sam-

pling fraction was used. The sample size was $n/(1+n/N) = 2,368/[1+(2,368/47,657)] = 2,255$ children and adolescents. Since the parents and/or participants might be lost from the study, 25% of the sample size was added. Thus, the sample size was 2,820 children and adolescents. Secondly, schools were selected using simple random sampling from public and private schools (primary to intermediate levels) by proportional allocation. There were 13 public and 9 private schools in this study. Thirdly, the participants were selected using simple random sampling from the schools involved. The children and adolescents in each age group (at one year intervals) and gender (boys and girls) varied in proportion with the allocation. At the end of this study, there were 2,537 participants (1,215 boys and 1,322 girls) aged between 6 and 15 years, who were at the primary or intermediate level of education in the academic year of 2001. To minimize the bias possible during the measurement, quality of the apparatus (weight and height meters and tape) was checked both for accuracy and precision. Each anthropometric measurement was carried out three times by well trained persons to reach an average value. The weight, height, and waist and hip circumference of the participants were measured. The waist circumference was measured midway between the lowest rib (the tenth rib) and superior border of the iliac crest, as recommended by the WHO (2000) [9]. Hip circumference was measured at the widest point over the buttocks [10]. Waist-hip circumference ratio and body mass index were calculated.

The nutritional status was categorized into 4 groups. The under-nourished group was defined as having weight for height (WT/HT) <1.5 S.D. of standard Thai growth references [11]. Since there is no standard Thai BMI reference, the normal, overweight and obese children were distinguished and grouped by the proposed reference standard for obesity in children of the International Obesity Task Force [12].

Statistical analysis

Descriptive statistics were employed including frequency, mean, standard deviation, and minimum and maximum. The Komogorov-Smirnov Test was used for testing data distribution. Three-way ANOVA was used to determine the association between WHR, BMI, age and gender. All analyses were performed using the Statistical Package for Social Science version 17.0 software (SPSS Inc., Chicago, IL, USA) and Stata/SE 10.0 for Windows (4905 Lakeway Drive College Station, TX 77845 USA).

Results

There were 2,537 children and adolescents at the start of the study (1,215 boys and 1,322 girls aged between 6 and 15 years). Their weight, height and waist-hip circumference ratio (WHR)

Table 1. Mean and standard deviation of weight, height, waist circumference, hip circumference and WHR of boys (n=1,215) categorized by age groups

Age (years)	n	Weight (kg) (Mean $\pm$ SD)	Height (kg) (Mean $\pm$ SD)	Waist circumference (cm) (Mean $\pm$ SD)	Hip circumference (cm) (Mean $\pm$ SD)	Waist-hip circumference ratio (Mean $\pm$ SD)
6	99	24.39 $\pm$ 7.48	118.63 $\pm$ 6.17	54.76 $\pm$ 9.16	62.96 $\pm$ 8.38	0.87 $\pm$ 0.04
7	117	24.86 $\pm$ 6.40	122.42 $\pm$ 6.11	54.98 $\pm$ 7.86	63.01 $\pm$ 7.28	0.87 $\pm$ 0.05
8	125	29.48 $\pm$ 9.29	128.58 $\pm$ 6.32	58.68 $\pm$ 10.33	67.47 $\pm$ 8.97	0.87 $\pm$ 0.06
9	134	29.67 $\pm$ 8.71	131.86 $\pm$ 6.74	57.22 $\pm$ 9.21	67.51 $\pm$ 8.68	0.85 $\pm$ 0.05
10	157	36.02 $\pm$ 12.75	138.10 $\pm$ 7.61	62.25 $\pm$ 12.35	72.63 $\pm$ 10.24	0.85 $\pm$ 0.06
11	155	38.83 $\pm$ 11.97	143.04 $\pm$ 7.61	63.17 $\pm$ 11.08	75.08 $\pm$ 9.91	0.84 $\pm$ 0.05
12	129	42.40 $\pm$ 12.17	149.10 $\pm$ 7.98	63.63 $\pm$ 10.76	77.00 $\pm$ 9.81	0.82 $\pm$ 0.05
13	114	46.79 $\pm$ 12.53	156.74 $\pm$ 9.11	63.99 $\pm$ 9.04	80.20 $\pm$ 9.16	0.80 $\pm$ 0.04
14	138	50.38 $\pm$ 10.92	161.44 $\pm$ 6.95	65.66 $\pm$ 7.99	82.73 $\pm$ 7.56	0.79 $\pm$ 0.04
15	47	53.13 $\pm$ 11.55	164.82 $\pm$ 6.42	66.61 $\pm$ 8.62	83.97 $\pm$ 7.10	0.79 $\pm$ 0.05

Table 2. Mean and standard deviation of weight, height, waist circumference, hip circumference and WHR of girls (n=1,322) categorized by age groups

Age (years)	N	Weight (kg) (Mean $\pm$ SD)	Height (cm) (Mean $\pm$ SD)	Waist circumference (cm) (Mean $\pm$ SD)	Hip circumference (cm) (Mean $\pm$ SD)	Waist-hip circumference ratio (Mean $\pm$ SD)
6	86	22.37 $\pm$ 4.52	117.64 $\pm$ 4.97	51.57 $\pm$ 6.09	61.79 $\pm$ 5.79	0.83 $\pm$ 0.05
7	145	23.89 $\pm$ 6.11	121.51 $\pm$ 5.18	52.66 $\pm$ 6.96	63.22 $\pm$ 6.70	0.83 $\pm$ 0.04
8	108	27.10 $\pm$ 6.58	127.77 $\pm$ 6.23	54.06 $\pm$ 7.16	65.91 $\pm$ 6.35	0.82 $\pm$ 0.05
9	173	29.86 $\pm$ 7.60	133.05 $\pm$ 7.34	55.81 $\pm$ 7.55	69.00 $\pm$ 7.54	0.81 $\pm$ 0.05
10	123	35.71 $\pm$ 10.12	139.12 $\pm$ 7.02	59.87 $\pm$ 9.27	74.26 $\pm$ 8.55	0.80 $\pm$ 0.06
11	121	40.05 $\pm$ 11.09	146.00 $\pm$ 7.42	60.76 $\pm$ 9.11	78.19 $\pm$ 9.19	0.78 $\pm$ 0.05
12	151	43.61 $\pm$ 10.71	151.73 $\pm$ 6.60	61.71 $\pm$ 7.87	81.62 $\pm$ 8.30	0.76 $\pm$ 0.04
13	156	46.95 $\pm$ 10.49	153.92 $\pm$ 5.85	63.23 $\pm$ 8.35	84.78 $\pm$ 8.20	0.74 $\pm$ 0.04
14	198	47.79 $\pm$ 8.81	156.27 $\pm$ 5.50	62.75 $\pm$ 7.25	85.58 $\pm$ 6.76	0.73 $\pm$ 0.04
15	61	49.70 $\pm$ 8.59	156.18 $\pm$ 5.02	64.06 $\pm$ 7.41	87.23 $\pm$ 6.70	0.73 $\pm$ 0.05

are shown in Table 1 and Table 2 for boys and girls, respectively. The mean and standard deviation of WHR for all children and adolescents was 0.81 ± 0.06 .

Anthropometric assessment was performed. Of the 2,537 participants, 222 (8.8%) were under-nourished. The rest of them (2,315) were grouped by their BMI values into normal (1,811 children: 71.4%), overweight (310; 12.2%), and obese children and adolescents (194; 7.6%). After running a boxplot of the waist-hip circumference ratio values, using the SPSS program, 46 children were found to be outliers (1.5 interquartile range). There were 7, 28, 6 and 5 children in the under-nourished, normal, overweight and obese

group, respectively. Once the outliers had been excluded, the mean standard deviation and 95% CI of the waist to hip ratio in 215 under-nourished, 1,783 normal, 304 overweight and 189 obese participants in each age group and gender were constructed for the boys (Table 3) and girls (Table 4).

The relationships between WHR and gender, age and nutritional status are shown in Table 5 and Figure 1. When WHR was categorized by gender, all of the data showed that WHR was higher in boys than in girls. There was a statistically significant difference ($p < 0.05$) in WHR between boys and girls (Table 5). WHR had a tendency to decrease with increasing age and the

Table 3. WHR of Thai boys by age and nutritional status

Nutritional status	Age (years)	Boys (N=1,186)						
		N	Mean	SD	Minimum	Maximum	95% CI	
							Lower Bound	Upper Bound
Under-nourished (N=102) 8.6%	6	7	0.86	0.04	0.81	0.90	0.83	0.89
	7	10	0.87	0.04	0.81	0.95	0.84	0.89
	8	5	0.81	0.03	0.78	0.85	0.78	0.85
	9	16	0.81	0.04	0.75	0.89	0.79	0.83
	10	12	0.82	0.03	0.77	0.87	0.80	0.85
	11	10	0.81	0.03	0.77	0.87	0.78	0.83
	12	17	0.80	0.02	0.77	0.84	0.78	0.82
	13	10	0.77	0.03	0.72	0.81	0.75	0.80
	14	14	0.79	0.04	0.73	0.87	0.77	0.81
	15	1	0.77	.	0.77	0.77	0.70	0.85
Normal (N=836) 70.5%	6	66	0.85	0.03	0.76	0.92	0.84	0.86
	7	80	0.86	0.04	0.78	0.96	0.85	0.87
	8	86	0.85	0.05	0.75	0.96	0.85	0.86
	9	90	0.84	0.04	0.74	0.95	0.83	0.85
	10	100	0.83	0.03	0.76	0.91	0.82	0.83
	11	107	0.82	0.04	0.74	0.90	0.81	0.83
	12	81	0.80	0.03	0.73	0.89	0.79	0.81
	13	84	0.79	0.03	0.73	0.85	0.78	0.80
	14	106	0.79	0.03	0.71	0.85	0.78	0.79
	15	36	0.78	0.03	0.71	0.84	0.76	0.79
Overweight (N=140) 11.8%	6	5	0.89	0.03	0.86	0.93	0.86	0.92
	7	12	0.89	0.05	0.81	0.96	0.87	0.91
	8	17	0.88	0.04	0.80	0.97	0.86	0.90
	9	16	0.86	0.05	0.79	0.95	0.84	0.88
	10	26	0.88	0.04	0.80	0.95	0.87	0.90
	11	21	0.88	0.05	0.80	0.99	0.87	0.90
	12	17	0.87	0.04	0.81	0.94	0.86	0.89
	13	14	0.83	0.06	0.74	0.93	0.81	0.85
	14	9	0.81	0.02	0.78	0.85	0.79	0.84
	15	3	0.84	0.05	0.78	0.87	0.80	0.88
Obesity (N=108) 9.1%	6	20	0.91	0.04	0.84	1.01	0.90	0.93
	7	12	0.93	0.03	0.89	0.97	0.91	0.95
	8	12	0.93	0.03	0.88	0.97	0.90	0.95
	9	11	0.92	0.05	0.83	0.98	0.90	0.94
	10	18	0.95	0.04	0.88	1.03	0.93	0.97
	11	15	0.91	0.05	0.83	0.96	0.89	0.93
	12	9	0.92	0.04	0.85	0.98	0.89	0.94
	13	4	0.88	0.01	0.87	0.89	0.84	0.92
	14	6	0.89	0.05	0.86	0.98	0.86	0.92
	15	1	0.94	.	0.94	0.94	0.87	1.02

Table 4. WHR of Thai girls by age and nutritional status

Nutritional status	Age (years)	Girls (N=1,305)						
		N	Mean	SD	Minimum	Maximum	95% CI	
							Lower Bound	Upper Bound
Under-nourished (n=113) 8.7%	6	4	0.83	0.01	0.82	0.84	0.79	0.86
	7	9	0.83	0.03	0.78	0.86	0.80	0.85
	8	5	0.80	0.04	0.74	0.86	0.77	0.83
	9	19	0.79	0.05	0.71	0.88	0.77	0.81
	10	9	0.77	0.03	0.72	0.80	0.74	0.79
	11	9	0.75	0.02	0.73	0.78	0.73	0.78
	12	20	0.74	0.03	0.69	0.80	0.73	0.76
	13	19	0.73	0.03	0.65	0.79	0.71	0.75
	14	18	0.72	0.03	0.66	0.77	0.70	0.74
	15	1	0.67	.	0.67	0.67	0.60	0.75
Normal (n=947) 72.6%	6	59	0.83	0.04	0.72	0.91	0.82	0.84
	7	110	0.82	0.03	0.75	0.89	0.82	0.83
	8	79	0.81	0.04	0.68	0.88	0.80	0.82
	9	120	0.80	0.04	0.71	0.89	0.79	0.81
	10	78	0.79	0.04	0.72	0.89	0.78	0.80
	11	82	0.76	0.04	0.67	0.85	0.76	0.77
	12	102	0.75	0.04	0.67	0.85	0.74	0.76
	13	109	0.74	0.04	0.65	0.83	0.73	0.74
	14	158	0.73	0.03	0.64	0.82	0.72	0.73
	15	50	0.72	0.04	0.67	0.80	0.71	0.73
Overweight (n=164) 12.6%	6	9	0.84	0.02	0.80	0.87	0.81	0.86
	7	12	0.86	0.03	0.82	0.93	0.84	0.89
	8	15	0.84	0.05	0.75	0.94	0.82	0.86
	9	23	0.84	0.05	0.78	0.93	0.83	0.86
	10	25	0.82	0.05	0.71	0.93	0.81	0.84
	11	17	0.80	0.05	0.73	0.90	0.79	0.82
	12	21	0.79	0.04	0.71	0.85	0.77	0.80
	13	21	0.77	0.04	0.69	0.84	0.76	0.79
	14	16	0.78	0.03	0.71	0.84	0.76	0.80
	15	5	0.77	0.03	0.74	0.80	0.74	0.81
Obesity (n=81) 6.2 %	6	11	0.87	0.07	0.74	0.98	0.85	0.89
	7	13	0.87	0.05	0.76	0.93	0.85	0.90
	8	9	0.90	0.04	0.84	0.96	0.87	0.92
	9	8	0.87	0.07	0.78	0.96	0.84	0.89
	10	9	0.86	0.03	0.81	0.89	0.84	0.89
	11	10	0.85	0.05	0.78	0.91	0.82	0.87
	12	7	0.81	0.04	0.77	0.87	0.78	0.84
	13	6	0.81	0.06	0.74	0.89	0.78	0.84
	14	6	0.80	0.06	0.72	0.87	0.77	0.83
	15	2	0.80	0.03	0.78	0.83	0.75	0.86

average WHR of some age groups showed a statistically significant difference from that in others ($p<0.05$) (Table 5). The under-nourished group had the lowest WHR, whereas the obesity group had the highest. All mean WHR had a statistically significant difference ($p<0.05$) (Table 5).

Discussion

This study demonstrated that factors associated with the WHR of Thai children and adolescents included gender, age and nutritional status. WHR in girls was significantly smaller than that in boys ($p<0.05$), and it also decreased with age. The mean WHR of the participants could be divided into sub-groups: 6-7-8, 9-10, 11, 12 and 13-14-15 years old, since it was not significantly different among Thai children and adolescents in each age group. In other words, the average WHR in some age groups showed a statistically significant difference from that in others ($p<0.05$).

Regarding nutritional status, which was categorized into 4 groups of under-nourished, normal, overweight and obese children and adolescents, all mean WHR had a statistically significant difference ($p<0.05$) from each other. The under-nourished group had the lowest WHR, whereas the obesity group had the highest.

Although changing WHR in age and gender is well known, this study was the first to show the degree of changes in Thai children and adolescents. The WHR of Thai children and adolescents in each group of nutritional status has been investigated rarely. The only study describing distribution of WHR, and its relation to age, gender and ethnicity, is on children and adolescents of the USA, carried out by Gillum R. F. in 1999 [5]. It showed that mean WHR varied consistently with age and gender, which is similar to this study. WHR also varied with ethnicity, namely non-Hispanic blacks, non-Hispanic whites and Mexican Americans. Therefore, the results of this

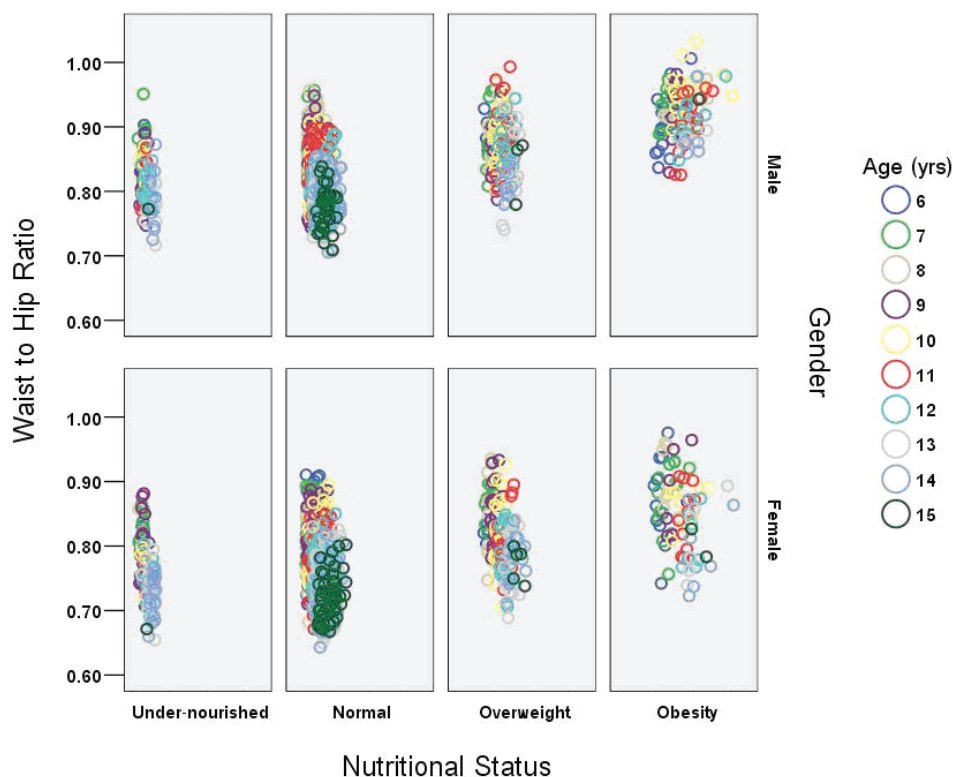


Figure 1. Associations between WHR and demographic parameters (gender, age and nutritional status)

Table 5. Mean, standard deviation and 95% CI of WHR by gender, age and nutritional status

Factors	N	Mean $\pm$ SD*	95% Confidence Interval		p value
			Lower Bound	Upper Bound	
Gender					0.001
Male	1,186	0.84 $\pm$ 0.05	0.83 (0.833)	0.84 (0.839)	
Female	1,305	0.78 $\pm$ 0.06	0.78 (0.778)	0.78 (0.784)	
Age (years)					0.0002
6	181	0.85 $\pm$ 0.05 ^a	0.85	0.86	
7	258	0.85 $\pm$ 0.05 ^a	0.84	0.85	
8	228	0.84 $\pm$ 0.06 ^{a, f}	0.84	0.85	
9	303	0.82 $\pm$ 0.05 ^{b, c}	0.82	0.83	
10	277	0.83 $\pm$ 0.06 ^{b, f}	0.82	0.84	
11	271	0.81 $\pm$ 0.06 ^c	0.80	0.82	
12	274	0.79 $\pm$ 0.06 ^d	0.78	0.79	
13	267	0.77 $\pm$ 0.05 ^e	0.76	0.77	
14	333	0.76 $\pm$ 0.05 ^e	0.75	0.76	
15	99	0.75 $\pm$ 0.05 ^e	0.74	0.76	
Nutritional status					0.0002
Under-nourished	215	0.79 $\pm$ 0.05 ^a	0.78	0.79	
Normal	1,783	0.80 $\pm$ 0.06 ^b	0.79	0.80	
Overweight	304	0.84 $\pm$ 0.06 ^c	0.83	0.85	
Obesity	189	0.89 $\pm$ 0.06 ^d	0.88	0.90	
Total	2491	0.81 $\pm$ 0.06	0.80	0.81	

¹t-Test was used for testing the effect of gender on WHR; ²One way ANOVA was used for testing the effect of age and nutritional status on WHR; * Different letters show statistically significant difference at $p < 0.05$.

study could be used for Thai children and adolescents, but not for other nationalities.

In a study by Uruwan Y. et al, the mean $\pm$ SE WHR value in 51 normally nourished 8-year old Thai children was 0.86 ± 0.04 , which was similar to the values found in this study. The value in 107 obese children in their study was slightly higher (0.95 ± 0.05) than that in this one. This may be due to the higher degree of obesity in that study [13]. However, the children in the obesity, overweight and underweight groups, or those in some age groups in this study, might be small in number. It may be necessary to have more participants for these groups in further study. Anthropometric indices, especially waist circumferences in children and adolescents, have been studied for the purpose of correlation with obesity and lipid profile, [14-16] and not for the correlation with maldistribution of body fat.

Finally, this was the first study to provide tables of WHR by gender, age, and nutritional status in Mueang district, Chiang Mai province. They provide a standard for subsequent surveillance study as well as the research of abnormality in childhood body form, including many childhood metabolic diseases.

Acknowledgements

We would like to thank the children and parents who participated in this study. We are grateful to the directors and teachers in the schools who supported us with data collection. The study was funded by Chiang Mai University. The contributions by the authors to the manuscript are as follows: SP: study design, data collection, and analysis and writing the manuscript; ST: data analysis and writing the manuscript and VS: concept of idea, data analysis, comment and suggestion, and reviewing the manuscript. All authors read and approved the final manuscript.

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ความสัมพันธ์ระหว่างอัตราส่วนเส้นรอบวงเอวต่อเส้นรอบวงสะโพก เพศ อายุ และภาวะโภชนาการ ในเด็กไทย อำเภอเมือง จังหวัดเชียงใหม่

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วัตถุประสงค์ เพื่อศึกษาความสัมพันธ์ระหว่างอัตราส่วนเส้นรอบวงเอวต่อเส้นรอบวงสะโพก และปัจจัยทางด้านประชากรศาสตร์ ได้แก่ เพศ อายุ และภาวะโภชนาการ และสร้างตารางเกณฑ์มาตรฐานสำหรับอัตราส่วนเส้นรอบวงเอวต่อเส้นรอบวงสะโพก (WHR) ในเด็กไทยรวมทั้งวัยรุ่น

วิธีการศึกษา การศึกษาแบบภาคตัดขวางนี้ดำเนินการในช่วง พ.ศ. 2544-2545 ในอำเภอเมืองจังหวัดเชียงใหม่ มีเด็กจำนวน 2,537 คน (เด็กชาย 1,215 คน และเด็กหญิง 1,322 คน) อายุระหว่าง 6-15 ปี และสุ่มจากโรงเรียนของรัฐ (13 โรงเรียน) และเอกชน (9 โรงเรียน) ซึ่งนำหนัก วัดความสูง วัดเส้นรอบวงเอวและวัดเส้นรอบวงสะโพกของเด็ก ภาวะโภชนาการของเด็กถูกแบ่งเป็น 4 กลุ่ม ได้แก่ ภาวะโภชนาการขาด สมส่วน น้ำหนักเกิน และอ้วน วิเคราะห์ความสัมพันธ์ระหว่างอัตราส่วนเส้นรอบวงเอวต่อเส้นรอบวงสะโพก (WHR) และปัจจัยทางด้านประชากรศาสตร์ โดยใช้ ANOVA

ผลการศึกษา ได้ข้อมูลของเด็กไทยจำนวน 2,537 คน มาสร้างตารางเกณฑ์มาตรฐานสำหรับ WHR ในเด็กไทยรวมทั้งวัยรุ่น โดยจำแนกตาม อายุ เพศ และภาวะโภชนาการ พบว่าค่าเฉลี่ยเลขคณิตและส่วนเบี่ยงเบนมาตรฐานของ WHR ในเด็กไทยโดยรวม มีค่าเท่ากับ 0.81 ± 0.06 และ พบว่าปัจจัยที่มีความสัมพันธ์กับ WHR ของเด็กไทยได้แก่ เพศ อายุ และ ภาวะโภชนาการ WHR ของเด็กหญิงน้อยกว่าของเด็กชายอย่างมีนัยยะสำคัญทางสถิติ WHR มีค่าลดลงเมื่ออายุเพิ่มขึ้น สำหรับภาวะโภชนาการของเด็กซึ่งแบ่งออกเป็น 4 กลุ่มพบว่า ค่าเฉลี่ย WHR ในเด็กทั้ง 4 กลุ่มแตกต่างกันอย่างมีนัยยะสำคัญทางสถิติ โดยเด็กที่มีภาวะโภชนาการขาดมีค่า WHR ต่ำสุดในขณะที่เด็กที่อ้วนมีค่า WHR มากที่สุด

สรุป การศึกษานี้เป็นการศึกษาแรกที่ได้ตารางเกณฑ์มาตรฐานสำหรับ WHR ของเด็กไทยรวมทั้งวัยรุ่นที่จำแนกตามเพศ อายุ และภาวะโภชนาการ ซึ่งสามารถใช้เป็นมาตรฐานในการศึกษาเชิงสำรวจรวมทั้งการศึกษาเกี่ยวกับรูปร่างที่ผิดปกติในเด็กไทยและวัยรุ่น **เชียงใหม่เวชสาร 2555;51(2):29-37.**

คำสำคัญ: อัตราส่วนเส้นรอบวงเอวต่อเส้นรอบวงสะโพก ปัจจัยทางด้านประชากรศาสตร์ ดัชนีมวลกาย เด็กวัยรุ่น ไทย