Low Sleeping Time, High TV Viewing Time, and Physical Inactivity in School Are Risk Factors for Obesity in Pre-Adolescent Thai Children

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Objective: *Explore the association between physically active behavior and obesity in 7- to 12-years-old Thai children.*
Material and Method: *As part of SEANUTS Thailand, information on anthropometry, physical activity, and socio-demographic variables were collected in 7- to 12-years-old urban and rural Thai children. Multi-stage sampling technique was used and 1,345 children (32% urban, and 50.3% boys) participated in the study. Anthropometric measurements included weight, height, and BMI-for-age Z-scores (BAZ) using World Health Organization Growth Reference. Obesity was defined as BAZ >2SD. Physical activity was assessed using a validated physical activity questionnaire (PAQ). The PAQ provided an activity score, activity time in school, sleeping hours, and TV watching time as categorical variable, low, moderate, and high. Chi-square by likelihood ratio test and logistic regression were used to compare obese and non-obese groups.*
Results: *The overall prevalence of overweight and obesity was 10.2 and 10.8% respectively, whereas 8.2% was classified as thin. Maternal education and religion did not differ between obese and non-obese children. However, obese children's family income was higher. After controlling for family income, maternal education, and religion, obese children were significantly less active during break times in school, slept less, and watched more TV than non-obese. However, there was no difference in the activity score of obese and non-obese children.*
Conclusion: *The study showed that physical activity during break time in school, sleep duration, and hours of TV viewing were associated with obesity in pre-adolescent Thai children. It is important to note that activity score was not associated with obesity. One of the most important benefits to be physically active in childhood is the potential to maintain this behavior into adulthood. Therefore, programs that encourage healthy behaviors and address these modifiable risk factors should be incorporated in the school curriculum.*

Keywords: *Obesity, Sleep duration, TV viewing, Active activity, Thai children*

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In recent years, the lifestyle and physically active behavior of Thai children have been changing because of the development and availability of high technology gadgets such as computer games and smart phones. This is leading to an increasingly sedentary lifestyle[1]. Physical activity is an important factor related to health and growth development in children. There is evidence that active children remain active during adulthood[2,3]. Modifiable environmental factors such as children's participation in physical education classes at school and community recreation programs are found to be associated with physical activity and inactivity patterns in US adolescents[4]. Moreover, systematic reviews show a significant relationship in children and youth between health indicators and sedentary behaviors such as TV viewing time[5,6]. In addition, a systematics review of socioeconomic status in past few years showed an association between socioeconomic status (SES) and obesity variables in developing countries[7]. A cross-sectional survey in Germany reported that parental education was strongly associated with young children's obesity[8], while a study from Ireland showed that the risks of being overweight and obese were associated with parental weight, maternal education, and family income[9].

While malnutrition is reported[10,11] in Thailand, South-East Asia, and western countries, obesity in Thai children has increased over the past decades[12]. In addition, the recent Thai National Health Examination

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Survey (2008 to 2009) reported an increase in the prevalence of overweight and obese among children aged 6 to 12 years[13]. This survey also showed an association between sleeping hours and nutritional status. In children aged 1 to 5 years, the prevalence of overweight was significantly higher in children who slept less than 10 hours per day compared to children who slept longer. In children aged 10 to 14 years, less sleeping hours was related to stunting[14].

The complexity of physical activity measurements leads to a variety of methods to assess physical activity especially in young children[15-18]. Physical activity questionnaires are commonly used to describe the population behavior and physical activity pattern. The items or contents in the questionnaire vary according to the lifestyle of the target group and the objectives of the study that lead to the validation of the questionnaires before use[19,20].

Physical activity and inactivity are important factors that represent major avenues for obesity prevention and treatment. Hence, the objective of the present study was to investigate the association between physical activity, TV viewing time, and sleeping time with obesity in Thai children. The study was part of the South East Asian Nutrition Surveys (SEANUTS) in which four countries, Malaysia, Indonesia, Vietnam, and Thailand participated[18].

Material and Method

SEANUTS aimed to assess nutritional status, dietary intake, cognitive function, and physical activity of children aged from 6 months to 12 years. Further details about the design, protocol, and methods used in SEANUTS can be found elsewhere[21,22]. The present study used the data of 7 to 12 years school children and focused on their physical activities, TV viewing time, sleeping hours in relation to obesity classified by BMI for age Z score using WHO growth reference[23].

Subjects

Multi-stage cluster randomized sampling stratified for age, gender, and residential area (urban/rural) was used to recruit children from four regions of Thailand and in the Bangkok Metropolitan Area as there might be differences in lifestyle behavior in the Bangkok area[22]. The study protocol was approved by the Ethics Committee on Human Right Related to Research Involving Human Subjects, Faculty of Medicine, Ramathibodi Hospital, Mahidol University, Thailand (MURA 2010/467). Written informed consents from the parents or caretakers of the children were obtained prior to data collection. Village health volunteers or school teachers in each study site made an appointment with the target children. Data collection was performed mostly at the health centers in each village, and at schools in the Bangkok Metropolitan Area.

Anthropometric measurements

All anthropometric parameters were measured twice using a standardized protocol and a third measurement was taken if there were more than 10% difference between the first two. Weight was measured with a digital weighing scale (Seca model 882, Seca GmbH, Hamburg, Germany) to the nearest 0.1 kg, while height was measured in the standing position without shoes by a microtoise (Stanley-Mabo Ltd., Besancon, France) to the nearest 0.1 cm. Waist circumference was measured midway between the lower rib margin and the iliac crest using a non-stretch tape to the nearest 0.1 cm.

Obesity in children was classified using BMI-for-age Z score (BAZ) according to WHO reference standard for children aged 5 to 19 years (obese-BAZ >2 SD, and non-obese-BAZ ≤2 SD). Thinness was defined as BAZ ≤ -2SD[23].

Socio-economic information

The information of socio-economic status (parental education level, family income, and religion) was collected using a self-administered questionnaire. In case of missing information particularly on family income and parental education, children were asked again to get the completed questionnaire, or the parents were contacted by phone. Maternal education was classified into three groups, primary school or less, secondary school, and bachelor or above degree. Family income was classified into five groups according to quintiles of family income in the present study.

Physical activity and behavior

Activity scores

To explore the habitual physical activity in the present study, the Thai Validated Physical Activity Questionnaire (TPAQ) was used. This questionnaire, based on the International Physical Activity Questionnaires (IPAQ)[24] was validated against accelerometer scores and covers 53 typical Thai activities[25]. The frequency of these 53 physical activities, ranging from outdoor games, sports, body movement to household chores over the past week,

was recorded. From these items, an activity score was computed by multiplying the frequency with the intensity of each activity according to the compendium of physical activities[26], and the sum represented the 'activity score'. Children's activity level were classified in three groups, least active (first quintile), moderate active (second to fourth quintile), and highly active (fifth quintile).

Active time in school

During weekdays, most Thai children spend around eight hours a day (8 a.m. to 4 p.m.) in school and have a short recess period in the morning, after lunch, and in the afternoon. Children were asked to select the activity that they mostly did in school during these break times. There were three categories of activities: 1) moving around, 2) sitting doing light activities (i.e., playing music, drawing), and 3) sitting activities (i.e., talking, reading). Children who answered that they mostly run or play sports would get 1 score while the other answers for sitting doing light activity and sitting activity would get 0 score. The scores from the three break periods were summed up to represent the child's activity score in school. Maximum score was three for children who selected moving around for all their break times and zero score for children who never moving around. Active time in school scores were grouped into three categories, never active (zero score), sometimes active (scores 1-2), and always active (score 3).

Hours of sleep and TV viewing

Children recorded their awake and sleep time, and estimated TV viewing time during weekday and weekend. The weighted average (over five weekdays and two weekends) of hours of sleep and TV viewing were used in the analyses. The recommendation[27] for healthy and active living children were used to categorize sleeping time (<9 hours, 9 to 10 hours, and >10 hours of sleep), and TV viewing time (>2 hours, 2 to 1 hour, and <1 hour of TV viewing).

Statistical analysis

All variables were analyzed using the STATA/IC 12.1 for Windows (StataCorp LP, College Station, Tx, USA). Weighed data were representing the Thai children population aged 7- to 12-years-old to reflect the distribution proportion of gender and residential area based on census data from the Department of Provincial Administration, Ministry of Interior in 2010. Analyses of covariance (ANCOVA) expressed by mean and standard deviation (SD) was used to compare the mean differences in body composition and physical activity variables between groups. Likelihood ratio test was used to test the differences in proportion of mother education, family income, religion, active score, active time in school, sleep duration, and TV viewing in obese and non-obese children. After adjusting for confounding factors (gender, residential areas, age, maternal education income, and religion), logistic regression was used to determine factors related to obesity in the present study group. Significance level was set at $p<0.05$.

Results

One thousand three hundred forty five children, aged 7 to 12 years participated in the present study as shown in Table 1. After weighing, representing the 6,570,591 Thai children population of that age, there were 50.3% boys and 32% urban children. Most children were Buddhist and about half of the children's mothers had education at primary school level (Table 2).

Anthropometric parameters

Anthropometric characteristics of the Thai children were presented in Table 1. Girls had similar age and body composition as boys except lower waist circumference ($p<0.01$). Urban children were slightly elder than rural children ($p<0.05$), had higher body weight, BMI, BAZ, and waist circumference than rural children ($p<0.01$). The prevalence of overweight and obesity were 10.2% and 10.8% respectively. Prevalence of thinness was 8.2%. Obesity was more prevalent in boys than girls (13.9% vs. 7.6%). The prevalence of obesity in urban children was twice as much as in rural areas (16.8% vs. 8.1%).

Physical activity behavior

Boys had similar activity scores as girls, as well as obese and non-obese children. However, when considering residential area, mean activity scores of children in urban area were significantly higher than in rural area ($p<0.05$). During break times in school, boys were more active than girls ($p<0.01$), and rural children were more active than urban children ($p<0.05$). However, obese and non-obese children did not have different activity time in school (Table 1).

Urban children slept significantly less than rural children (9.7 vs. 9.9 hours, $p<0.001$) as well as obese children did comparing to non-obese children (9.6 vs. 9.9 hours, $p<0.001$), but there was no difference between genders. Average time per day spent in TV

Table 1. Characteristics of the children

Sample (n)	Boys (676)		Girls (699)		Urban (431)		Rural (914)		Obese[a] (142)		Non-obese[a] (1,203)		All (1,345)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Age (year)	9.9	1.7	10.0	1.7	9.8*	1.6	10.0	1.7	9.9	1.6	9.9	1.7	9.9	1.7
Weight (kg)	32.1	11.8	32.3	11.2	33.5**	12.4	31.6	11.1	52.3***	14.3	29.9	8.4	32.2	11.5
Height (cm)	134.4	11.1	135.6	12.0	135.0	11.2	135.0	11.8	141.0***	10.9	134.3	11.5	135.0	11.6
Body mass index (kg/m^2)	17.4	4.1	17.2	3.7	17.9***	4.3	16.9	3.7	25.9***	3.9	16.2	2.4	17.3	3.9
BAZ	-0.04	1.65	-0.13	1.41	0.25***	1.60	-0.24	1.48	2.87***	0.73	-0.43	1.20	-0.08	1.53
Waist circumference (cm)	59.4**	11.3	57.8	9.6	60.6***	11.5	57.6	9.9	80.6***	10.3	56.0	6.9	58.6	10.5
PA variables														
Activity score[b] (scores/week)	358	192	360	180	388*	207	346	173	358	207	359	183	359.2	185.8
Activity time in school[c] (time/day)	1.7**	0.9	1.1	0.9	1.3*	0.9	1.5	0.9	1.3	0.9	1.4	0.9	1.4	0.9
Hours of sleep (hour/day)	9.9	1.0	9.8	1.0	9.7***	1.1	9.9	1.0	9.6***	1.2	9.9	1.0	9.9	1.0
Television viewing (hour/day)	1.9	1.2	2.0	1.3	2.1*	1.2	1.9	1.3	2.2*	1.3	1.9	1.3	2.0	1.3

Mean values were significantly different between groups (boys vs. girls, urban vs. rural, and obese vs. non-obese) by ANCOVA, adjusted for age: * $p<0.05$, ** $p<0.01$, and *** $p<0.001$

[a] Body mass index for age Z-score (BAZ) was used to classify obesity (BAZ >2 SD) and non obese (BAZ ≤2 SD) children

[b] Activity score was summation from children's activities during the past week multiplied with the intensity (MET)(23)

[c] Activity time in school was calculated from 3 questions about their type of activities (moving around, sitting doing light activities, and sitting) during 3 periods of free time in school (range from 0 to 3)

viewing was around two hours. Significant differences were observed between the residential areas as well as in obese and non-obese ($p<0.05$).

Factors associated with obesity

Maternal education and religion had no influence on the obesity of Thai children, but more children from higher income families were obese (Table 2). Physical activity assessed by the activity score did not differ between obese and non-obese children, but activity in school during recess time was lower in obese children. Obese children slept fewer hours and watched more TV.

Table 3 showed the Odds ratios for being obese, after correcting for the possible confounding effects of age, maternal education, income, and religion. Boys had higher risk of being obese than girls and urban children trended to be obese more than rural children in significance. If gender and residential area were added as confounding factors, activity score from PAQ was not a risk factor for obesity, but being more active during break times in school significantly lowered the risk of obesity. In addition, sleeping less than nine hours per day was a risk factor for obesity as well as watching TV more than 1 to 2 hours per day.

Table 2. Socio-economic factors and physical activity distribution in obese and non-obese children

	Obese (%)	Non-obese (%)	*p*-value	All (%)
Socio-economic				
Maternal education			0.442	
- Bachelor or higher degree	9.8	8.1		8.3
- Secondary school	42.4	36.9		37.5
- Primary school	47.8	55.0		54.2
Family income			0.005	
- Very high	29.4	16.1		17.5
- High	23.8	18.5		19.1
- Moderate	16.9	18.1		18.0
- Low	14.1	22.1		21.3
- Very low	15.8	25.2		24.1
Religion			0.177	
- Buddhism	79.5	83.1		82.7
- Christianity	0.4	1.7		1.6
- Islam	20.2	15.2		15.7
Physical activity				
Activity score[a]			0.907	
- Least active	21.4	20.8		20.9
- Moderate active	57.7	59.9		59.7
- Highly active	20.9	19.3		19.4
Activity time in school			0.016	
- Never	24.3	15.9		16.8
- 1 time a day	43.2	36.7		37.4
- 2 to 3 times a day	32.5	47.4		45.8
Hours of sleep			0.000	
- <9 hours/day	34.5	14.9		17.0
- 9 to 10 hours/day	36.9	46.1		45.1
- >10 hours/day	28.6	39.0		37.9
Television viewing			0.022	
- >2 hours/day	44.8	37.3		38.1
- 1 to 2 hours/day	37.5	32.0		32.6
- <1 hours/day	17.7	30.7		29.3

[a] Activity score was classified by grouping as least actives (1st quintile), moderate active (2nd to 4th quintiles), and highly active (5th quintile)

Discussion

This cross-sectional survey showed a higher prevalence of overweight and obesity in boys, urban, higher family income, low activity pattern in school

Table 3. Odds ratio (OR) and 95% confidence intervals (95% CI) of physical activity gender and area of residence for obese children

	OR	95% CI
Active score		
Least active	1.04	0.51, 2.11
Moderate active	1.06	0.59, 1.90
Highly active	1.00	-
Active time in school		
Never	2.68	1.44, 4.98
1 time	1.93	1.13, 3.29
2-3 times	1.00	-
Hours of sleep		
<9 hours	2.14	1.17, 3.90
9 to 10 hours	0.93	0.54, 1.61
>10 hours	1.00	-
Television viewing		
>2 hours	2.32	1.24, 4.34
1 to 2 hours	2.21	1.17, 4.17
<1 hour	1.00	-

Adjusted for gender, residential area, age, education mother, income, and religion

recess time, longer TV viewing time and shorter sleeping hours. However, the physical activity score from the used questionnaire was not significantly different between obese and non-obese children.

Laursen et al[28] reported that children who failed to meet the recommendation of physically activity (13,000 step/day for boys and 11,000 step/day for girls), screen time (less than 2 hours/day) and sleep duration (at least 10 hours/day) were more likely to be obese than the others. The National Longitudinal Survey of Canadian children and youth also found that physical activity was negatively associated with being overweight and obese while excessive screen time was a risk factor for overweight and obesity[29].

From the present study, all physical activity behavior variables except for activity score were associated with obesity in Thai children. Activity during school recess time was the most sensitive factor to predict obesity. Children who reported to be inactive during break times had 2 to 3 times higher risk of obesity than children who were often or always active during recess time. In general, Thai children usually have break times in school for 1 to 2 hours per day and the school physical education session of 50 minutes is once a week. Thus, it can be expected that providing a good school environment for children can increase their physical activity in school more than at home, where TV and electronic gadgets are available. In addition, several studies have shown that exercise promotion programs and health education during break times in school could prevent childhood obesity[30-33].

In the present study, sleeping less than nine hours and watching TV more than one hour per day more than double the risk to be obese. A recent study in southern Thailand showed that sedentary behavior was not only associated with obesity but also with learning performance. Adolescents who played electronic games for more than two hours per session were more likely to have a lower academic achievement evaluated by the school grade point average (GPA) below 3.00[34]. When children spend more time on electronic games, they are likely to have shorter sleeping time.

The activity score that represented the children's habitual physical activity was not related to the risk of being obese in the present study. Both obese and non-obese children had similar habitual activity (Table 3). However, there were some limitations in the use of the activity score as the questionnaire only included activities and frequencies but not duration. Thus, although the activity score indicated similar results, the duration, and hence the energy spent on the activity, could be different. For example, children who reported only one strenuous activity in a week might have lower activity score than children who reported several moderate activities. In addition, the surprisingly higher activity score in urban children compared to rural children might be an artifact as urban children might have the chance and choice to play more sports than rural children.

It also has to be kept in mind that the classification of obesity based on BAZ might not be adequate, as a highly active child might have a higher BMI due to muscle development.

The study from Jackson et al in the Aberdeen area of northeast Scotland[35] showed that the more TV watching the higher body fat in children. However, physical activity was not related with adiposity. Thus, the association between physical activity and obesity in children is still controversial.

Conclusion

Short sleeping time, long TV viewing time, and physical inactivity in school were found to be the risk factors for obesity in pre-adolescent Thai children. One of the most important benefits of establishing physically active and less sedentary lifestyle in childhood is the potential to continue maintaining these behaviors in (young) adulthood. Therefore, the programs that encourage healthy behaviors and address these modifiable risk factors should be incorporated in school curriculum.

What is already known on this topic?

Less physical activity and/or more physical inactivity are known to be a crucial risk factor for childhood obesity. Many publications from the literatures showed physical activity questionnaire was used to measure how active the target group was. Only few publications studied on measuring physical inactivity.

What this study adds?

Physical activity and physical inactivity in terms of active score, activity during school break time, sleeping time and TV viewing time were measured. Our study demonstrated that being active during school break time is the most sensitive factor to predict obesity. Compared to the previous survey in Thai children, less sleeping time (<10 hours) was associated with stunting, whereas our study showed this magnitude could double the risk to be obese. TV viewing more than two hours was reported to associate with an obesity risk factor, but our study showed that this association was found in less time spent on TV viewing as more than one hour could be associated with obesity.

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Authors' contributions

Thasanasuwan W, Kijboonchoo K, Wimonpeerapattana W, Yamborisut U, Rojroongwasinkul N, Khouw I, and Deurenberg P were involved in design and protocol preparation of the study. Thasanasuwan W and Srichan W were responsible for data collection and management. Data analysis and evaluation were done by Wimonpeerapattana W and Deurenberg P. Thasanasuwan W and Kijboonchoo K prepared drafting of the manuscript with English edited by Khouw I and Deurenberg P. All the authors contributed to review and approve the final version of the manuscript for publication.

Potential conflicts of interest

None.

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การนอนน้อย การดูโทรทัศน์มาก และกิจกรรมทางกายน้อยในโรงเรียน เป็นปัจจัยการเกิดโรคอ้วนในเด็กไทยก่อนวัยรุ่น

วิยะดา ทัศนสุวรรณ, วีรชาติ ศรีจันทร์, กัลยา กิจบุญชู, อุรุวรรณ แย้มบริสุทธิ์, วันเพ็ญ วิมลพีรพัฒนา, นิภา โรจน์รุ่งวศินกุล, Ilse Tan Khouw, Paul Deurenberg

วัตถุประสงค์: *เป็นการศึกษาเพื่ออธิบายความสัมพันธ์ระหว่างกิจกรรมทางกายและความอ้วนในเด็กไทยอายุ 7-12 ปี*
วัสดุและวิธีการ: *การศึกษาครั้งนี้เป็นส่วนหนึ่งของโครงการ SEANUTS ประเทศไทย ทำการเก็บข้อมูลด้านสัดส่วนร่างกาย กิจกรรมทางกาย สังคมและเศรษฐฐานะ ในเด็กช่วงอายุ 7-12 ปีทั้งในเมืองและชนบทจำนวน 1,345 คน (ร้อยละ 32 เป็นเด็กในเมือง และร้อยละ 50.3 เป็นเด็กชาย) ข้อมูลสัดส่วนร่างกายประกอบด้วยน้ำหนัก ส่วนสูง และ BMI for age Z-score (BAZ) โดยใช้ค่าเปรียบเทียบมาตรฐานขององค์การอนามัยโลก เกณฑ์ชี้วัดแบ่งกลุ่มอ้วนที่ระดับค่า BAZ มากกว่า 2 SD การเคลื่อนไหวร่างกายใช้แบบสอบถามกิจกรรมทางกายที่ผ่านการตรวจสอบความน่าเชื่อถือได้ ซึ่งบอกค่า activity score, activity time ในโรงเรียน จำนวนชั่วโมงการนอน และการดูโทรทัศน์ โดยแบ่งเป็นน้อย ปานกลาง และมาก ใช้สถิติ Chi-square by likelihood ratio test และ logistic regression ในการเปรียบเทียบเด็กอ้วนและเด็กไม่อ้วน*
ผลการศึกษา: *ในภาพรวม อัตราการเกิดน้ำหนักเกิน และอ้วนมีค่าร้อยละ 10.2 และ 10.8 ตามลำดับ ขณะที่อัตราการเกิดภาวะผอมร้อยละ 8.2 ไม่พบความแตกต่างของระดับการศึกษาของมารดาและศาสนาระหว่างเด็กอ้วนและไม่อ้วน อย่างไรก็ตามพบว่ากลุ่มเด็กอ้วนมาจากครอบครัวที่มีรายได้สูงมากกว่า หลังจากการควบคุมตัวแปรด้านรายได้ครอบครัว ระดับการศึกษาของมารดา และศาสนา เด็กอ้วนมีกิจกรรมทางกายในช่วงพักเรียน รวมทั้งระยะเวลานอนน้อยกว่า และดูโทรทัศน์มากกว่ากลุ่มเด็กไม่อ้วนอย่างมีนัยสำคัญทางสถิติ แต่ไม่พบความแตกต่างของ activity score ของเด็กอ้วนและไม่อ้วน*
สรุป: *การศึกษาครั้งนี้พบว่า กิจกรรมทางกายช่วงพักเรียนในโรงเรียน ชั่วโมงการนอน และการดูโทรทัศน์ของเด็กมีความสัมพันธ์กับความอ้วนของเด็กไทยก่อนวัยรุ่น แต่ไม่พบความสัมพันธ์ของความอ้วนกับ active score ดังนั้นสิ่งสำคัญที่จะเป็นประโยชน์คือการสร้างนิสัยรักการทำกิจกรรมทางกาย และลดกิจกรรมที่ไม่ค่อยได้ออกแรงในวัยเด็ก เพื่อที่จะมีแนวโน้มการมีพฤติกรรมสุขภาพที่ดีในวัยผู้ใหญ่ โปรแกรมที่ช่วยกระตุ้นพฤติกรรมสุขภาพและเน้นปัจจัยเสี่ยงที่ปรับเปลี่ยนได้ จึงควรมีอยู่ในหลักสูตรการเรียนของเด็กไทยด้วย*