Original Article

Childhood overweight and obesity amongst primary school children in Hai Phong City, Vietnam

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Background and Objectives: Childhood obesity is a rising health concern in Vietnam, however, research in this area is not extensive. The aim of this study was to determine the prevalence of childhood overweight and obesity, and to study associations between weight status and selected lifestyle factors, such as diet and physical activity levels, among children aged 6-10 years in Hai Phong City, Vietnam. **Methods and Study Design:** Two hundred and seventy-six children from an urban and a rural primary school participated in this cross-sectional study. Data on weight, height and waist circumference were used to calculate BMI, and waist-height ratio to determine the proportion of children who were overweight, obese and had high central adiposity. Information on diet, physical activity and socioeconomic status of families was collected using questionnaires. **Results:** Prevalences of overweight, obesity and high abdominal adiposity were 11.2%, 10.1% and 19.9%, respectively. Children who completed ≥60 minutes of physical activity daily were 50% and 80% less likely to be overweight and have high abdominal adiposity, respectively. Computer usage increased the odds of overweight and high abdominal adiposity by 4.5 and 3.9 times, respectively. Mothers with higher education and income levels increased the risk of their children being overweight (p<0.05). **Conclusions:** Physical inactivity and high maternal education and income levels increased the risk of childhood overweight and obesity in this cohort. Future interventions should target parents and their children by providing both with educational modules centred on healthy eating habits, parental feeding practices and strategies for increasing physical activity.

Key Words: Vietnam, childhood overweight, childhood obesity, diet, physical activity

INTRODUCTION

Obesity is a major public health concern in many developed and developing countries. It is also a risk factor for the onset of diseases such as type II diabetes, cardiovascular diseases, stroke and other metabolic disorders.[1] Childhood obesity is equally concerning, where excessive fat mass can affect many of the body's systems from an early age.[2] Children who are obese are at greater risk of being obese as adults.[1] In terms of quality of life, obese children can find movement and breathing difficult and uncomfortable. They also tend to be less self-confident with their appearance.

In Asian countries, the emerging problem of overweight and obesity was highlighted more than a decade ago.[3] Determinants such as changing eating habits, food availability, Western dietary influences and lack of physical activity may be the cause of rapid increases in the prevalence of overweight and obesity.[4]

In Vietnam, childhood obesity has been rapidly increasing. In 1995, the prevalence of childhood obesity among primary school children in Ho Chi Minh City was 1.4% according to the CDC definition of obesity (BMI >95th percentile).[5,6] Then, prevalence rose to 10.4% during 2002-2003, 16.3% in 2007,[7] and 20.8% in 2008-2009 (International Obesity Task Force definition of overweight and obesity).[8] Similarly, the figure was 10.4% in Hai Phong City (2000),[9] 5.8% in Nha Trang (2001),[10] and 10.4% in Buon Ma Thuot (2004), according to the World Health Organisation (WHO) definition of overweight and obesity.[11]

To date, there is insufficient data for childhood overweight and obesity in many provinces of Vietnam. Previous studies commonly focused on adults in urban areas rather than in rural areas and in ethnic subgroups.

Recently, the number of children suffering from overweight and obesity in Hai Phong City has grown rapidly, but childhood overweight and obesity research has not been extensive, particularly with regards to prevalence, nutritional quality of diets and physical activity levels between overweight and non-overweight children in urban and rural areas of this region. The lack of data among

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children may adversely impact the efforts of the Vietnamese health care system for childhood obesity control and management. Therefore, while childhood overweight and obesity are a growing concern, further studies are required to identify the particular factors that are associated with Vietnamese children and develop appropriate prevention programs.[12]

The aim of this study was to determine the prevalence of childhood overweight and obesity, and assess associations between weight status and selected lifestyle factors such as diet and physical activity levels, among children in Hai Phong City, Vietnam.

METHODS

Study design and subjects

A cross sectional study was designed and conducted among 276 primary school children and their mothers/primary caregivers in one school in an urban area and the other in a rural area in Hai Phong City, Vietnam in November 2012.

Ethical approval

Ethical approval of the study was obtained from the Ethical Committee of the NIN-Vietnam (ethical approval number: 351/QD-VDD dated 27/6/2012) and the Queensland University of Technology-Australia (ethical approval number: 1200000474).

Sampling and data collection

A representative sample of 276 students was selected using multi-stage cluster sampling. Two schools, Nguyen Van To (urban area) and Cao Nhan (rural area), were randomly selected from the list of all public primary schools in Hai Phong City. In each of the selected schools, 14 boys and 14 girls from each grade were randomly selected from the full class list of students from each grade. Primary care givers of the selected children were sent flyers of the research and the consent forms. Parents who agreed to participate in the study sent back the signed consent to the study team.

There were three stages of data collection. The first stage was between November 5 to 12, 2012 and involved collecting information on diet, physical activity (PA) and parental demographics using a semi quantitative Food Frequency Questionnaire (sqFFQ) and 24 hour Food Recall (24FR); Physical Activity Questionnaire (PAQ) and parenting questionnaire, respectively. Children and parents were asked to fill the forms together in order to fully and reliably provide information of diet and physical activity of children in schools and at home. The next stage of data collection was between November 12 to 16, 2012 for anthropometric assessment and to re-check information from the submitted forms at schools. The final phase was for interviewing children and their mothers regarding any unclear information from questionnaires, through phone calls, from November 19 to 30, 2012. At the end of the data collection, 264 (95.7%) PAQ forms, 251 (90.9%) 24FR forms and 243 (88.0%) sqFFQ forms had been completed.

Anthropometric data

Height was measured to 0.1 cm using the UNICEF's three-piece wooden stadiometer. Weight was measured to 0.1 kg, waist circumference (WC) was measured by non-stretch tape and recorded to the nearest 0.1 cm. Children's weight, height and WC were assessed three times if the first two sessions differed by more than 0.5 kg or 0.5 cm, respectively, and the final results was expressed as the average.

Questionnaires

The sqFFQ asked interviewees about the kinds and the amount of foods consumed. Foods listed included starchy food with an emphasis on rice; kinds of meat including pork, beef, poultry; fast foods and soft drinks; fatty foods consisted of fried noodle, fried rice, fried potato; and sweetened foods such as cakes, candy, and sugar. The sqFFQ is a validated tool, based on the FFQ of the National Institute of Nutrition (NIN) Vietnam, which was used in the national nutrition surveys.

24FR recorded foods and drinks that children consumed in the preceding 24-hour period. The parents were instructed to write down the time, place, names of dishes and the amount of foods that children had consumed, including supplements, in the last 24 hours.

The PAQ was used to collect information for the total minutes that children spent on PA and sedentary activity (SA) in a typical week (five weekdays and two weekend days). The PAQ surveyed various sport such as football, swimming, running, badminton, basketball, wrestling, dancing, volleyball, table tennis; daily physical activities such as walking, doing house chores, transportation to and from school; and sedentary activities such as watching TV, playing games, reading, sitting, access computers, listening to music. The intensity and location of PA, as well as the children's opinion of PA were also surveyed.

Defining overweight and obesity

BMI was calculated using weight in kilograms divided by height in metres squared and converted to Body Mass Index for age z-score (BAZ) based on the WHO reference for children 5-19 years old.[13] If the BAZ of a child was greater than +1 or +2, the child was categorised as overweight or obese, respectively. With regards to waist to height ratio (WHtR), the 90th percentile cut-offs developed by Nambiar et al (2009) was chosen to define high abdominal obesity. These values were 0.532 and 0.531, respectively, for girls and boys aged 5-7 years and 0.557 and 0.540, respectively, for 7-10 years old girls and boys.[14]

Data analysis

A statistician from NIN entered anthropometric data at each school using the WHO Anthro Plus software version 1.0.4, to be able to immediately correct possible errors.

All the questionnaire forms were cleaned and checked by the principal researcher before being double entered to eliminate entry errors. The PA and sqFFQ data were entered and analysed using the Stata version 10 (Stata for windows – Texas, USA). The data of 24FR were entered using dietary software developed by NIN and analysed by the Stata version 10 (Stata for windows – Texas, USA). The indices were analysed by appropriate statistics for the prevalence of childhood overweight and obesity. The

sample was then dichotomized to assess the associations between weight status and diet and physical activity levels, so that overweight and obesity groups were combined and called 'obese' children while children who weighed less than those groups were designated 'non-obese' children.

RESULTS

The age and gender distribution of the children studied are shown in Table 1. There were approximately equal numbers of girls and boys in each school and the age distribution between schools was similar, as was the gender distribution between ages.

Table 1 shows that a significantly higher proportion of children in Nguyen Van To (urban area) than in Cao Nhan (rural area) were overweight and obese and high abdominal adiposity. The proportion of overweight and obese boys was significantly higher than the proportion of overweight and obese girls.

As detailed in Table 2, there were no significant differences in PA or SA between the schools or genders. Surprisingly, it was found that a significantly higher proportion of obese children reported spending more than 60 minutes per day being physically active than non-obese children. Participating in PA ≥60 mins/day had a protective role against overweight and obesity, while computer usage at home was determined as a risk factor. The odds for overweight and obesity and high abdominal adiposity, based on computer usage, were 4.5 (p<0.05, 95% CI: 1.3-15.4) and 3.9 (p<0.05, 95% CI: 1.1-13.6), respectively (Table 4).

Table 3 shows that children in Cao Nhan (rural) consumed starchy foods (excluding rice and including bread, noodles, sticky rice, sweet potato, and potato) more frequently than those in Nguyen Van To (urban). Boys consumed significantly more of these starchy foods and fatty foods than girls. Non-obese children consumed significantly more fatty foods and significantly less meats than obese children. Mean energy intake of the children was 77.8%-93.3% of the daily energy requirements recommended by NIN for children 6-10 years old. The ratios of energy from protein, fat and carbohydrate were 17.4%: 19.9%: 63.8% in Cao Nhan (rural) and 16.3%: 22.5%: 60.3% in Nguyen Van To (urban). Children consumed roughly 70% of their daily requirements of calcium and iron, but 170% of the recommended salt intake. The children in Cao Nhan (rural) consumed significantly less protein, fat and salt than those in Nguyen Van To (urban). The non-obese children consumed significantly less protein, fat, carbohydrate, calcium, iron and salt than the obese children.

Table 4 reports on the associations between selected determinants related health and being overweight and obese. Children from the urban school had an odds ratio that was 5.4 higher than children from the rural school for being overweight and obese. The OR was even higher (12.1) for urban children for high abdominal adiposity. As mothers' education and income levels increased, the

Table 1. Characteristics of sample size and prevalence of overweight, obesity and high abdominal adiposity

Variables		Cao Nhan (n=138)	Nguyen Van To (n=138)	Boys (n=141)	Girls (n=135)	Total
Gender (%)	Girl	49.3	48.6			
	Boy	50.7	51.4			
Age (%)	6 years old	19.6	19.6	18.4	20.7	
	7 years old	18.8	19.6	16.3	22.2	
	8 years old	18.1	17.4	18.4	17.0	
	9 years old	20.3	21.0	23.4	17.8	
	10 years old	23.2	22.5	23.4	22.2	
Overweight (%; 95% CI)		5.8* (2.5; 11.1)	16.7 (10.9; 24.0)	14.9* (8.9; 20.9)	7.4 (2.9; 11.9)	11.2 (7.8; 15.6)
Obese (%; 95% CI)		2.9* (0.8; 7.3)	17.4 (11.5; 24.8)	14.9* (8.9; 20.9)	5.2 (1.3; 8.9)	10.1 (6.9; 14.3)
Abdominal obesity (%; 95% CI)		4.3* (1.6; 9.2)	35.5 (27.6; 44.1)	16.3* (9.9; 22.6)	23.4 (16.4; 30.5)	19.9 (15.4; 25.1)

*p<0.05 (χ^2 test, between Cao Nhan-rural and Nguyen Van To–urban, and boys and girls).

Table 2. Characteristics of mother's education and income, and PA and SA of children

Variable		Cao Nhan (n=130)	Nguyen Van To (n=134)	Non-obese children (n=205)	Obese children (n=59)
Education of mothers (%)	Under high school level	48.5*	14.2	34.6*	18.6
	At least high school level	50.7*	85.9	64.9*	81.4
Income of mothers (%)	<3 VND mil	46.2*	19.4	37.1*	16.9
	≥3 VND mil	53.8*	80.6	62.9*	83.1
PA† (min) (mean±SD)		32.3±24.9	34.9±25.9	32.1±15.4	38.7±24.1
≥60 min/day for PA (%)		11.9	19.9	13.2*	25.0
SA‡ (min) (mean±SD)		118.6±64.3	122.5±58.5	123.7±64.3	108.0±48.6
<120 min/day for SA (%)		61.1	58.6	57.4	70.3

†PA: Physical Activity; ‡SA: Sedentary Activity
*p<0.05 (χ^2 test, between Cao Nhan-rural and Nguyen Van To- urban, and non-obese children and obese children).

Table 3. Percentage of children who consumed typical types of foods daily and nutrient intake of children (mean±SD)

Variable	Cao Nhan (n=115)	Nguyen Van To (n=136)	Boys (n=130)	Girls (n=121)	Non-obese children (n=192)	Obese children (n=59)	Total (n=251)	Recommendations[†]
Rice (%)	92.5	93.6	92.4	89.2	92.2	87.5	91.0	
Other starchy foods[‡] (%)	83.2[*]	71.0	81.1[*]	72.0	76.5	78.2	77.0	
Meats (%)	64.7	57.3	61.4	60.4	57.1[*]	71.9	60.8	
Dairy food (%)	47.5	52.5	42.4	57.6	84.8[*]	15.3	49.8	
Fast-food, soft drinks (%)	28.6	35.5	34.8	29.7	31.3	34.4	32.2	
Fried foods[§] (%)	11.8	6.4	20.4[*]	10.1	10.7[*]	4.7	9.1	
Sweetened foods (%)	66.5	72.6	75.0	63.0	71.5	64.1	69.5	
Energy intake (kcal)	1389.3±294.7	1409.1±355.6	1479.4±349.9[*]	1315.5±282.2	1280.9±239.7[*]	1785.8±279.0	1400±328.8	1500-1800
% energy intake from:								
Protein	17.4	16.3	16.8	16.9	16.9	16.7	16.9	12-14
Fat	19.9	22.5	22.3	20.2	20.2	25.0	21.3	20-25
Carbohydrate	63.8	60.3	61.0	62.8	63.0	58.5	61.9	66-70
Protein intake (g)	56.2±13.0[**]	60.9±16.8	62.2±17.2[**]	55.1±12.1	54.0±12.3[**]	74.3±13.8	58.8±15.4	
Fat intake (g)	31.2±12.1[**]	36.1±17.5	37.7±16.7[**]	29.8±12.9	29.1±11.5[**]	49.5±16.1	33.9±15.4	
Carbohydrate intake (g)	221.1±50.3	210.7±54.8	223.7±53.2[**]	206.7±51.1	201.2±42.5[**]	261.7±57.4	215.4±53.0	
Calcium intake (mg)	459.3±280.0	511.1±240.9	512.7±275.5	460.6±241.1	469.8±249.5[**]	544.8±287.1	487.5±260.2	600-700
Iron intake (mg)	8.4±3.6	8.3±3.6	8.9±4.1[**]	7.8±2.9	7.5±2.7[**]	11.1±4.8	8.4±3.6	8.4-11.9
Salt intake (g)	5.5±5.3[**]	8.0±5.9	7.1±6.2	6.6±5.3	6.3±5.6[**]	8.5±6.3	6.8±5.8	4-5

[†]NIN recommendations for protein intake for children aged 6 years: 29 g/day, 7-9 years: 34 g/day, 10 years: 48 g/day; fat intake: 20-25% the total energy intake; carbohydrate intake: 60-65% the total energy intake.
[‡]Starchy foods included sticky rice, bread, noodles, sweet potato, and potato.
[§]Fried foods included fried rice, fried noodles, and fried vegetables.
[*]$p<0.05$ (χ^2 test, between Cao Nhan-rural and Nguyen Van To- urban, boys and girls, and non-obese children and obese children).
[**]$p<0.05$ (Mann-Whitney test, between Cao Nhan-rural and Nguyen Van To- urban, boys and girls, and non-obese children and obese children).

Table 4. Relationships between the factors that increase or decrease the risk of overweight and obesity and high abdominal adiposity

Factors	OR	*p*	95% CI
Overweight and obese (urban vs rural)[†]	5.4	<0.01	2.6-11.8
High abdominal adiposity (urban vs rural)	12.1	<0.01	4.9-35.8
Overweight and obese (boys compared to girls)[‡]	2.9	<0.01	1.5-5.9
High abdominal adiposity (boys compared to girls)	1.4	>0.05	0.8-2.7
Education of mother for children to be overweight and obese[§]	0.4	<0.05	0.2; 0.9
Education of mother for children to have high abdominal adiposity	0.3	<0.01	0.1–0.7
Mothers' income for children to be overweight and obese[¶]	0.4	<0.01	0.2; 0.7
Mothers' income for children to have high abdominal adiposity	0.4	<0.05	0.2-0.8
Participating in PA ≥60 mins/day with:			
Overweight and obesity	0.5	<0.05	0.2-0.9
High abdominal adiposity	0.2	<0.01	0.1-0.7
Accessing computer with[††]:			
Overweight and obesity	4.5	<0.05	1.3-15.4
High abdominal adiposity	3.9	<0.05	1.1-13.6

[†]Logistic regression (rural=0, urban=1).
[‡]Logistic regression (girls=0, boys=1).
[§]Logistic regression (at least high school level=0, under high school level = 1).
[¶]Logistic regression (above 3 VND million=0, below 3 VND million=1).
[††]Logistic regression (did not assess computer at home =0, accessed computer at home =1).

children were exposed to higher risk of being overweight and obese.

Multiple regression analysis between macronutrient intakes and BAZ of the children revealed that for every 1 gram increase in intake of fat and carbohydrate, the children's BAZ increased by 0.034 and 0.013 units, respectively.

DISCUSSION

The aim of this study was to assess the prevalence of overweight and obesity in two primary schools in Hai Phong City, Vietnam and study the impact of certain lifestyle factors on overweight and obesity risk.

It was found that the prevalences of overweight, obesity and high abdominal adiposity were 11.2%, 10.1% and 19.9%, respectively. This was a significant increase from 2000, where the prevalence of overweight and obesity combined in Hai Phong city, was 10.4%.[9]

There were significantly more children classified as overweight and obese and with high abdominal adiposity in the urban school (Nguyen Van To) than the rural school (Cao Nhan), by factors which ranged from approximately from 3 to 8 times. The rates of overweight and obesity reported in Hai Phong City were higher than the figures in Hanoi City (6.0% in 2002),[15] Binh Thuan province (4.6% in 2008),[16] and in Ho Chi Minh City (10.7% in 2010).[17] This finding provides further evidence for the need of interventions targeting primary school children, for the purpose of preventing obesity and its complications from occurring earlier in life.

In our study, overweight and obesity were significantly more prevalent in boys than in girls ($p<0.05$). The higher prevalence of overweight and obesity in boys could be explained by the different social expectations about weight and body shape for boys and girls. In Vietnam, society typically places more importance on males compared with females,[18] resulting in boys being fed and taken care of very well. This was evident in our study, where boys consumed a greater variety of foods than girls (Table 3).

In terms of dietary intakes, the energy intake of children in the two schools just met 78% of the recommendations of NIN. The low energy intake of children in the given sample could be the result of under-estimation from the children and their parents, particularly among obese children, whose intakes were lower than non-obese children. Under reporting amongst heavier individuals is commonly reported in the literature.[19,20] In addition to this, it must also be noted that children ate lunch in schools, and may not have been able to sufficiently or accurately report the portions consumed for this meal, thus leading to further underestimation.

While there may have been some under-reporting of food intake, children in our study were actually over-consuming salt (6.8 g/day). Overweight children in particular, consumed nearly 8.5 g/day, which is 200% of the NIN recommendation for salt consumption (4-5 g/day) for children aged 6-10 years old.[21] Together with their excessive weight, high salt intake could potentially increase their risk of hypertension much earlier in life, particularly if intake is habitual. In contrast, meat was consumed by approximately three-quarters of the children. As a result, iron was at the lower end of the recommended range. In the long term, this may lead to poor growth and cognitive performance, as well as iron deficiency, which could progress to anaemia. Dairy foods were only consumed by half the sample on a daily basis. As a result, calcium intake was also lower than recommendations. In the long term, this can impact growth and bone development.

Our study also found that participating in PA for more than 60 minutes per day, significantly reduced the odds of being overweight and obese, and having high abdominal adiposity. These results are consistent with a wide range of studies that detected a relationship between PA and childhood overweight and obesity.[8,22,23] For example, Lam et al (2013)[22] reported that PA intervention was able to decrease the prevalence of overweight and obesity in primary school children, from 12.2% to 10.3% in 6 months. One surprising result in our study was that we

found a significantly higher proportion of obese children spending more than 60 minutes per day in physical activity than the non-obese children. This finding was inconsistent with current literature, where typically, obese children were found to be far less active.[23-25] Again, this may have resulted from an overestimation by parents and children about children's physical activity participation. In the literature, self-report of PA is biased and frequently over-reported.[26]

In our study, SA such as using a computer at home was significantly positively related to overweight and obesity. This result was similar to Hong et al (2013), who found that computer use increased the risk of obesity among children in Ho Chi Minh City (OR=2.8, $p<0.05$, 95% CI: 1.4-5.3).[27] However, a meta-analysis conducted on 52 independent samples of children aged 3-18 years old showed that the associations between SA and weight status were small and non-significant[28] while another study found that there was no relationship between them.[29] Thus, further research in Vietnam is needed to investigate the role of SA in the development of childhood overweight and obesity.

In this study, higher education level was associated with greater risk of childhood overweight and obesity. This contradicts current literature, where, higher education levels of parents were associated with lower risk of childhood overweight and obesity.[16,30,31] One explanation could be that in the given social context, parents who received higher education could find a better jobs and command higher incomes. This in turn, could result in less time being spent at home with children and less time spent preparing and providing of healthier meals (for example, greater reliance on fast food).[32] We also found the lower the income level of mothers, the lower odds of children being overweight and obese (OR ranged 0.3-0.4 for overweight and obesity, and abdominal obesity). Again, this is in contrast to what is typically reported in literature.

This study has a number of limitations. As the study was cross sectional in design, it is difficult to determine the temporal associations between the factors. The sample size was also relatively small and just selected from two schools in Hai Phong City. The quality of dietary and PA data could be affected due to the limited capacity of children or the proxy of parents in recalling information. To the best of our ability, all data was reviewed in order to minimise this.

The main findings of this study were that the prevalences of childhood overweight and obesity amongst primary school children in Hai Phong City, Vietnam was at a high level, participation in PA of at least 60 minutes a day protected against overweight, obesity and high abdominal adiposity, and children of mothers with higher education and income level were at higher risk of being overweight and obese. Although the direction of associations was not evident, the study supports that future interventions should be designed as education modules targeting parents and children. The focus of these modules should be principles of healthy eating, increasing physical activity levels, positive child eating behaviours and positive parental feeding practices.

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AUTHOR DISCLOSURES

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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