Original Article

Gender and socio-economic differences in BMI of secondary high school students in Ho Chi Minh City

Hong K. Tang PhD, MSc, MD[1], Michael J. Dibley MPH, MB BS[2], David Sibbritt PhD MSc[2] and Hanh M.T. Tran PhD, MD[3]

[1]*Department of Community Health, University Training Centre, Ho Chi Minh City, Vietnam*
[2]*Centre for Clinical Epidemiology and Biostatistics, Faculty of Health, University of Newcastle,Callaghan, NSW, Australia*
[3]*Department of Community Nutrition, Nutrition Centre, Ho Chi Minh City, Vietnam*

Objective: To assess the nutritional status of adolescents in Ho Chi Minh City, and in particular determine the prevalence of overweight and obesity in adolescents across different sub groups, based on gender, household economic status and geographic location. Design: A cross-sectional survey based on a two-stage cluster sampling design. Setting: Secondary high schools in Ho Chi Minh City. Subjects: There were 1504 adolescents involved in the study, of which 50% were girls and the mean age of participants was 13.1 years. Results: Overall, 4.9% of the students were overweight and 0.6% were obese, while 13.1% of the students were underweight. The prevalence of underweight was significantly higher in boys than girls (p=0.001) and overweight and obesity were also higher in boys although these differences were not statistically significant (p=0.074). There was a much higher prevalence of overweight and obesity in students from schools in wealthy urban districts (8.2% and 0.6%, respectively) in comparison to students from schools in rural or semi-rural districts (1.6% and 0.2%, respectively) and these differences were statistically significant (p<0.001). Conclusions: A transition in nutritional status is underway in this population of adolescents where overweight and obesity are emerging as a public health problem, but underweight remains a significant problem.

Key Words: Obesity, body mass index, anthropometry, adolescent, Vietnam

Introduction

Overweight and obesity in children and adolescents has increased significantly in developed countries over the last decade, with the highest prevalence found in the United States.[1-5] A trend of increasing prevalence of overweight and obesity has also been reported in developing countries especially in urban populations.[6-12] This global epidemic represents a major public health problem, due to the consequences of childhood obesity both during childhood and adult life[13, 14] and the resulting heavy burden on health services.[15]

Until recently, problems of chronic non-communicable diseases were not considered to be public health problems in most developing countries. However, in East Asia and South East Asia, rapid urbanisation and socio-economic development are leading to changes in diet and activity patterns which are promoting a nutrition transition and the emergence of obesity in both children and adults.[16-19] In Thailand, the prevalence of obesity in school children has increased dramatically. Results from periodic surveys from 1992 to 1994 in Bangkok showed the prevalence of overweight and obesity among school children (aged 6-12 years old) in low, middle and high income families was 11.2%, 25.7% and 27.4%, respectively. After three years of follow-up, the prevalence had increased to 14.6%, 28.1%, and 32.3%, respectively.[16] Reports from Malaysia also revealed that at a population level, a high prevalence of obesity resulted from a complex interaction between an inherited metabolic predisposition to fatness, and changes in the population's lifestyle resulting from economic development.[17] A study of male adolescents from Malaysia carried out in the same four schools in 1990 and again in 1997 revealed an increase in the prevalence of obesity from 1% to 6%.[20] In India, a study found that urbanisation was influencing dietary patterns and contributing to changing trends in chronic diseases, including obesity.[21] The study highlighted the high prevalence of overweight in adolescents in urban India and that life style factors influenced BMI in adolescents. Similarly, overweight, especially in girls was identified as an epidemic health problem among adolescent students in Tehran, Iran.[10]

Corresponding Author: Dr Hong K. Tang, Department of Community Health, University Training Centre for Health Care Professionals, 520 Nguyen Tri Phuong, Ho Chi Minh City, Vietnam.
Tel: + 84 8 8631383; Fax: + 84 8 8650025
Email: hongutc@yahoo.com
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The prevalence of overweight among girl students was significantly higher (23.1%) than that among boys (18.8%) even after adjustment for age. In Taiwan, the Taipei Children Heart Study showed that from 1988 to 1994, mean body weight of children aged 12 to 15 years old increased significantly over increases in body height (especially in boys). Although the percentage of overweight children remained steady from 1988 to 1994 in both genders, the prevalence of obesity increased significantly, especially among boys and older girls.[22]

Recent surveillance reports from urban areas of Vietnam suggest that the prevalence of overweight and obesity in children and adolescents is increasing,[23-25] although there are no published reports of the extent of the problem. Vietnam faces an increasing diversity of nutritional problems. In rural populations childhood malnutrition remains the dominant problem, with 28% of children under five reported to be underweight in 2003 (National Institute of Nutrition). In contrast, in the rapidly growing urban populations, an economic transformation has led to the introduction of new environments and life styles with the potential to promote obesity. A 'nutrition transition' is characterised by rapid changes in nutrition status in a portion of the population, leading to a situation where both malnutrition and an emerging problem of obesity can be found in child and adult populations within a single city, neighbourhood and even family.[26, 27] This study aimed to assess the nutritional status of adolescents in Ho Chi Minh City, which is the largest and most rapidly growing urban area in Vietnam. In particular, we wanted to estimate the prevalence of overweight and obesity in adolescents and across different sub groups, based on gender, household economic status and geographic location, within this population.

Methods

Study design and setting

A cross-sectional survey was conducted throughout secondary high schools in Ho Chi Minh City between November and December 2002. The primary respondents were junior high school students. The reference population of this study was Vietnamese adolescents aged 11-16 years of both gender living in HCMC, Vietnam. The sampled population was junior high school students of both gender aged 11-16 years living in HCMC. The City is divided into four administrative levels; districts, wards, quarters and hamlets. Districts in HCMC have been classified into urban, sub-urban and rural districts. There are 22 districts in Ho Chi Minh City, of which four are wealthy urban districts, eight are less wealthy urban districts and ten are rural and semi-rural districts.[28] In urban areas there were 140 schools with 155,850 students while in the semi rural and rural areas there were 100 schools with 91,376 students.[29]

Sampling and subjects

As the primary objective of the survey was to collect information about nutritional status including anaemia in junior high school students, the sample size was calculated using the formula for estimating single proportions. The sample size estimate was multiplied by two to account for the design effect from the cluster sampling method used, giving a total estimated sample size of 1200 students. The sample was further expanded to 1500 to allow for survey data loses. This sample size was large enough to estimate the prevalence of high BMI in the population with a precision of 5%.

A two-stage cluster sampling design was used. In the first stage 30 schools (clusters) were randomly selected from 140 secondary high schools across the city using probability proportionate to population size sampling (PPS). In the second stage, 25 male students and 25 female students were chosen by systematic random sampling from each school selected in stage one.

Questionnaire

In this study, students were asked to answer a questionnaire that investigated household economic data, the number of children in the family, the student's usual frequency of intake of selected foods, their recent disease history and knowledge about anaemia symptoms. To investigate the household economic status, the students were asked to indicate household ownership of 12 types of assets including bicycles, motorbikes, televisions, radios, videos, cassette players, computers, gas stoves, CD players, cars, fax machines, and air-conditioners.

Anthropometric assessment

The anthropometric measurements were taken by two trained data collectors. These measurements were standardised before and during the data collection. Weight was measured with shoes and heavy clothes removed using an electronic digital scale. Weight was measured by Tanita electronic scale (Tanita BF 571, Tanita Corporation, Japan) and was recorded to the nearest 100g. Standing height was measured with a suspended Microtoise tape to the nearest 0.1 cm using standard methods.[30]

Statistical Analysis

Body mass index (BMI) was calculated as weight/height^2 (kg/m^2) and BMI cut off values were used to define overweight and obesity. The cut off values were determined by converting BMI of 25 and 30 kg/m^2 for children aged 18 years into an exact Z score from a BMI for age reference, which was constructed from six large nationally representative cross sectional growth studies using LMS growth curve methods.[31, 32] These cut off values, or Z score curves which are equivalent to the traditional adult BMI cut off values, have been widely used to define overweight and obesity in children and adolescents.[5, 33-38] There are no universally accepted definitions of underweight for adolescents. In this paper underweight adolescents were identified by low BMI which was defined as a BMI Z score derived from the CDC growth reference <-2SD.[30] All data was checked for missing values and outliers and was cleaned prior to data analysis. Analysis was undertaken using Stata version 9.0 with appropriate "svy" commands to adjust for the cluster sampling design (Stata Corp Tx).

In this survey, the proportionate to population size sampling was used to ensure that the sample was self weighted. Nonetheless, sampling weights were calculated to confirm that the sample was self weighted. These weights were used in the analyses although they indicate

that a nearly self-weighted sample was selected using the PPS sampling method.

To assess economic status, ownership of twelve different assets (bicycles, motorbikes, televisions, radios, video cassette players, computers, gas stoves, CD players, cars, fax machines, air-conditioners) was used to construct a household wealth index using the principal components method to assign a weight for each asset.[39] Principal component analysis is a method of finding patterns using relationships between variables. "The aim of principal components analysis is to explain as much of the total variance of the data as possible with as few factors or principal components as possible".[40] A wealth index was constructed using methods recommended by the World Bank Poverty Network and UNICEF, and described by Filmer & Pritchett 1998.[39] The first principal component output was used as a scoring factor to weight each of the assets or facilities in the wealth index.

The index was ranked and divided into five categories and each household was assigned to one of these wealth index categories from poorest to the richest. This wealth index was used to rank families by their wealth status and to assess relationships between household wealth and nutritional status.

Using two tailed significant tests, categorical data was tested with Pearson chi-square, normally distributed continuous data with Student's *t*-test. One way ANOVA was applied to test for differences of mean weight, height, BMI among different groups of age. The Bonferroni test was conducted for pair-comparisons as needed. The prevalence of BMI categories and their 95% confidence intervals were calculated, as well as BMI distributions (central tendency and spread) for each geographic area surveyed, urban versus rural residence, and by household economic status, gender and age group.

Ethical clearance

The cross-sectional study conducted in 2002 was approved by the research committee of the Ho Chi Minh City Health Department. The secondary data analysis was approved by Human Research Ethics Committee of the University of Newcastle in 2003 (HREC Approval No: H-704-1103). All aspects of the study were conducted in accordance with internationally agreed ethical principles for the conduct of medical research.

Results

There were 1,505 students enrolled in this study, of which 50% were girls. The information from one student who was over 18 years of age was deleted leaving 1504 participants. The mean age of the students surveyed was 13.1 years. Two thirds of the participants were studying in urban schools. Anthropometry was collected from all the adolescents recruited into the survey. The mean weight, height and BMI for each age group are presented in Table 1. As expected the mean weight, height and body mass index progressively increased with age for both males and females. Furthermore, the mean weight, height and body mass index were significantly different across age groups for each gender ($p< 0.001$).

Table 2 shows that both underweight and overweight-obesity coexist in this population, where 4.9% and 0.6% of the students were overweight and obese, respectively. Nevertheless in the same population 13.1% of the students were underweight. The prevalence of underweight was significantly higher in boys than girls ($p= 0.001$) and overweight and obesity were also higher in boys than in girls although these differences were not statistically significant ($p= 0.074$).

Students from schools in rural or semi-rural districts had a higher prevalence of underweight than students from schools in wealthy urban districts, although the difference was not statistically significant (Table 2). The relationship was reversed for overweight and obesity, and there was a much higher prevalence of overweight in students from schools in wealthy urban districts (8.2% and 0.6%, respectively) in comparison to students from schools in rural or semi rural districts (1.6% and 0.2%, respectively) and these differences were statistically significant ($p< 0.001$). There was a similar difference for the prevalence of obesity in students from schools in wealthy urban districts, in comparison to students from rural and

Table 1. Mean weight (kg), height (cm) and BMI (kg/cm2) by gender and one-year age groups for adolescents in Ho Chi Minh City, 2002 (n = 1504)

Characteristics	Weight (kg) Mean (95%CI)	Height (cm) Mean (95%CI)	BMI (kg/m^2) Mean (95%CI)	Total number of adolescents
Boys				
≤ 11 years	33.3 (31.6, 35.0)	140.0 (138.6, 141.5)	16.8 (16.2, 17.3)	165
12 years	35.4 (34.1, 36.7)	145.1 (143.8, 146.5)	16.7 (16.3, 17.0)	186
13 years	42.0 (40.5, 43.5)	153.4 (151.9, 154.9)	17.7 (17.3, 18.0)	172
≥ 14 years	45.5 (43.2, 47.8)	158.9 (157.5, 160.4)	17.9 (17.3, 18.5)	230
Girls				
≤ 11 years	33.5 (32.4, 34.6)	142.6 (141.2, 143.9)	16.3 (16.0, 16.7)	174
12 years	36.2 (34.9, 37.4)	146.4 (145.1, 147.7)	16.7 (16.3, 17.2)	196
13 years	40.0 (38.6, 41.4)	150.5 (149.4, 151.6)	17.6 (17.1, 18.0)	167
> 14 years	43.0 (41.9, 44.2)	152.7 (151.9, 153.6)	18.4 (18.0, 18.0)	214

Table 2. Prevalence of underweight, overweight and obesity among adolescents by gender, age group, school location and household wealth status in Ho Chi Minh City, 2002 (n = 1504)

Characteristics	Under weight* % (95% CI)	Overweight# % (95% CI)	Obese# % (95% CI)	Mean BMI (95% CI)	Number of adolescents
Gender (%)					
Male	16.0 (13.0, 19.0)	5.8 (3.8, 7.9)	0.9 (0.2, 1.7)	17.3 (17.0, 17.6)	753
Female	10.3 (7.5, 13.0)	4.1 (2.7, 5.6)	0.3 (0.0, 0.6)	17.3 (17.0, 17.6)	751
Age (%)					
<12 years	12.1 (8.2, 16.0)	7.3 (4.1, 10.6)	0.6 (0.0, 1.5)	16.5 (16.2, 16.9)	339
12 years	14.7 (10.7, 18.6)	5.0 (2.6, 7.4)	0.3 (0.0, 0.8)	16.7 (16.4, 17.0)	382
13 years	11.2 (7.0, 15.5)	4.1 (2.1, 6.1)	1.2 (0.1, 2.3)	17.6 (17.3, 17.9)	339
>14 years	14.0 (10.5, 17.5)	3.8 (2.0, 5.6)	0.5 (0.0, 1.1)	18.1 (17.8, 18.5)	444
School location (%)					
Wealthy urban districts	9.4 (4.0, 14.7)	8.2 (4.0, 12.5)	0.6 (0.0, 1.6)	17.9 (17.3, 18.4)	352
Less wealthy urban districts	13.4 (10.6, 16.1)	5.8 (4.0, 7.7)	0.9 (0.2, 1.7)	17.5 (17.1, 17.8)	651
Rural & semi-rural districts	15.4 (10.7, 20.0)	1.6 (0.8, 2.4)	0.2 (0.0, 0.6)	16.7 (16.4, 17.0)	501
Household wealth index (%)					
Poorest (1st quintile)	19.7 (15.1, 24.3)	2.3 (0.5, 4.2)	0.3 (0.0, 1.0)	16.4 (16.1, 16.7)	299
2nd quintile	13.9 (9.2, 18.6)	2.4 (0.3, 4.5)	0.0	16.9 (16.6, 17.2)	252
3rd quintile	14.9 (10.6, 19.2)	5.1 (2.8, 7.4)	0.6 (0.0, 1.4)	17.1 (16.7, 17.4)	350
4th quintile	10.9 (6.6, 15.2)	6.8 (4.0, 9.6)	1.0 (0.0, 2.2)	17.8 (17.4, 18.2)	294
Richest (5th quintile)	6.2 (3.3, 9.0)	7.7 (4.0, 11.5)	1.0 (0.0, 2.1)	18.3 (17.9, 18.7)	309
Total (%)	13.1 (10.8, 15.4)	5.0 (3.7, 6.3)	0.6 (0.2, 1.0)	17.3 (17.0, 17.5)	1504

* BMI Z score < -2; # Cut off values are defined by IOTF

semi-rural districts (Table 2), but the difference was not statistically significant (p= 0.354).

As expected, the prevalence of underweight progressively increased as household wealth decreased and the difference between the richest and poorest households was statistically significant (p= 0.001). The pattern for overweight was in the reverse direction and there was no overlap of the confidence intervals between any of the household wealth index categories. Although there was a similar trend of increasing prevalence of obesity with increasing household wealth, the differences were not statistically significant.

As seen in Table 3, the prevalence of underweight was higher in boys than in girls although there was no age pattern evident. As with underweight, the prevalence of overweight and obesity was higher in boys than in girls.

In Table 4, the prevalence of overweight and obesity was classified according to the location of the schools where the students were studying. Students studying at schools located in wealthy urban areas were more likely to be overweight and obese than those studying at schools in less wealthy urban areas and rural areas.

In the Table 5, the prevalence of overweight and obesity is classified according to gender and the economic status of the adolescent's family. The prevalence of underweight was significantly higher in both boys and girls from the poorest households compared to the adolescents from the richest households. The pattern was reversed for overweight, especially in boys. The prevalence of obesity was too low to assess the pattern by gender and household economic status.

The entire BMI-for-age distribution for adolescents in Ho Chi Minh City by household wealth group compared to the reference distribution is illustrated in Figure 1. This

Table 3. Prevalence of underweight, overweight and obesity by gender and age groups in adolescents in Ho Chi Minh City, 2002 (n = 1504)

Characteristics	Under weight[a] (95% CI)	Over weight[b] (95% CI)	Obese[c] (95% CI)
Male			
≤ 11 years old	14.6 (8.5, 20.6)	10.9 (5.0, 16.7)	1.2 (0.0, 3.0)
12 years old	18.3 (12.2, 24.4)	4.3 (1.2, 7.4)	0.5 (0.0, 1.6)
13 years old	11.1 (6.2, 16.0)	6.4 (2.7, 10.0)	1.2 (0.0, 2.8)
≥ 14 years old	18.7 (11.8, 25.6)	3.0 (0.4, 5.6)	0.9 (0.0, 2.0)
Female			
≤ 11 years old	9.8 (5.1, 14.4)	4.0 (0.7, 7.3)	0..0
12 years old	11.2 (6.3, 16.1)	5.6 (1.8, 9.4)	0.0
13 years old	11.4 (5.1, 17.6)	1.8 (0.0, 3.8)	1.2 (0.0, 2.9)
≥ 14 years old	8.9 (5.2, 12.6)	4.7 (2.1, 7.3)	0.0

[a] BMI Z score < -2; [b,c] Cut off values are defined by IOTF

Table 4. Prevalence of underweight, overweight and obesity by gender and school location in adolescents in Ho Chi Minh City, 2002 (n = 1504)

Characteristics	Under weight[a] (95% CI)	Over weight[b] (95% CI)	Obese[c] (95% CI)
Male			
Wealthy urban districts	11.5 (4.6, 18.5)	10.4 (3.6, 17.2)	1.2 (0.0, 3.3)
Less wealthy urban districts	18.1 (13.8, 22.5)	6.5 (3.8, 9.3)	1.2 (0.1, 2.3)
Rural & semi-rural districts	16.0 (10.7, 21.2)	1.6 (0.0, 3.4)	0.4 (0.0, 1.2)
Female			
Wealthy urban districts	7.3 (1.9, 12.6)	6.1 (2.2, 10.0)	0.0
Less wealthy urban districts	8.3 (5.3, 11.2)	5.1 (2.6, 7.5)	0.6 (0.0, 1.5)
Rural & semi-rural districts	14.8 (8.7, 20.9)	1.6 (0.2, 2.9)	0.0

[a] BMI Z score < -2; [b,c] Cut off values are defined by IOTF

Table 5. Prevalence of underweight, overweight and obesity by gender and household economic status in adolescents in Ho Chi Minh City, 2002 (n = 1504)

Characteristics	Under weight[a] (95% CI)	Over weight[b] (95% CI)	Obese[c] (95% CI)
Male			
Poorest (1st quintile)	24.0 (17.9, 30.1)	2.1 (0.0, 4.5)	0.7 (0.0, 2.1)
2nd quintile	14.8 (8.1, 21.4)	2.6 (0.0, 6.5)	0.0
3rd quintile	19.2 (12.7, 25.8)	4.6 (1.4, 7.9)	0.6 (0.0, 1,8)
4th quintile	15.4 (8.1, 22.7)	7.7 (3.3, 12.0)	1.9 (0.0, 4.1)
Richest (5th quintile)	6.7 (2.5, 11.0)	11.0 (4.7, 17.2)	1.2 (0.0, 3.0)
Female			
Poorest (1st quintile)	15.7 (9.3, 22.0)	2.6 (0.2, 5.0)	0.0
2nd quintile	13.1 (6.9, 19.3)	2.2 (0.0, 4.8)	0.0
3rd quintile	10.7 (5.4, 15.9)	5.6 (2.1, 9.2)	0.6 (0.0, 1.7)
4th quintile	5.8 (2.3, 9,3)	5.8 (2.3, 9.4)	0.0
Richest (5th quintile)	5.5 (1.5, 9.6)	4.1 (0.7, 7.5)	0.7 (0.0, 2.1)

[a] BMI Z score < -2; [b,c] Cut off values are defined by IOTF

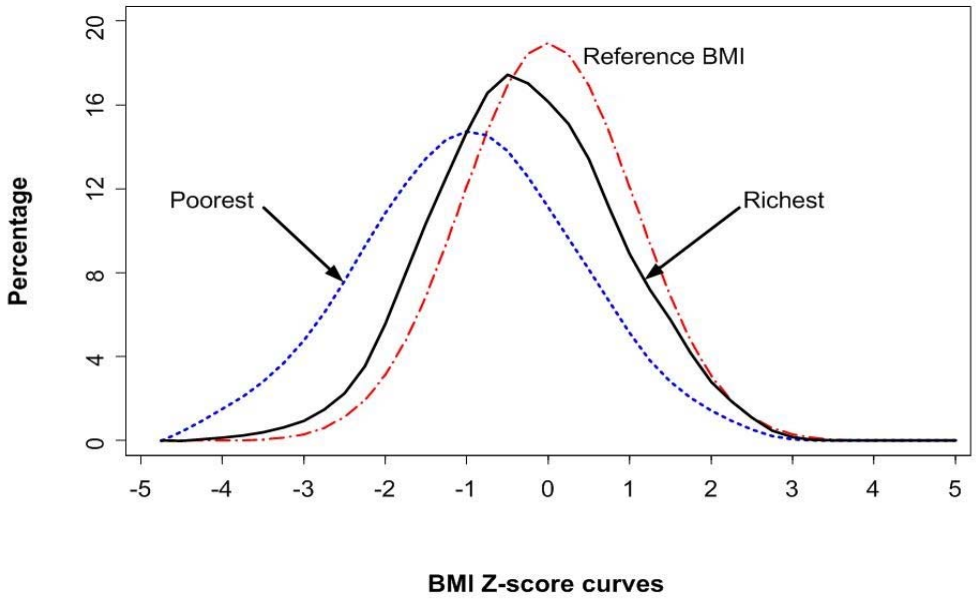

Figure 1. BMI z-score curves by poorest versus richest group

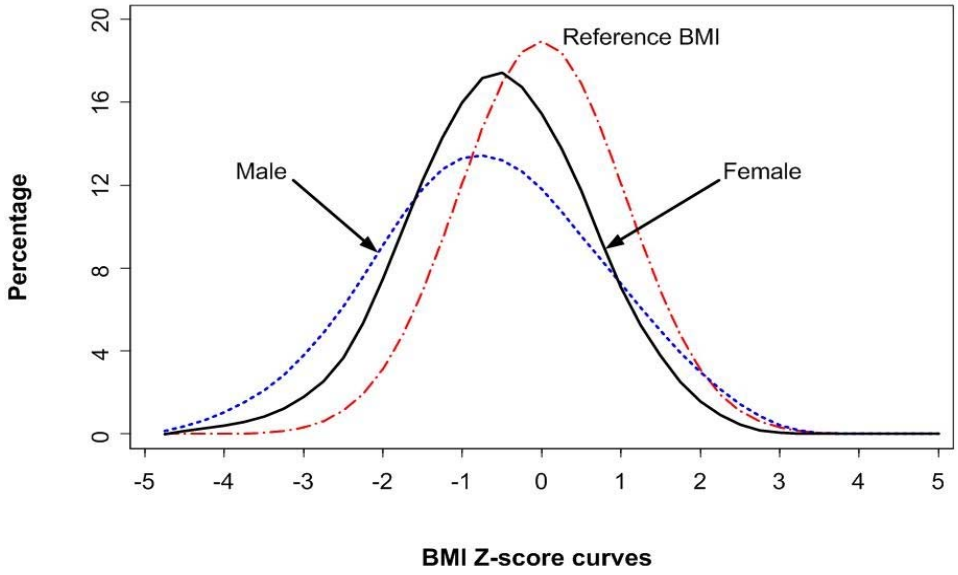

Figure 2. BMI z-score curves by males versus females

This plot reveals that the Z-score curve for BMI-for-age for the children from the poorest households is shifted more to the left than that of the children from the richest households, indicating more underweight children among the children from poorest households. However, both Z-score curves were shifted to the left of the reference curve indicating a trend toward underweight of the population in 2002. Furthermore, in poorest group the shape of the curve suggests a higher rate of underweight than overweight.

The entire BMI-for-age distribution for adolescents in Ho Chi Minh City by gender compared to the reference distribution is illustrated in Figure 2. This plot reveals that the Z-score curve for BMI-for-age for males was wider at both ends of the distribution, but especially on the right hand side (indicating a shift toward overweight/obesity). The shape of the BMI-for-age Z-score curve for females was similar to the shape of the reference curve, though it was shifted to the left. These results indicate there was more overweight and underweight in boys than in girls.

Discussion

The overall prevalence of underweight, overweight and obesity in this representative sample of secondary high

school students of Ho Chi Minh City was 13.1%, 4.9% and 0.6%, respectively. The prevalence of underweight, overweight and obesity was higher in males (16.0%, 5.8%, 0.9%, respectively) compared to females (10.3%, 4.1%, 0.3%, respectively). The prevalence of overweight was higher in richer households and urban schools whereas the prevalence of underweight was higher in poorer families and rural schools.

This is the first study to describe the prevalence and examine the socio-demographic factors associated with overweight and obesity in adolescents in Ho Chi Minh City, Vietnam. The finding of a coexistence of both over-nutrition and under-nutrition in adolescents in Ho Chi Minh City in 2002 provides evidence of an early nutrition transition. This nutrition transition is mainly taking place with boys and in wealthy households.

A number of difficulties were encountered when trying to compare the findings from our survey in Ho Chi Minh City with the results from other countries. The estimates of prevalence of underweight, overweight and obesity from different countries were based on different reference data, different cut off values, and different indicators[41] making cross country comparisons complicated. A further difficulty was the limited number of reported surveys assessing overweight and obesity in adolescents from Asia.

A two year follow up study from Thailand reported the prevalence of obesity of school children, as defined by weight-for-height > 120% of the Bangkok reference, rose from 12.2% in 1991 to 15.6% in 1993.[42] A cross-sectional study conducted in an affluent area in New Delhi, India reported the overall prevalence of overweight and obesity according to IOTF cut offs as 24.7% and 7.4% respectively. Even though it is difficult to make comparisons with the other studies, it does appear that the prevalence of overweight and obesity in Ho Chi Minh City in 2002 was lower than that for other developing countries in the Asia region. The lower prevalence of overweight and obesity found in Ho Chi Minh City indicates the nutrition transition is at an early stage where underweight remains more prevalent than overweight. The study in Ho Chi Minh City included students from rural areas that have a lower prevalence of over-nutrition, whereas several of the studies conducted in other countries were restricted to urban populations.

Similar to many countries in Asia, this study found overweight and obesity was more prevalent in boys than in girls. In China (mainland), a higher prevalence of both underweight and overweight was found for boys compared to girls, but the differences were not significant.[33] A study from Taiwan found trends of obesity increased significantly especially among boys and older girls.[22] In urban India the prevalence of overweight in adolescents was higher in boys then in girls but no gender difference was seen for obesity.[21]

The results of many studies[3, 4, 43] including a systematic review[5] confirms that the prevalence of overweight and obesity is particularly high in countries located in North America, Great Britain and Europe, and Pacific countries such as Australia and New Zealand. Although the increase in overweight and obesity in HCMC is an alarming phenomenon, the overall level of child overweight and obesity in HCMC is still far lower than in most western countries.

An examination of the height of the boys and girls in the survey revealed that the mean height of the girls was higher than that of boys for age groups less than 13 years, but thereafter the boys were taller. This finding suggests the girls had an earlier pubertal growth spurt than the boys. Similar results were also found among girls in Quang Binh – a province in the north of Vietnam.[24] In general, the increase of weight and height in male students was more rapid than that of female students. The weight, height and BMI of the male and the female adolescents in Ho Chi Minh City was lower than for boys and girls of the same age in Taiwan and in India.[21, 22]

In the present study higher rates of overweight were found in schools located in wealthy urban districts than in less wealthy urban districts and rural areas. In fact, many schools in wealthy urban districts are classified as "standard schools" and most students from higher socioeconomic class families want to study at these schools because of their high academic standards and well-equipped facilities. As seen in Table 5, the prevalence of overweight was higher among children from wealthier households, which in part explains the higher prevalence of overweight in students studying at schools in wealthy urban districts. However, the special characteristics of these schools in wealthy districts, in which academic achievement is emphasised over all other school activities including sports and physical education, may also in part explain the higher prevalence of overweight in these schools. Similar results have been reported recently from Xi'an, China where the prevalence of overweight and obesity was 2.7 times higher in adolescents studying in schools located in urban compared to rural areas.[44]

An increased risk of being overweight/obese was found in the adolescents from wealthier households, a finding similar to that seen in other developing countries.[8, 21, 45-47] In contrast to developed countries, where the risk of being overweight and obese in adolescents is related to low economic status[34, 45, 48-54] the survey in Ho Chi Minh City observed the reverse association between overweight and obesity and household wealth. These findings from Ho Chi Minh City were similar to those from other developing countries, where the risk of being overweight and obese increased with increasing household income[8, 55] or an index of household wealth.[44]

Findings of the present study should be interpreted keeping in mind the following limitations of the study. Firstly, this survey was designed to determine the prevalence of anaemia, and hence there were a limited number of co-variables measured because the survey was not specifically designed as an assessment of overweight and obesity in adolescents. The survey did not consider the more proximate determinants of overweight and obesity such as diet, activity and maturation that may vary by socioeconomic variables and in turn affect the risk of being overweight and obese. Secondly, the household assets used to assess household economic status were obtained from interviewers of the adolescents rather than their parents and may not have been adequate in scope (only twelve assets were recorded and characteristics of the household's dwelling were not included) to fully

characterize household wealth.

In conclusion, the findings from this study reveal that a transition in nutritional status is underway in this population of adolescents where overweight and obesity are emerging as a public health problem, but underweight remains a significant problem. Further assessments of nutritional status are needed to define the rate of increase in overweight and obesity and decline in underweight in this population of adolescents.

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Original Article

Gender and socio-economic differences in BMI of secondary high school students in Ho Chi Minh City

Hong K. Tang PhD, MSc, MD[1], Michael J. Dibley MPH, MB BS[2], David Sibbritt PhD MSc[2] and Hanh M.T. Tran PhD, MD[3]

[1]*Department of Community Health, University Training Centre, Ho Chi Minh City, Vietnam*
[2]*Centre for Clinical Epidemiology and Biostatistics, Faculty of Health, University of Newcastle,Callaghan, NSW, Australia.*
[3]*Department of Community Nutrition, Nutrition Centre, Ho Chi Minh City, Vietnam*

胡志明市初中學生 BMI 之性別與社經狀況差異

目的：評估胡志明市的青少年營養狀況，尤其是性別、家戶經濟狀況和地理位置各子群的青少年過重及肥胖的盛行率。設計：兩階段集束抽樣設計之橫斷性調查。地點：胡志明市初級中學。對象：共有 1504 名青少年參與本研究，50%為女生，平均年齡為 13.1 歲。結果：整體來看有 4.9%學生為過重、0.6%為肥胖，而有 13.1%的學生過輕。男生的過輕盛行率顯著高於女生(p<0.001)，男生的過重及肥胖也較高，雖然未達統計上顯著差異(p=0.074)。就過重或肥胖的盛行率而言，富裕城市地區的學生(分別為 8.2% 及 0.6%)比起鄉村或是半鄉村地區的學生(分別為 1.6% 及 0.2%)為高，且達統計顯著意義(p<0.001)。結論:這個族群的青少年營養狀況變遷正在進行中，過重及肥胖是新興的公共衛生問題，然而過輕仍然是重要的問題。

關鍵字：肥胖、身體質量指數、體位測量、青少年、越南。