

Factors Affecting High School Overweight Students in Pattani Province of Thailand

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Abstract: A cross sectional study was conducted to investigate the relationship between body mass index (BMI) and demographic and environmental factors among public high school students in Pattani Province. The results show that BMI is related to age group, sex, religion group, birthplace and parents' income. The prevalences of overweight and obesity of non-Muslim students are 8.7% and 3.0%, respectively. For Muslim students, these prevalences are 4.3% and 1.0%, respectively. The process of development childhood obesity could vary in populations with different cultural backgrounds. Therefore, it would be useful to examine the cultural factors influencing the development of childhood obesity.

Key words: Overweight, obesity, body mass index

Introduction

Childhood obesity is an increasing health problem in developed countries, and is of growing concern in developing countries. An increase in childhood obesity has been reported in Asian countries, including Korea, Singapore, Malaysia, Indonesia and Thailand.

Obesity is defined as a condition where fat has accumulated to such an extent that health is adversely affected. Although several proxy measures for adiposity and obesity related risk exist, BMI is currently the measure of choice for defining childhood obesity. BMI is defined as weight in kilograms divided by the square of height in meters. It is cheap, easy to measure, reproducible and fairly well correlated with fatness. However, it is associated with more drawbacks in children than in adults, because, for example, age, sex, and maturation varies within and between populations (Neovius *et al.*, 2004).

A great number of studies have investigated factors related to obesity but very few have been conducted in mix cultural background area. Findings in a big city studies may not be applicable to a largely non-metropolitan region like Pattani Province.

Materials and Methods

Subjects: In this study, there were 9393 students in public high schools in Pattani province in 2004 whose heights and weights are available in the database. The total number of students attending high schools in 2004 was 9537, so our study sample comprises 98.5% of the total.

Data: The variables of interest for this study comprise 12 determinants and one outcome. The variables may be divided into two groups. Outcome is BMI and

determinants are demographic and socio-economic and environmental factors. The demographic factors are sex and age. The other factors comprise religion, parent status, level year, school, birth place, school district, relation of student and parents, father's income, mother's income and parent's income.

Statistical analysis: Graphical and statistical methods used are correlation coefficients, t-tests, chi-squared tests, odds ratios, one-way analysis of variance and multiple regression analysis.

Data Transformation: BMI and parents' income are right-skewed so we use a logarithmic transformation of the form $\ln(\text{BMI}-c)$ where c is constant chosen to induce symmetry for BMI, and we use $x' = \log(x+1)$ for parents' combined income because these data have zero values.

Imputing Missing Data: This study had a substantial proportion of missing data for parents' combined incomes, coded as zeroes. To impute values, the association with age group and religion group is used, by fitting a multiple linear regression model of this outcome (parents' combined income) with age group and religion group as predictors.

Formula for Adjusted BMI: The linear regression model to $\ln(\text{BMI}-8)$ using the variables (1) (age, sex, religion) group, (2) birthplace, and (3) parents' combined income with 0s imputed. The expected value of the BMI is then calculated by assuming that $\ln(\text{BMI}-8)$ is normally distributed with mean m and standard deviation s , say, and consequently BMI has a lognormal distribution with mean $\exp(m+s^2/2)$.

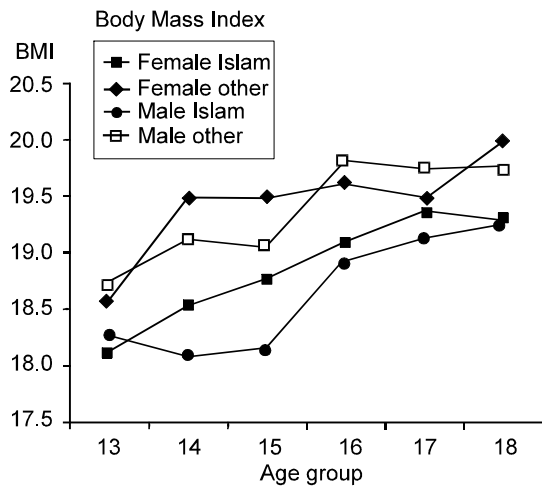


Fig. 1: Age patterns of BMI from the data

Age Patterns of BMI: In this study we created two age patterns of body mass index for the four groups, female Islam, male Islam, female other, and male other religion, with any age group. The first pattern is base on the collected data and the second is base on the adjusted BMI for age, sex, religion, parent’s combined income, and birth place.

The Pattani province’s BMI map: We also created two schematic range map of body mass index of all students in the various birth places in Pattani province. The first map is calculated directly from the collected data and the second is calculated from the expected values of BMI, based on the average of referent median (age, sex, religion) group, namely 15 year-old students with the average parent’s combined income, that is, with the value of $\ln(\text{parents' income})$ equal to 8.736.

Definitions of overweight and obesity: We can define overweight and obesity in non-adult person using the international cut-off points for body mass index for overweight and obesity by sex between 2 and 18 years, estimated to have body mass index of 25 and 30 kg/m^2 at age 18, obtained by averaging data from Brazil, Great Britain, Hong Kong, the Netherlands, Singapore, and the United States (Cole *et al.*, 2000) to classify group of the students into three groups (1: normal, 2: overweight but not obese, and 3: obese). For normal students the BMIs are lower than the cut off value for overweight, for overweight (but not obese) students the BMIs are between the cut-off values for overweight and obesity, and for obese students the BMIs are greater than the cut-off value for obesity. These cut-off values depend on age and sex. We use the body mass index for age 12.5 years for the age group 12-13 years in our study.

Overweight/Obese Students map for Pattani province: We created a schematic range map of the proportion of

overweight and obesity students in the various birth places of the students attending public high schools in Pattani province.

Results

The BMI distribution is positively skewed. This skewness is largely eliminated by using a transformation function of the form $\ln(\text{BMI}-8)$. Missing data for parents’ combined income is imputed using a linear regression model of parents’ combined income as the outcome, with age group and religion group as the determinants. The methods for preliminary analysis involve use odds ratios and chi-squared tests to investigate the associations between age, sex, religion and the other categorical determinants.

The patterns of mean BMI by age, religion and sex for the students attending public high schools in Pattani province show that BMI is different among the four groups. Non-Muslim females had higher BMIs than their male counterparts at ages 14, 15 and 18. For Muslim students, females had higher BMI for all ages, with the exception of age 13 as shown in Fig. 1.

The schematic range maps of mean BMI of all students in the various birth places for the students attending public high schools in Pattani province show that the highest means are in Saiburi and Khokpho districts, Sabarang and Bana subdistricts and the lowest means are in Panare, Yaring and MaiKan districts as shown in Fig. 2.

Multiple regression analysis is used to model the dependence of the transformed BMI on the demographic and environmental determinants. It is found that age, sex, religion, birth place and parents’ combined income are determinant of BMI. Also, the mean BMI based on the model is calculated using the formula $\exp(m+s^2/2)$ to adjust for the effect of the nonlinear transformation, where m is the mean and s is the standard deviation of $\ln(\text{BMI}-8)$, assuming that this variable is normally distributed.

After comparing the mean BMI separated by age, sex and religion, it is found that the females have higher BMI than males, and the BMIs for students in the other religion are higher than for Muslim students. Female Muslim students have higher BMI than others in only one age group (17 year-olds), but male Muslim students have lower BMI than others in every age group as shown in Fig. 3.

We also created a schematic range map of the expected values of BMI in the various birth places of the students attending public high schools in Pattani province, with these expected values based on the average of the reference median (age, sex, religion) group, namely 15 year-old students with average parents’ combined income, that is, with the value of $\ln(\text{parent's income})$

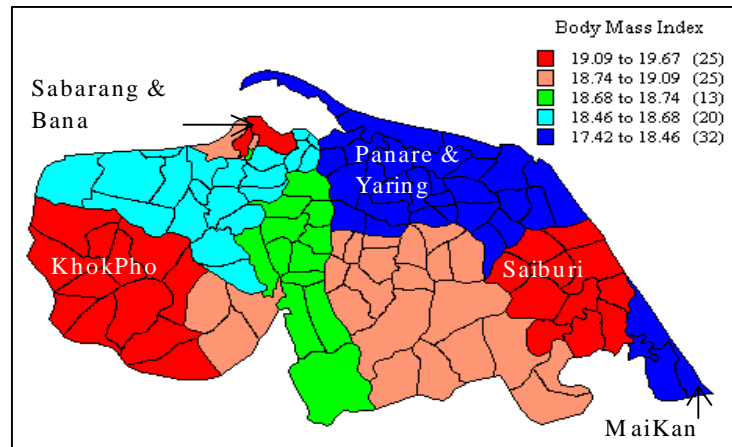


Fig. 2: The Pattani province's BMI map from the data

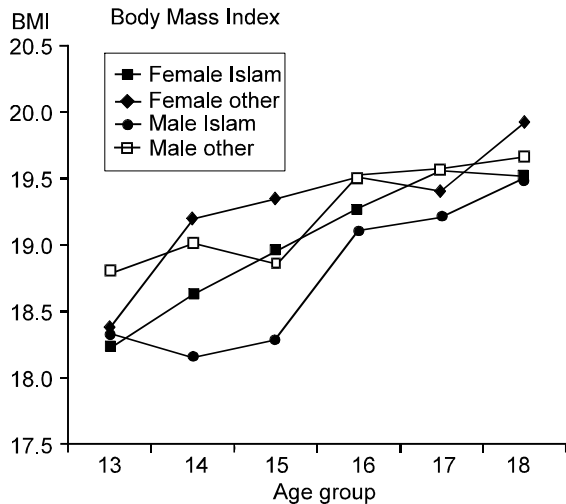


Fig. 3: Age patterns of BMI from the model

equal to 8.736. It is found that the students who were born in Panare and MaiKan districts have lowest mean BMI (between 17.42 and 18.46). The group with highest mean BMI (between 19.09 and 19.67) comprises those born in Yarang and Kapor districts, and Sabarang subdistrict as shown in Fig. 4.

The association between obesity index and (age, sex) group for non-Muslim students shows that the proportions of overweight and obese are 8.7% (474 of 5460) and 3.0% (163 of 5460), respectively. The male students are more obese than the females in age groups up to 17 years, but not among those aged 18 or more.

The association between group of obesity and (age, sex) group for the Islam religion group shows that the male students are more obese than the females in age groups 12-13, 14, and 17 years, but female students are more obese in age groups 15, 16 and 18 or more years.

The percentage of Muslim students who are overweight is 4.3% (169 of 3933) and the proportion of them who are obese is 1.0% (40 of 3933), lower than the other religion group.

The IOTF cut off definition was used to classify children as overweight or obese, and we found that 8.7% of non-Muslim students are overweight and 3.0% are obese. For the Muslim students there are 4.3% overweight and 1.0% obese.

In this study we found 846 of 9393 students to be overweight or obese: 643 students are overweight and 203 students are obese. The students who were born in Pattani province comprise 445 overweight students and 127 obese students. A schematic range map of the proportion of overweight and obesity students in the various birth places of the students attending public high schools in Pattani province is shown in Fig. 5. The students who were born in Sabarang, Arnohru, JabangTiko, Bana, and Rusamilae subdistricts of Pattani city, and in Saiburi and KhokPho districts have the highest prevalence of overweight and obesity (7.5% to 13.1%), whereas the lowest prevalences, 2.2% to 2.6%, are in Mayor and Yarang districts.

Discussion

The process of development childhood obesity could vary in populations with different cultural backgrounds. Therefore, it is important to examine the cultural factors influencing the development of childhood obesity.

The students who were born in Pattani city, Saiburi and KhokPho district have greater prevalence of overweight and obesity than other locations because these locations are more urbanized and developed areas. There are also differences in BMI for the children with different religious backgrounds, reflecting differences in culture and lifestyle.

The BMIs of female students are higher than males, in contrast to an earlier study of students in Hat Yai,

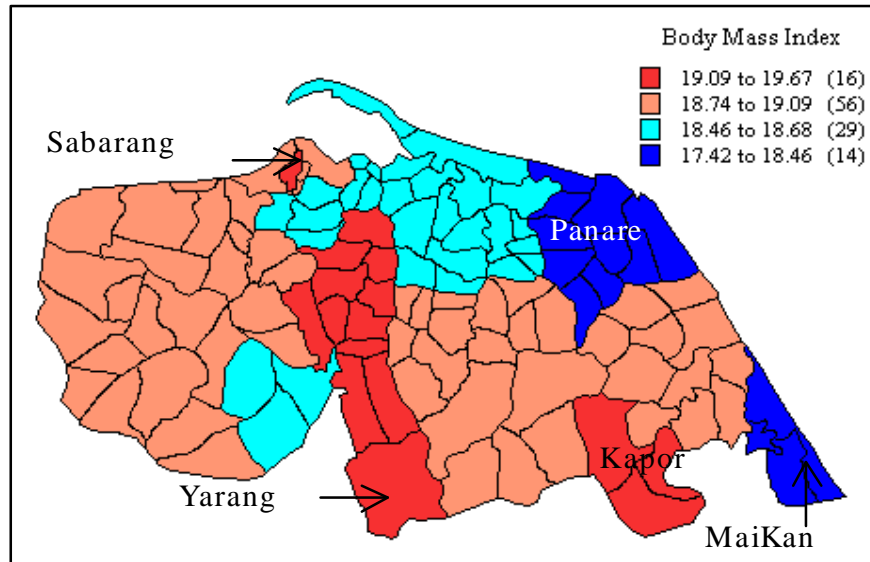


Fig. 4: The Pattani province's BMI map from the expected values

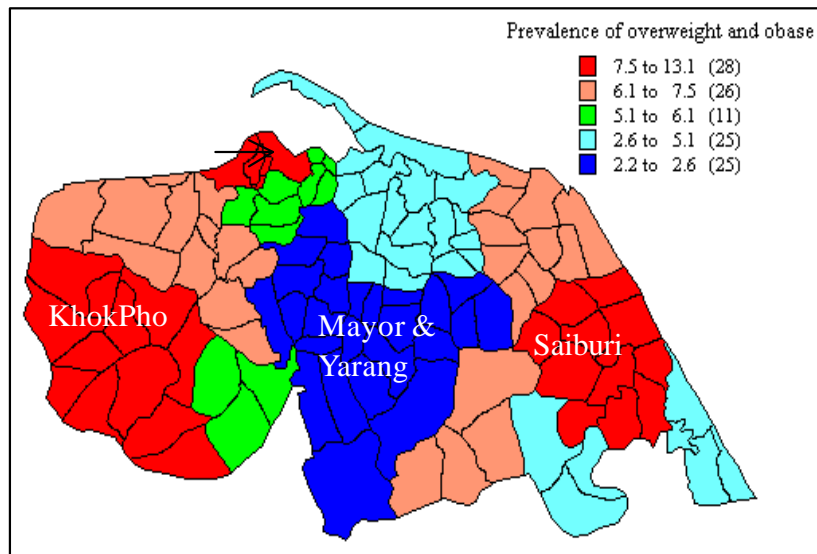


Fig. 5: Overweight/obese student map for Pattani

Thailand in 1997 (Mo-Suwan *et al.*, 2000). However, the data for our study were collected from the student's self reports, whereas the data for the Hat Yai study were measured by health professionals from the same students in successive years.

The age patterns of body mass index shown in Fig. 3 are based on fitting a statistical model that adjusts for the student's combined parents' income, whereas the graph shown in Fig. 1 does not take parents' income into account. While the curves show the same broad patterns, the main difference is that the adjusted curves are steeper than the unadjusted curves.

The schematic range maps of BMI shown in Fig. 4 are

based on the average median (age, sex, religion) group, namely 15 year-old students with average parents' combined income in the various birth places. In contrast, Fig. 2 is created from all students. The results from the two maps are similar with highest BMI in Sabarang subdistrict, high BMI in Yarang and TungYangDang districts, and Arnohru and Rusamilae subdistricts, low BMI in Muang other subdistricts, and lowest BMI in MaiKan and Panare districts.

The prevalence of overweight and obesity of this study is 11.7%. It is slightly higher than the prevalence (10%) from the study based on Thai students in public high school aged 10-25 years (Ruangkanjanaset, 2004).

Chadarat *et al.*: Factors Affecting High School Overweight Students

From Fig. 5 we found that the male students had a higher percentage of obesity than females, in agreement with a study of students in Hat Yai, Thailand in 1997 (Tongkumchum, 2002).

Conclusions: From this study, we found that the body mass index related to age group, sex, religion group, birthplace and parents' combined income. And the prevalence of overweight and obesity of non-Muslim students are 8.7% and 3.0%, respectively. For Muslim students, these prevalences are 4.3% and 1.0%, respectively.

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