

Chapter 5

Conclusions and Discussions

This study aims to investigate the prevalence of overweight and obesity by modeling the distribution of BMI for 9393 public high school students in Pattani province. In this chapter we summarise the statistical methods used and the findings from the study.

5.1 Conclusions

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 salary is imputed using a linear regression model of parents' combined salary 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. It is found that there are associations between age and sex, and age and religion.

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 with higher BMIs for non-Muslim students. 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 to age 13.

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

groups are in Saiburi and Kholpho districts, Sabarang and Bana subdistricts and the lowest groups are in Panare, Yaring and Maikan districts.

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 salary are associated with 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.

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 referent median (age, sex, religion) group, namely 15 year-old students with average parents' combined salary, that is, with the value of $\ln(\text{parentSalary})$ equal to 8.736. It is found that the students who were born in 10 subdistricts of Panare district, and 4 subdistricts of MaiKan district 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 12 subdistricts of Yarang district, 3 subdistricts of Kapor district, and Sabarang subdistrict.

From these data we can create a new variable, obesity, 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/m² 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. This variable is classified into three groups (1: normal, 2: overweight but not obese, and 3: obese) as follows. 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 as shown in Table 5.1.

Table 5.1 uses the body mass index for age 12.5 years for the age group 12-13 years in our study.

Age (years)	Body mass index 25 kg/m ²		Body mass index 30 kg/m ²	
	Males	Females	Males	Females
12.5	21.6	22.1	26.4	27.2
14	22.6	23.3	27.6	28.6
15	23.3	23.9	28.3	29.1
16	23.9	24.4	28.9	29.4
17	24.5	24.7	29.4	29.7
18	25	25	30	30

Table 5.1: Cut-off values for overweight and obesity by age and sex

The two variables age group and sex are combined using the coding system AgeSexGrp = 10*(age group) + sex. This means, for example, that students who are 12-13 years old and male are coded as 130. Next, we examine the association between obesity and (age, sex) group with religion group, as shown in Figures 5.1 and 5.2.

Figure 5.1 shows the association between obesity index and (age, sex) group for non-Muslim students. Overall, 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.

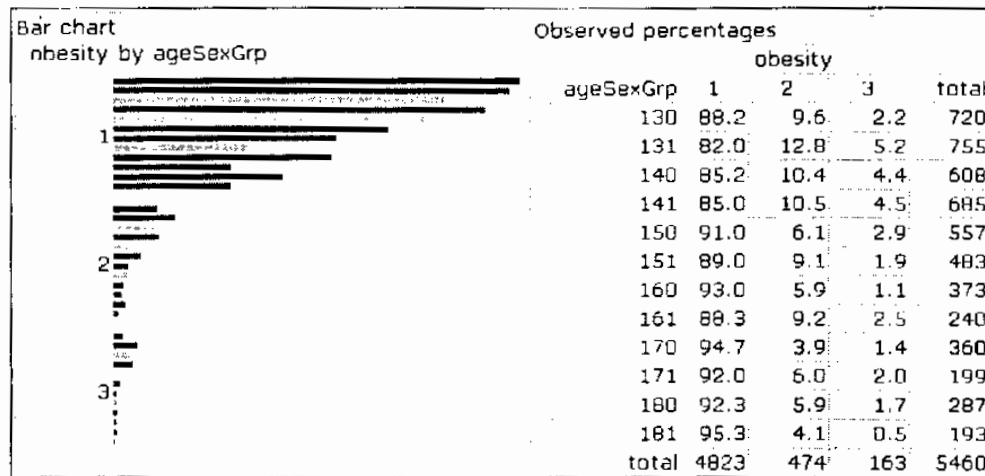


Figure 5.1: Overweight/obesity by (age, sex) group for non-Muslim students

Figure 5.2 shows the association between group of obesity and (age, sex) group for the Islam religion group. It 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.

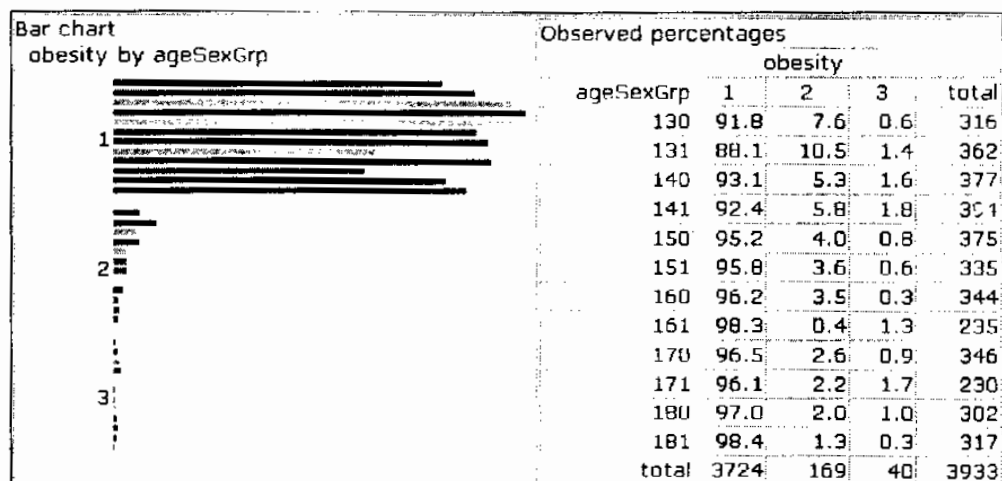


Figure 5.2: Association between obesity and (age, sex) group for Muslim students

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 Figure 5.3.

Figure 5.3 shows that 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.

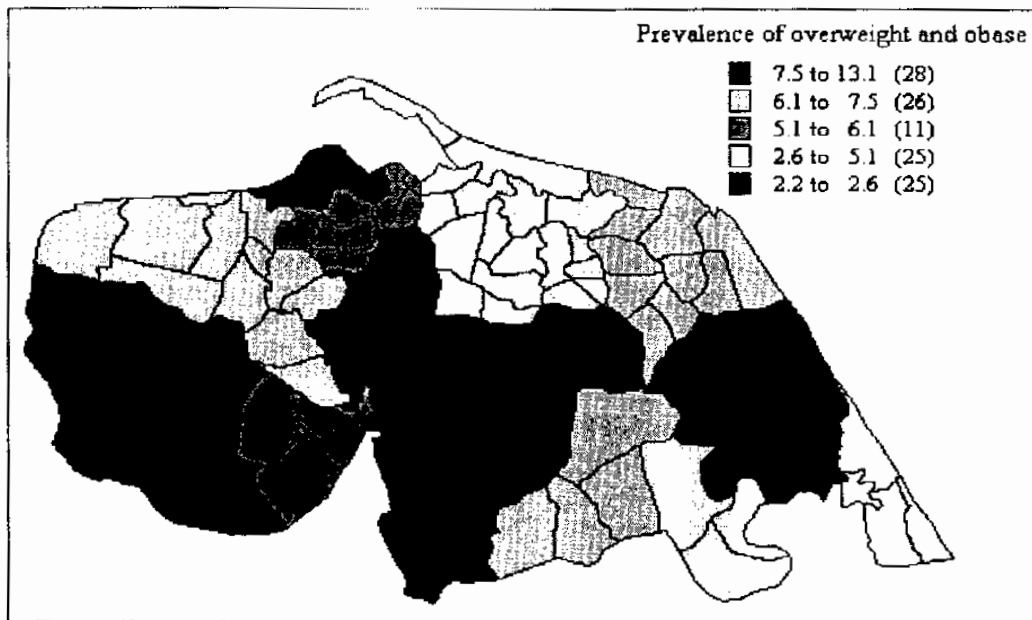


Figure 5.3: Overweight/obese student map for Pattani province

5.2 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, 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 Figure 4.3 are based on fitting a statistical model that adjusts for the student's combined parents' salary, whereas the graph shown in Figure 3.23 does not take parents' salary 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 Figure 4.4 are based on the average median (age, sex, religion) group, namely 15 year-old students with average parents' combined salary in the various birth places. In contrast, Figure 3.23 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).

From Figure 5.1 we found that the male students had a higher percentage of obesity than females, in agreement with a study of students in HatYai, Thailand in 1997 (Tongkumchum, 2002).

5.3 Limitations and Future Research

Limitations

In this study the data about weight, height, and parents' salary are collected from self-reports of students and might not be accurate. The data were collected only for one year, and only from public high schools.

Future Research

- (1) To analyse factors affecting overweight or obesity in children in public high schools in Pattani province by selecting only overweight or obese students and to collect more information from these students and their parents.
- (2) To take a sample of students giving self reports of the height and weight and compare these data with measurements made by qualified health professionals.
- (3) To compare the data collected in 2003 with similar data collected from the same students in following years, using the student's 13-digit ID to match these measurements.