Prevalence and Determinants of Overweight and Obesity in Thai Adults: Results of the Second National Health Examination Survey

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To describe the prevalence of overweight and obesity and examine their relationship with socio-demographic factors in Thai adults. Using data from a cross-sectional survey, the National Health Examination Survey II (NHESII), the authors examined the prevalence of overweight (BMI ≥ 25 kg /m^2) and obesity (BMI ≥ 30 kg /m^2) in 3,220 Thai adults aged 20-59 yr. Univariate analyses and Logistic regression models were used to examine the association of overweight and obesity with socio-demographic and behavioral risk factors. The overall age-adjusted prevalence of overweight and obesity were 28.3 % and 6.8% respectively, with a higher prevalence for women than for men (overweight : 33.9% vs 19.2% and obesity : 8.8% vs 3.5%). The prevalence of overweight and obesity was greater among older compared to younger people and among residents of urban (34.8% and 9.9%) compared to rural areas (26.4% and 5.9%). The prevalence of overweight and obesity varied by region in line with the level of economic development - Bangkok, Central, North, South and North-East. By using logistic regression analysis, overweight was associated with a number of characteristics as follows: age (per ten years increase) with adjusted Odds Ratio (OR) of 1.3; women 1.4; married 2.2; being a current smoker 0.4, and living in Bangkok and the central region 1.6 (compare to North-East). There was no clear difference in prevalence of overweight and obesity among education levels and type of occupation after controlling for other covariates. In conclusion, women of middle age, married, and living in Bangkok and the Central region, are at greater risk of overweight and obesity. Without effective lifestyle modification programs to curb these physiologic risk factors at population level, it is likely that related disease burden will ensue. Public health surveillance and intervention to modify the risk factors of excessive weight should be implemented.

Keywords : *BMI, Overweight, Obesity, Thai, Adults*

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There is substantial evidence that the prevalence of overweight and obesity are increasing worldwide and while the rise has been best documented for industrialized nations, it appears that similar changes are also occurring in many developing countries[1]. There appear to be substantial health implications consequent upon the rise in overweight and obesity[1,2]. Numerous cross-sectional studies, conducted in diverse populations from around the world, have demonstrated associations of overweight

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and obesity with a major determinant of vascular risks, such as blood pressure, type 2 diabetes and dyslipidaemia[3-6]. In addition, longitudinal studies have shown continuous associations between body mass index (BMI), the most commonly reported measurement of overweight and obesity, and the risks of major vascular events such as stroke and heart attack[7]. While most data about the long-term effects of BMI on health are derived from studies conducted among western populations, new evidence from cohort studies performed in Asia suggests that the effects of BMI are likely to be at least as great in these populations[8].

Nationally representative data about the prevalence of overweight and obesity are available for a number of countries in Asia but have not been reported for Thailand. Such data are important for assessing the prevalence of overweight and obesity, quantifying the likely associated burden of obesity-related diseases and planning national treatment and prevention programs. The aim of these analyses was to determine the prevalence of overweight and obesity in Thai adults and to identify the likely determinants of overweight and obesity, using data collected as part of the Second National Health Examination Survey (NHES II).

Material and Method

The NHES II conducted in 1997, included four nationally random samples of non-institutionalized Thai citizens categorized by age groups of (i) 0-5 years, (ii) 6-12 years, (iii) 13-59 years, and (iv) 60 years and over. Prevalence of dementia among elderly was reported[9]. Here the authors analyzed and reported the prevalence of overweight, obesity and their determinants for the 13-59 years age group.

Sampling methods

Administratively, Thailand comprises four main geographic regions, each with a varied number of provinces (North 17, South 14, Northeast 19, and Central 25 and the capital, Bangkok). Each province consists of urban and rural areas. These areas are made up of enumeration blocks in urban areas and villages in rural areas.

Eight provinces were randomly selected from each region and eight districts from Bangkok. In the selected province, between one and eight enumeration blocks in urban, and between one and nine villages were randomly selected. The number of enumeration blocks and villages selected was proportional to the size of the population in the corresponding urban and rural areas. Lists of names and addresses of people living in each enumeration block and village for each of the four age groups was obtained. To ensure an adequate number of participants in the block or village level, 15 individuals in each of the four age groups were then systematically sampled. As a result, between 61 to 71 blocks or villages were selected for each region to a total of 185 blocks and 149 villages. All 67 selected blocks in Bangkok were in urban areas because there was no rural area. Finally, a total of 5,010 individuals (Bangkok urban1005; Central, 420 urban and 495 rural; North, 420 urban and 585 rural; Northeast, 465 urban and 600 rural; and South, 465 urban and 555 rural) for each of the four age groups were invited to participate.

Data collection

Data collection comprised an interview and physical examination conducted in a survey station established close to the residential area of the study participants. The questionnaire and examination were

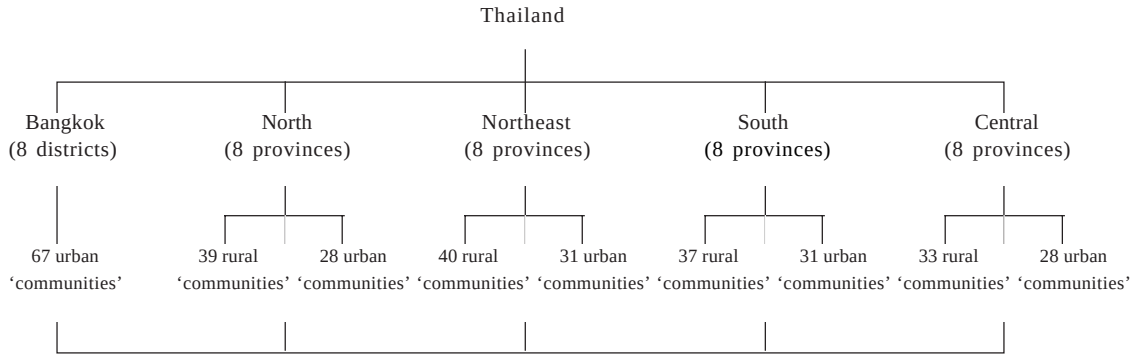

Fig. 1 Sampling method

done by specially trained study staff according to a standardized protocol. The questionnaire included broad ranging questions about demographic characteristics, health-related behaviors and history of illnesses. The physical examination comprised measurement of body weight, height, blood pressure and visual acuity using standardized anthropometric techniques and equipment[10].

Definitions

Overweight and obesity were defined on the basis of measurements of BMI, calculated as weight in kilogrammes divided by height in metres squared (Kg/m^2). Both were classified according to World Health Organization (WHO) criteria, whereby obesity is defined as a BMI $\geq$ 30 kg/m^2, and overweight is defined as BMI $\geq$ 25 kg/m^2. Educational level was classified as: primary ($\leq$ 6 years of full-time education), secondary (7-12 years) and post secondary ($\geq$ 12 years). Occupational status was classified according to the following categories: agricultural (including unskilled laborers), skilled laborer (including commercial, transportation service), professional (including administrative work) and unemployed (including women engaging in housework).

Analysis

With regard to the World Heath Organization's criteria for classification of overweight and obesity based on cut point of BMI at 25 and 30 respectively, the definition was defined for adults, while other criteria of obesity and overweight were defined for children and adolescents. In the present study the authors chose to analyze the data for participants aged 20-59 years. In Bangkok and each main geographic region, mean levels of BMI, the prevalence of overweight and the prevalence of obesity were determined for age and sex groups, according to area of residence (rural and urban). Although the number of participants selected in urban and rural were proportional to the size of the selected provinces, the probability of sampling for each sample across regions was not equal. Prevalence estimates and standard errors (SE) for the total population were calculated by weighting the region and area of residence-specific (urban-rural) estimates using sampling factors derived from population estimates for the year 1997 from a population changes survey in 1995 made by the Thai National Statistic Office[11]. The statistical analyses for complex sampling design were performed using region as stratum (5 strata) and province (district in Bangkok) as primary sampling units (32 provinces and 8 districts). Comparisons of the prevalence of overweight and obesity between population sub-groups were performed using chi-square-tests and comparisons of BMI were done using t-tests. All estimates of standard errors and all comparisons between risk factors in population sub-groups incorporated allowances for the complex survey design. Logistic regression models for complex survey design were fitted to determine the associations of age, sex, marital status, educational level, employment status, smoking habit, alcohol consumption and area of residence with the odds of obesity and overweight. 95% confidence intervals (95%CI) were calculated about each estimate. Final models with determinants associated with outcomes controlling for other potential confounding factors and their ORs were reported. Missing data were dropped out from the analysis. The analyses were firstly performed stratified by sex, however, there was no significant difference between sex with regard to the association of potential determinants with either overweight or obesity, therefore, the final analysis of both sexes was pooled into one group. All analyses were conducted using STATA 7.0 statistical software (StataCorp, College Station, TX, USA)[12].

Results

Study participants

A total of 5,010 individuals aged 13-59 years were invited to participate in the study; of these, 4,260 (85.0%) agreed to participate and provided informed consent. The response rate was higher in rural than in urban areas (97.9% vs. 72.4%, $p < 0.001$), but no difference between sexes was observed. The response rates among the samples of other age groups were 0-5 yr 66.0%, 6-12 yr 84.6 % and 60 yr and over 88.0%. 1,050 were excluded from the present analysis because their age was less than 20 years leaving 3,220 individuals aged 20-59 years. 1,402 of the participants were from urban areas and 1,818 were from rural areas; Bangkok 451, Central 239 and 499, North 209 and 475, Northeast 243 and 450, and South 260 and 394 respectively.

Distributions of body mass index

The estimated population distributions of BMI, overall and by age, sex and urban or rural area-of-residence are shown in Fig. 2, 3 and 4. The overall mean BMI of the population was 22.0 kg/m^2 (S.E 0.5). Mean levels of BMI were slightly higher in women (22.5 kg/m^2, SE 0.6) than in men (21.2 kg/m^2, SE 0.5) (p

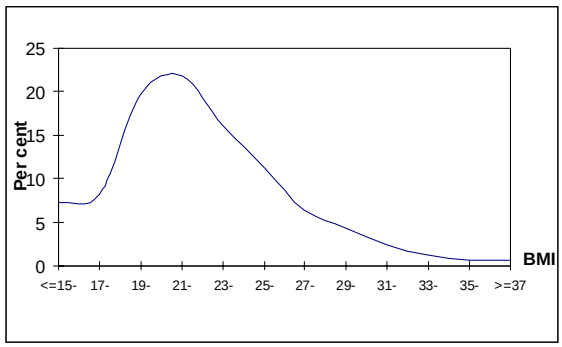

Fig 2. Distribution of BMI of Thai population aged 20-59 years old, National Health Examination Survey II, 1997

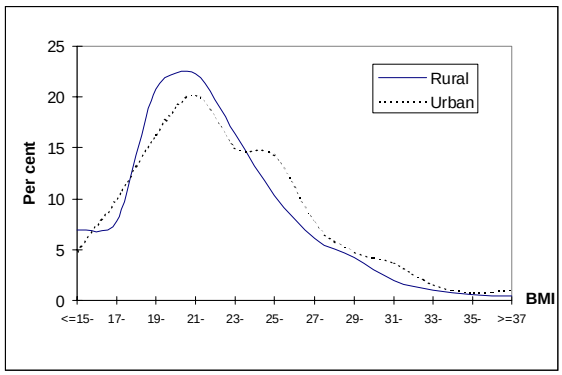

Fig. 3 Distribution of BMI of Thai population aged 20-59 years old by place of residence, National Health Examination Survey II, 1997

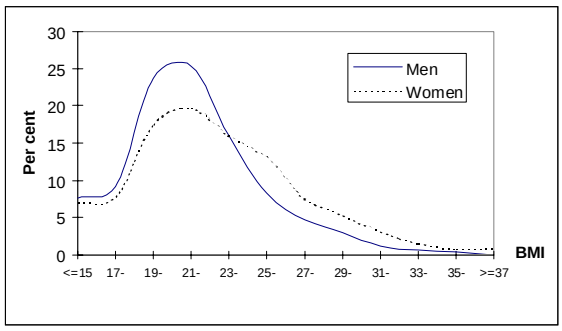

Fig. 4 Distribution of BMI of Thai population aged 20-59 years old by sex, National Health Examination Survey II, 1997

< 0.001) among older compared to younger people (20-29: 20.8 kg/m^2, SE 0.5; 30-39: 21.8 kg/m^2, SE 0.5; 40-49: 22.5 kg/m^2, SE 0.7 and 50-59: 23.0 kg/m^2, SE 0.5) (p < 0.001) and among the residents of urban (23.1 kg/m^2, SE0.3) compare to rural (21.7 kg/m^2, SE0.7) areas (p = 0.03).

Prevalence of overweight and obesity

The overall prevalence of overweight (BMI $\geq$ 25 kg/m^2) in Thai adults aged 20 years or over was estimated to be 28.3% (Table 1). The prevalence of overweight was greater in women than in men (33.9% vs 19.2%, p < 0.001), among older compared to younger people (p < 0.001) and among residents of urban compared to rural areas (34.8% vs 26.4%,p = 0.01). Prevalence of overweight increased with age. The prevalence of overweight also varied by region of Thailand broadly in line with the level of economic development - high in Central Thailand (37%) and Bangkok (36%) and low in the North (25%), South (24%) and North-East (22.%). The overall prevalence of obesity (BMI $\geq$ 30 kg/m^2) was 6.8% with patterns of obesity by age, sex, education, type of occupation, area of residence and region very similar to the patterns observed for the prevalence of overweight (Table 1).

Associations of participant characteristics with overweight and obesity

Table 2 shows crude and adjusted odds ratio for determinants of overweight and obesity. Since the prevalence of overweight and obesity in the central region and Bangkok were similarly high the authors combined them into one group and compared them to the other three combined. In univariate analysis, factors associated with overweight and obesity included age, sex, marital status, living in urban area, current smoking, alcohol drinking, living in Bangkok and central region. Using the multiple logistic regression model controlling for other variables, factors independently associated with overweight were age, female, married, current smokers and central region (included Bangkok). An increase of ten years of age was associated with 1.31 times (95% CI 1.19, 1.44) of overweight. Risk of overweight was 1.37 times higher in women than in men. Factors that remain strongly associated with obesity included; being married, current smokers and living in Bangkok and Central region. Married individuals were more likely to be overweight (adjusted OR = 2.22, 95% CI, 1.58, 3.11) and obese than single individuals (adjusted OR = 1.80, 95%CI 1.13, 2.87). Both overweight and obesity were markedly higher in the central region and Bangkok than in others with adjusted OR 1.63 (95%CI 1.17, 2.29) for overweight and 1.68 (95% CI 1.14, 2.47) for obesity. Smokers were less likely to be overweight (OR = 0.40, 95% CI 0.30, 0.54)) and obese (OR = 0.51, 95%CI 0.27, 0.97) than non-smokers. Although

Table 1. Prevalence of overweight and obesity, % (standard error) overall and for men and women, by age, areas of residence and regions of Thailand

	Overweight, % (SE)			Obesity, % (SE)		
	Total	Men	Women	Total	Men	Women
Overall	28.3 (1.5)	19.2 (1.6)	33.9 (1.5)	6.8 (0.6)	3.5 (0.6)	8.8 (0.8)
Age (yr)						
20-29	19.1 (1.5)	9.8 (1.9)	24.3 (1.9)	5.1 (1.0)	1.4 (1.1)	7.2 (1.3)
30-29	23.6 (1.4)	18.4 (2.4)	26.8 (1.9)	5.9 (0.7)	3.6 (1.0)	7.1 (1.1)
40-49	34.9 (2.5)	23.5 (2.7)	42.4 (3.0)	8.9 (1.3)	4.9 (1.2)	11.6 (1.6)
50-59	36.7 (3.0)	24.0 (3.3)	45.6 (3.3)	7.2 (1.1)	3.7 (1.1)	9.6 (1.8)
Area of residence						
Rural	26.4 (1.9)	16.6 (1.8)	33.2 (2.0)	5.9 (0.7)	2.5 (0.7)	8.2 (1.0)
Urban	34.8 (1.5)	31.6 (2.7)	36.0 (1.8)	9.9 (0.9)	8.5 (1.6)	10.5 (0.9)
Bangkok	35.7(2.3)	36.8(4.8)	35.2 (2.6)	10.5 (1.3)	10.5 (2.8)	10.5 (1.1)
Central	37.2 (3.2)	28.2 (5.0)	40.7 (3.2)	9.4 (1.0)	4.1 (2.0)	11.5 (1.2)
North	24.7 (2.5)	18.0 (2.7)	29.6 (3.1)	6.6 (1.3)	4.8 (1.4)	7.9 (2.0)
South	23.6 (1.9)	17.4 (2.7)	28.2 (1.8)	5.4 (1.2)	3.6 (1.5)	6.7 (1.0)
Northeast	22.3 (2.9)	12.1 (2.1)	31.4 (3.0)	3.8 (1.0)	0.9 (0.6)	6.3 (1.7)

Table 2. Crude and adjusted Odds ratios (95% confidence intervals) for determinants of overweight and obesity

	Overweight		Obesity	
	Crude Odds ratio (95%CI)	Adjusted Odds ratio (95%CI)	Crude Odds ratio (95%CI)	Adjusted Odds ratio (95%CI)
Age (per 10 year increase)	1.37(1.26,1.49)*	1.31(1.19, 1.44)*	1.16(0.99,1.35)	1.07(0.91, 1.27)
sex (female)	2.17(1.83,2.56)*	1.37(1.12, 1.81*)	2.63(1.75,3.94)*	1.45(0.94, 2.25)
Married	2.29(1.69,3.11)*	2.22(1.58, 3.11)*	1.66(1.05,2.62)*	1.80(1.13, 2.87)*
Urban residents	1.48(1.17,1.88)*	1.01(0.74, 1.38)*	1.77(1.28,2.44)*	1.26(0.83, 1.91)
Current smoking	0.31(0.24,0.40)*	0.40(0.30, 0.54)*	0.29(0.15,0.56)*	0.51(0.27, 0.97)*
Alcohol drinking	0.59(0.47,0.74)*	0.92(0.69,1.23)	0.47(0.29,0.65)*	0.68(0.44,1.06)
Central region and Bangkok	1.90(1.44,2.50)*	1.63(1.17, 2.29)*	2.10(1.48,2.97)*	1.68(1.14, 2.47)*
Education				
Primary education	1.18(0.87,1.61)	1.34(0.91,1.98)	1.17(0.68,2.01)	1.63(0.83,3.20)
Secondary education	0.85(0.65,1.10)	1.19(0.89,1.59)	1.03(0.66,1.62)	1.43(0.85,2.38)
Post secondary education	1	1	1	1
Occupation				
Agriculture	1	1	1	1
Professsional	1.77(1.38,2.27)*	1.70(1.28,2.25)*	1.65(1.11,2.46)*	1.35(0.82,2.22)
Skill labor	1.11(0.81,1.51)	1.31(0.94,1.81)	0.94(0.56,1.59)	0.93(0.53,1.64)
No job	1.54(1.15,2.07)	1.23(0.87,1.75)	1.94(1.23,3.05)	1.30(0.80,2.11)

** Statistical significant at 95% confidence interval level*

those residing in urban areas were more likely to be overweight and obese compared with those in rural areas, the association attenuated and no statistical significance was observed after controlling for other factors. Risk of overweight and obesity were not significantly different across education levels. For effects of occupation, those in professional work were slightly more likely to be overweight than those in agriculture work and the association persisted after controlling for other variables, however, no significant association with obesity was observed. Additional analysis was performed using BMI as a response variable in a multiple linear regression including all the explanatory variables used in the logistic regression. The results showed that factors associated with BMI in the multiple linear regression models were

similar to the results obtained from logistic regression models.

Discussion

The present national health examination survey identified a high magnitude of overweight and obesity in Thailand. The overall mean BMI of 22kg/m^2 and the prevalence of overweight and obesity of 28.3 %and 6.8 % respectively was lower compared to those in the developed western countries[1,13]. However, more than a quarter of Thai adults were considered to be overweight. When these rates were applied to the 1997 Thai population, there were 8.6 million and 2.0 million individuals estimated to be overweight and obese respectively. Because overweight and obesity is one of the important risk factors for cardiovascular diseases and its complications, these findings suggested that obesity is an emerging adverse health condition among Thai people.

The prevalence rates of overweight and obesity were relatively higher than those in other developing countries in Asia such as China, where the figures in men and women were 13.6% and 19.2% for overweight, 0.5% and 1.5% for obesity respectively[14]. The prevalence of Thai people with BMI $\geq$ 25 kg/m^3 in the present study (total; 35.1 %, men 22.7% and women 42.7%) was relatively comparable to those of Taiwanese in the same age group, however, the predominant sex-specific prevalence were in the opposite direction; (men 33.1% and women 21.5%)[15]. The prevalence of obesity (BMI $\geq$ 30 kg/m^3) was similar to those of Singapore (8.5% for women and 5.9 % for men)[16]. The discrepancy and similarity in rates among these Asian countries might be due to certain factors including age structures, proportions of living in urban and rural communities, dietary pattern, culture and lifestyle.

Previous studies on diet-related chronic diseases, reported that obesity was increasing in Thai affluent urban populations. The 1985 data among 35-54- year-old Thai officials, 2.2% of men and 3.0% of women had BMI $\geq$ 30[17]. The first National Health Examination survey conducted in 1991 reported that the prevalence of overweight was 13.2% for men and 25.0% for women, and obesity was 1.5 for men and 5.6% for women[18]. Compared to the findings of the present study, this might suggest that the prevalence of obesity in the Thai population is increasing.

Similar trends in overweight and obesity have been experienced in other developing countries. Reductions in physical activity and changes in diet may account for some of the trends[2,19]. However, other determinants of obesity such as the difference in study areas, changes in population age structure and urban to rural ratios might also account for the rate differences.

Regional difference in prevalence of obesity was observed in the present study. The higher prevalence of overweight and obesity in Bangkok and the central region compared with other regions might be related to environmental and socio-economic factors, including difference in diet, physical activity and culture. Because Bangkok and the central region are considered to be a more modernized areas compared with other regions. In 1997, gross regional product (GRP) per capita of Bangkok was almost 10 times that of the North and the Northeast region, whereas GRP per capita of the Central region was 2-3 times that of the other two regions in the same year[20]. The influence of socio-economic level on the prevalence of obesity has been investigated in developed and developing countries and showed that high socio-economic status and obesity is negatively correlated in developed countries, but it is positively correlated in developing countries[9,21-23].

Urban residents generally have a higher BMI than those living in rural areas. The effect of urbanization was associated with a wide range of factors that resulted in dietary intakes. Urban residents are more likely to eat more western style food and less likely to perform physical activity. In most countries, urban residents consume a greater proportion of protein and fat, and a smaller proportion of carbohydrates[24]. However, the present study found that the effect of being an urban resident on overweight and obesity was weakened when the authors controlled for other covariates including region. This might be partly due to the fact that there were slight differences in life style between urban and rural residents in most regions except for Bangkok and central with a greater extent of urbanization compared to others. In other words, differences in lifestyle related to obesity and overweight might be larger between central and peripheral regions than among urban-rural disparity.

Overweight and obesity were found to be higher among married individuals compared with singles after adjusting for other confounders. This might suggest that people after their marriage could have less physical activity, change in dietary pattern or in exposure to other environmental factors. More

studies may be required to examine the factors related to weight gain among married individuals.

The negative association between smoking and overweight and obesity might be partly explained by the knowledge that smoking causes an increase in metabolic rate and a tendency of reducing in food intake compared with non-smokers[25]. Although, the risk of gaining weight is found among non-smokers, a great number of studies have shown that smoking has a larger impact on morbidity and mortality than any small rise in BMI[26-28]. For alcohol intake, the present studies found a negative association with overweight and obesity. Those who are alcohol drinkers were less likely to be overweight and obese. However, the modest effect disappeared after controlling for other covariate factors. Studies of the relationship between alcohol consumption and weight have been inconsistence. The heavy drinkers often do not experience weight gain[29]. Alcohol consumption may bemetabolically associated with an increased risk of abdominal fat in those who combine alcohol consumption and eating high fat food. However, the findings that alcohol drinkers tend to be thinner than non-alcohol drinkers is consistent with other epidemiological studies[30].

Occupation was also slightly linked with overweight after controlling for other factors. The type of occupation might reflect the nature of their work on daily energy expenditure and socio-economic status. In general, those in agriculture work had the lowest risk of overweight whereas; those in professional work were at greatest risk due to their more sedentary working style. Concurrently, people in agriculture work are generally associated with low socio-economic status and limited access to high protein and fat diet, but they engage in moderate to heavy manual work.

The findings of the present study are subject to some limitations. The number of participants for age groups by regions or by other factors might be relatively small and account for the inability to examine the association among these sub-groups. The unavailability of reliable data representing socioeconomic status such as annual income also might pose some limitation to identify the high risk group. Moreover, the sampling procedure at the final stage for individual participants might not be completely at random which might affect the accuracy of the estimated prevalence to a certain extent. However, the present study had its strength in including several provinces in a region with a large number of small clusters which could reduce the effect of homogeneity within the cluster and made the samples a sound representativeness of the national level. The procedures in collection of data were also well standardized.

Conclusion

The present study indicates that overweight and obesity are emerging public health problems with an alarming rate in Thailand as in other developing countries. There were variations in the prevalence of overweight and obesity across regions and socio-economic groups. Overweight seems to be a problem among women, middle aged, married, living in Bangkok and the Central region. Since optimal weight is a desirable public health goal, surveillance and intervention programs to modify the risk factors of weight gain should be appropriately implemented.

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อัตราชุกและปัจจัยเสี่ยงของภาวะน้ำหนักเกินและโรคอ้วนในคนไทย: รายงานการสำรวจภาวะสุขภาพประชาชนครั้งที่ 2

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เป็นการศึกษาเกี่ยวกับอัตราชุก และปัจจัยเสี่ยงของภาวะน้ำหนักเกิน (BMI ≥ 25 kg /m^2)และโรคอ้วน (BMI ≥ 30 kg /m^2) ในประชากรไทย อายุ 20-29 ปี จำนวน 3,220 คน จากการสำรวจภาวะสุขภาพประชาชนครั้งที่ 2 ผลการศึกษาพบว่าอัตราชุกของภาวะน้ำหนักเกินเท่ากับร้อยละ 28.3 และอ้วน ร้อยละ 6.8% กลุ่มอายุกลางคนมีภาวะน้ำหนักเกินและอ้วนสูงกว่าคนอายุน้อย. คนอาศัยในเมือง มีภาวะน้ำหนักเกิน (34.8%)และอ้วน (9.9%) สูงกว่าในคนชนบท (26.4%, 5.9%) คนที่อาศัยใน กทม.มีอัตราชุกสูงสุด รองลงมาคือ ภาคกลาง, เหนือ, ใต้และ อีสานตามลำดับ การวิเคราะห์ logistic regression พบว่าปัจจัยที่มีความสัมพันธ์กับภาวะน้ำหนักเกิน คือ อายุ โดยอายุที่เพิ่มขึ้นทุก 10 ปี อัตราเสี่ยงสูงขึ้น 1.3 เท่า, อัตราเสี่ยงใน เพศหญิง 1.4, ในคนแต่งงานแล้ว 2.2, คนอาศัยในกทม.และภาคกลาง 1.6 (เทียบกับภาคอีสาน) ส่วนในคนสูบบุหรี่ 0.4 เท่าของคนไม่สูบบุหรี่ สรุปคนที่เสี่ยงต่อภาวะน้ำหนักเกินคือ ผู้หญิงวัยกลางคน แต่งงานแล้ว และอาศัยในกทม. และภาคกลาง ควรมีการรณรงค์เพื่อควบคุมไม่ให้น้ำหนักเกินในประชาชน และมีการติดตามเฝ้าระวังเป็นระยะต่อไป