

FACTORS ASSOCIATED WITH OBESITY AMONG WORKERS IN A METROPOLITAN WATERWORKS AUTHORITY

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Abstract. To examine the relationship of socio-demographic characteristics, psychological factors, knowledge, attitude and behavior towards obesity among Metropolitan Waterworks Authority (MWWA) officers, a cross-sectional study was conducted between July and September, 2004. Two hundred and eighty-eight obese [body mass index (BMI) ≥ 25 kg/m²] and 106 non-obese persons, aged 20-60 years, were recruited as study subjects. Data were collected by a self-administered questionnaire, comprised of three parts: socio-demographic; psychological factors (depression and stress); and knowledge, attitude, behavior related to obesity. Univariate analyses and Logistic regression models were used to study the association between obesity and possible risk factors. The results demonstrate significant associations between older age and obesity. Volunteers in the age groups of 40-49 and 50-59 years had a significantly higher risk of being obese than the age group of less than 40 years (adjusted OR = 3.4, 95% CI = 1.1-11.1 and adjusted OR = 10.4, 95% CI = 3.3-32.7, respectively). Volunteers with unhealthy behaviors were at significantly higher risk than those with healthy behaviors (adjusted OR = 10.3, 95% CI = 2.0-52.4) while persons with moderately healthy behaviors also had increased risk, but to a lesser extent (adjusted OR = 4.5, 95% CI = 1.7-11.4). There were no associations between psychological factors and obesity in this group of volunteers. When we focused on whether they consumed more food when they were stressed, it was found that the obese consumed significantly more food during stress (p-value=0.003). Watching television, videos, or playing computer continuously for more than 3 hours, were significantly associated with obesity. We conclude that although the obese have a good knowledge and attitude towards obesity, they still practise unhealthy behavior, have a sedentary lifestyle, and over eat when they are stressed. Future research regarding behavioral modification should be implemented at both community and country levels.

INTRODUCTION

The worldwide prevalence of obesity is increasing at a rate which has caused it to be an emerging public health problem (WHO, 1998). Recognized as a disease in itself, obesity is also a leading cause of many chronic illnesses, such as diabetes mellitus (DM), hypertension, dyslipidemia, cardiovascular diseases, musculoskeletal diseases, gall bladder diseases, respiratory diseases, reproductive disorders and

some forms of cancer. Like in western countries, the prevalence of obesity in Thailand has risen from 20.7% in 1991 (Chuprapavarn, 1996) to 35.1% in 1997 (Aekplakorn *et al*, 2004) and 35.8% in 2000 (Cheepudomwit *et al*, 2003).

In the era of globalization, social competition is so strong that it leads to depression and stress. There are a lot of studies confirming an association between obesity and depression. Some studies provide evidence for a relationship between depressive symptoms, in children, adolescents, and adults, and body mass index (BMI) (Carpenter *et al*, 2000; Erickson *et al*, 2000; Faith *et al*, 2002; Goodman and Whitaker, 2002; Roberts *et al*, 2000).

Comfort eating is a compensatory mecha-

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nism, giving a positive energy balance and leading to obesity. Chronic stress may disturb neurohormonal functions (hypothalamic-pituitary-adrenal axis), inducing central obesity (Bjorntorp and Rosmond, 2000; Bjorntorp, 2001; Rosmond and Bjorntorp, 2000; Laitinen *et al*, 2002; Dallman *et al*, 2003). Therefore, it is important to study the psychological aspects as well as the social characteristics of obese persons.

A study in The Electricity Generating Authority of Thailand (EGAT) (Sritara *et al*, 2003) showed a progressive increase in the prevalence of obesity from 1987 to 1995 (24% to 42%). Contributing factors for this increasing prevalence may be divided into environmental and behavioral causes. These findings challenged us to study social characteristics, knowledge, attitudes and practices in diet, exercise, behavior, and psychopathology as possible factors associated with obesity in this group of people. Due to a number of confounding interventions in EGAT, a study at the Metropolitan Waterworks Authority of Thailand (MWWA), another state enterprise with similar social characteristics (middle class, educated, rather good income, urban behavior, and westernized environment) was carried out instead.

This study was reviewed and approved by the Ethics Committee of the Faculty of Tropical Medicine, Mahidol University.

MATERIALS AND METHODS

Study population

All the personnel working at the MWWA during the study period who met the inclusion criteria were invited to participate in the study. The inclusion criteria were: (a) age between 20-60 years and (b) voluntarily agreed to participate the study with informed consent. The exclusion criteria were: (a) pregnant women and (b) having underlying diseases that may affect weight, such as renal disease, congestive heart failure, cirrhosis, receiving steroid treatment, and malignancies.

Sample size

The sample size was calculated using data from a previous study which set the prevalence of depression in the population at around 10%

(Stunkard *et al*, 2003) and the relative risk for obesity in adulthood from depressed late adolescent age girls was 2.32 (Richardson *et al*, 2003). With a confidence level of 95% and a power of 80%, the ratio of obese to normal volunteers of 1 to 3 was used, then, the sample size was calculated. The number of cases that were needed was 285.

Definition of obesity

People with a BMI (calculated as weight in kilograms divided by height in meters squared) ≥ 25 kg/m² were defined as obese (The Western Pacific Region, World Health Organization, 2000).

Methods

Over 700 MWWA officers participated. Their heights, weights, waist circumferences and waist-hip-ratios (WHR) were measured. Self-reporting questionnaires were filled out by the volunteers under supervision of the interviewers. The questionnaires consisted of 3 parts.

Questionnaires

The questionnaires were developed and tested in a pilot population before being used. The first part contained demographic, familial and social data. The second part evaluated depressive status by using the Center for Epidemiologic Studies-Depression scale (CES-D). For interpretation, a score of 19 or higher was considered indicative of depression with 93.33% sensitivity, 94.2% specificity and 0.9154 reliability (Kuptniratsaikul and Ketuman, 1997). CES-D was also used to retrospectively assess depression during their adolescent period (a cut-off point of 22 produced the best overall screening characteristics with 72% sensitivity, 85% specificity, and 82% accuracy) (Trangkasombat *et al*, 1997). The Thai Stress Test (TST) (Phattharayuttawat *et al*, 2000) was used with permission to determine the stress scores (Cronbach's Alpha coefficient = 0.84, Split-half coefficient = 0.88). The third part of the questionnaire assessed knowledge, attitude, and behavior (KAB). The questionnaires was modified in part from a thesis by Pattapong (2000).

For knowledge and attitude, participants whose scores were less than the mean minus one standard deviation (SD), within the mean \pm

SD, and greater than the mean plus SD were classified as having poor, average, or a good knowledge or attitude, respectively. Regarding behavior, persons whose scores were greater than the mean plus SD, within the mean \pm SD, and less than the mean minus SD were considered as having poor, average and good behaviors, respectively.

Statistical analysis

Data analysis was performed using the Stata Program version 7 (StataCorp, College Station, TX, USA). Means, standard deviations, and percentages, were calculated for continu-

ous and categorical data, respectively.

The associations between obesity and socio-demographic characteristics, psychosocial factors, and KAB were examined by univariate analysis and then by multiple logistic regression.

RESULTS

Demographic characteristics

There were three hundred and ninety-four volunteers enrolled in the study, comprised of 288 obese and 106 non-obese people. Their demo-

Table 1
Demographic factors associated with obesity.

Variables	Obese / (%) Total	OR	95%CI	p-value
Gender				0.016
Male	123/154 (79.9)	1.8	1.1-2.9	
Female	165/240 (68.8)	1		
Age (years)				0.003
< 40	58/93 (62.4)	1		
40-49	58/86 (67.4)	1.3	0.7-2.3	
50-59	172/215 (80.0)	2.4	1.4 -4.1	
Marital status				0.049
Single	70/109 (64.2)	1		
Couple	190/248 (76.6)	1.8	1.1-3.0	
Widow/Divorce/Separate	28/37 (75.7)	1.7	0.7-4.0	
Occupation				0.035
Non-labor	191/273 (70.0)	1		
Moderate labor	97/121 (80.2)	1.7	1.0-2.9	
Education				0.001
Primary-Secondary	76/89 (85.4)	5.2	2.2-12.6	
Certificate-Bachelor	193/269 (71.7)	2.3	1.1-4.6	
Higher than Bachelor	19/36 (52.8)	1		
Personal income (baht/month) (1 US\$ \approx 40 baht)				0.83
<10,000	18/26 (69.2)	1		
10,000 - <50,000	196/265 (74.0)	1.3	0.5-3.0	
\geq 50,000	74/103 (71.8)	1.1	0.4 -2.9	
Family income (baht/month)				0.35
<50,000	172/227 (75.8)	1		
50,000 - <100,000	90/131 (68.7)	0.7	0.4 -1.1	
\geq 100,000	26/36 (72.2)	0.8	0.4 -1.8	
Number of household member				0.15
1-2	43/63 (68.3)	1		
3-4	142/203 (70.0)	1.1	0.6 -2.0	
5-6	76/94 (80.9)	2.0	0.9 -4.1	
>6	27/34 (79.4)	1.8	0.7-4.8	

graphic characteristics are shown in Table 1.

Factors associated with obesity in volunteers

Univariate analysis of the factors associated with obesity in the volunteers are summarized in Tables 1-4. As shown in Table 1, males, older age group (50-59 years old), married people, people who work physically harder, and lesser educated people, were significantly more likely to be obese, while income and number of household members were not significant risk factors.

Volunteers who had obese siblings or spouses were significantly more at risk for obesity than those who had non-obese ones (OR = 1.6, and 2.4, respectively). There were no significant associations between parental or child obesity and the volunteer's obesity (Table 2).

Depression and stress

There were 79 volunteers (20%) who were classified as having depression, and 32 volunteers (8%) had depressive episodes during ado-

Table 2
Association of obesity in relatives and spouses with obesity in the volunteers.

Variables	Obese / (%) Total	OR	95%CI	p-value
Father				0.11
Not-obese	196/277 (70.8)	1		
Obese	92/117 (78.6)	1.5	0.9-2.5	
Mother				0.10
Not-obese	154/221 (69.7)	1		
Obese	134/173 (77.5)	1.5	1.0 -2.4	
Siblings				0.031
Not-obese	129/190 (67.9)	1		
Obese	156/201 (77.6)	1.6	1.1-2.6	
Offspring				0.50
Not-obese	151/198 (76.3)	1		
Obese	52/61 (85.2)	1.8	0.8-3.9	
Spouse				0.009
Not-obese	111/155 (71.6)	1		
Obese	89/104 (85.6)	2.4	1.2-4.5	

Table 3
Association between psychological factors and obesity.

Variables	Obese / (%) Total	OR	95%CI	p-value
Current depression				0.29
Not-depressed	234/315 (74.3)	1		
Depressed	54/79 (68.4)	0.8	0.4 -1.3	
Adolescent depression				0.55
Not-depressed	266/361 (73.7)	1		
Depressed	22/32 (68.8)	0.8	0.4 -1.7	
Stress				0.10
Excellent mental health	43/53 (81.1)	2.0	0.9-4.2	
Normal mental health	130/190 (68.4)	1		
Mild stress	115/151 (76.2)	1.5	0.9-2.4	

Table 4
Knowledge, attitude, and behavior in association with obesity.

Variables	Obese / (%) Total	OR	95%CI	p-value
Knowledge				0.039
Poor ^a	35/52 (67.3)	1		
Moderate	216/301 (71.8)	1.2	0.7-2.3	
Good ^b	37/41 (90.2)	4.5	1.4 -14.7	
Attitude				0.15
Poor ^c	47/56 (83.9)	2.0	0.8-5.1	
Moderate	202/284 (71.1)	1.0	0.5 -1.8	
Good ^d	39/54 (72.2)	1		
Behavior				0.028
Poor ^e	45/53 (84.9)	3.4	1.4 -8.4	
Moderate	203/277 (73.3)	1.7	0.9 -2.9	
Good ^f	40/64 (62.5)	1		

^a = A poor knowledge of the disease obesity.

^b = A good knowledge of the disease obesity.

^c = A poor attitude regarding the need to manage the obesity problem.

^d = A good attitude regarding the need to manage the obesity problem.

^e = Behavior likely to cause or contribute to obesity.

^f = Behavior not likely to cause or contribute to obesity.

lescence. One hundred and fifty-one volunteers had mild stress; no volunteers had severe stress, and lower proportion of the obese volunteers had depression; none of these associations reached statistical significance (Table 3).

Knowledge, attitude, and behavior in obesity

A significantly larger number of people with a good knowledge of obesity were obese, compared with those with a poor knowledge of obesity (OR = 4.5). In contrast, persons with poor behavior (behavior likely to contribute to obesity) had a significantly higher risk of obesity than those with good behavior (behavior less likely to contribute to obesity) (OR = 3.4) (Table 4). Obese volunteers had significantly lower behavior scores (29.2 ± 8.5 vs 31.7 ± 10.0 , $p = 0.021$). The behaviors that were significantly different between obese and non-obese volunteers were: less physical activity (14.4 ± 4.4 vs 15.6 ± 4.2 , $p = 0.009$), and spending longer periods of time watching TV, videos, or playing computer (> 3 hours) in the obese volunteers (2.1 ± 1.9 vs 2.8 ± 2.3 , $p = 0.002$). There was no significant difference in reported food consumption. However,

obese volunteers reported that they consumed more when they were stressed (0.9 ± 1.2 vs 1.3 ± 1.5 , $p = 0.003$). There was no significant association between attitude and obesity.

Multivariate analyses were applied to variables that were significantly associated with obesity in the univariate analyses. There were only 3 risk factors for obesity found in this study: higher age, a good knowledge of obesity, and poor behavior (Table 5).

DISCUSSION

This study was done in a group of volunteers who had specific socioeconomic and occupational characteristics and therefore, may not be able to be extrapolated to the general population. However, the population with similar characteristics to our study volunteers is increasing, especially in developing countries where there is increasing economic growth, and for which, the findings of this study may be beneficial.

Generally, females have more stored body fat and are more likely than males to be obese

Table 5

Multivariate analysis of factors associated with obesity (Stepwise Multiple Logistic Regression).

Variables	Adjusted OR	95%CI	p-value
Age (in years)			
<40	1		
40-49	3.4	1.1-11.1	<0.001
50-59	10.4	3.3-32.7	<0.001
Knowledge			
Poor ^a	1		
Moderate	0.9	0.3-2.8	0.88
Good ^b	7.5	1.1-52.1	0.043
Behavior			
Poor ^c	10.3	2.0-52.4	0.005
Moderate	4.5	1.7-11.4	0.002
Good ^d	1		

^a = A poor knowledge of the disease obesity.

^b = A good knowledge of the disease obesity.

^c = Behavior likely to cause or contribute to obesity.

^d = Behavior not likely to cause or contribute to obesity.

(Brown, 1991; Kuczmarski *et al*, 1994). In Thailand, the National Health Examination Surveys I (Chuprapavarn, 1996) and II (Aekplakorn *et al*, 2004) also showed a higher prevalence of obesity in females. In contrast, in this study, males had a significantly higher risk of obesity than females. This finding may result from selection bias or may reflect a real socioeconomic characteristic. There may be selection bias because obese males may have been more concerned about their health than females, and thus participated in this study. On the other hand, this study was carried out on working people, and there are fewer working women who are obese compared to non-working women or housewives.

Thai males may also have a tendency to be obese when they get married or are older. In the Thai culture, males are usually the head of the house and are not involved in household activities. In urban life, like in this group of volunteers, people usually spend most of their time in their daily occupations and neglect exercise or any additional physical activity. This is compounded by labor-saving technology and transportation. They often go to work early in the morning and return home late in the evening because of traffic and the crowded environment. At home, af-

ter dinner, males usually rest or watch television before bedtime, while females have to take responsibility for the household activities. This may account for why Thai males in this group of volunteers had a higher risk of obesity on univariate analysis. However, on multivariate analysis, sex was not significantly associated with obesity.

Regarding age, the statement that young people place greater emphasis on slimness than older people (Pliner *et al*, 1990), may be true across cultures. In NHES II (Aekplakorn *et al*, 2004), age (per ten year increase) is associated with obesity with an adjusted OR of 1.3. Our study demonstrated that the age groups 40-49 and 50-59 had a significantly higher risk of obesity than the age group of less than 40, which confirms the previous study. This result, therefore, may be extrapolated to the general population. The explanation may be a slower metabolism, less physical activity, and frequent consumption of food in the elderly. Moreover, older individuals may be less concerned with their body shape.

People tend to gain weight after marrying (Craig and Truswell, 1990; Kahn *et al*, 1991), and couples tend to synchronically gain and lose weight together (Garn *et al*, 1984). In NHES II

(Aekplakorn *et al*, 2004), marriage was associated with obesity with an adjusted OR of 2.2. Spouses eat the majority of their meals and snacks together, both at home and away from home, therefore, people consume most of their calories with their marital partner. The social obligation of spending time together as spousal partners presents an opportunity for many forms of exercise activities. This study supports the previous study in this regard.

However, in multivariate analysis, marital status was not a significant risk factor for obesity, probably because obesity is a multifactorial disease, and there were many confounding and interactive factors in the analysis.

Energy expenditure varies considerably in different occupations. Some jobs involve high levels of energy expenditure over extended periods of time, while others involve minimal physical activity for long periods. This study showed that the participants who performed moderate labor had a significantly higher risk of obesity than those who provided non-labor jobs. These results may be explained by a higher positive energy intake. Moderate labor persons may feel that they work hard and need more energy. Most of them are in a lower socioeconomic class, consume lower quality food and have fewer recreational activities. However, on multivariate analysis, occupation contained no significant risk factors for obesity. This may be because this factor was masked by other factors.

Educational level is one of the strongest predictors of body weight and obesity. People who have higher levels of education are thinner. In this study, using univariate analysis, our results concurred. Knowledge, thinking skills, and normative socialization acquired through education appear to be important in preventing weight gains during adulthood, and dealing with weight gains when they occur. Although there was no significant association between educational level and obesity on multivariate analysis, public investments in education of the population may be one of the most effective ways to limit the development of and lower the prevalence of obesity.

Genetic factors almost certainly contribute to some of the variations in body weight and

composition within a population (Stunkard *et al*, 1986; Cardon *et al*, 1994). Polygenic factors as well as major gene effects may act to produce the complex phenotype of obesity. It is difficult to estimate accurately the extent of this contribution, but the available data indicate it may be between 25% and 70%.

In our study, there was no association between obesity in parents or offspring and obesity in the volunteer. There was a significant association between sibling or spouse obesity and the obesity in the volunteer. This finding demonstrates the possible effect of child rearing practices and the difficulty of identifying genes which influence obesity, polygenic effects, and gene-environment interactions.

Many previous studies have revealed that depressed adolescents are at increased risk for the development and persistence of obesity (Pine *et al*, 2001; Goodman and Whitaker, 2002; Richardson *et al*, 2003; Stunkard *et al*, 2003). Some studies provide evidence for a relationship between depression and BMI (Carpenter *et al*, 2000; Erickson *et al*, 2000; Roberts *et al*, 2000; Faith *et al*, 2002). However, Uengrungseesophon (2001) studied the relationship between depression, eating disorders and BMI and reported that there was no statistically significant relationship between depression, eating disorders and BMI.

Chronic stress usually decreases body weight gain in rats; by contrast, in stressed or depressed humans, chronic stress induces either increased comfort food intake and body weight gain or decreased intake and body weight loss.

In this study, although there was no significant association between depression or stress and obesity, obese people seemed to be less depressed but were more stressed. This may be a difference between Thai and western people. Thai, mild to moderately obese people usually have a good mood and are well-adapted in society. However, the finding that obese people seemed to be more stressed is very interesting. Over-eating may be a compensatory mechanism for stress. Due to the limitation of cross-sectional study, the relationship between chronic stress or depression and obesity, should be investigated more in prospective studies over

a certain period of time.

A few studies (Thakur and D'Amico, 1999; Gordon-Larsen, 2001) suggested that there were no significant differences in nutritional knowledge between obese and non-obese students with the exception that obese students were better able to identify high-fiber foods.

Our study also found that people with good knowledge and poor behavior had a significantly higher risk of obesity, while attitude had no role in obesity. It should not be presumed that people with good knowledge are at higher risk for obese, but that obese people are more interested in and search for knowledge about their disease. This finding emphasizes that changing behavior (habits) is more important than just giving knowledge or changing attitudes in obese persons, for controlling obesity.

In conclusion, in our study, male sex, older age, being married, having a moderate-labor occupation, a lower educational level, and obese siblings or spouse were significantly associated with obesity, which is in concordance with other studies. The independent risk factors for obesity in this study were aging and poor behavior. Regarding knowledge, obese people may perceive themselves as obese, which stimulates an interest in learning more about obesity. Therefore, the obese volunteers in our study had significantly better knowledge regarding obesity.

Thai lifestyle has changed dramatically during the past three to four decades due to globalization and westernization, especially in middle-class urban people. Bangkokians have been affected more than Thais living in other provinces. Industrialization, transportation, computerization and other technology has led Bangkokians to have a more sedentary lifestyle. Low quality, ready-to-eat or frozen foods have replaced the conventional Thai cooked food. Urbanization and westernization have led to obesity. Although many people have a good perception of, a knowledge of, and attitude about obesity, their behavior increased their risk for obesity. They have a sedentary lifestyle and compensatory eating when they are under stress. This demonstrates that they neglect to do what they know they should do, or they are too busy

to control or modify their behavior. The future mission is to focus on behavior modification and management at the level of the community and the country.

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