ORIGINAL CONTRIBUTION

Epidemiology of Obesity in Elderly People

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Our study used data collected at Chung-Shing-Shin-Tseun community in Taiwan in May 1998 to evaluate the relationship between obesity and the cardiovascular and sociodemographic risk factors in elderly people. Individuals aged 65 and over were recruited as study subjects. A total of 1093 persons, out of 1774 registered residents, were contacted in face-to-face interview. The response rate was 61.6 percent. However, only 586 respondents took blood tests and completed questionnaires. Analysis in this study was based on these 586 subjects. The χ-square analysis and multivariate logistic regression were used to study the significant correlates of obesity. Our results showed that 66 percent were men and 34 percent were women. The mean age was 73.1 ± 5.3 years. The overweight proportions were 24.8 percent in elderly men and 29.7 percent in elderly women. The obesity proportions were 12.7 percent in elderly men and 11.5 percent in elderly women. After controlling the other covariates, the multivariate logistic regression analysis showed that overweight and obesity were associated with hypertension, hypertriglyceridemia, and hyperglycemia. In conclusions, the prevalence of overweight and obesity is high in Taiwanese elderly people. Thus, it is necessary to evaluate other metabolic disorders if one metabolic abnormality is observed.

INTRODUCTION

Obesity in adult life is associated with several chronic disorders, including coronary artery disease, hypertension, dyslipidemia, diabetes mellitus, gallbladder disease, osteoarthritis, some cancers and increased mortality [1]. However, obesity is a very common disorder in many countries and is considered one of the major public health problems in industrialized countries [2]. Obesity is characterized by an excess of fat tissue relative to lean body mass [3]. It is sometimes difficult and complex to measure body fat. Therefore, a definition of obesity based on weight and height is usually used in clinical practice [3]. Body mass index (BMI[e]: weight [kg] ÷ height [m]^2) is one indirect method to detect body fat. However, the population in Taiwan is over 21 millions and the population aged $\geq$ 65 years has exceeded 7 percent since 1994. A continued increase in numbers of elderly people is detected [4].

Up to now, only a few studies about the elderly obesity in Taiwan have been reported. Thus, it is time to pay attention to the health status of the elderly people in this country.

For early detection of obesity, and early identification of risk factors and early intervention for obesity, under conduction of comprehensive studies in elderly people living in Chung-Shing-Shin-Tseun community in Taiwan, the relationship between obesity and the cardiovascular and sociodemographic risk factors was discerned.

SUBJECTS AND METHODS

In May 1998, a cross-sectional study was conducted at Chung-Shing-Shin-Tseun community in Taiwan. All of the individuals aged 65 and over were candidates for the study, for a total of 1774 subjects, according to the official household registration records. A total of 1093 persons, out of the possible 1774 subjects, participated in the study. The response rate was 61.6 percent. However, only 586 respondents took blood tests and completed questionnaires. Analysis in this study was based on these 586 subjects. Information about the subject's socioeconomic status, family structure, and educational level was collected by well-trained interviewers in face-to-face interviews.

The subject's educational level was identified as junior high school or less, senior high school, professional training college, and undergraduate or graduate. If the subject had retired from work, that status was identified. If the subject still lived with a spouse, the marital status was defined as living together. If not, marital status was defined as living alone.

Blood pressure was measured by a mercury sphygmomanometer in the sitting position. Weight and height were measured. Blood samples were obtained in the morning after a 12-hour overnight fast. A number of biochemical markers, such as total cholesterol, triglyceride, fasting glucose, creatinine and uric acid, were analyzed by a biochemical autoanalyser (Chem1$^+$, Technicon, USA) at the Department of Clinical Laboratory of Chung-Shing hospital within four hours of collection.

Body mass index was measured as follows: weight (kg) ÷ height (m)^2. BMI $\geq$ 28 was defined as obesity; $25 \leq$ BMI < 28 as overweight; $20 \leq$ BMI < 25 as normal; and BMI < 20 as underweight [5]. Hypercholesterolemia was defined as total cholesterol $\geq$ 200 mg/dl and hypertriglyceridemia was defined as triglyceride $\geq$ 200 mg/dl [6]. Hyperglycemia was defined as fasting glucose $\geq$ 110 mg/dl [7]. Subjects were considered to have hypertension if the average of three readings exceeded 140 mmHg systolically and/or 90 mmHg diastolically [8]. Hypercreatininemia was defined as creatinine $\geq$ 1.5 mg/dl [9]. Hyperuricemia was defined as serum uric acid $\geq$ 7 mg/dl in men and $\geq$ 6.5 mg/dl in women [10].

The statistical analyses were performed by the aid of a SAS package (Version 6.12, SAS Institute Inc., Cary, North Carolina). The methods of statistical analysis applied in this study were χ-square analysis and multivariate logistic regression. Statistical significance was defined as p-value less than .05.

RESULTS

Among 1093 subjects, 65.7 percent were men and 34.3 percent were women. The mean age was 73.5 $\pm$ 5.6 years. Our study disclosed that 66 percent were men and 34 percent were women out of 586 subjects. The mean age was 73.1 $\pm$ 5.3 years. We performed t-test and χ-square analysis to examine the gender and age distributions between these two samples. No significant difference was observed.

Therefore, the potential non-response bias could be minimized.

In Figure 1, the overweight proportions were 24.8 percent in men and 29.7 percent in women. The obesity proportions were 12.7 percent in men and 11.5 percent in women.

The results of χ-square analysis for obesity among the cardiovascular and sociodemographic risk factors were shown in Table 1. The significant correlates of obesity were high systolic pressure, hypertriglyceridemia, and hyperuricemia (p < .05). No significant association was found between obesity and gender, age, high diastolic pressure, hypercholesterolemia, hyperglycemia, hypercreatininemia, education level, retirement status, or marital status.

The results of multivariate logistic regression for obesity among the cardio-

vascular and sociodemographic risk factors were shown in Table 2. Overweight people were more likely to have hypertension than normal weight people (Odds ratio [OR] = 1.6; 95 percent confidence intervals [CI] = 1.1-2.5). Obese people were more likely to have hypertension than normal weight people (OR = 1.9; 95 percent CI = 1.1-3.2). Overweight people were more likely to have hypertriglyceridemia than normal weight people (OR = 1.7; 95 percent CI = 1.0-2.7). Obese people were more likely to have hypertriglyceridemia than normal weight people (OR = 2.0; 95 percent CI = 1.0-3.8). Overweight people were more likely to have hyperglycemia than normal weight people (OR = 2.2; 95 percent CI = 1.4-3.6). Obese people were more likely to have hyperglycemia than normal weight people (OR = 2.3; 95 percent CI = 1.2-4.4).
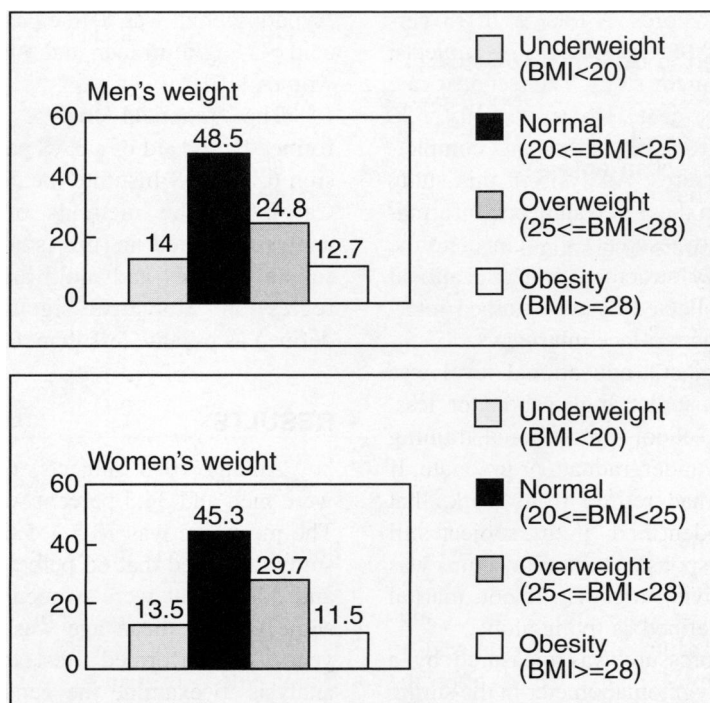

Figure 1. The distribution of BMI in the elderly population by gender.

Table 1. Correlates of obesity in χ-square test among elderly people

Variate	Total	Obesity (%)	P value
Gender:			
Men	379	48 (13)	0.68
Women	192	22 (11)	
Age (years):			
65-69	165	23 (14)	0.47
70-74	189	22 (12)	
75-79	146	14 (10)	
≥80	67	11 (16)	
Systolic pressure ≥140 (mm Hg):			
No	380	38 (10)	0.04
Yes	186	30 (16)	
Diastolic pressure ≥90 (mmHg):			
No	448	50 (11)	0.22
Yes	118	18 (15)	
Total cholesterol ≥200 (mg/dl):			
No	288	35 (12)	0.93
yes	282	35 (12)	
Triglyceride ≥200 (mg/dl):			
No	444	47 (11)	0.03
Yes	123	22 (18)	
Fasting glucose ≥110 (mg/dl):			
No	452	51 (11)	0.16
Yes	118	19 (16)	
Creatinine ≥1.5 (mg/dl):			
No	394	51 (13)	0.53
Yes	172	19 (11)	
Uric acid (men ≥7.0, women ≥6.5 mg/dl):			
No	275	26 (9)	0.04
Yes	293	44 (15)	
Level of education:			
Junior high school or less	160	19 (12)	0.51
Senior high school	149	23 (15)	
Professional training college	70	6 (9)	
Undergraduate or graduate	130	15 (12)	
Retirement status:			
Non-retired	146	16 (11)	0.58
Retired	425	54 (13)	
Marital status:			
Living together	416	49 (12)	0.70
Living alone	154	20 (13)	

DISCUSSION

Most of people living in Chung-Shing-Shin-Tseun community moved to Taiwan from Mainland China after the civil war during their military service. Because most of them were male, the pro-portion of male in this sample was higher than that of female.

In Melchionda's report, the prevalence of overweight was 13 percent for Italian elderly men and 28 percent for Italian elderly women [11]. In DeVore's report, overweight or obesity was present in 60 percent of the elderly men and 45.6

Table 2. Results of multivariate logistic regression for obesity among elderly people.

Variate	Hypertension OR (95% CI)	Hyper-CHO OR (95% CI)	Hyper-TG OR (95% CI)	Hyperglycemia OR (95% CI)	Hyper-Cr OR (95% CI)	Hyperuicemia OR (95% CI)
Gender (men as reference):						
Women	1.0 (0.6-1.8)	**1.9 (1.1-3.4)**	1.4 (0.7-2.8)	1.1 (0.5-2.1)	**0.1 (0.03-0.2)**	**0.5 (0.3-0.9)**
Age (65-69 years as reference):						
70-74	1.0 (0.6-1.6)	0.8 (0.5-1.2)	1.0 (0.6-1.8)	1.3 (0.8-2.4)	1.5 (0.9-2.6)	**0.6 (0.4-0.9)**
75-79	1.2 (0.8-2.0)	**0.6 (0.4-0.9)**	0.8 (0.4-1.4)	1.1 (0.6-2.0)	1.5 (0.9-2.7)	**0.5 (0.3-0.9)**
≥80	1.1 (0.6-2.1)	**0.4 (0.2-0.7)**	0.4 (0.2-1.0)	1.1 (0.5-2.3)	1.7 (0.8-3.4)	0.6 (0.3-1.2)
Educational level (junior high school or less as reference):						
Senior high school	0.8 (0.5-1.2)	1.0 (0.6-1.7)	0.9 (0.5-1.6)	0.6 (0.4-1.2)	1.3 (0.8-2.3)	1.4 (0.9-2.3)
Professional training college	0.6 (0.3-1.2)	**1.9 (1.0-3.6)**	0.7 (0.3-1.6)	0.9 (0.4-1.8)	1.9 (0.9-3.6)	1.1 (0.6-2.0)
Undergraduate or graduate	0.8 (0.5-1.3)	1.1 (0.6-1.9)	1.3 (0.6-2.4)	1.1 (0.6-2.1)	0.8 (0.4-1.4)	1.3 (0.8-2.3)
Retirement (non-retirement as reference):						
Retired	1.0 (0.5-1.8)	0.8 (0.4-1.5)	1.0 (0.5-2.2)	1.2 (0.6-2.8)	0.6 (0.2-1.6)	1.0 (0.5-1.9)
Marital status (living together as reference):						
Living alone	1.0 (0.6-1.6)	**1.6 (1.0-2.6)**	**1.7 (1.0-2.9)**	1.0 (0.6-1.7)	0.9 (0.5-1.5)	**0.6 (0.4-0.9)**
BMI (normal as reference):						
Overweight	**1.6 (1.1-2.5)**	0.9 (0.6-1.4)	**1.7 (1.0-2.7)**	**2.2 (1.4-3.6)**	1.3 (0.8-2.1)	1.4 (0.9-2.2)
Obesity	**1.9 (1.1-3.2)**	0.8 (0.5-1.4)	**2.3 (1.0-3.8)**	**2.3 (1.2-4.4)**	0.9 (0.5-1.8)	1.7 (0.9-3.0)

Hyper-CHO, hypercholesterolemia; Hyper-TG, hypertriglyceridemia; Hyper-Cr, hypercreatininemia; OR, odds ratio; 95% CI, 95% confidence interval. Entries in **boldface** are considered significant.

percent of the elderly women [12]. In our present report, the overweight proportions were 24.8 percent in elderly men and 29.7 percent in elderly women. The obesity proportions were 12.7 percent in elderly men and 11.5 percent in elderly women. As in other developed countries of the world [3], overweight and obesity has become a major health problem in Taiwanese elderly people.

Cardiovascular disease is one of the leading causes of mortality and morbidity in the modern countries, especially for the elderly people [13]. Cigarette smoking, hypertension, hypercholesterolemia, hypertriglyceridemia, low serum HDL (high density lipoprotein) cholesterol, diabetes mellitus, obesity, physical inactivity, increased age, prior coronary artery disease, and left ventricular hypertrophy are associated with cardiovascular disease [14]. The greater the number of major risk factors, the higher the incidence of new cardiovascular events [14]. Therefore, modification of certain major risk factors may lower a patient's risk for the cardiovascular disease and its serious complications in the elderly [14]. In Taiwan, the cardiovascular disease is the third leading cause of death after neoplasm and the cerebrovascular disease [15]. In Liau's report, the prevalence of the cardiovascular disease was 11.4 percent in Taiwan [16]. Obesity was often associated with hyperlipidemia, diabetes, hyperuricemia, and hypertension [10, 17-18]. Hypercholesterolemia, hypertriglyceridemia, hyperuricemia, and hypertension were noted in people with insulin resistance [19-20]. Therefore, this association suggested the same pathogenesis for obesity, hyperlipidemia, hyperglycemia, hyperuricemia, and hypertension [10,17-21]. In our present report, overweight and obesity were associated with hypertension, hypertriglyceridemia, and hyperglycemia. These findings further indicated that multiple metabolic disorders would often cluster within the same individual. Thus, it is necessary to survey other metabolic disorders if one metabolic abnormality is observed.

In conclusion, the prevalence of overweight and obesity is high in Taiwanese elderly people. Thus, it is necessary to evaluate other metabolic disorders if one metabolic abnormality is observed.

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