Kaohsiung J Med Sci 18: 53 – 61, 2002

PREVALENCE OF CARDIOVASCULAR RISK FACTORS OF ELDERLY PERSONS IN TAIWAN

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Cardiovascular disease has been one of the top-ten causes of death continuously for older persons in Taiwan. However, There is still a lack of sufficient information on prevalence rates of cardiovascular risk factors. The present study was intended to provide prevalence rates of biological and behavioral risk factors for cardiovascular disease by gender, age group, and dwelling area. Data were extracted from a nationwide, cross-sectional, geriatric survey (1989-1991) by four medical centers in Taiwan. A total of 2,600 community senior residents were successfully interviewed for analysis. For the whole sample, hypertension was found to be the most prevalent biological risk factor (36.9%), while being overweight was the first behavioral risk factor (34.38%). By gender, higher prevalence rates of biological risk factors were found in older women except for the low value of high density lipoprotein cholesterol (HDL-C); higher prevalence rates of behavioral risk factors were found in men except for being overweight. No statistically significant difference in prevalence rates was found between the 65-74 and 75^{+} years age groups. By dwelling area, significant differences in the prevalence rates of risk factors existed across the four study areas. In conclusion, hypertension and excessive weight are critical cardiovascular risk factors that can be early identified or prevented by screening programs and health education. Cardiovascular prevention programs for elderly people should be designed in their gender and dwelling area.

Key words: cardiovascular disease, prevalence, risk factor, elderly, Taiwan

(Kaohsiung J Med Sci **18:** 53 – 61, 2002)

Ever since the beginning of twentieth century, cardiovascular disease has been one of the major causes of death for human beings, particularly in industrialized countries [1]. According to the data from the National Department of Health in Taiwan, cardiovascular disease has remained in the top-five-death-causes list for the last decade, especially for the population aged 65 years and over [2, 3]. For those aged 85 years and over, cardiovascular disease ranked as the first cause of death. By the definition of WHO, Taiwan became an "aging society" in 1993. In recognition of the increasing importance of elderly care, more understanding of this threatening disease in its risk factors and their prevalence rates is essential for prevention programs and care planning.

According to literature, the development of cardiovascular disease can be predicted by the three categories of risk factors: individual characteristics [4-8], biological factors [9-18], and behavioral factors [19-26]. Most of the previous studies focused on only one area of cardiovascular risk factors. However, cardiovascular disease has a multi-factorial etiology [27,28]. To develop appropriate strategies for the prevention of cardiovascular disease for elderly people, it is important in considering its risk factors from different views of possibilities. Based on the data collected from the first nationwide geriatric survey in Taiwan, the main purpose of this study

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was to provide an insight into the prevalence rates of cardiovascular risk factors for elderly residents in Taiwan by the classifications of gender, age group, and dwelling area.

MATERIALS AND METHODS

Sample and data

The study design was a cross-sectional community survey, which was funded by the National Department of Health in Taiwan from 1989 to 1991. The original purpose of this geriatric epidemiological study was to evaluate disease patterns, health status, and life styles of the community -dwelling elderly persons aged 65 years or more. A stratified random sampling was used to select the study sample. Geographically, Taiwan was divided into four regions, that is, northern, central, southern, and eastern areas. The major metropolitan city in each area (i.e., Taipei, Taichung, Kaohsiung, and Hualein) served as the center of the survey; and each city had one medical center responsible for conducting the survey. The sampled community-dwelling elderly persons in each city were intended to represent the elderly population residing in each region.

The base administrative unit, *Li*, was used as the last strata for random sampling. One elderly man and woman of each Li in the three study cities (i.e., Taipei, Taichung, and Kaohsiung) were recruited for the study. Two elderly men and two women of each Li in Hualian were sampled because of its relatively small population size. The household data was obtained from the city census bureau, which was responsible for population registry of births and deaths. Based on this random sampling design, 5,453 subjects were on the list and had been invited to participate in the study. At the end, a total of 2,600 participants completed the survey from April 1989 to June 1991, with a response rate of 48.6%. Although the response rate was modest, chi-square statistics (X^2=4.012, df =4, p= .404) indicated that the distributions of different age groups of participants did not significantly differ statistically from the entire elderly population in Taiwan. The data for the chi-squared test was based on the national census data derived from the National Department of Health in Taiwan.

However, the response rates varied by regions. Kaohsiung had the highest response rate (63.1%); Taichung had the lowest one (37.3%); Taipei and Hualian had moderate response rates (48.9% and 47.9%). Table 1 displays the distributions of participants by gender, age group, and dwelling area. Across the four areas, 1,322 elderly men and 1,278 elderly women were recruited. Appropriately, 77% of them (2001 of 2600) were aged 65-74 years. By age group and dwelling area, Taichung had a relatively lower percentage of participants aged 75 years and over (50 of 400; 12.5%) as compared with other areas, which may be due to its very low response rate.

Validity and reliability of data

The sampled subjects were invited to the designated medical centers for a comprehensive health status examination that was combined with physical, neurological, and laboratory evaluation. Also a questionnaire, including the information on past medical history, alcohol consumption, and cigarette smoking, was administered by physicians upon taking comprehensive health examinations [25]. To enhance the validity and reliability of the data, the National Taiwan University Hospital (NTUH) operated as the quality control center for the standardization of clinical examination and interpretation of laboratory, X-ray, and electrocardiogram (ECG) samples. Further, the blood samples collected in the

Table 1. The distribution of participants by age group, gender and dwelling area

		Dwelling area				
Gender & age group		North (Taipei)	Center (Taichung)	South (Kaohsiung)	East (Hualein)	Total
Men	65-74	512	177	189	110	988
	75+	211	25	64	34	334
Women	65-74	528	173	193	119	1013
	75+	166	25	54	20	265
	Total	1417	400	500	283	2600

other three study medical centers were delivered the same day to the NTUH; the ECGs were reviewed by two professors using the same established criteria [29]. Therefore, the variations in the examination results were minimized [30].

Measurement of cardiovascular risk factors and analysis

The cardiovascular risk factors included biological risk factors and behavioral risk factors. Following the criteria established by the National Cholesterol Education Program, the included cardiovascular biological risk factors were defined as follows: hypertension (taking regular antihypertensive medication and/or diastolic blood pressure (DBP) ≥ 95 mm Hg and/or systolic blood pressure (SBP) ≥ 160 mm Hg), high-risk total cholesterol (≥ 240 mg/dl), high-risk triglyceride (≥ 200 mg/dl), high value of low density lipoprotein cholesterol (High LDL-C) (≥ 160 mg/dl), and low value of high density lipoprotein cholesterol (Low HDL-C) (< 35 mg/dl). For behavioral risk factors, being overweight body mass index (BMI) ≥ 25 Kg/m^2, heavy smoker (> 20 cigarettes per day), and ex-smoker (having quitted for more than 6 months) were included for analysis smoking.

Statistical analysis

To avoid the comparison bias in different groups, a direct method was adopted to adjust the prevalence rate for each cardiovascular risk factor [31]. The age-adjusted prevalence rate was computed to minimize the bias caused by the composition of the study population. Descriptive analysis was used to provide distributions of cardiovascular risk factors and their prevalence rates. Chi-square tests were performed to reveal whether significant differences existed in prevalence rates of cardiovascular risk factors by gender, age group, and dwelling area.

RESULTS

Descriptive statistics of cardiovascular risk factors

Out of the 2,600 subjects, the mean age was 71.4 years (Table 2). For biological risk factors, the mean value of DBP was 82.2 mm Hg, while SBP was 143.1 mmHg. The means levels for cholesterol, HDL, LDL, and triglyceride were 204.7 mg/dl, 45.8 mg/dl, 121.5 mg/dl, and 126.4 mg/dl, respectively. The mean BMI was 24.0kg/m^2, which did not reach the overweight level as defined. Regarding smoking, 14.2 percent were heavy smokers, while 4.5 percent were ex-smokers (not shown in the table). The number of total cases varied by each biological factor due to missing values.

Crude prevalence rates of cardiovascular risk factors

According to the definition of each risk factor, Table 3 lists the prevalence rates of the selected risk factors for the whole study sample. Overall, hypertension was the most prevalent biological risk factor, whereas overweight was the most significant cardiovascular behavioral risk factor for the subjects. Specifically, the prevalence rate for hypertension was 36.9%, followed by low value of HDL-C (25.34%), hypercholesterolemia (18.26%), high value of LDL-C (16.03%), and hypertriglyceridemia (11.23%). With respect to behavioral risk factors, being overweight was ranked as the first behavioral risk factor (35.76%), followed by heavy smoking (14.23%), and having been a smoker (4.46%).

Age-adjusted prevalence rates of cardiovascular risk factors by gender

As shown in Table 4, age standardized preva-

Table 2. Descriptive statistics of cardiovascular risk factors

Variable	Mean	Std. deviation	Range	Case number
Age(yr)	71.4	4.5	65-93	2600
DBP(mmHg)	82.2	11.3	48-130	2555
SBP(mmHg)	143.1	21.3	84-240	2553
Cholesterol(mg/dl)	204.7	42.3	93-462	2524
HDL(mg/dl)	45.8	16.6	9-100	2202
LDL(mg/dl)	121.5	41.8	18-389	2183
Triglyceride(mg/dl)	126.4	93.4	27-2012	2520
BMI(kg/m^2)	24.0	3.6	11.8-49.6	2500

Table 3. Prevalence rates of cardiovascular risk factors: overall

Factor	n /N	Prevalence (%)
Biological factor		
Hypertension	959/2600	36.9
Hypercholesterolemia	461/2524	18.26
Hypertriglyceridemia	283/2520	11.23
Low HDL-C	558/2202	25.34
High LDL-C	350/2183	16.03
Behavioral factor		
Overweight	894/2500	35.76
Heavy smoker	370/2600	14.23
Ex-smoker	116/2600	4.46

lence rates were estimated separately for each gender. For elderly men, hypertension was ranked as the first biological risk factor (34.36%), followed by low value of HDL-C (29.20%), hypercholesterolemia (13.55%), high value of LDL-C (13.47%), and hypertriglyceridemia (10.40%). For each biological risk factor, the ranking of the prevalence rate in elderly men was as the same as the whole sample. For elderly women, slightly differently, hypertension still served as the first (39.5%); hypercholesterolemia the second (23.02%); and low value of HDL-C (21.39%) followed. In terms of behavioral factors, the first cardiovascular risk factor for elderly men was being overweight (29.54%), followed by heavy smoker (26.85%). Being overweight was also the most prevalent risk behavioral factor for the elderly women (39.35%), which was much higher than men's prevalence of weight (29.54%).

In the comparison of men and women, furthermore, the results of Chi-square tests indicated that there were statistically significant differences in the prevalence rates of each cardiovascular risk factor ($p< 0.05$) except for hypertriglyceridemia. In addition to the low value of HDL-C (21.39% in women vs. 29.20% in men), elderly women obviously had higher prevalence rates in biological risk factors. On the other hand, men had significantly higher prevalence rates in behavioral risk factors except for

Table 4. Age-adjusted prevalence rates of cardiovascular risk factors by gender

	Prevalence (%)		
Factor	Men	Women	*p* value
Biological factor			
Hypertension	34.36	39.50	0.000
Hypercholesterolemia	13.55	23.02	0.000
Hypertriglyceridemia	10.40	12.10	NS
Low HDL-C	29.20	21.39	0.000
High LDL-C	13.47	18.42	0.000
Behavioral factor			
Overweight	29.54	39.35	0.000
Heavy smoker	26.85	1.50	0.000
Ex-smoker	7.85	0.96	0.000

NS= not statistical significant. Tested by chi-square

being overweight. Elderly women had a higher prevalence rate of excessive weight (39.35%) than men (29.54%).

Prevalence rates of cardiovascular risk factors by age group

Table 5 provides the prevalence rates of cardiovascular risk factors by age group. The study sample was divided into the two age groups, aged 65-74 and 75+ years. In the comparison of the two age groups, the younger age group had higher prevalence rates in most of the biological risk factors. The prevalence rates of the low value of HDL-C were almost equal in both age groups. For behavioral risk factors, the 65-74 years age group had higher prevalence rates in being overweight and heavy smoking.

In the two age groups, the prevalence rankings for each cardiovascular risk factor were the same groups. Hypertension and being overweight remained the first biological and behavioral risk factors for each age group. However, statistically significant differences in the prevalence rates of hypertriglyceridemia and being overweight ($p < .05$) were found in the study.

Age-adjusted prevalence rates of cardiovascular risk factors by dwelling area

Table 6 lists the age-adjusted prevalence rates of cardiovascular risk factors in the four dwelling areas. Statistically significant differences in the prevalence rate of each biological and behavioral risk factor were found across the four geographic areas ($p < .01$). For biological risk factors, hypertension constantly was the first biological risk factor across the four areas. However, regional variations in the prevalence rates existed in other biological risk factors. As an example, the second ranking of biological risk factor was low value of HDL-C for Taipei, Taichung, and Hualein areas, but hypercholesterolemia for Kaohsiung. For behavioral factors, excessive weight and heavy smoker served as the first and the second prevalent risk factors for the four areas.

By dwelling area of the elderly sample, Taipei areas had the highest prevalence rates in most of the cardiovascular risk factors (hypertension, hypercholesterolemia, low value of HDL-C, high value of LDL-C, being overweight, heavy smoking, and having smoked). In the contrast, the Hualein areas had the lowest prevalence rates in several risk factors, including hypertension, hypertriglyceridemia, high value of LDL-C, being overweight, and having been a smoker.

DISCUSSION

The present study was descriptive-oriented to provide the information on prevalence rates in cardiovascular risk factors for the elderly population in Taiwan. In terms of biological and behavioral risk factors, the present findings indicated that hypertension and being overweight were the most prevalent cardiovascular risk factors for older persons in Taiwan. As a whole, the high prevalence rates of hypertension and being overweight were sustained.

Table 5. Prevalence rates of cardiovascular risk factors: by age group

Factor	Age group (%) 65-74 yr	75+ yr	*p* value
Biological factor			
Hypertension	36.78	37.23	NS
Hypercholesterolemia	18.40	17.78	NS
Hypertriglyceridemia	11.92	8.85	0.042
Low HDL-C	25.16	25.93	NS
High LDL-C	16.15	15.64	NS
Behavioral factor			
Overweight	35.43	30.88	0.040
Heavy smoker	14.89	12.02	NS
Ex-smoker	4.10	5.68	NS

NS= not statistical significant. Tested by chi-square

Consistently, previous studies also have demonstrated a significant association between high blood pressure and the development of cardiovascular disease [2,9,10]. Some researchers even argued that high blood pressure is the leading cause of cardiovascular disease [13,14].

The study sample was divided into sub-samples by gender, age group, and dwelling area. In the comparison of prevalence rates between elderly men and women, women were found to have higher prevalence rates in most of the biological risk factors. For elderly men, they only had a higher prevalence rate in the low value of HDL-C. Previous studies also pointed out that men had higher prevalence rates of biological risk factors [17,19]. However, it should be noticed that prior studies usually examined the adult aged 20-64 years rather than an elderly sample as in the present study.

One the other hand, elderly men did have higher prevalence rates in behavioral risk factors except for being overweight. The higher prevalence rate of excessive body weight in elderly women may have derived from their traditional roles of being house keepers: women are inclined to over-eat in order not to waste the food after family meals, which thus results in the accumulation of body fat. In addition , the decreasing level of hormones for elderly women may also contribute a high prevalence of being overweight. The higher prevalence of excessive weight in elderly women may correspond to the current finding that higher prevalence rates in the three biological risk factors were found in elderly women because body weight may have a potential effect on hypertension, hypercholesterolemia, and hypertriglyceridemia [2, 24, 26, 27].

Moreover, it was not surprising to learn that smoking is more prevalent in elderly men than women [13]. It has been reported that heavy smoking will cause a higher possibility of injury to endothelial cells, which in turn will initiate cardiovascular disease [20, 21]. Therefore, a cessation program on smoking is important in the prevention of cardiovascular disease, especially for the male elderly.

The results also showed that the 65-74 years age group had significantly higher prevalence rates in hypercholesterolemia and being overweight as compared with the 75^{+} years age group. As Borkan & Norris [24] ascertained, excessive body weight was more prevalent among people aged below 75 years. Another interesting finding is that the older age group had a relatively higher prevalence of past smoking as compared with the younger age group, although the difference did not reach the statistically significant level. The higher prevalence of ex-smoker in the 75^{+} years age group may be due to the degradation of spirometry and maximum breathing capacity decreasing with age [16].

From the perspective of geographic location, Taipei had six risk factors with the highest prevalence rates across the four areas; in contrast, Hualien areas had five risk factors with the lowest prevalence rates. As mentioned earlier, the prevalence rates of cardiovascular risk factors and other chronic diseases as well are highly associated with life styles

Table 6. Age-adjusted prevalence rates of cardiovascular risk factors by dwelling area

	Dwelling area (%)				
	North (Taipei)	Center (Taichung)	South (Kaohsiung)	East (Hualein)	*p* value
Biological factor					
Hypertension	38.69	39.65	38.88	24.19	0.000
Hypercholesterolemia	20.36	13.39	17.04	14.90	0.000
Hypertriglyceridemia	11.67	10.12	11.79	7.38	0.000
Low HDL-C	29.65	23.52	16.94	18.94	0.000
High LDL-C	19.61	9.76	12.05	9.71	0.000
Behavioral factor					
Overweight	36.77	31.58	35.35	26.58	0.000
Heavy smoker	15.19	12.08	12.92	13.19	0.008
Ex-smoker	5.92	4.54	2.15	1.38	0.000

NS= not significant. Tested by chi-square

and environmental factors. In Taiwan, the Hualien areas are relatively less urbanized areas where people still lead life in more traditional ways. On the other hand, the Taipei areas have much higher degrees of urbanization, which may provoke more high-calorie diet, decreases in exercise due to convenient accessibility to transportation, and stressful life styles. Eventually, people's health status will be affected along with the degree of urbanization [28].

Previous researchers investigated the prevalence rates of cardiovascular risk factors for the people living in the areas with different degrees of urbanization and concluded positive relationships among them [1, 32]. Campos and his colleagues [32] also found a higher prevalence in the urban area. Similarly, the present findings are compared to the Framingham study in the United States [15], which only included the sample aged 65-79 for the comparison. As expected, relatively lower prevalence rates of cardiovascular risk factors were found among the elderly in Taiwan (lower-developed country) than that in the Framingham study (a well-developed country).

However, it should be noted that the present study sample only represented an urban community-dwelling elderly population, which may hinder the general application of current findings. Therefore, it is suggested that a more generalized elderly sample is critical for future research, although the present study sample did not significantly differ from the entire elderly population in terms of age distribution. Nonetheless, while demographic characteristics and geographic locations are independent, people can prevent cardiovascular risk factors through appropriate life styles or healthy behaviors, especially for preventing hypertension and being overweight. For example, decreasing the digestion of saturated fat, taking more vegetables and fruits, and suitable exercise in an attempt to control body weight are all possible ways to increase HDL-C, and decrease LDL-C; consequently, blood pressure can be controlled. In addition, routine measure of blood pressure can help identify hypertension at the first place and put it under management. Likewise, maintaining healthy behavior by not heavy-smoking is also important to the prevention of cardiovascular disease incidence, especially for elderly men in Taiwan.

ACKNOWLEDGMENTS

Supported in part by the grant from the National Health Research Institute (NHRI EX90-8903PL, Taiwan, and partially from the grant of the National Department of Health, (DOH80-25), Taiwan, ROC.

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台灣老人心血管疾病危險因子之盛行率

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在台灣，心血管疾病長久以來位居老年人十大死亡原因之一。然而，甚少研究提及有關心血管疾病危險因子之盛行率。本研究之主要目的即在於依性別、年齡層以及居住地區分類，以檢視心血管疾病中生理與行爲危險因子之盛行率。資料來源主要取自1989-1991年在台灣四個醫學中心所進行的一項全國橫斷性老人醫學調查研究，總計完成2,600位社區老人之評估。整體而言，高血壓是影響心血管疾病最盛行的生理危險因子(36.9%)，而在行爲危險因子方面則是體重過重(34.38%)。若依性別分類，除了低HDL-C值外，女性老人在生理危險因子方面的盛行率皆高於男性老人；而男性老人則在行爲危險因子上有較高的盛行率，但女性老人體重過重的盛行率則較高。若依年齡分層的結果來看，比較65-74歲與75歲(含)以上此兩組，發現在盛行率上並無統計顯著差異。依地區不同的分析則發現在各項危險因子的盛行率皆呈現地區性的差異。綜合上述，高血壓及體重過重應被視爲預防心血管疾病初步篩檢的重要項目，而不同的預防方案之設計更應考慮性別及地區的差異性。

（高雄醫誌18: 53－61, 2002）

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收文日期：90年9月19日 接受刊載：91年1月4日
索取抽印本處：劉宏文 高雄醫學大學附設醫院家庭醫學科 高市十全一路100號