

Original Article

Interview to study the determinants of hypertension in older adults in Taiwan: a population based cross-sectional survey

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The aim of the study was to assess the association of socioeconomic, anthropometric and lifestyle factors with self-reported hypertension in older adults in Taiwan. The data were part of the "1999 Survey of Health and Living Status of the Elderly in Taiwan". The survey was conducted in-home, face-to-face, by interviews of 4440 men and women, 53 years or older, in a population-based cross-sectional study. The prevalence of self-reported hypertension was 31.1% for men and 38.0% for women. A logistic regression model showed a higher probability of self-reported hypertension for female gender, older age, and greater BMI, and lower probability for increased consumption of leguminous foods. No association was observed with cigarette smoking, alcohol consumption or physical activity. Current cigarette smokers and alcohol-drinkers underreported their hypertension status. Compared to the medically measured hypertension of a sub-sample study of the same cohort, only about 60% of medically-substantiated hypertensive patients self-reported their hypertensive status, indicating that the interview survey underestimated the prevalence of hypertension in this Taiwanese elderly population. The interview survey appears to identify associations of hypertension with age, gender, BMI and some food patterns, but does not recognize the likely associations with the candidate risk factors of physical inactivity, cigarette smoking, alcohol consumption and limited education, at least in this Taiwanese population. Thus caution must be applied where interview alone categorises individual older Taiwanese as hypertensive or not. A survey which has validation or cross-checking questions about the medical diagnosis of hypertension and the likelihood of its memory and appreciation by the patient (such as method, definition, communication with patient, recall and follow-up, lifestyle advice or pharmaco-therapy, presence of cognitive impairment) may clarify the significance of the discrepancy between self-reporting and medical record. In turn, this would allow a more robust evaluation of blood pressure determinants in such populations. Nevertheless, there is a role for community-based surveys that utilise self-reporting in the identification, prioritization and surveillance of putative contributors to hypertension; this is the case where, as in the Taiwanese elderly, it assumes major importance in the burden of disease and premature mortality.

Key Words: hypertension, interview surveys, self-reporting, medical records, body mass index, elderly, foods, legumes, Taiwan, validation

Introduction

Hypertension is a chronic health condition prevalent in most industrialized populations around the world. It is a major risk factor for coronary heart disease, stroke, diabetes mellitus and renal disease. In Taiwan, all these chronic diseases were among the ten leading causes of death in 2004.¹ Using JNC-6 (Sixth Report of the Joint National Committee on Prevention, Detection, Evaluation and Treatment of High Blood Pressure) definition of ≥ 140 mmHg for systolic pressure and ≥ 90 mmHg for diastolic pressure, approximately 60-70% of the elderly in most industrialized countries have hypertension.²⁻⁴ Age, race, genetics, gender, body fatness, socioeconomic status, psychosocial stress, diet and lifestyle factors, especially daily physical activity, cigarette smoking and alcohol consumption, are known to affect one's blood pressure. Many epidemiological hypertension studies have been conducted to identify the risk factors for hypertension in various populations around the world. However, because

each population has its unique genetic makeup, lifestyle and dietary habits, the risk factors for hypertension may be different from population to population, and therefore each population must conduct studies to assess their specific risk factors.

Traditionally, hypertension studies involve clinical measurements of subjects' blood pressures, with their associated costs.

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In recent years, researchers and health workers have increasingly used interview surveys as a tool to gain information on hypertension status and prevalence, along with other medical and health conditions, in target populations. Interview surveys can have considerable advantage in time and cost over clinical studies, especially if the study requires large samples. However, these potential advantages come with potential drawbacks, particularly concerning the accuracy and reliability of results that can be affected by participants' knowledge of their own health status and willingness to reveal the information without bias. Thus, the objective of this study was to assess the usefulness of information obtained through interview as a tool for assessing the association of socioeconomic, anthropometric and lifestyle factors with the prevalence of hypertension in older Taiwanese.

Methods and procedures

Data for this study were part of the 1999 wave of the "Survey of Health and Living Status of the Elderly in Taiwan" (SHLSET), a longitudinal research project initiated in 1989 aimed to gain an understanding of the roles of anthropometric, demographic, socioeconomic, lifestyle, dietary and healthcare factors on health, well-being and quality of life of older adults in Taiwan.^{5,6} SHLSET conducts periodic interview surveys on participants in the cohort.^{7,8} Participants were selected according to a process involving multi-stage national probability sampling. The 1999 survey involved 4915 remaining participants in the cohort. The youngest participants were 53 years old. Trained interviewers accompanied by local health workers conducted in-home, face-to-face, interviews. If a participant was unable or unavailable to have an interview, a proxy respondent, usually a close relative or caregiver of the participant was interviewed. Of the 4915 participants in the cohort, 4440 successfully completed the interviews.^{7,8} The study was conducted by the former Taiwan Provincial Institute of Family Planning (TPIFP), now a component of the Bureau of Health Promotion of the Department of Health, according to the ethical standards set forth in the Helsinki Declaration of 1995. All participants were given informed consent and subject anonymity was preserved.

This study statistically analysed rates of self-reports of hypertension and the association of age, gender, body mass index (BMI), years of formal education, lifestyle factors (including physical activity, alcohol drinking, and cigarette smoking) and intake frequencies of the major food items or categories with hypertension. For the calculation of BMI (kg/m^2), self-reported weight and height of each participant were first converted to measured weight and height using the regression equations developed by Kuczmarski *et al.*⁹ Physical activity was classified into four levels (0, 1-2, 3-5 and 6 and greater), according to the total times of physical exercise lasting >30 min/session/week. Cigarette smoking habit was classified into never smokers, past smokers and current smokers. The current smokers were further classified into three categories, 1-10, 11-20, and >20 cigarettes/day. Alcohol drinking status was classified into non-drinkers and current drinkers which were further classified into four levels: 1-2 times/month, 1 time/week, 2-3 times/week and >4

times/week. Questions on participant's blood pressure status included: (a) whether he/she ever had hypertension, (b) whether the disease was diagnosed by a doctor, (c) whether he/she visited a doctor because of hypertension during the past 12 months, (d) whether he/she had hypertension currently, and (e) whether he/she was taking any medication or receiving any treatment for this disease. Those who answered "yes" to questions (d) or (e) were considered having hypertension.

The prevalence of self-reported hypertension in the current study was compared to the results of the SEBAS (Social Environment and Biomarkers of Aging Study-2000),¹⁰ a sub-sampling study of the same cohort and included results of both self-reported and medically measured hypertension. Each subject in the SEBAS study underwent comprehensive clinical and biochemical examinations, in addition to the interview. Binary logistic regression analysis was applied to estimate the association of socio-demographic, anthropometric, lifestyle and dietary factors with the rate of self-reported hypertension using the Statistical Package for the Social Sciences (SPSS Base 10.0 Application Guide, 1999 by SPSS Inc. Chicago, IL). Self-reported "prevalence" of hypertension was stratified by gender and 10-year age-ranges. Variables included in the regression model are factors that have been observed to be associated with hypertension in the general population from epidemiological studies, including gender, age, education, BMI, physical activity, alcohol consumption, smoking, and diet.^{11,12} Findings in the current study were also compared with those of the Tainan City Study conducted by Lu *et al.*¹³ The Tainan City study was a cross-sectional community-based study involving a three-stage stratified cluster sampling process. One family physician and one research assistant made home visits and performed the questionnaire interviews and measured blood pressure on 876 of 1435 eligible elderly (a 70.2% response rate). The crude prevalence of hypertension (according to JNC-V), the known cases (according to medical history) and the new cases (newly diagnosed hypertension) were statistically analysed. Published data in the Tainan City study were recalculated to show the known cases, new cases and known/new cases for alcohol drinking, smoking and physical activities. A probability level of $p < 0.05$ was designated as the level of statistical significance.

Results

Table 1 shows the "prevalence" of hypertension on the basis of self-reports from the interview survey (the current study), and the prevalence of hypertension and the proportion of new cases (previously unrecognized hypertension) based on clinical measurement of the sub-sampling SEBAS study.¹⁰ Table 2 shows the estimated odds ratios (OR) and their 95% confidence intervals (CI) for the logistic regression model of the association of the rate of socio-demographic, anthropometric, lifestyle and dietary factors with self-reported hypertension. The model showed that female gender, old age, and body fatness were positively associated with self-reported hypertension ($p < 0.05$) while legume consumption ($p < 0.05$) was negatively associated with self-reported hypertension. The rate of self-reported hypertension was positively associated

with most but not all levels of increased formal education. Alcohol consumption, cigarette smoking, physical activity and the consumption frequency of most food categories did not show a significant association with self-reported hypertension. The impact of gender on self-reported hypertension became more apparent after age 65. Greater proportions of women than men reported having hypertension after this age (Fig 1). Table 3 shows a comparison of the results of the present study with that of Lu *et al.*¹³ Their results were recalculated to demonstrate that both current smokers and current drinkers under-reported their hypertension status according to Chi-square tests ($p < 0.05$) and as evidenced by their lower ratios of known/new cases of hypertension relative to non-smokers and non-drinkers, respectively.

Discussion

Self-reported hypertension

Results of the interview survey show that 34.3% of older adults, 53 years or older, in Taiwan have self-reported hypertension (Table 1). As expected, this fraction repre-

Table 1. Proportions (%) of participants reported having hypertension and other related conditions

	Current study [†] (n = 4440)	SEBAS [†] (n = 1003)
Prevalence of hypertension	NA [‡]	57.3
Self-reported hypertension	34.3	30.3
Diagnosed hypertension [§]	97.3	97.8
Visited a doctor within 12 m [§]	90.6	90.5
Currently have hypertension [§]	89.7	88.7
Under medication/treatment [§]	88.7	89.5
Unrecognized (new cases) [¶]	NA	27.0

[†]Data were self-reported in the current study and were self-reported and clinically measured in SEBAS on basis of JNC-6 standards.¹⁰ [‡]Not applicable. [§]As % of self-reported hypertension cases. [¶]Fit the medical definition of hypertension but not recognized or reported by patients.

sents only those who are aware of their hypertension status. According to SEBAS, a sub-sampling study of the same cohort, 57.3% of the participants had hypertension based on JNC-6 definitions. These results suggest that only about 60% (34.3% of 57.3%) of medically diagnosed hypertensive older adults have recognized their hypertensive status. This rate is somewhat lower than that observed in the US.² There are several possible reasons as to why the interview survey might underestimate the prevalence of hypertension in these elderly Taiwanese. Some elderly may not have had a recent physical check-up or a blood pressure measurement; he/she may not have been properly informed of the result; or he/she may not be able and willing to provide the information accurately to the interviewer. However, Goldman *et al.*¹⁰ have observed that self-reports of hypertension do accurately reflect most of those who fit the medical definition of hypertension and few who do not fit the definition would report the condition. Thus, interview survey still may be a useful tool for certain aspects of a public health study of hypertension, such as the ascertainment of the most likely contributors to the problem in a particular community, the required focus for interventions and the need for subsequent monitoring and surveillance.

Socio-demographic determinants

Compared to the younger, 53-59-year old adults, greater proportions of older participants have self-reported hypertension. The proportion of self-reported hypertension peaks during the 70-79 year-old-period (Fig. 1). Results of the present study also show that more elderly women have self-reported hypertension than do elderly men (38% vs. 31%, $p < 0.01$). The NAHSIT-1993-1996 study showed similar results (31.2% vs. 21.6%) among persons who were 65 years or older.¹⁴ Lu *et al.*¹³ reported that 56% of men and women, 65 years or older, had clinically measured hypertension in the Tainan City Study. It appears that an interview survey can reasonably assess the association of age and gender with blood pressure status.

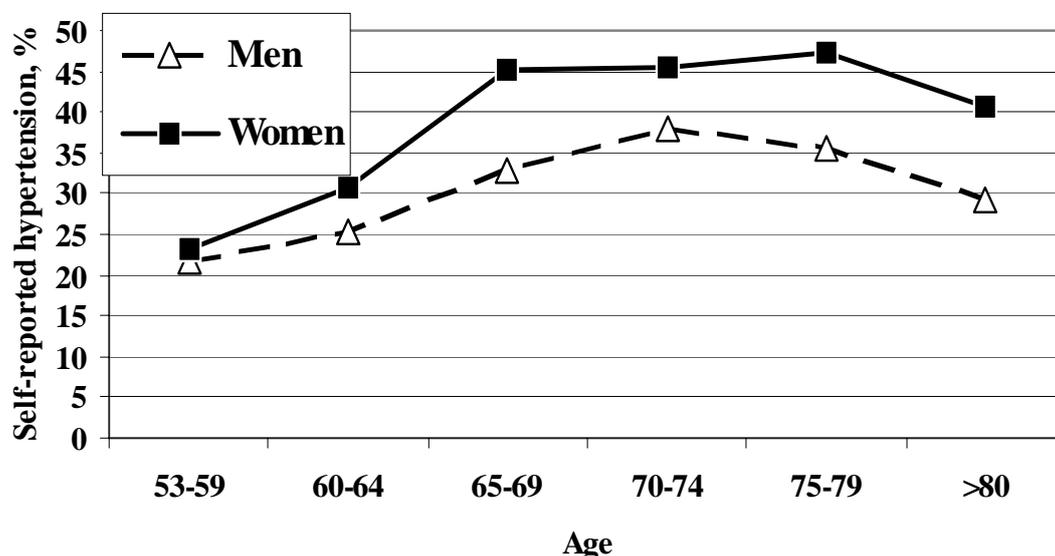


Figure 1. Age-related changes in the proportion (%) of self-reported hypertension among >53-year old men and women in Taiwan stratified by 5-year-age ranges

Table 2. Logistic regression analysis of the association of anthropometric, socio-demographic and lifestyle variables with self-reported hypertension in >53-year-old men and women in Taiwan

Variables [†]	% of total	% HTN	OR [‡]	95% CI [‡]
Total (N = 3943)	100			
Self-reported hypertension	34.3			
Male	53.2	31.1	1	
Female	46.8	38	1.36	1.11-1.66**
Age				
53-59	20.5	22.4	1	
60-69	26.6	32.8	1.7	1.37-2.11***
70-79	41	41	2.59	2.11-3.18***
>80	11.9	35.2	2.1	1.59-2.77***
BMI (kg/Ht ²)				
<18.5	6.6	25.3	0.59	0.43-0.80***
18.5-24.9	65.2	31.3	1	
25.0-29.9	24.5	41.9	1.64	1.40-1.93***
>30.0	3.7	52	2.32	1.63-3.29***
Education				
0 y	34.2	34.9	1	
1-6 y	41.8	33.7	1.22	1.02-1.45*
7-9 y	10.3	32.9	1.23	0.94-1.60
10-12 y	7.5	36.7	1.7	1.26-2.29***
>12 y	6.1	35.3	1.55	1.11-2.15**
Physical activity				
<1d/wk	41.7	33.1	1	
1-2 d/wk	6.8	35.2	1.09	0.83-1.46
3-5 d/wk	10.4	35.8	1.01	0.79-1.29
>6 d/wk	41.1	35.1	0.95	0.81-1.12
Alcohol-consumption				
Non-drinkers [§]	82.3	35.6	1	
1-2/m	4.5	28.3	1.05	0.74-1.48
1/wk	2.4	29	0.96	0.58-1.60
2-3/wk	3.9	31	1.13	0.78-1.63
>4/wk	7	27.3	0.87	0.64-1.17
Smoking				
Never	60	36.8	1	
1-10/d	9.1	26.9	0.77	0.58-1.02
11-20/d	10.6	25.5	0.79	0.58-1.03
>20/d	3.2	19.9	0.64	0.40-1.05
Ex-smokers	17.1	37.8	1.12	0.89-1.40
Dietary factors				
Meat & poultry			0.96	0.90-1.03
Fish			1.03	0.97-1.11
Egg			0.95	0.88-1.02
Dairy			1.01	0.96-1.06
Legume			0.93	0.87-0.99*
Vegetables			1.01	0.88-1.18
Fruits			1.01	0.94-1.09
Tea			0.96	0.90-1.01

Footnotes: [†]Food consumption frequencies were treated as continuous numbers while all other variables were categorized. [‡]OR=Odd ratio, CI= confidence interval. [§]Non-drinkers are any one who drank less than once per month. * $p<0.05$, ** $p<0.01$ and *** $p<0.001$.

In the US, persons with more than high school education have lower prevalence of hypertension than persons who have less than high school education.² The present study show an opposite relationship namely that those who have completed a college degree are more likely to report hypertension ($p<0.001$, 95% CI=1.06-1.22). Education-related bias in self-reporting is at least part of the reason for this anomaly. In the SEBAS study, Goldman *et al.*¹⁰ showed that participants who had higher education were more likely to participate in physical examination and more likely to provide an accurate self-report of hypertension while those without higher education were less likely to self-report hypertension. These observations suggest that special care must be taken when using inter-

view surveys for ecological studies of hypertension in populations with high rates of illiteracy.

Body fatness

Regression analysis of the present study suggests that BMI is a strong determinant of hypertension in the Taiwanese elderly. Underweight (BMI<18.5) is significantly associated with reduced self-reported hypertension while overweight (BMI 25-29.9) and obesity (BMI>30) are significantly associated with increased rates of self-reported hypertension. Among the major lifestyle and dietary factors, overweight has been shown to make the greatest contribution to hypertension in Western populations, ranging from 11% in Italy to 25% in the US.¹⁵ The current

Table 3. Comparison of the effect of lifestyle factors (drinking, smoking and physical activity) on the rate of self-reported hypertension of the SHLSET 1999 Survey (n =3934) with that of the study of Lu *et al.*¹³ (Tainan City Study)[†] (n =876).

Variables	Current study		Tainan City Study [†]		
	Known cases	New cases	Known cases	New cases	Known/New
Drinking					
Non-drinkers	35.6	NA	32.2	29.4	1.1
Current drinkers	28.6	NA	22.8	33.0*	0.69
Smoking					
Never	36.8	NA	34	27.8	1.22
Ex-smokers	37.8	NA	31.7	32.9	0.96
Current smokers	25.3	NA	23.4	30.1*	0.76
Physical activity					
<1 time/wk	33.1	NA	29.4	25.9	1.14
>1 time/wk	35.3	NA	31.8	31	1.03

[†]Recalculated from data in Table 4 of Lu *et al.*¹³ *Indicating significant differences in the distribution of known and new cases from their non-drinkers or never smokers, respectively, on basis of Chi-square tests ($p < 0.05$).

study shows that it is possible to demonstrate the well-recognized association of increasing BMI with rates of hypertension through an interview survey, and that the method is useful to detect the phenomenon, if underestimate it, in the Taiwanese elderly population.

There are studies to suggest that Taiwanese and other Asian populations are different from Caucasians in their body composition at similar BMI and that a BMI of 27 rather than 30 should be used as the cut-off for obesity.^{16,17} The current study shows that there is a nearly 50% increase in self-reported hypertension for elderly whose BMI is above 27 kg/m² compared to those who are below (46.9% vs. 29.1% for men and 52.3% vs. 35.1% for women).

Lifestyle factors

The present study also showed that those elderly who have more frequent physical exercise do not have a lower rate of self-reported hypertension than their more sedentary counterparts. The study of Lu *et al.*¹³ even showed a positive association between physical activity and hypertension. These results are not in line with the repeated finding that routine or programmed exercise is effective in lowering elevated blood pressure and reducing other cardiovascular risks in case-control¹⁸ or randomized controlled trials.^{19,20} While the reason for this discrepancy is not known, it is possible that the expected beneficial effect of activity might have been neutralized, at least in part, by the corrective measures, like pharmacotherapy, already taken in hypertensive individuals, leading to reverse bias. Inadequate definition and inaccurate reporting of physical activity are also potential reasons.

Also, the present study does not show a significant association of alcohol-consumption with self-reported hypertension in older Taiwanese. This observation also contrasts with findings in many epidemiological studies that show a hypertensive effect of alcohol-consumption, at least in heavy drinkers²¹⁻²³ if not linear at all dosage lev-

els. A meta-analysis of 14 studies by Corrao *et al.*²⁴ concluded that there is a strong correlation between alcohol consumed and hypertension. One possible reason for this atypical finding in Taiwan might be the reporting bias of the drinkers as shown in the study of Lu *et al.*¹³ In that study each subject was interviewed about hypertension and then clinically measured for blood pressure to confirm self-reports and also to reveal new cases. The study showed that current drinkers reported much lower rates of hypertension (22.8%) than did non-drinkers (32.2%). The ratio of "known cases" to "new cases" was much lower in current drinkers than in non-drinkers ($p < 0.05$), suggesting that current drinkers under-reported hypertension (Table 3).

Under-reporting of hypertension also occurs in current smokers. The present study shows a 36.8% self-reported hypertension for never smokers, 25.3% for current smokers and 37.8% for ex-smokers. Under-report of hypertension by smokers was also observed in the study of Lu *et al.*¹³ who showed that 23.4% of current smokers ($p < 0.05$) compared to 31.7% of ex-smokers and 34% of never-smokers reported hypertension. The ratio of "known cases" to "new cases" of hypertension was much lower for current smokers than never-smokers (Table 3). These data suggest that both current drinkers and current smokers under report their hypertensive status. The reasons for under reporting remain to be determined. These observations, again, illustrate the importance of watching for bias in self-report data, especially in variables that are associated with one's lifestyle or health status.

Dietary factors

The present study also shows that the consumption of leguminous foods, mainly soymilk, tofu and other soy products, is negatively ($p < 0.05$) associated with the rate of self-reported hypertension after adjusting for confounding factors. These results support the observation that usual intake of soy may have a beneficial effect on blood pressure in humans. In a population-based longitudinal

study involving 45,594 Chinese women (40-70 y) in Shanghai, Yang *et al.*²⁵ observed an inverse association of soy protein intake with both systolic and diastolic blood pressures. The blood pressure-lowering effect of soy has also been observed in a double-blind randomized study in men and women with mild to moderate hypertension.²⁶ Fish consumption displayed a trend toward a positive association with the rate of self-reported hypertension, but was not statistically significant ($p < 0.1$).

Elderly who habitually drink tea (mainly infused camellia oolong tea) 3-5 times/wk appear to have a tendency toward a reduced ($p < 0.1$) rate of self-reported hypertension in the present study. In a prospective study which compared tea-drinkers with non-tea-drinkers, Yang *et al.*²⁷ observed that habitual drinking of green or oolong tea, at an amount of 120 ml/day or more for one year, significantly reduced the risk of developing hypertension in normotensive adults. Higher tea intake and higher 4-*O*-methylgallic acid (a biomarker derived from tea polyphenols) excretion have also been observed to be associated with significantly lower systolic blood pressure in >70 y old women.²⁸ Although these results are of interest, we must point out that habitual tea drinking is a fairly self-selective lifestyle, and perhaps only those who can tolerate the caffeine effects and are healthy will do so. Randomized control studies are needed to confirm the potential blood pressure-lowering effect of habitual tea drinking.

Study limitations

There are limitations in trying to identify the food factors in a population-based study, especially in the elderly. Methodologically, it is impossible to examine the effect of every individual food item. Some food categories such as vegetables and fruits include large number of items that in many cases may have opposing or interactive effects on blood pressure. Frequency of consumption may not always reflect quantity of consumption. Many foods, especially fruits and vegetables are seasonal. Also, people do change dietary preferences.

Using cross-sectional data from a cohort study has both advantages and weaknesses. The availability of data sets with known quality is a big advantage but the associated cohort effects (due to repeated interviews) seem to lead to bias. The deteriorating health condition of older subjects in the cohort is both a feature and a weakness of the study. The age-associated health problems such as memory impairment and delirium negatively impact on the quality of the data. Using regression equations developed by Kuczmarski *et al.*⁹ based on data from the US population to adjust self-reported weight and height for calculation of BMI (kg/m^2) may have some shortcomings. Ideally, the regression equations should be derived from data of the target population. Unfortunately, to the best of our knowledge, no such equation is available for Taiwan at the present time.

In conclusion, interview survey can usefully reveal, but under-estimate, previously known cases of hypertension but not "previously unrecognized or new cases". Interview surveys can evaluate the associations of age, gender, BMI and food intake pattern with self-reported hypertension in older Taiwanese. However, interview surveys do

have serious limitations in the appraisal of associations of physical activity, alcohol-consumption, cigarette smoking or the level of education with self-reported hypertension, at least in the current Taiwanese elderly population.

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Original Article

Interview to study the determinants of hypertension in older adults in Taiwan: a population based cross-sectional survey

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以訪談調查研究台灣老人高血壓之影響因子：一族群代表性之橫斷研究

本研究的目的是探討以受訪者問卷自陳方式來瞭解台灣中老年人的高血壓症與社會、經濟、體位指標及生活習性等因素間的關聯性。本研究之原始資料來自「1999年台灣地區中老年身心社會生活狀況長期追蹤調查」。該調查以橫斷方式對4440位53歲以上的中老年人進行在家訪談。研究發現有31.1%的台灣中老年男性自答有高血壓，女性則有38%。資料經羅吉斯迴歸分析顯示女性、年齡大及肥胖者患高血壓的可能性較高；而多攝取豆類食品者患高血壓的機率則較低。是否有吸菸、飲酒或運動等行為則與高血壓無關。本研究也發現，吸菸者及常飲酒者有低報患有高血壓的情形。本研究亦分析經實際血壓測定的樣本子群的資料，以驗證自陳高血壓的準確性，發現只有60%有高血壓的患者自答有高血壓。此結果顯示，自陳式調查低估了台灣中老年人高血壓的盛行率。自陳式調查大致可以偵測出高血壓與年齡、性別、肥胖及一些飲食因素之關聯性，但不能偵測出高血壓與吸菸、飲酒、運動或教育程度之關聯性。因此引用自陳的方式判別有無高血壓的資料時，必需格外謹慎。要減少臨床檢查與自陳方法間估計高血壓罹患率之差異，或許可以採用一個能對臨床診斷結果及受訪者之記憶力加以驗證及對照的問卷來補強。儘管有這些缺點，自陳式調查在社區健康研究方面仍佔有重要的角色。此工具在判別、衡量及追蹤台灣中老年人高血壓的致病因子等方面具重要的任務。

關鍵字：高血壓、面談式調查、自答、病歷、身體質量指數、食物、豆類、台灣、效度。