



Quality issues of self-report of hypertension: Analysis of a population representative sample of older adults in Taiwan

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ABSTRACT

The study was to evaluate the quality of self-report of hypertension and examine the factors associated with under- and over-reporting of hypertension in older Taiwanese. Data for this analysis were from the Social Environment and Biomarkers Study in Taiwan 2000, which involved a national sample of 1021 Taiwanese over 54 years of age. We performed binary classification tests to compare the prevalence rates of self-reported vs. clinically measured hypertension according to World Health Organization (WHO) (blood pressure $\geq 160/95$ mm Hg or on hypertension medication) and JNC-6 (140/90 mm Hg or on hypertension medication) definitions. Logistic regression analysis was performed to analyze the potential factors associated with under- or over-reporting of blood pressure status. Results showed the test characteristics of self-reports were: sensitivity 73%, specificity 93%, and kappa = 0.68 ($p < 0.001$) based on the WHO definition; and sensitivity 51%, specificity 95% and kappa = 0.43 ($p < 0.001$) based on the JNC-6 definition. Old age was associated with over-reporting whereas having no health checkup during the past 12 months was associated with under-reporting. The relatively low agreement between self-reports and clinically measured hypertension (JNC-6 definition) was mainly due to the lack of a well-defined hypertension practice guideline and the failure of clinicians to clearly inform patients of their diagnoses. The consistency of hypertension practice guidelines and the effectiveness of informing the patients of their diagnoses are two main factors impacting the quality of self-report of hypertension in elderly Taiwanese. Better self-reports of health data can improve the efficiency of public health surveillance efforts.

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1. Introduction

Hypertension is prevalent in most industrialized populations, especially in the elderly. It is a chronic condition that can often increase the risk of stroke, heart disease, diabetes mellitus and chronic kidney disease, the leading causes of death in many industrialized populations (Rutan et al., 1988; Agarwal, 2005; Barri, 2006; Ganne et al., 2007). In Taiwan, more than 50% of the elderly are hypertensive (Pan et al., 2001; Chiu et al., 2006). Hence, surveillance programs and preventive activities aiming to reduce the prevalence of hypertension are important to public health.

Ideally, hypertension surveillance should be done by measuring blood pressure of individuals. However, because of cost and complexity, large scale surveys are conducted only rather

infrequently, and self-report is often used as an alternative to estimate the trend of hypertension at both national and local levels. Therefore, the validity of self-reports is an important issue. Self-report must be able to correctly reflect the diagnosis of hypertension or it would have little value. Several studies have shown that self-report has a fair sensitivity and can yield a reasonable estimate of the prevalence of hypertension in Western populations (Bush et al., 1989; Kehoe et al., 1994; Martin et al., 2000; Tormo et al., 2000). However, observations made in Taiwanese are somewhat less satisfactory. The validity of self-report of hypertension has been shown to be affected by a number of factors including gender, age, ethnicity, level of education, whether one has had a recent health check-up and the willingness to reveal personal health status (Tormo et al., 2000; Wu et al., 2000; Goldman et al., 2003).

The difference in the accuracy of self-report of hypertension between the Western populations and the Taiwanese (a newly industrialized population) deserve further investigation. Although population-related cultural (socioeconomic and lifestyle) differences are important, we believe that the variation in health care

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systems and daily clinical practice (such as the way patients are informed of their diagnosis) also play a role. Thus, the objectives of the present study were to evaluate the quality of self-report of hypertension and to explore the factors associated with the accuracy of self-report of hypertension in elderly Taiwanese.

2. Methods

2.1. Design and subjects

Data used in this report were from the SEBAS (Social Environment and Biomarkers Study in Taiwan, 2000, Weinstein and Goldman, 2006). The SEBAS was a sub-sample of a larger cohort study entitled “Survey of Health and Living Status of the Elderly in Taiwan” (SHLSET) which was initiated in 1989 with a population-representative sample of 4049 persons aged 60 years or older (Hermalin et al., 1989). In 1996, the sample was extended to include 2462 near-elderly persons aged 50–66 years (Chang and Hermalin, 1996a,b). The SEBAS study was drawn from this combined cohort in 2000. Both SHLSET and SEBAS were conducted by the Bureau of Health Promotion of the Department of Health of Taiwan and the protocols were reviewed and approved by government-appointed representatives. The studies were conducted according to the ethical standards set forth in the Helsinki Declaration.

2.2. Measurements

Among 4400 subjects in the cohort, 1713 were selected randomly. Among those selected, 1698 were contacted for interview and 1497 provided interviews. Among respondents to the initial interview, 1023 participated in the physical examination and 1021 had complete data, which is the data base used in the current analysis. The composition of the sub-sampling was shown to be not different from the parent cohort (Weinstein and Goldman, 2006).

The SEBAS survey included a face-to-face in-home interview conducted by trained interviewers and a comprehensive physical examination. Questions related to the current study were: “Do you ever have or currently have high blood pressure?” and “Are you taking anti-hypertensive medicine?” The questionnaire used simple talking Chinese for these conditions and was administered according to respondent’s dialect without any description about the nature of the conditions. As part of the physical examination, registered nurses took two blood pressure readings (1 min apart) using a mercury sphygmomanometer with the respondent in a seated position at least 20 min after the respondent arrived at the hospital. Finally, a physician performed a medical examination including a third blood pressure reading.

In the present analysis, the prevalence rates of hypertension were estimated separately from self-reports and from the measured values. Self-reported blood pressure values were cross-tabulated with the outcome of measured results. For comparison purposes, hypertension was defined according to two definitions (a) the WHO-definition at the time of the survey: SBP/DBP (diastolic blood pressure/diastolic blood pressure) \geq 160/95 mm Hg or taking anti-hypertensive medication (WHO, 1993) and (b) the JNC-6 definition: SBP/DBP \geq 140/90 mm Hg or taking anti-hypertensive medication (JNC VI, 1997).

2.3. Statistical analysis

Binary cross-tabulation tests were performed to evaluate the significance of differences between the two methods. Regression analyses were performed to determine the factors associated with over- or under-reporting of blood pressure status, respectively. All

Table 1
Characteristics of subjects ($n = 1021$).

Variables	n (%)
Sex	
Men	589 (57.7)
Women	432 (42.3)
Age, years	
54–64	382 (37.4)
65–74	372 (36.4)
75–84	242 (23.7)
≥ 85	25 (2.4)
Formal education, years	
≤ 6	753 (73.8)
≥ 7	268 (26.2)
Current smokers	
No	779 (72.3)
Yes	242 (23.7)
Drink alcohol (≥ 1 time/month)	
No	783 (76.7)
Yes	238 (23.3)

analyses were performed with SPSS 15.0 Software Package (SPSS Inc., Chicago, IL). Statistical significance was evaluated at $\alpha < 0.05$.

3. Results

Table 1 shows the characteristics of subjects. The study included slightly more men than women which reflected the composition of the specific age group. Approximately 37% were near-old (54–64 years), 60% were 65–84 years old and 2.4% were 85 years or older. Nearly one quarter (23.6%) of the respondents were current smokers and a similar proportion (23%) drank alcohol at least once per month.

Table 2 shows the cross tabulation analysis of self-reported blood pressure status and measured blood pressure based on the WHO (BP \geq 160/95 mm Hg) and JNC-6 (BP \geq 140/90 mm Hg) criteria, respectively. The test characteristics of self-reports using BP \geq 160/95 mm Hg as a reference were: sensitivity 73%, specificity 93% and kappa = 0.68 ($p < 0.001$). The test characteristics using JNC-6 definition were: sensitivity 51%, specificity 95% and kappa = 0.43 ($p < 0.001$). Using the WHO definition as a reference, 44 elderly over-reported and 104 under-reported; using JNC-6 as a reference, 23 over-reported and 285 under-reported.

Table 3 shows the outcome of logistic regression analysis of the association of various variables with over- or under-reporting a blood pressure status. Among variables examined, old age was the only variable shown to be associated with over-reporting whereas having a physical check-up during the last 12 months was the only variable associated with under-reporting based on the WHO or JNC-6 definition.

Table 2
Cross tabulation of self-reported hypertension against measured hypertension according to two hypertension definitions.

Self-reported	Measured SBP/DBP ^a			
	WHO definition		JNC-6 definition	
Hypertension ^b	Yes	No	Yes	No
Yes	281	44	302	23
No	104	592	285	411
Sensitivity	0.73		0.51	
Specificity	0.93		0.95	
PPV ^c	0.86		0.93	
NPV ^c	0.85		0.59	
Kappa	0.68		0.43	

^a WHO definition is $\geq 160/95$ mm Hg or on anti-hypertensive medication, and JNC-6 is $\geq 140/90$ mm Hg or on anti-hypertensive medication.

^b Self-reported hypertension or on anti-hypertensive medication.

^c PPV, positive predictive value; NPV, negative predictive value

Table 3Logistic regression analysis of the factors potentially associated with over- or under-reporting of self-report of hypertension in ≥ 54 years Taiwanese.

Variables	% Total	WHO (160/95 mm Hg)				JNC-6 definition (140/90 mm Hg)			
		Over (44) ^a		Under (104) ^a		Over (23) ^a		Under (285) ^a	
		% Case	OR (95%CI)	% Case	OR (95%CI)	% Case	OR (95%CI)	% Case	OR (95%CI)
Age, years									
54–64	382 (37.4)	13 (3.4)	1	35 (9.2)	1	9 (2.4)	1	95 (24.9)	1
65–74	372 (36.4)	16 (4.3)	1.93 (0.87–4.28)	38 (10.2)	0.86 (0.48–1.53)	4 (1.1)	0.85 (0.24–3.00)	110 (29.6)	0.81 (0.53–1.24)
≥ 75	267 (26.2)	15 (5.6)	2.43 (1.07–5.51) [*]	31 (11.6)	1.06 (0.57–1.98)	10 (3.7)	2.78 (1.00–7.75) [*]	80 (30.0)	0.91 (0.60–1.45)
Health exam past 12-m									
No	665 (65.1)	26 (3.9)	1	79 (11.9)	1	16 (2.4)	1	209 (31.4)	1
Yes	356 (34.9)	18 (5.1)	1.39 (0.74–2.64)	25 (7.0)	0.53 (0.31–0.91) [*]	7 (2.0)	0.86 (0.31–2.21)	76 (21.3)	0.57 (0.40–0.82) [*]
Number of observations		636		385		434		587	

Notes: All regression models are adjusted for gender, years of education, ethnicity, living location and lifestyle factors (smoking, drinking and physical activity).

^{*} Significantly different from the reference group ($p < 0.05$).^a Based on WHO definition, 44 of the 636 who were normotensive over-reported and 104 of 385 who were hypertensive under-reported; based JNC-6 definition, 23 of 434 who were normotensive over-reported and 285 of 587 who were hypertensive under-reported.**Table 4**

History of hypertension definition changes in Taiwan.

Year	Event
1993	WHO published the "1993 Guidelines for the management of mild hypertension" and defined hypertension as BP $\geq 160/95$ mm Hg
1996	The Dept. of Health of Taiwan published the first edition of "Hypertension Prevention & Treatment Manual" and defined hypertension per WHO (BP $\geq 160/95$ mm Hg) definition but also discussed the JNC-5 (140/90 mm Hg) criteria
1997	JNC published JNC-6 (BP $\geq 140/90$ mm Hg) definition
2003	JNC published JNC-7 (BP $\geq 140/90$ mm Hg) definition
2004	Dept. of Health of Taiwan revised the "Hypertension Prevention & Treatment Manual" and adopted the JNC-7 (BP $\geq 140/90$ mm Hg) definition
2005	Taiwan Medical Association adopted JNC-7 definition

Notes: WHO/ISH, World Health Organization, International Society of Hypertension; JNC, Joint National Committee on prevention, detection, evaluation, and treatment of high blood pressure; National High Blood Pressure Education Program Coordinating Committee; BP, blood pressure.

Table 4 lists the major events related to the establishment of an official criterion for hypertension in Taiwan.

4. Discussion

4.1. Self-reported vs. measured values

The prevalence rate of clinically measured hypertension among elderly Taiwanese is 37.7% based on the WHO definition (BP $\geq 160/95$ mm Hg) and 57.5% based on JNC-6 definition (BP $\geq 140/90$ mm Hg) whereas the prevalence rate is 31.8% based on self-report. Self-report is relatively good (sensitivity 73%, specificity 95% and kappa = 0.68) at confirming hypertension against clinically measured outcome based on the WHO definition, and the result is comparable to that observed in the US and other Western countries (Bush et al., 1989; Kehoe et al., 1994; Martin et al., 2000; Tormo et al., 2000). Vargas et al. (1997) analyzed the NHANES-III (National Health and Nutritional Examination Survey III, 1988–1991) data and found the test characteristics of self-reports were: sensitivity 71% and specificity 90% among adults 25–74 years old based on JNC-6 criteria. In a smaller scale study comparing self-reports of a random sample of health maintenance organization (HMO) subscribers in Colorado with HMO medical records, the test characteristics of self-reports were: sensitivity 81% and specificity 73% for patients 65 years of age or older based on JNC-6 criteria (Martin et al., 2000).

However, the present study shows that self-report under-predicted hypertension by a relatively large margin against

clinically measured values based on the JNC-6 definition (BP $\geq 140/90$ mm Hg). The test characteristics of self-reports were sensitivity 51%, specificity 95% and kappa 0.43. These results are in line with that observed by Wu et al. (2000) who showed sensitivity 49%, specificity 83% and kappa = 0.33 based on JNC-6 definition (BP $\geq 140/90$ mm Hg) in a study involving 228 elderly Taiwanese in 1992–1993. Goldman et al. (2003) analyzed self-report of the SEBAS data against clinically measured hypertension and found 49% sensitivity, 95% specificity and kappa = 0.41 based on JNC-6 definition (BP $\geq 140/90$ mm Hg). Goldman et al. (2003) attributed the low reliability of self-report of hypertension by elderly Taiwanese to a number of factors such as the traditional Chinese beliefs about hypertension, low levels of blood pressure screening, failure of clinicians to communicate diagnosis with patients and poor recall by respondents. While we agree that those are contributory factors, we believe that there are other factors unique to the Taiwanese that cause the bias.

4.2. Reasons for under-reporting

Our analyses suggest that the reliability of self-report is much dependent on the reference value suggesting that the differences in practice guidelines used by the clinicians is a contributing factor to the low reliability of self-report of hypertension in the current study when tested against JNC-6 criteria.

In principle, the reference value should be the defined criterion of hypertension in the practice guideline at the time of the survey. However, Taiwan was in transition at the time of the SEBAS study. There was not an officially defined criterion (or practice guideline) for hypertension until 1996 when the Department of Health (DOH) of Taiwan issued "The Hypertension Prevention and Treatment Manual" for the first time (Dept. of Health, Taiwan, 1996). This first manual described both the WHO (1993) and the JNC-6 (1997) definitions but did not clearly specify an official definition for Taiwanese. Only by 2004, the DOH published the first revision of the Manual and officially adopted the JNC-7 (BP $\geq 140/90$ mm Hg, same thresholds as the JNC-6) criteria (JNC VII, 2003) as the official definition for Taiwanese (Bureau of Health Promotion of the Dept. of Health, Taiwan, and Taiwan Internal Medicine Association, 2004). Thus, at the time of the SEBAS survey (2000), the criterion for hypertension was not officially defined and it was pretty much left to the clinicians. A recent survey by us showed that the threshold for hypertension used by practicing nurses and physicians in Central Taiwan before 2004 ranged from BP 130/80 to 160/110 mm Hg (unpublished observation).

Without a set of well-defined practice guideline, the clinicians could not have adopted a uniform definition, and as a result the patients would not be able to produce the correct recalls of the

diagnoses. Our survey also shows that many clinicians do not inform the diagnosis to their patients forcefully and unambiguously. In many cases, subjects are only gently informed that his/her blood pressure is “a bit high” without clearly telling the exact values or whether it exceeds a set standard. So, many patients may think that his/her blood pressure is only slightly high, not enough to be classified hypertensive. Results show that many subjects being classified hypertensive only because they are on anti-hypertension medication. Thus, unless patients are correctly and unambiguously informed of their blood pressure diagnoses, they are likely to under-report their hypertension status.

4.3. Variables associated with under- or over-reporting

The present study also show that according to the regression models, those who are 65 years or older (compared to younger old, 54–65 y) are more likely to over-report hypertension based on either the WHO (BP \geq 160/95 mm Hg) or the JNC-6 (BP \geq 140/90 mm Hg) definition. This finding is consistent with the observation of Wu et al. (2000). The exact reason for the over-reporting is not known but may be in part due to age-related memory or cognitive impairment and the undetected old age-related blood pressure decline. Blood pressure generally reaches a peak around 75 years old for systolic pressure and around 60 years old for diastolic pressure and then declines (Dept. of Health, Taiwan, 1996). It is possible that some older individuals remember earlier diagnosis but do not know the recent changes. Results also show that having a health examination during the past 12-month significantly reduces the probability of under-reporting, as was observed by Goldman et al. (2003).

Self-report supposedly reflects the recall of recently measured blood pressure status. However, the accuracy of self-report is dependent not only on the subject's ability to recall it correctly but also the subjects to maintain the same blood pressure status. Further, blood pressure normally fluctuates considerably in hypertensive and non-hypertensive individuals. In the elderly, changes in health condition and medication aggravate the fluctuations.

4.4. Limitations

There are limitations to this study. (a) Subjects of the SEBAS study, a sub-sampling of longitudinal cohort study, have undergone personal interviews every 3–4 years since the beginning of the project in 1989. It is possible that these subjects have been “educated” more than the average citizens about health issues. (b) Although free annual health check-up was available to those who were 65 years or older through the National Health Insurance Program, participation was voluntary and is not consistent throughout all elderly age ranges and that may affect the outcome of self-report. (c) As mentioned earlier, Taiwan was in transition in defining hypertension, clinicians seemed to have defined hypertension differently and that will also affect the accuracy of self-report.

5. Conclusions

Results of the present study suggest that the reliability of self-report of hypertension is much dependent on having the correct reference standard (practice guidelines). Clinicians should be instructed to adhere to the official definition of medical conditions and clearly inform patients of their diagnoses. These findings are useful for improving the result of self-report of hypertension which is often a part of health surveys. Accurate survey results are essential for making proper public health policies. Knowledge

learned from this analysis should be applicable to many other countries aiming to improve hypertension surveillance.

Conflict of interest statement

None.

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