

Research Article

Vulnerability Assessment of Hypertension in the Communities of Guangdong, South of China

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Abstract

Background: Hypertension is the most common cardiovascular disease. However, there is few reports have applied vulnerability assessment technology for the study of community hypertension.

Objectives: We investigated community hypertension in Guangdong, south of China using vulnerability assessment technology.

Methods: Stratified random cluster sampling was used to collect data from a total of 65 communities in Guangdong Province. 15,832 residents aged over 18 participants responded to a questionnaire survey to collect information about of vulnerability of community hypertension from June to September in 2017.

Results: The total hypertension prevalence was 18.9%, while 18.7% of respondents had a family history of hypertension and 26.4% of respondents were overweight or obese. Social factors indicating access to healthcare were as follows: 12.6% of the residents paid medical costs at their own expense; the travel time to get health care was 14.7mins and the average housing area was 111.3m²; the demographic details over 60 years old was 12.1%. Multiple factor logistic regression analysis suggested that awareness of the prevention and treatment of hypertension (OR = 0.473) and health education initiative (OR = 0.628) were protective factors, while risk factors for hypertension were age (OR = 1.489), family history (OR = 1.278), overweight or obesity (OR = 1.366), smoking (OR = 2.318), alcohol consumption (OR = 1.989), salty diet (OR = 2.173) and daily sitting time (OR = 2.824). In addition the overall satisfaction rate with the community health services was 66.9%.

Conclusion: This study infers that the vulnerability of community hypertension in Guangdong Province was relatively large, thus, community health services should improve the management level of hypertension and including adopting a fully management of hypertension for the community to reduce the risk of hypertension. Keywords: Hypertension; Community; Vulnerability assessment

Introduction

Hypertension is the most common cardiovascular disease. A lot of research on the prevention and control of high blood pressure have been performed in developed countries, which has yielded highly desirable results on the improvement in hypertension awareness, treatment and control [1-3]. In recent years, the disease spectrum of Chinese residents has undergone profound changes; specifically, hypertension has shown a rising trend in both incidence and mortality [4,5].

Since 2008, the Chinese government has implemented community care programs in community health services and required the local community to use standardized management for patients with hypertension. Although the policy has helped in the standardization of care, there are still many weaknesses in the management of hypertension [6]. Currently, there have been a large number of reports related to epidemiological characteristics of community hypertension, the patient's knowledge, attitude, and practice, methods to control the disease and relative risk factors [7-9]. However, few reports have studied community hypertension using

vulnerability assessment technology.

Vulnerability is a term related to risk that was first proposed by Timmerman [10] in 1981. Susceptibility, fragility and instability are words similar to vulnerability that have different meanings in different disciplines [11-14]. In public health, Daniel (2007) [15] defined "vulnerability" as the result of the aggregation of risk and the response capacity of the community, local government and emergency response organizations. Satu (2006) [16] defined it as "a function of susceptibility, resilience and environment". Fan *et al* believed that, with regards to a threat to public health, public health vulnerability referred to the possibility for and extent of losses of population health resulting from changes in public health factors [17]. Vulnerability includes both susceptibility and resilience. A vulnerability assessment is also known as "risk assessment" or "disaster analysis", which are based on a series of techniques used to determine the unexpected events in individual communities and their possible impact on the community. The susceptibility to community-related issues can be determined through analysis of multiple factors, such as community infrastructure, economic status, and demographic composition of the community. Vulnerability assessment has been widely used in

Table 1: Demographic and social characteristics of the subjects by sex.

Variables	Male	Female	Total
	(n=8328)	(n=7504)	(n=15,832)
Age	41.284 ±20.5	41.691 ±22.95	41.5 ±23.5
Education			
Illiteracy and semi- illiteracy [n (%)]	479(5.8)	503(6.7)	982(6.2)
Elementary and school [n (%)]	1545(18.6)	1621(21.6)	3166(20.0)
Junior high school [n (%)]	1849(22.2)	1808(24.1)	3657(23.1)
Senior high or vocational school [n (%)]	2235(26.8)	1929(25.7)	4164(26.3)
College diploma [n (%)]	1377(16.5)	1156(15.4)	2533(16.0)
Bachelor or above [n (%)]	843(10.1)	487(6.5)	1330(8.4)
Marital status			
Unmarried [n (%)]	4242(50.9)	3880(51.7)	8122(51.3)
married [n (%)]	3633(43.6)	3159(42.1)	6792(42.9)
Divorced [n (%)]	216(2.6)	180(2.4)	396(2.5)
widowed [n (%)]	237(2.8)	285(3.8)	522(3.3)

various fields, and is mainly concentrated in the environmental sciences, natural disasters, social security, power, water, computers and ecological areas [18-22]. Vulnerability has become an issue which must not be disregarded in particular for complex systems. However, there are few reports concerning vulnerability assessments of hypertension in a community.

Here, we applied vulnerability assessment technology to discuss the hypertension by assessing pathogenic vulnerability, social vulnerability, population vulnerability and vulnerability of the response in communities of Guangdong Province and to provide scientific basis to draft a community hypertension prevention strategy and decrease the prevalence of hypertension.

Subjects and Methods

Subjects

65 communities from Guangdong Province (Guangzhou, Shenzhen, Foshan and Zhongshan city), south of China were studied.

Methods

Stratified random cluster sampling was used to collect data from

a total of 65 communities in Guangzhou, Shenzhen, Zhongshan and Foshan City, Guangdong Province from June to September in 2017. Firstly, random sample of families was selected from using a stratified, secondly, questionnaire and physical examination was used to collect information for all family members aged over 18. Therefore, these residents were representative of the general population. The hypertension vulnerability information was collected from survey data.

A household questionnaire and physical examination was used to collect information of community residents aged over 18. More than 200 community residents were involved in each community survey and a total of 16,000 residents were investigated in this study, and 15,832 residents valid questionnaire were completed (participation rate was 98.95%, and the refusal rate was 1.05%). We used a standardized questionnaire to survey residents, which included general information, prevalence of hypertension, family history, hypertension-related knowledge, attitudes, and behavior. Medical staff in the community health service centers was trained as investigators to perform the survey. The survey assessed common risk factors for hypertension, including age, gender, family history of hypertension, overweight or obese, cultural conditions, awareness of the prevention and treatment of hypertension, Cigarette smoking, alcohol consumption, salty diet, exercise, daily sitting time, regular measurement of blood pressure and health education initiative. Overweight was defined as BMI $\geq 24\text{kg/m}^2$ according to the 2006 Guidelines on Preservation and Control Overweight and Obesity in Chinese Adults classification [23]. Cigarette smoking was defined as having one cigarette per day and keeping on smoking for at least 1 year [24]. Lack of exercise was defined as having physical exercise less than one time per week keeping on this status for at least 1 year. People who took more than 2 standard units of drink per day (women) or more than 3 per day (men) were defined as having an excessive alcohol intake. People who self-reported preferring daily foods that contained more salt than other members in the family or people around them were classified as having salty diet.

Physical examination included anthropometry and blood pressure measurement. Height was measured in centimeters using a wall-mounted measuring tape and weight was measured in kilogram's using a digital scale (Jingzhun, Armamentarium Limited Company,

Table 2: Vulnerability of hypertension in communities residents aged over 18 of developed areas in Guangdong Province.

Items	Total	Guangzhou			Zhongshan			Shenzhen			Foshan		
		M	F	Total	M	F	Total	M	F	Total	M	F	Total
Hypertension prevalence (%)	18.9	24.9	21.8	23.2	17.9	17.1	17.4	15.1	14.8	14.9	22.9	16.2	21.6
Family history of hypertension (%)	18.7	18.1	19.2	18.8	15.6	14.9	15.2	26.4	24.3	25.5	15.6	14.7	14.9
Overweight /obesity (%)	26.4	23.8	24.2	24	26.6	25.6	26.1	29.1	27.1	28.3	27.2	26.6	27

Note: The percentage has adjusted for age.

Table 3: The social vulnerability to hypertension in developed areas of Guangdong Province.

Items	Total	Guangzhou	Zhongshan	Shenzhen	Foshan	P value
Residents at their own expense (%)	12.6	15.5	1.7	21.1	1.9	<0.01
Travel time to get health care	14.7	8.9±6.5	9.2±7.0	13.2±12.0	12.1±6.0	<0.05
The median household area (m ²)	111.3	115.4±86.21	184.2±114.9	42.6±51.4	152.1	<0.01
Elderly aged over 60(%)	12.1	14.4	13.5	4.8	16.5	<0.01

Note: The percentage has adjusted for age.

Table 4: Population vulnerability of community hypertension in developed areas of Guangdong Province.

Items	Total	Guangzhou			Zhongshan			Shenzhen			Foshan		
		M	F	Total	M	F	Total	M	F	Total	M	F	Total
Average age of patients with hypertension (Years)	63.5	63.8	66.1	64.5	67.3	65.1	66.1	57.2	52.3	54.8	65.8	63.1	64.6
Awareness of hypertension (%)	47.9	48.2	52.6	51.4	43.2	45.8	44.5	36.7	42.2	39.5	42.7	47.7	45.5
People who do not know their blood pressure (%)	73.7	61.4	54.2	57.4	86.9	84.2	85.5	62.3	67.7	69.5	83.3	84.6	84
Smoking (%)	23.8	38.4	12.4	19.6	45.8	6.5	25.5	40.1	3.1	20.9	43.6	2.3	22.3
Alcohol consumption (%)	18.2	29.8	7.1	17.6	18	4.1	13.5	44.7	10.3	26.8	29.4	6.2	17.4
Salty diet (%)	13.1	6.5	5.4	5.9	10.1	10.7	10.5	26.6	23.2	25.2	13.1	10.2	11.6
Lack of exercise (%)	48.1	55.6	59.6	57.5	24.5	20.3	22.6	40.8	49	45.1	53	56.9	55
Daily sitting >8 h (%)	33.2	33.2	36.3	35.1	29.3	25.8	27.1	39.4	41.1	40.3	22.4	24.3	23.8
Residents without measuring blood pressure over a year (%)	21.8	22.8	19.6	21.2	22.6	21.9	22.2	22.2	19.7	21	24.1	21.7	22.9
Study hypertension knowledge proactively (%)	33.6	38.9	41.3	40.1	30.5	35.1	32.5	21.3	25.1	24.5	30.9	35.7	33.6
Hypertension medication (%)	49	45.5	49.4	47.6	56	53.1	55.2	39.8	51.8	47.2	41.5	49	47.5

Note: This table was just for people found to have hypertension.

Tianjin, China). Body mass index (BMI) was calculated as weight in kilogram's divided by the height in meters squared (kg/m^2).

Blood pressure was measured using calibrated desktop sphygmomanometers (Yuyue, Armamentarium Limited Company, Jiangsu, China) after the participants were seated for at least 5min, consistent with current recommendations [25]. Blood pressure was measured three times consecutively, with at least 1min between measurements, and the reported blood pressure was the average of these three measurements. A subject was considered to have hypertension if (i) SBP $\geq 140\text{mmHg}$, and/or (ii) DBP $\geq 90\text{mmHg}$ and/or (iii) the subject was taking an antihypertensive drug [26]. Controlled hypertension was defined as pharmacological treatment of hypertension associated with an average SBP $< 140\text{mmHg}$ and DBP $< 90\text{mmHg}$.

All research carried out was conducted with integrity and in line with generally accepted ethical principles, was in compliance with the Helsinki Declaration, and approved by Research Ethic Committee of Shenzhen Futian Hospital for prevention and treatment of Chronic Disease, We did the survey under the agreement of the residents. All the personal information of the residents was managed confidentially.

Statistical analysis

Epidata version 3.1 (Epidata Association, Odense, Denmark) was applied to establish a database for double-entries and was cross-validated. Statistical analysis was performed using SPSS version 16.0. Statistical inference of measurement data was subjected to a t-test or analysis of variance. The composition ratio or percentage was compared using χ^2 test and multi-factor analysis was performed using non-conditional logistic regression.

Results

General characteristics of study subjects

Among the 65 communities surveyed, 22 communities (33.8%) were in Guangzhou city, 12 communities (8.3%) were in Shenzhen City, 15 communities (23.1%) were in Zhongshan City, and 16 communities (24.6%) were in Foshan city. A total of 15,832 community residents were surveyed, of whom 6,500 were from

Guangzhou, 2,404 from Shenzhen, 3,278 from Zhongshan and 3,650 from Foshan. Surveyed residents were aged 41.5 ± 23.5 years (male 52.6%, female 47.4%). Unmarried respondents accounted for 51.3%; the demographic details of married, divorced and widowed participants were 42.9%, 2.5% and 3.3%, respectively, as seen in Table 1.

Pathogenic vulnerability of community hypertension in Guangdong Province

The prevalence of hypertension, the percentage of family history of hypertension and overweight /obesity were analyzed to describe the pathogenic vulnerability of community hypertension. The overall prevalence of hypertension was 18.9% of the community residents aged over 18 in Guangdong Province. 18.7% of respondents reported a family history of hypertension and 26.4% were overweight or obese. Residents from Guangzhou reported the highest prevalence of hypertension, 23.2%. The city with the lowest prevalence of hypertension was Shenzhen with 14.9%. In addition, there were statistically significant differences between the prevalence of hypertension in the four cities surveyed ($\chi^2 = 124.610$, $P < 0.05$). Shenzhen residents showed the highest percentage with a family history of hypertension and the highest overweight or obese prevalence, which were 25.5% and 28.3%, respectively. The rate of family hypertension history and overweight or obesity were significant difference between the four cities (χ^2 values were 96.354 and 8.517, $P < 0.05$). In Guangzhou and Foshan, the prevalence of hypertension in men was significantly higher than in women ($P < 0.05$). Moreover, the differences of the other indicators were not statistically significant between men and women ($P > 0.05$, Table 2).

Social vulnerability of community hypertension in Guangdong Province

We investigated the social vulnerability of community hypertension by analyzing the percentage of residents at their own expense, travel time to get health care, the median household area (m^2), and the elderly aged over 60. Our survey showed that 12.6% of the respondents paid their medical costs by themselves. The average travel time to get health care was 14.7mins and the median area of a housing unit was 111.3m^2 . 12.1% of respondents were aged 60

Table 5: Multiple factor logistic regression analysis of community hypertension in Guangdong province.

Items	B	S.E.	Wald	df	P	OR(95%C.I for B)
Age	0.255	0.034	42.381	1	0	1.489(1.201-1.967)
Family history	0.246	0.066	3.646	1	0	1.278 1.122-1.456)
Awareness of the prevention and treatment of hypertension	-0.841	0.094	71.621	1	0	0.473(0.324-0.614)
Overweight or obese	0.247	0.047	28.856	1	0	1.366(1.256-1.489)
Smoking	0.758	0.234	2.397	1	0	2.318(1.453-3.148)
Alcohol consumption	0.672	0.341	4.869	1	0.024	1.989(1.091-3.143)
Salty diets	0.694	0.214	10.957	1	0	2.173(1.521-3.415)
Daily sitting time	0.885	0.452	4.542	1	0.008	2.824(1.980-5.841)
Health education initiative	-0.459	0.082	30.568	1	0	0.628(0.531-0.741)

Table 6: Vulnerability of community responses to hypertension in developed areas of Guangdong Province.

Items	Total	Guangzhou	Zhongshan	Shenzhen	Foshan	P value
Screening of adults over the age of 30 years [n (%)]	65(100.0)	22(100.0)	15(100.0)	12(100.0)	16(100.0)	>0.05
Paper or electronic files of hypertension (%)	65(100.0)	22(100.0)	15(100.0)	12(100.0)	16(100.0)	>0.05
Full-time medical staffs of chronic disease management [n (%)]	65(100.0)	22(100.0)	15(100.0)	12(100.0)	16(100.0)	>0.05
Regular training for blood pressure management physicians [n (%)]	65(100.0)	22(100.0)	15(100.0)	12(100.0)	16(100.0)	>0.05
Regular hypertension health education [n (%)]	65(100.0)	22(100.0)	15(100.0)	12(100.0)	16(100.0)	>0.05
Overall satisfaction rate with community health services (%)	66.9	62.2	54.6	71.9	69.3	<0.05
Ratio of physicians to nurses	1/0.97	1/0.94	1/1.00	1/0.95	1/1.07	>0.05

and older in our survey. Among the four indexes, the proportion of residents who paid their own medical expenses (1.9% to 21.1%) showed the greatest difference. In Shenzhen, the proportion of residents at their own expense was 21.1%, which were significantly higher than that of other cities. However, the median household area (42.6m²) and the proportion of elderly aged over 60 (4.8%) of Shenzhen residents were lower than other cities. Residents in Guangzhou had the shortest travel time (8.9 minutes) to the medical-care stations. The highest proportion of people over the age of 60 was in Foshan (16.5%). there were significant difference of the four risk factors between the four cities ($P < 0.05$, Table 3).

Personal risk factors for hypertension in each community

Average age of patients with hypertension (Years), awareness of hypertension, the percentage of people who do not know their blood pressure, smoking, alcohol consumption, salty diet, lack of exercise, daily sitting 8h, residents without measuring blood pressure, study hypertension knowledge proactively, hypertension medication were analyzed to describe the personal risk factors for hypertension. The survey indicated that the average age of patients with hypertension was 63.5 years old. The awareness rate of hypertension was 47.9%. Moreover, 73.7% of the patients didn't know their blood pressure. The proportion of respondents that smoke, consume alcohol, eat salt diets, lack exercise and sedentary over 8h per day were 23.8%, 18.2%, 13.1%, 48.1% and 33.2%, respectively. 21.8% of residents have never measured their blood pressure in over a year. Shenzhen had the lowest average age (54.8 years old) of patients with hypertension and the lowest awareness of hypertension (39.5%), while residents in Zhongshan City had the lowest awareness of their own blood pressure values (14.5%). Regarding risk factors, the detailed results were as follows: Guangzhou shared the largest proportion of residents

lacking exercise (57.5%); Shenzhen residents had the highest alcohol consumption (26.8%), salty diets (25.2%), daily sitting for over 8h (40.3%); the smoking residents in Zhongshan City was the highest and up to 25.5%. The differences of the above four indicators between the four cities were statistically significant ($P < 0.05$). Guangzhou residents were best in following: the awareness of hypertension, studying the hypertension knowledge proactively (40.1%) and hypertension medication (47.6%) as seen in Table 4.

Logistic regression analysis between community hypertension and pathogenic vulnerability or population vulnerability

The hypertension prevalence of residents was considered the dependent variable (0 indicating non- disease, 1 indicating disease). The following 13 factors were calculated as independent variables: age, gender, family history of hypertension, overweight or obese, cultural conditions, awareness of the prevention and treatment of hypertension, smoking, alcohol consumption, salty diet, exercise, daily sitting time, regular measurement of blood pressure and health education initiative. Then, we investigated the impact on population vulnerability and hypertension in the community using unconditional logistic regression analysis. Based on the univariate logistic regression analysis, statistically significant factors in single-factor analysis were introduced to multiple factor logistic regression analysis and a regression model was set up using Backward: LR method. Eventually, nine factors were identified (Table 5), including protective factors: awareness of the prevention and treatment of hypertension ($OR = 0.473$) and health education initiative ($OR = 0.628$), and risk factors for hypertension, age ($OR = 1.489$), family history ($OR = 1.278$), overweight or obese ($OR = 1.366$), smoking ($OR = 2.318$), alcohol consumption ($OR = 1.989$), salty diet ($OR = 2.173$) and sedentary lifestyle ($OR = 2.824$).

Vulnerability of community responses to hypertension

In all of the communities we investigated screened hypertension regularly for adults over the age of 30 years, there were paper or electronic files of hypertension full-time medical staffs of chronic disease management, regular training for blood pressure management physicians, and provided regular hypertension health education. In addition, the overall satisfaction rate with the community health services, and the ratio of physicians to nurses were 66.9%, and 1/0.97, respectively. The overall satisfaction rate with community health services ranged from 54.6% to 71.9 %, and satisfaction rate was the highest for Shenzhen residents ($P < 0.05$, Table 6).

Discussion

Hypertension is currently a major public health problem, affecting the health of community residents in China [27,28]. In-depth understanding of the vulnerability of community hypertension allows area managers to better understand the risk of high blood pressure which will also provide a scientific basis for developing targeted interventions in the future. Moreover, vulnerability assessments of community blood pressure can also explore the capacity of community-level responses to high blood pressure, and thus target the corresponding deficiencies.

In this study, we evaluated the vulnerability of community hypertension in Guangdong, south of China by assessing four aspects, including pathogenic vulnerability, social vulnerability, population vulnerability and vulnerability of the response. The survey results suggested that the overall vulnerability of community hypertension were relatively large in the four cities of Guangdong Province. Indeed, the population vulnerability and vulnerability of the response to high blood pressure were far from optimistic: awareness of hypertension was 47.9% and 73.7% of the patients didn't know their own blood pressure values. In the meantime, the proportion of smoking, alcohol consumption and residents lacking regular exercise were high, while the percentage of health education initiatives and hypertension medication were relatively low. In terms of coping with this hypertension vulnerability, although the communities in the four cities have used regular blood pressure screening and carried out the hypertension standardized management for all patients over 30 years and regularly carried out health education, the overall satisfaction rate with the community health services in the four cities were low.

Studies have shown that integrated management of hypertension in the community is an effective way to prevent and control high blood pressure [29,30]. China has promoted a nationwide standardized management of community hypertension and implemented health service plans in the community which is supported by the government. Notably, the plan for standardized management of community hypertension is an important element. After years of efforts, China's management of community hypertension has also had some success [31,32]. Since 2007, Guangdong Province, especially in Guangzhou, has strengthened its community health services with standardized management of hypertension; most of the community health service agencies in Guangdong have participated in the project. Studies showed that standardized management of hypertension had a stronger ability to manage chronic disease. However, hypertension standardized management among Guangdong are in the start stage, the vulnerability of the response to hypertension still was

low. Therefore, in order to effectively control hypertension in the community, reduce the vulnerability of community hypertension, we should strive to improve community health services for hypertension management and promote the implementation of standardized management of hypertension within the community.

Conclusions

The community vulnerability to hypertension in Guangdong, south of China was relatively large and there is no significantly difference in the community vulnerability to hypertension between the four cities. This means that community hypertension in Guangdong Province is sensitive, while the ability of the community-level response to high blood pressure is low, which are the serious risks for the health of the community residents in Guangdong Province. Therefore, community health services should strive to improve the management level of hypertension and improve fully standardized management of community hypertension to reduce its vulnerability.

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Author's Contributions

Zhiheng Zhou and Wenru Chen participated in the design of the study, and carried out epidemiological investigation and drafted the manuscript. Baoxin Chen Zhijie Huang and Chanjiao Zheng participated in epidemiological investigation. Chanjiao Zheng participated in the design and performed the statistical analysis. All authors read and approved the final manuscript.

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