RISK FACTORS FOR HYPERTENSION AMONG RURAL THAIS

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Abstract. A community based case-control study was conducted to determine the risk factors for hypertension among a rural population in Nakhon Ratchasima Province, Thailand. Seventy-two subjects diagnosed with hypertension (BP ≥140/90 mmHg) were randomly selected. Seventy-two controls with normal blood pressure (BP <120-80 mmHg) were also randomly selected from the same or nearest house to the subjects. Data collection was carried out in February 2010 using a structured questionnaire. Statistics used were percentages, arithmetic means, standard deviations, odds ratios (OR), adjusted odds ratios (aOR), confidence interval (95% CI) for the OR and logistic regression. After adjusting for the effect of other variables in the study, significant risk factors for hypertension were age ≥50 years old (aOR 5.67, 95% CI 1.98-16.24), education level of primary school or lower (aOR 8.09, 95% CI 2.17-30.20), occupation of farmer or unemployed (aOR 2.88, 95% CI 1.14-7.30), body mass index ≥30.0 kg/m^2 (aOR 7.43, 95% CI 1.68-32.87), presence of high cholesterol (aOR 11.26, 95% CI 2.55-49.75), and having mild stress to high stress (aOR 5.33, 95% CI 1.45-19.61). Forty percent of the variation in the presence of hypertension is explained by the developed model for the above risk factors. These findings are useful for health education and health promotion program development in order to prevent hypertension among rural Thai populations.

Keywords: hypertension, risk factors, rural Thais

INTRODUCTION

Non-communicable diseases (NCDs) have become a major public health concern worldwide and their dramatic growth has become a serious healthcare burden in recent decades. NCDs have become more prevalent in developing countries, where they cause double burden as infectious diseases (Boutayeb and Boutayeb, 2005). This includes Thailand where the disability adjusted life years (DALY) lost among Thai people in 2004 was 65.1%, compared to 20.2% and 14.8% for communicable diseases and accidents, respectively (Wibulpolprasert, 2007). Hypertension, a major health concern among NCDs, is a leading cause of cardiovascular disease and a primary cause of stroke, coronary heart disease, heart failure, kidney disease, and blindness (Singh *et al*, 2000; Gu *et al*, 2002; Hajjar *et al*, 2006; Alcocer and Cueto, 2008). In 2001, high blood pressure repre-

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sented 5.6% of the global DALY loss; more than five-sixths of this burden occurred in low- and middle-income countries (Lopez *et al*, 2006). The estimated total number of adults with hypertension in 2000 was 957 to 987 million, of which 625 to 654 million were in economically developing countries. The number of adults with hypertension in 2025 is predicted to increase to 1.56 billion (1.54-1.58 billion) (Kearney *et al*, 2005). Treatment of hypertension requires an investment over many years to prolong disease-free years of life. The high prevalence and high cost of the disease has a significant impact on the microeconomics and macroeconomics of countries and regions (Alcocer and Cueto, 2008).

Hypertension is a major health problem in Thailand. Findings from the 2004 Third National Health Examination Survey (NHESIII) (Aekplakorn *et al*, 2008) indicate an increase in hypertension and prehypertension in Thailand. The prevalence of hypertension and prehypertension in Thai adults aged 15 years and over, weighted to the national population in 2004 were 22.0% (9.9 million individuals) and 32.8% (14.7 million individuals), respectively. As a result of the increase in hypertension cases, the Thai Ministry of Public Health established goals for a screening program in 2006, wherein 60% of adults aged 40 years and over were screened for hypertension. Seventy percent of hypertensive patients were aware of their condition and 50% of them had adequate blood pressure control (Ministry of Public Health Thailand, 2006).

The increased prevalence of hypertension was due to changes in lifestyles, living conditions, the economy, society and the environment and were a result of development and modernization. In the past, the prevalence of hypertension was high among people who lived in urban areas (Singh *et al*, 2000; Oliveria *et al*, 2005), but findings from the 2004 NHESIII showed a uniform prevalence of hypertension and prehypertension across all regions, with a small difference being observed between urban and rural areas (Aekplakorn *et al*, 2008). This shows development and modernization impact lifestyle and the environment of people who live in rural areas.

Nakhon Ratchasima Province is located in northeastern Thailand. This region has been specifically targeted for economic and social development, with particular attention having been paid to industrialization (Cherdchai, 2010). Many industrial estates and manufacturing operations have been established. Urbanization and modernization continues to expand rapidly throughout the whole province, having an impact on lifestyle, behavior and the environment itself, which are reflected by consumption of unhealthy foods and physical inactivity, particularly in Gudjig Subdistrict, Soong Noen District. In 2008, the mortality rate from hypertension in Nakhon Ratchasima was higher than that overall for Thailand, with rates of 5.39 and 3.90 per 100,000 population, respectively. The morbidity rate was also high compared to the overall country, with rates of 565.65 and 860.53, respectively (Bureau of Non-Communicable Diseases, 2010). Since hypertension is influenced by several factors, prevention and management of hypertension is needed, integrated with continuous monitoring of risk factors for the disease. A number of studies regarding risk factors for hypertension have been carried out, but the results are not always in concordance. Most studies reported hypertension is associated with age, gender, education, physical activity, body mass index (BMI), smoking, alcohol

consumption, family history of hypertension, eating habits (including high salt intake and high fat intake) and total blood cholesterol (He *et al*, 1994; Pauvilai and Laorakpongse, 2000; Jo *et al*, 2001; Perez *et al*, 2001; Quasem *et al*, 2001; Mitzumoto, 2004; Onal *et al*, 2004; Oliveria *et al*, 2005; Howteerakul *et al*, 2006; Aekplakorn *et al*, 2008). The findings of this research vary due to differences in study design, settings and target groups. Most previous research targeted urban settings using cross-sectional studies among the overall risk groups, or descriptive studies among hypertensive patients, while little research targeted rural populations. Case-control studies were conducted using different criteria for recruiting cases and controls, which might have impacted the findings and interpretations.

Our study aimed to determine risk factors for hypertension among a rural population using a community based case-control design. The findings of the research will provide key information for prevention and control programs for hypertension among people who live in rural areas.

MATERIALS AND METHODS

Design and subjects

A community based case-control study was conducted in all six villages of Gudjig Subdistrict, Soong Noen District, Nakhon Ratchasima Province, Thailand. Although the subdistrict is located in a rural area, there has been a high prevalence of hypertension over the past few years (Gudjig Primary Care Unit, 2009). Cases were persons > 35 years whose systolic blood pressure was ≥ 140 mmHg, and diastolic blood pressure ≥ 90 mmHg, following WHO-ISH hypertension guidelines (WHO and ISH, 2003) and who had been taking antihypertensive medication for at least 3 months according to the medical records of the Gudjig Primary Care Unit. Cases were sampled proportionately by a simple random sampling from all 6 villages. Controls were persons aged > 35 years whose systolic blood pressure was < 120 mmHg and whose diastolic blood pressure was < 80 mmHg, sampled from people who lived in the same house or the nearest house to the subject. In the case where there was more than one control in the house, a control was sampled using simple random sampling. Sample size was calculated using an unmatched case control formula with Epi Info (2002) software, using the proportion of cases and controls with a body mass index (BMI) among cases and controls (8.90% and 8.15%, respectively), an expected odds ratio for high body mass index (4.01), a 95% confidence level and 80% power for the study (Mitzumoto, 2004).

Data collection and analysis

Data collection was carried out in February 2010 using a structured questionnaire by trained interviewers. The questionnaire comprised of five parts which covered the variables in the study, including general characteristics (age, gender, marital status, educational attainment and occupation), health conditions (family history of hypertension, weight, height, BMI, presence of diabetes and high cholesterol), behavior factors (smoking, alcohol drinking, exercise, eating habits and stress), predisposing factors (knowledge about hypertension and perceptions about hypertension) and enabling and reinforcing factors (information accessibility, health promotion program participation and social support).

The BMI was classified into underweight or normal (≤22.9 kg/m^2), pre-obese

(23-24.9 kg/m^2), obese I (25.0-29.9 kg/m^2) and obese II (≥30.0 kg/m^2). Dietary habits were classified into high risk (≥70% of the total score) and low risk (<70%). Stress was classified according to the criteria of the Mental Health Department, Ministry of Public Health, Thailand, into normal, mild stress, moderate stress and high stress. Knowledge levels about hypertension was classified into high (≥80% of the total score), moderate (60-79%), and low (<60%) levels. Perceptions regarding hypertension were classified into good support (>range/2) and poor (≤range/2). Social support was classified into low social support and high social support using the same criteria as perception. Participation in health promotion programs was classified into never, low (1 program), and high (2-3 programs) participation.

The questionnaires were tested for content validity and reliability. Using Kuder Richardson 20 and Cronbach's alpha coefficient, the reliability of the questionnaire was 0.75 to 0.93.

Data were processed and analyzed using SPSS 17.0 software for windows. Variables were described using percentages, arithmetic means, standard deviations and odds ratio (OR). Logistic regression analysis and adjusted odds ratio (aOR) with a 95% confidence interval (CI) were used to evaluate the association between hypertension and the various risk factors. A p-value < 0.05 and a 95% CI ≠1 was considered as having statistical significance.

Ethical considerations

The research was conducted in accordance with the principles of the Declaration of Helsinki and was approved by the Faculty of Public Health Ethical Review Committee before being conducted (MUPH 2010-015, approval date 15 January 2010).

RESULTS

General characteristics

Seventy-two cases and 72 controls were studied. The mean age of cases and controls were 64.3±11.4 and 48.5±10.01 years, respectively. People aged 50-59, 60-69, and >69 years were at risk for hypertension 3.3, 16.0, and 38.9 times greater than people aged <50 years, respectively, with statistical significance. The risks for hypertension among males and females were not different. Married people had the same risk for hypertension as single people, but this was not true for widowed or divorced people, where the risks for disease was 4.4 times greater than for single people. The risks for hypertension among farmers and unemployed people were 2.9 and 8.6 times greater than among employed people; whereas, people who had graduated from primary school or had a lower education level were at 7.4 times greater risk than people who graduated from high school or had a higher education level (Table 1).

Health conditions

Approximately 60% of cases and controls had a family history of hypertension, most of which were mothers or siblings, but the risk for hypertension among people with and without a family history of hypertension were not different. People whose BMI ≥30.0 kg/m^2 (Obese II) had a 3.5 times greater risk for hypertension than people whose BMI ≤22.9 kg/m^2 (underweight or normal); whereas, people whose BMI was between 23 and 24.9 kg/m^2 (Pre-obese) or between 25.0 and 29.9 kg/m^2 (Obese I) had the same risk as underweight or normal weight people. People who suffered from diabetes mellitus (DM) were 9.6 times more likely to have hypertension than people who did not have DM; people having high cholesterol were 6.3

Table 1
Association between general characteristics and hypertension.

General characteristic	Hypertension (n = 72)		Control (n = 72)		Odds ratio	95% CI
	No.	%	No.	%		
Age (years)						
<50	9	17.6	42	82.4		Reference
50-59	14	41.2	20	58.8	3.27	1.21-8.81*
60-69	24	77.4	7	22.6	16.00	5.28-48.44*
>69	25	89.3	3	10.7	38.89	9.62-157.27*
Mean ± SD	64.3 ± 11.4		48.5 ± 10.1			
Gender						
Male	19	50.0	19	50.0		Reference
Female	53	50.0	53	50.0	1.00	0.48-2.09
Marital status						
Single	5	35.7	9	64.5		Reference
Married	45	45.5	54	54.5	1.50	0.47-4.80
Widowed/divorced	22	71.0	9	29.0	4.40	1.15-16.81*
Occupation						
Employed	18	28.1	46	71.9		Reference
Farmer	17	53.1	15	46.9	2.90	1.20-7.00*
Unemployed	37	77.1	11	22.9	8.59	3.62-20.44*
Educational attainment						
High school or higher	7	17.9	32	82.1		Reference
Primary school or lower	65	61.9	40	38.1	7.43	2.99-18.41*

* Significant association

times more likely to have hypertension than people who did not have high cholesterol (Table 2).

Behavior factors

The risks for hypertension among smokers and non-smokers were not different. The same risk for hypertension was found among alcohol drinkers and non-drinkers, those who exercised and those who did not, and those with a low risk diet and those with a high risk diet. People experiencing mild stress to high stress had a 3.1 times greater risk of hypertension than those without stress (Table 3).

Predisposing, enabling and reinforcing factors

The risk for hypertension was not different among people who had a high, and low to moderate level of knowledge about hypertension, in people who had good support, and people who had less support in controlling hypertension, in people who had access to, and those who did not have access to health information, in people who often participated and those who seldom or never participated in health promotion programs, and in people who had both good and poor social support (Table 4).

After adjusting for the effect of all other variables using multivariate logistic regression (Table 5) the significant risk factors for hypertension were age ≥50 years old (aOR 5.67, 95% CI 1.98-16.24), education level of primary school or lower

Table 2
Association between health conditions and hypertension.

Health condition	Hypertension (n = 72)		Control (n = 72)		Odds ratio	95% CI
	No.	%	No.	%		
Family history of hypertension						
No	29	50.9	28	49.1		Reference
Yes	43	49.4	44	50.6	0.94	0.48-1.84
BMI (kg/m^2)						
Underweight or normal (≤22.9)	21	40.4	31	59.6		Reference
Pre-obese (23-24.9)	16	55.2	13	44.8	1.82	0.72-4.55
Obese I (25.0-29.9)	23	50.0	23	50.0	1.48	0.66-3.29
Obese II (≥30.0)	12	70.6	5	29.4	3.54	1.09-11.54*
Presence of diabetes mellitus						
No/ don't know	46	40.4	68	59.6		Reference
Yes	26	86.7	4	13.3	9.61	3.14-29.37*
Presence of high cholesterol						
No/ Don't know	49	42.2	67	57.8		Reference
Yes	23	82.1	5	17.9	6.29	2.23-17.70*

* Significant association

Table 3
Association between behavior factor and hypertension.

Behavior factor	Hypertension (n = 72)		Control (n = 72)		Odds ratio	95% CI
	No.	%	No.	%		
Smoking						
No	69	51.1	66	48.9		Reference
Yes	3	33.3	6	66.7	0.48	0.11-1.99
Alcohol drinking						
No	68	52.3	62	47.7		Reference
Yes	4	28.6	10	71.4	0.36	0.11-1.22
Exercise						
No	16	53.3	14	46.7		Reference
Yes	56	49.1	58	50.9	0.84	0.38-1.89
Eating habit						
Low risk intake	60	52.0	60	48.0		Reference
High risk intake	7	36.8	12	63.2	0.54	0.20-1.46
Stress level						
Normal	50	44.2	63	55.8		Reference
Mild stress to high stress	22	71.0	9	29.0	3.08	1.30-7.28*

* Significant association

Table 4
Association between predisposing, enabling and reinforcing factors and hypertension.

Predisposing, enabling, and reinforcing factors	Hypertension (n = 72)		Control (n = 72)		Odds ratio	95% CI
	No.	%	No.	%		
Knowledge of hypertension						
High	42	51.2	40	48.8		Reference
Low to moderate	30	48.4	32	51.6	0.89	0.46-1.73
Perceptions about hypertension						
Good support for control	68	48.9	71	51.1		Reference
Less support for control	4	80.0	1	20.0	0.24	0.03-2.20
Health information accessibility						
Yes	70	50.7	68	49.3		Reference
No	2	33.3	4	66.7	0.49	0.09-2.74
Health promotion program participation						
High participation	50	51.0	48	49.0		Reference
Low or never participation	22	47.8	24	52.2	0.88	0.44-1.77
Social support						
Good social support	30	52.6	27	47.4		Reference
Poor social support	42	48.3	45	51.7	0.84	0.43-1.64

Table 5
Significant risk factors for hypertension by multivariate logistic regression analysis.

Risk factors	Adjusted odds ratio	95% CI
Age ≥ 50 years old	5.67	1.98-16.24
Education level: primary school or lower	8.09	2.17-30.20
Occupation of farmer or unemployed	2.88	1.14-7.30
Body mass index ≥30.0 (Obese II)	7.43	1.68-32.87
Presence of high cholesterol	11.26	2.55-49.75
Having mild to high stress	5.33	1.45-19.61

(aOR 8.09, 95% CI 2.17-30.20), occupation as a farmer or unemployed (aOR 2.88, 95% CI 1.14-7.30), a BMI ≥30.0 kg/m^2 (aOR 7.43, 95% CI 1.68-32.87), the presence of high cholesterol (aOR 11.26, 95% CI 2.55-49.75) and having mild to high level of stress (aOR 5.33, 95% CI 1.45-19.61). Variation in the presence of hypertension per the following model was 39.3%.

Hypertension = -4.32 + 1.74(age ≥ 50 years old) + 2.09(education level of primary school or lower) + 1.06(occupation as a farmer or unemployed) + 2.00(BMI ≥30.0 (Obese II)) + 2.42(presence of high cholesterol) + 1.67(having mild to high stress).

DISCUSSION

After adjusting for the effects of all other variables using multivariate logistic regression, the significant risk factors for hypertension were age, education, occupation, BMI, high cholesterol and stress.

Elderly people were more likely to develop hypertension than younger people. These findings are consistent with those of Pauvilai and Laorakpongse (2000), Jo *et al* (2001) and Howteerakul *et al* (2006). As age increases, so does the risk for high blood pressure. The reasons for increased age being associated with increased blood pressure include hardening of the arteries, decreased kidney function, greater body sensitivity to salt and other factors and hormonal changes, such as menopause. Elderly people are less likely to be physically active which is also a risk factor for hypertension.

People with low education levels were more likely to develop hypertension than those with a higher education level. This finding is consistent with Jo *et al* (2001), Quasem *et al* (2001) and Onal *et al* (2004). Individuals with a lower education level are less likely to be knowledgeable about their health and disease.

Famers and unemployed people were more likely to develop hypertension than employed people. This finding agrees with the findings of Jo *et al* (2001) and Howteerakul *et al* (2006). This may be due to the occupations of the subjects and their influence on daily physical activity. Farmers believe working in the rice field is adequate exercise, or they are too exhausted to exercise. Most unemployed people have low education levels leading to lack of awareness regarding health and hypertension. A majority are also elderly and prone to degenerative diseases.

People with a high cholesterol and a BMI ≥ 30 kg/m^2 were more likely to develop hypertension than those with a normal cholesterol and a BMI < 30 kg/m^2. These findings are consistant with the findings of Mitzumoto (2004) and He *et al* (1994). Obesity, hypertension, high triglyceride levels and low high density lipoprotein (HDL) cholesterol levels and premature coronary heart disease (CHD) have metabolic syndrome, a theoretical cause of hypertension.

People with mild to high stress levels were more likely to develop hypertension than those with normal stress, consistent with the findings of Perez *et al* (2001). Regular stress can cause hypertension through repeated elevations in blood pressure, as well as by stimulating the nervous system to produce vasoconstrictive hormones that increase blood pressure. Hypertension is a chronic disease, patients must continually take medicines, follow up and modify their behavior.

Misclassification of cases and controls was prevented by keeping a gap in blood pressure between the two groups: BP ≥140/90 mmHg for subjects and BP <120-80 mmHg for controls. The problem of different contexts and environments between cases and controls was solved by sampling controls from the same house or nearby houses to cases. Some biases may have occured for the following reasons: data were collected using a structured questionnaire to determine history; subjects were diagnosed at least 3 months prior to being interviewed, therefore recall bias and confusion regarding exposure time may have occurred. Since there was no direct observation of respondent behavior, it is possible they may have answered incorrectly. Further research regarding hypertension should take these points into account.

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