การเปลี่ยนแปลงปัจจัยเสี่ยงของสุขภาพในระยะเวลา 4 ปี ของนักศึกษามหาวิทยาลัยสุโขทัยธรรมาธิราช จำนวน 60,569 คน และผลกระทบต่ออัตราความชุกของโรคความดันโลหิตสูง

A 4-Year Transition of Health-Risk Factors and Its Effects on the Prevalence of Hypertension Among a Cohort of 60,569 Sukhothai Thammathirat Open University students

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บทคัดย่อ

วัตถุประสงค์การวิจัย

การเปลี่ยนแปลงของประเทศไทยที่กำลังจะก้าวจากประเทศกำลังพัฒนาสู่ประเทศที่พัฒนาแล้วที่มีรายได้ปานกลางนั้นเป็นผลกระทบจากการเติบโตทางเศรษฐกิจอย่างรวดเร็ว การเปลี่ยนแปลงดังกล่าวส่งผลต่อการเปลี่ยนผ่านของปัจจัยเสี่ยงทางสุขภาพ เช่น การเพิ่มอัตราความชุกของโรคความดันโลหิตสูง ซึ่งเป็นปัจจัยเสี่ยงสำคัญของการเกิดโรคหัวใจและโรคหลอดเลือดสมองตีบตัน การศึกษานี้ประเมินการเปลี่ยนแปลงของปัจจัยเสี่ยงทางสุขภาพและผลกระทบต่อโรคความดันโลหิตสูงของสมาชิกโครงการวิจัยสุขภาพในช่วงระยะเวลา 4 ปี

วิธีดำเนินการวิจัย

ข้อมูลนี้ได้จากกลุ่มตัวอย่างที่เป็นนักศึกษามหาวิทยาลัยสุโขทัยธรรมาธิราชที่ลงทะเบียนเรียนใน พ.ศ. 2548 จำนวน 60,569 คนที่ตอบแบบสอบถามโครงการวิจัยสุขภาพเมื่อ พ.ศ. 2548 และติดตามผลใน พ.ศ. 2552 กลุ่มตัวอย่างนี้อาศัยอยู่ทุกภูมิภาคของประเทศ

ผลการวิจัย

อัตราความชุกของโรคความดันโลหิตสูงในประชากรไทยเพิ่มขึ้นจากร้อยละ 5 ใน พ.ศ. 2548 เป็นร้อยละ 6.1 ใน พ.ศ. 2552 อัตราความชุกในเพศชายเพิ่มจากร้อยละ 7.6 เป็นร้อยละ 9.4 และในเพศหญิงเพิ่มจากร้อยละ 2.8 เป็นร้อยละ 3.4 ตามลำดับ ในเพศชายและเพศหญิงอัตราเสี่ยงของโรค

ความดันโลหิตสูงมีความสัมพันธ์กับภาวะสูงวัย ภาวะอ้วน มีโรคเบาหวาน มีระดับไขมันในเส้นเลือดสูง และผลจากการดื่มสุรา ในชายไทยอัตราเสี่ยงของโรคความดันโลหิตสูงเพิ่มขึ้นมีความสัมพันธ์กับปัจจัยการสมรส การมีรายได้ต่อเดือนสูงขึ้น และการสูบบุหรี่

สรุปและข้อเสนอแนะการวิจัย

อัตราความชุกของโรคความดันโลหิตสูงในประเทศไทยเพิ่มขึ้นมีความสัมพันธ์กับการมีภาวะอ้วน โรคเบาหวาน ระดับไขมันในเส้นเลือดสูง และการดื่มสุรา สำหรับปัจจัยด้านการสูบบุหรี่ การสมรส และการมีรายได้ต่อเดือนสูงขึ้นเพิ่มอัตราเสี่ยงของโรคความดันโลหิตสูงเฉพาะในเพศชาย แนวทางการลดความเสี่ยงของโรคความดันโลหิตสูงควรส่งเสริมให้ประชาชนเพิ่มการออกกำลังกาย หยุดสูบบุหรี่ ลดปริมาณการดื่มสุรา และรับประทานอาหารที่มีประโยชน์ต่อสุขภาพตลอดจนลดการบริโภคอาหารที่มีไขมันสูง

คำสำคัญ: ปัจจัยเสี่ยง/ความดันโลหิตสูง/ผลกระทบต่อสุขภาพ/การศึกษาแบบติดตาม

Abstract

Objective

Rapid economic growth transformed Thailand from a developing to a newly industrialized middle-income country. This fuelled a transition in health-risk factors including an increase in the prevalence of hypertension, an important risk factor for mortality associated with heart disease and stroke. This study analyses changes in health-risk factors and associated hypertension trends over a 4 year period in a large national cohort of Thai adults.

Design and methods

Data derived from 60,569 Sukhothai Thammathirat Open University students living all over Thailand and participating in the Thai Cohort Study by responding to mail-based questionnaire surveys in both 2005 and 2009.

Results

Overall, the prevalence of hypertension among cohort members increased from 5.0% in 2005 to 6.1% in 2009. Hypertension prevalence in 2009 was higher in both sexes, 7.6% vs 9.4% for males and 2.8% vs 3.4% for females. In both sexes, hypertension associated with increasing age, obesity, diabetes, high blood lipids and alcohol consumption. In males, hypertension associated with marriage, smoking and higher income.

Conclusion

In Thailand, hypertension prevalence is increasing and is associated with obesity, diabetes mellitus, high blood lipids and alcohol consumption. Smoking, being married and having a high income are associated with hypertension in males but not in females. Thais should be encouraged to exercise more and control weight, stop smoking, drink less alcohol and consume healthy low fat foods.

Keywords: Risk factor/Hypertension/Health impact/Cohort study

Introduction

A systematic review covering the period 1980 to 2003 estimated that the prevalence of hypertension among adults around the globe was about 30% overall, varying substantially in each region by age, gender and ethnicity. The lowest rate was among rural Indians (5.2%) while the highest was in middle aged Poles (70.7%) (Kearney, Whelton, Reynolds, Whelton, & He, 2004). Across the review period, especially in the last decade, the rates in developed countries tended to be stable or fell while in developing countries, prevalence increased. Hypertension has been identified as a major risk factor for cerebrovascular disease and ischemic heart disease which together cause 7.1 million deaths per year (Chobanian et al., 2003).

Although the exact etiology of hypertesion is unknown, it is associated with many risk factors such as overweight, high sodium intake, low physical activity, excessive alcohol

consumption (Chobanian et al., 2003), diabetes mellitus and hyperlipidaemia (Halperin et al., 2006; Messerli, Williams, & Ritz, 2007). One study estimated that diabetes mellitus increased the risk of hypertension by 41% (Levin et al., 2010). Chronically high alcohol consumption also induces high blood pressure (Saremi, Hanson, Tulloch-Reid, Williams, & Knowler, 2004; Wildman et al., 2005), heart failure and kidney failure (Klatsky, 2003). Sodium overload leads to extracellular volume expansion and an increased blood pressure; salt is therefore a risk factor aggravating blood pressure (He & MacGregor, 2007). Salt intake in Asian countries can be as high as 12 grams per day (He & MacGregor, 2010), far exceeding the daily requirement, believed to be less than 0.25 grams.

In Thailand, a recent National Health Survey estimated the prevalence of hypertension among adults in 2009 to be 22% (Aekplakorn et al., 2012). Hypertension is an underlying factor for important causes of death in the Thai population including stroke (10.7%) and ischemic heart disease (7.8%) (Porapakkham et al., 2010); these contributed to 976,000 disability-adjusted life years (DALYs) (9.8%) (Bundhamcharoen, Odton, Phulkerd, & Tangcharoensathien, 2011).

Rapid socio-economic development has encouraged Thai people to migrate from rural to urban areas. At present, around 40% live in urban areas (Lim et al., 2009). Urban people tend to have unhealthy diets (more "junk" food), sedentary life-styles and physical inactivity (Banwell et al., 2009; Lim et al., 2009) and higher inter-related hypertension, obesity, elevated cholesterol and elevated glucose (Aekplakorn et al., 2008; Aekplakorn et al., 2012).

Thais need to understand the trends in hypertension risk factors in order to plan and implement timely prevention. The study reported here utilizes data from the ongoing national Thai Cohort Study (TCS) described below. We examine the transition in health-risk factors including demography, socio-economic status, health history and personal behaviours, and associations with prevalence of hypertension in 2005 and in 2009.

Methods

Thai Cohort Study

In order to track the dynamics of risks and outcome for population health research, a large nationwide cohort of young adults provides a suitable study group. However, health surveys are complex especially when conducted by mail questionnaires. Open University students have special attributes that make them suitable for such studies. This is because they live all over the country, are usually of modest means indistinguishable from the general population, and are capable of responding accurately to complex questions regarding health, illness, disability, diet and lifestyle.

The Thai Cohort Study (TCS) began with a baseline survey in 2005 (Sleigh, Seubsman, & Bain, 2008). Twenty-page questionnaires were sent to the 200,000 enrolled Sukhothai Thammathirat Open University (STOU) students with 87,134 responding. TCS participants lived in all areas of Thailand, had ages ranging from 15 - 87 years (mean age 30.5 years), and 54.7% were females (Sleigh et al., 2008). A 4-year follow-up survey was conducted in 2009 with around 60,000 (> 70%) of the original cohort responding. There was a small tendency for non-respondents to be young, male and urban. However, the effects on demographic parameters of the 2009 follow up cohort were minimal. Details regarding the TCS such as the 2005 and 2009 questionnaires, study population and survey methods have been published elsewhere (Seubsman, Yiengprugsawan, Sleigh, & Thai Cohort

Study, 2012; Seubsman et al., 2011; Sleigh et al., 2008; Thinkhamrop, Seubsman, Sleigh, Thinkhamrop, & Thai Cohort Study, 2011).

Cohort members were broadly representative of the Thai population although at baseline in 2005 the cohort were younger (aged < 40 years, 84% vs. 49%), more urban (51.8% vs. 31.1%), lived more in Bangkok and in the Central region (47% vs. 24%) and were better educated (most participants had graduated from high school) than the general Thai population (Sleigh et al., 2008). However, the members of cohort represent STOU students well in demography, geography and socio-economy (Seubsman et al., 2012).

Variables and categories

The baseline questionnaire evaluated health-risk factors and their association with chronic diseases and included several sections: demography, socio-economic status (SES), underlying diseases (doctor diagnosed diabetes, high blood lipids and kidney diseases), food consumption and physical activities, smoking and alcohol consumption.

Participants were classified into 3 age groups: younger (≤ 30 years), middle (31 - 40 years) and older (> 40 years) and their marital status was noted (partnered or not). Personal monthly income was reported in 4 categories: ≤ 7000 baht, 7001 - 10000 baht, 10001 - 20000 baht and > 20000 baht. One US dollar was equivalent to 42 baht in 2005 so these incomes were quite low.

Body mass index (BMI) was determined from self - reported weight and height and calculated as the ratio of weight in kilograms (kg) divided by the square of height in meters (m^2). BMI was categorised according to Asian criteria (Banwell et al., 2009; Seubsman et al., 2010; Weisell, 2002; Yiengprugsawan, Banwell, Seubsman, Sleigh, & Thai Cohort Study, 2012) into 4 categories: underweight (BMI < 18.5), normal (18.5 to < 23), overweight (23 to < 25), and obese (≥ 25).

Physical activity was categorised as follows: 1) house work and gardening frequency - divided into 4 categories ranging from ≤ 3 times per month to most days; 2) moderate and strenuous physical activity - for at least 20 minutes, and walking for at least 10 minutes, which were each reported with 4 choices ranging from never to ≥ 5 times per week. Sedentary behaviour was also recorded with participants reporting how many hours per day they regularly spend sleeping, sitting and watching television and /or using computers.

Food consumption frequency (deep fried, instant, roast or smoked, soybean products and soft drinks) was reported based on a ve-point Likert scale ranging from less than once a month to once or more a day. Western-style fast food exposure was noted on a three-point scale from less than once to more than 3 times per month. Fruit and vegetable consumption were recorded as standard serves eaten per day.

Smoking categories were “never”, “ex-smoker” and “current-smoker”. Alcohol categories were based on current behaviour and in 2005 were divided into “regular drinker” or “not regular drinker”; the latter category included non-drinkers. In 2009 regular drinking was based on actual frequency - 0 to 3 days/week (not regular drinker), 4 to 7 days/week (regular drinker).

Statistical analyses

All analyses were performed using SPSS software. Participants were separated into 2 groups, male and female. In each sex, the frequency noted for each variable in 2005 and 2009 was compared by Chi-square test of association. In the 2005 and 2009 surveys, the prevalence of hypertension and its 95% condence interval (CI) were calculated for each value of each categorical variable in both

male and female participants and the influence on prevalence by each variable was evaluated by Chi-square test. In each sex, the prevalence rates for 2005 and 2009 of each category in each variable were compared using a Chi-square test. All p-values were 2 tailed and 5% ($p < 0.05$) was used for the significance level.

Due to a small number of missing values, totals varied slightly for each muti-variate analysis.

Results

Risk factors for hypertension

Overall, from 2005 to 2009 the prevalence of hypertension among cohort members increased from 5.0% to 6.1%. In both years, the rate of hypertension for males was approximately 2.5 times higher than the corresponding rate in females. The prevalence of hypertension in 2009 was moderately higher among males and slightly higher among females when compared to levels in 2005 (Tables 1 and 2, $p < 0.0001$). In both males and females, the prevalence of hypertension significantly increased with age.

In both years more than half the males were married and the proportion married increased significantly across the four-year period (Table 1). In both married and unmarried groups, the prevalence of hypertension was significantly higher in 2009 than in 2005. In addition, married females were significantly more common in 2009 than in 2005; however marital status had no influence on hypertension in females (data not shown).

Personal monthly income of males was significantly higher in 2009 than in 2005 (Table 1). In both surveys, prevalence of hypertension in males increased with higher incomes. The effect of income as a risk factor for hypertension remained similar over the four-year period. In all categories of income, the rates of hypertension in 2005 and 2009 were not different except in those earning ≤ 7000 baht, for whom the rate was significantly higher in 2009 than in 2005. Among females, personal monthly income was significantly higher in 2009 than in 2005; however it had no association with hypertension (data not shown).

In males and females, proportions of overweight and obese participants were significantly greater in 2009 than in 2005 (Tables 1 and 2). In both 2005 and 2009 surveys, the prevalence of hypertension in males and females significantly increased with an increasing BMI. In both overweight and obese males and females the hypertension prevalence rates were higher in 2009 than in 2005 but these differences were statistically significant only among obese cohort members.

In males and females, the prevalence of type 2 diabetes was significantly higher in 2009 than in 2005 (Tables 1 and 2). In both years, the prevalence of hypertension among type 2 diabetics was notably higher than in non-diabetics. The effect of diabetes on hypertension was similar in both years for both sexes.

In 2009, among males and females high blood lipids prevalence increased and kidney disease prevalence decreased when compared to 2005 (Tables 1 and 2). In both years, the prevalence of hypertension in males and females who suffered from high blood lipids or kidney disease was significantly higher than in those without high blood lipids or kidney disease. The prevalence of hypertension in 2009 was moderately higher than that in 2005 in both male and female participants with high blood lipids or kidney disease.

In males, the percentage of smokers was slightly lower in 2009 than in 2005 (Table 1). In both years, the prevalence of hypertension in smokers was significantly higher than that in non-smokers. In both smokers and non-smokers, the prevalence of hypertension was slightly higher in 2009 than in 2005.

In males, the percentage of regular alcohol drinkers was slightly lower in 2009 than in 2005

(Table 1). The prevalence rate of hypertension in non-regular or non-drinkers in both sexes was a little higher in 2009 than in 2005. In both males and females in both years there was a substantial positive effect of drinking on the occurrence of hypertension; this alcohol effect was statistically significant in both years for males and in 2009 for females (Table 2).

Potential risk factors that had no influence on hypertension (data not shown)

Sedentary habits and physical activities

The study found that male and female participants did less house work or gardening in 2009 than in 2005 and they slept for more hours in 2009 than in 2005. They spent more time watching television or using computers and sitting for any purpose in 2009 than in 2005. Male and female participants spent more time engaged in walking, moderate or strenuous physical activity in 2009 than in 2005. However in either sex, sedentary habits or physical activity had no effect on hypertension.

Food consumption habits and fruits and vegetables consumption

Compared to 2005, male and female participants in 2009 consumed less deep fried or instant food and soft drinks, but more Western fast food. However, food consumption had no association with hypertension in either sex. Also, participants of both sexes consumed more fruit and vegetables per day in 2009 than in 2005, but this had no impact on hypertension.

Discussion

In the national Thai Cohort Study (TCS), hypertension has increased in both sexes between 2005 and 2009 reflecting an increase in risk factors such as older age, obesity, diabetes mellitus and high blood lipids. Smoking, alcohol consumption and kidney disease in both sexes slightly decreased between 2005 and 2009. In both survey years, the prevalence of hypertension was markedly higher in males than in females; this was compatible with the results of other studies (Choi et al., 2006; Porapakkham, Pattaraarchachai, & Aekplakorn, 2008; Rampal, Rampal, Azhar, & Rahman, 2008). One partial explanation is that in premenopausal women, which includes most of the cohort females, hypertension is less prevalent than in age-matched men; these findings reverse after menopause but it will be another decade before most cohort females reach that age (Burt et al., 1995).

The increase in hypertension prevalence across the 4-year period among males was more notable than that among females. This sex differential may be mainly explained by differences in exposures to risk factors reflecting higher health awareness among females (Aekplakorn et al., 2008; Aekplakorn et al., 2012; Rampal et al., 2008). For example, Thai females are less likely to drink alcohol and smoke cigarettes than males, both of these behavioural factors are associated with increased risk of hypertension. As well, cohort females weighed relatively less and were less likely to have diabetes or high blood lipids.

The prevalence of hypertension in the 2005 and 2009 increased with age in both sexes which was consistent with the results from previous studies in Thailand (Aekplakorn et al., 2008), China (Meng et al., 2011) and Korea (Jo et al., 2001). Blood pressure increases with age in part due to the gradual increase in peripheral vascular resistance (Franklin et al., 1997). The age effect on hypertension was similar in 2005 compared to 2009: in both years, the trend of increasing blood pressure with increasing age showed a five to six fold monotonic increase.

In both survey years, the higher prevalence of hypertension among partnered or married males agreed with the results of other studies (Min, Chang, & Balkrishnan, 2010; Rodrigues Barbosa & Ferreti Borgatto, 2010). However, these results were likely to be confounded to a small degree by age; in both survey years, the majority of married males

were middle and older aged whereas the majority of single males were young and middle age.

In males and females, a higher personal monthly income in 2009 compared to that in 2005 may be a result of a longer period of employment and a higher educational achievement. In both surveys, the prevalence of hypertension in males increased with an increase of personal monthly income; this was comparable with the results of other studies in Thailand (Porapakkham et al., 2008). High income males tended to consume more food and alcohol so they were likely to be obese. Our Thai study showed that the percentage of obesity and of current drinkers in high income males (> 10,000 baht) was higher than that of those with low income (≥ 10,000 baht). In contrast, the prevalence of hypertension in Korean males tended to decrease with an increase of household income (Jo et al., 2001). The risk of hypertension in adults also decreased with an increase of a personal monthly income in Korea (Choi et al., 2006) and of household income in the US (Kaplan, Huguet, Feeny, & McFarland, 2010). High income Koreans preferred to use a high quality health care service so they had a better health screening and prevention (Min et al., 2010). These results overall are commensurate with the concept of a tipping-point for the relationship between socio-economic status, body size and hypertension risk factors where developing countries have the pattern found here among Thai males (high income, high body size and high hypertension) and developed countries have the opposite pattern (high income is health protective) (Ball & Crawford, 2005; Diez-Roux et al., 1999; Seubsman et al., 2010; Sobal & Stunkard, 1989).

Our study agrees with previous research in Thailand (Aekplakorn et al., 2007) which has found obesity prevalence was rapidly rising. Overweight Thai adults increased from 16.2% in 1997 to 18.2% in 2004 (Aekplakorn et al., 2007). Likewise, the prevalence of class I and class II obesity of Thai adults (BMI 25-30 vs BMI 30+) rose from 19.3% and 6.3% in 1997 to 22.8% and 7.5% in 2004 respectively (Aekplakorn et al., 2007). In the Thai Cohort Study earlier analyses have shown that increased BMI associated with urbanization, reduced physical activity, doing less housework or gardening and over 4 hours per day watching television or using computers (Banwell et al., 2009).

In 2005 and 2009, the prevalence of hypertension in both sexes tended to increase as BMI increased and this effect was consistent with the results of other studies in Thailand (Aekplakorn et al., 2012) and the US (Wang & Wang, 2004). In addition, blood pressure (systolic and diastolic) in males and females significantly increased with an increase of BMI (Wang & Wang, 2004). Risk of hypertension in males and females had a direct association with BMI in Thai (Aekplakorn et al., 2008), Malaysian (Rampal et al., 2008) and Chinese people (Meng et al., 2011). This study confirmed that obesity was an important risk factor of hypertension.

The prevalence of diabetes mellitus in males and females was significantly and substantially higher in 2009 than in 2005. The 50 - 80% increase in prevalence may be due to aging and urbanization and was compatible with the results in other studies in Thailand (Aekplakorn et al., 2007; Aekplakorn et al., 2011). For our cohort, in both years the prevalence of hypertension in males and females who suffered from diabetes mellitus was remarkably higher than in their counterparts who were non-diabetic; this was consistent with results elsewhere, as reported from Barbados (Rodrigues Barbosa & Ferreti Borgatto, 2010) and the USA (Hsia et al., 2007). In other studies, diabetes was significantly associated with an increased relative risk of hypertension in the US (Wang et al., 2006) and Japan (Fukui et al., 2011).

In both sexes, the prevalence of high blood lipids was significantly higher in 2009 than in 2005; this may be the results of aging, higher education

attainment and urbanization. However, compared to the results of a previous national survey in 2004 (Khonputsa et al., 2010), the prevalence of high blood lipids in 2005 was similar in males (13.7% vs 13.6%) but notably lower in females (6.9% vs 17.1%). The prevalence of hypercholesterolemia increased with age, higher educational attainment and urban residence (Khonputsa et al., 2010). In the present study more highly educated people tend to consume more food, drink more alcohol and smoke more cigarettes and urban people were likely to consume more unhealthy food ("Junk" foods) and exercise less. In both years TCS participants with high blood lipids had a noticeably higher risk of hypertension compared to those without; this confirmed the results of previous studies in Thailand (Aekplakorn et al., 2008), Finland (Laaksonen et al., 2008) and the US (Halperin et al., 2006; Sesso, Buring, Chown, Ridker, & Gaziano, 2005).

We found that the prevalence of kidney disease in both sexes decreased about 30% from 2005 to 2009 which was in the opposite direction to the results of other Thai studies (Domrongkitchaiporn et al., 2005; Ingsathit et al., 2010). In these other Thai studies involving earlier and longer periods for several thousand participants the prevalence of chronic kidney disease rose from 1.7% in 1985 to 6.8% in 1997 (Domrongkitchaiporn et al., 2005) and 8.6% in 2007 (Ingsathit et al., 2010). In both TCS survey years, the prevalence of hypertension was significantly higher in participants with kidney disease than in those without; this was comparable with the results of others studies in the Czech Republic (Jancova et al., 2008), Spain (Ridao et al., 2001), the US (Buckalew et al., 1996) and the UK (Johnston & Davison, 1993).

In Thailand, the trend of smoking in both sexes has been declining partly due to an extensive government program which has included banning smoking in public areas and increased tobacco taxes (Pachanee et al., 2011). This trend is supported by TCS data which revealed that smoking was significantly lower in 2009 than in 2005 in both males and females. However, other surveys have shown that smoking tends to decrease in males but increase in females (Aekplakorn et al., 2008; Sangthong et al., 2012). Among 2009 TCS members smoking was substantially higher in males than in females (47.3% vs 3.3%) and the prevalence of smoking among both males and females was lower than in other Asian countries such as Malaysia (54.2% in males, 12.7% in females) and Korea (61.6% in males, 4.3% in females). The increased risk of hypertension among smokers in the present study, especially in males, was consistent with the results of previous studies (Halimi et al., 2002; Halperin, Gaziano, & Sesso, 2008; Pang et al., 2010). Also, in females, smoking had no detected influence on the risk of hypertension which was consistent with the results of other studies in the US (Schwandt, Coresh, & Hindin, 2010) and Korea (Jo et al., 2001).

In both sexes, the proportion of those who consume alcohol slightly decreased between 2005 and 2009; this may reflect that alcohol reduction program was able to achieve the targets especially in the younger population. The results were different from a previous study (Assanangkornchai, Sam-Angsri, Rerngpongpan, & Lertnakorn, 2010) which reported that per capita alcohol consumption in liters of the Thai population increased from 7.5 in 1990 to 8.5 in 2001. The prevalence of regular drinkers in our study was lower than the National Household Survey in 2007 (Assanangkornchai et al., 2010) (9.5% vs 48.4% for males, 0.61% vs 12.7% for females). These results are compatible with the results of other studies which showed that an increase in alcohol consumption was associated with increased prevalence of (Stranges et al., 2004) and risk of hypertension (Pang et al., 2010; Saremi et al., 2004; Witteman et al., 1989).

The results reported here have some strengths and limitations that should be noted. The data are derived from the largest cohort study in

Thailand. Participants live all over Thailand and they represent the Thai population well for many socio-demographic and socio-economic factors (Seubsman et al., 2012). They have a high educational attainment meaning self-reported questionnaire results can be more reliable although still subject to reporting and information error. We have validated self-reported hypertension (Prasutr Thawornchaisit, 2013, under review) in a random age-sex matched sub-sample of the cohort reporting hypertension (n = 240) or no hypertension (n = 240) phoned by a physician to investigate and confirm the diagnosis. The study found the sensitivity of self-report was high (82%) and that negative reports were usually accurate (86%). In addition, a study of the validity of self-reported weight and height in our cohort found that the accurary was quite acceptable (Lim, Seubsman, & Sleigh, 2009). However, most participants are younger, have a higher educational achievement and are slighly more urban than the overall Thai population. Most factors (risks and protections) were measured so the results reflected the true situation of hypertension in Thais. These analyses of 2005 and 2009 TCS data were cross-sectional so causes and effects are measured at one point in time so it is difficult to definitively demonstrate the causal links between risk factors and health outcomes.

In summary, prevalence of hypertension in the Thai population is increasing as a result of population ageing and a higher prevalence of obesity, diabetes mellitus and high blood lipids. The Thai government should consider expanding its village-based hypertension screening to include detection of overweight and obesity. This blood pressure screening in the population is essential to identify hypertensives for treatment. Adding BMI assessment enables health education regarding physical activity and diet, enhancing prospects of hypertension prevention. Successful policy implementation will prevent hypertension and mortality from cardiovascular diseases and stroke. Thais should be encouraged to eat a healthy diet, to increase physical activity, to stop smoking and to drink less alcohol.

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Conflict of interest

The authors declare that there are no conflicts of interest.

Ethical approval

Ethical approval was obtained from Sukhothai Thammathirat Open University Research and Development Institute (protocol 0522/10) and the Australian National University Human Research Ethics Committee (protocol 2004344 and 2009570). All participants gave informed consent to the study. All data were de-identified and encrypted. All data are stored in a locked cabinet only accessible to the project leader.

Table 1 Hypertension prevalence and risk factors in male Thai Cohort members, 2005 & 2009.

Risk factor	Cohort					Hypertension prevalence (%)		
	2005		2009		P-value[a]	2005	2009	P-value[a]
	n	%	n	%		95% CI	95% CI	
All participants	27407	100	27407	100		7.6	9.4	< 0.0001
						7.0 - 8.0	9.0 - 10.0	
Mean age-y (S.D.)	33.5 (8.9)		37.5 (8.9)					
Age range-year	17 - 88		21 - 92					
Demographic data								
Age group					< 0.0001			
≤ 30 y	11690	42.7	6688	24.4		3.4	2.8	< 0.038
						3.0 - 4.0	2.4 - 3.2	
31 - 40 y	9861	36.0	11519	42.0	6.9	6.2	< 0.026	
						6.0 - 7.0	5.8 - 6.6	
> 40 y	5856	21.4	9200	33.6		17.2	18.1	0.15
						16.0 - 18.0	17.3 - 18.9	
P-trend						P < 0.0001	P < 0.0001	
Married/partnered				< 0.0001				
No	11640	43.6	15582	37.7		5.0	6.4	< 0.0001
						4.6 - 5.4	6.0 - 7.0	
Yes	15057	56.4	9449	62.3		9.6	11.2	< 0.0001
						9.0 - 10.0	11.0 - 12.0	
P-value						P < 0.0001	P < 0.0001	
Socioeconomic status								
Personal monthly income (baht)[b]					< 0.0001			
≤ 7000	8396	31.3	4270	16.1		4.4	6.2	< 0.0001
						4.0 - 5.0	5.0 - 7.0	
7001 - 10000	6132	22.8	4526	17.0		5.6	5.1	0.28
						5.0 - 6.0	4.0 - 6.0	
10001 - 20000	8278	30.8	10339	38.9		8.8	8.3	0.25
						8.0 - 9.0	8.0 - 9.0	
> 20000	4054	15.1	7439	28.0		14.8	15.2	0.61
						14.0 - 16.0	14.0 - 16.0	
P-trend						P < 0.0001	P < 0.0001	
BMI classication[c]					< 0.0001			
Underweight	1506	5.6	1008	3.8		2.1	1.4	0.18
(BMI < 18.5)						1.0 - 3.0	1.0 - 2.0	
Normal	12833	47.6	11075	41.3		4.2	4.8	< 0.027
(18.5 ≤ BMI < 23)						4.0 - 5.0	4.0 - 5.0	
Overweight		6103	22.6	6730	25.1	7.9	8.7	0.11
(23 ≤ BMI < 25)						7.0 - 9.0	8.0 - 9.0	
Obese		6519	24.2	7989	29.8	15.0	16.9	< 0.0023
(BMI ≥ 25)						14.0 - 16.0	16.0 - 18.0	
P-trend						P < 0.0001	P < 0.0001	

[a]Chi-square test

[b]At the time of the survey in 2005, US$1 = 42 Thai baht

[c]BMI classification based on criteria used for Asian people.

Table 1 (continue)

Risk factor	Cohort					Hypertension prevalence (%)		
	2005		2009		P-value[a]	2005	2009	P-value[a]
	n	%	n	%		95% CI	95% CI	
Underlying diseases								
Diabetes mellitus type 2					< 0.0001			
Yes	419	1.5	637	2.3		42.2	42.9	0.84
						37.0 - 47.0	39.0 - 47.0	
No	26987	98.5	26756	97.7		7.1	8.6	< 0.0001
						7.0 - 7.4	8.0 - 9.0	
P-value						P < 0.0001	P < 0.0001	
High lipids					< 0.0001			
Yes	3760	13.7	5260	19.2		20.6	24.2	< 0.0001
						19.0 - 22.0	23.0 - 25.0	
No	23646	86.3	22133	80.8		5.5	5.8	0.18
						5.0 - 6.0	5.4 - 6.2	
P-value						P < 0.0001	P < 0.0001	
Kidney disease					< 0.0001			
Yes	732	2.7	511	1.9		17.3	23.1	< 0.012
						15.0 - 20.0	19.0 - 27.0	
No	26674	97.3	26882	98.1		7.3	9.1	< 0.0001
						7.0 - 8.0	8.7 - 9.5	
P-value						P < 0.0001	P < 0.0001	
Personal behaviours								
Smoking status					< 0.0001			
Never	13320	49.7	14238	52.7		6.2	7.5	< 0.0001
						5.8 - 7.0	7.0 - 8.0	
Ex-smoker	8390	31.3	7691	28.5		10.0	13.4	< 0.0001
						9.0 - 11.0	13.0 - 14.0	
Current-smoker	5114	19.1	5065	18.8		7.4	8.6	< 0.024
						7.0 - 8.0	8.0 - 9.0	
P-trend						P < 0.0001	P < 0.0001	
Drinking status					< 0.04			
Non-regular	24358	89.8	23727	90.5		7.2	9.0	< 0.0001
						6.8 - 7.6	8.6 - 9.4	
Regular	2779	10.2	2484	9.5		11.3	12.4	0.35
						10.0 - 12.7	11.0 - 14.0	
P-value						P < 0.001	P < 0.0001	

[a]Chi-square test

Table 2 Hypertension prevalence and risk factors in female Thai Cohort members, 2005 & 2009.

Risk factor	Cohort					Hypertension prevalence (%)		
	2005		2009		P-value[a]	2005	2009	P-value[a]
	n	%	n	%		95% CI	95% CI	
All participants	33162	100	33162	100		2.8	3.4	< 0.0001
						2.6 - 3.0	3.0 - 4.0	
Mean age-y (S.D.)	30.1 (7.7)		34.1 (7.7)					
Age range-year	15 - 73		19 - 77					
Demographic data								
Age group					< 0.0001			
≤ 30 y	19556	59.0	13004	39.2		1.7	1.3	< 0.005
						1.0 - 2.0	1.0 - 1.5	
31 - 40 y	9939	30.0	13168	39.7		3.0	2.5	< 0.01
						2.6 - 3.4	2.0 - 3.0	
> 40 y	3667	11.1	6976	21.0		8.1	8.9	0.17
						7.0 - 9.0	8.0 - 10.0	
P-trend						P < 0.0001	P < 0.0001	
BMI classication[b]				< 0.0001				
Underweight	6656	20.3	4637	14.2		1.4	1.1	0.19
(BMI < 18.5)						1.0 - 2.0	0.7 - 1.5	
Normal	19326	58.9	18321	56.3		2.1	1.9	0.18
(18.5 ≤ BMI < 23)						1.9 - 2.3	1.7 - 2.1	
Overweight	3389	10.3	4427	13.6		3.5	3.8	0.488
(23 ≤ BMI < 25)						3.0 - 4.0	3.0 - 4.0	
Obese	3431	10.5	5158	15.8		8.4	9.9	< 0.0167
(BMI ≥ 25)						7.0 - 9.0	9.0 - 11.0	
P-trend						P < 0.0001	P < 0.0001	

[a]Chi-square test

[b]BMI classification based on criteria used for Asian people.

Table 2 (continue)

Risk factor	Cohort					Hypertension prevalence (%)		
	2005		2009		P-value[a]	2005	2009	P-value[a]
	n	%	n	%		95% CI	95% CI	
Underlying diseases								
Diabetes mellitus type 2					< 0.0001			
Yes	166	0.5	293	0.9		25.9	32.4	0.143
						19.0 - 33.0	27.0 - 38.0	
No	32996	99.5	32855	99.1		2.7	3.1	< 0.0012
						2.0 - 3.0	2.9 - 3.3	
P-value						P < 0.0001	P < 0.0001	
High lipids					< 0.0001			
Yes	2301	6.9	3525	10.6		9.0	11.5	< 0.002
						8.0 - 10.0	10.0 - 13.0	
No	30861	93.1	29623	89.4		2.3	2.4	0.646
						2.0 - 2.5	2.0 - 3.0	
P-value						P < 0.0001	P < 0.0001	
Kidney disease					< 0.0001			
Yes	866	2.6	655	2.0		7.0	10.2	< 0.027
						5.0 - 9.0	8.0 - 13.0	
No	32296	97.4	32493	98.0		2.7	3.2	< 0.0001
						2.0 - 3.0	3.0 - 3.4	
P-value						P < 0.0001	P < 0.0001	
Personal behaviour								
Drinking status					0.67			
Non-regular	32501	99.4	31562	99.4		2.8	3.3	< 0.006
						2.6 - 3.0	3.0 - 4.0	
Regular	202	0.62	195	0.61		4.5	6.7	0.44
						2.0 - 7.0	3.0 - 10.0	
P-value						P = 0.148	P < 0.01	

[a]Chi-square test

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