Comparison of Cardiovascular Risk Factors in Five Regions of Thailand: InterASIA Data

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Background: *Age- and sex- standardized mortality rate of cardiovascular disease (CVD) was high in Bangkok and central Thailand in the year 2000. This may partially be related to differences in risk factors.*
Objective: *To compare prevalence of CVD risk factors among regions in Thailand in the same period.*
Material and Method: *From a survey in 2000 (InterASIA) which involved 5 regions in Thailand, conventional CVD risk factors were compared multivariate-wise among regions and subsequently aligned with CVD deaths obtained within similar regions from the registry.*
Results: *Bangkok and a central province had a higher prevalence of the following: hypertension, elevated body mass index, large waist circumference, elevated lipid associated with low density lipoprotein cholesterol and diabetes mellitus. The Northeast had a higher prevalence of smoking, low values of high density lipoprotein cholesterol and high triglyceride.*
Conclusion: *Definite regional differences existed of CVD risks and death in Thailand in 2000. Some of the metabolic risk factors may be more important than smoking in the link with CVD death in Thailand.*

Keywords: *Standardized mortality rate, Cardiovascular disease, Ischemic heart disease, Stroke*

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Cardiovascular disease (CVD) results from atheromatous process involving large and medium arteries, but in most reports, these diseases are often limited essentially to blood vessels of the brain (stroke) and the heart (myocardial infarct or ischemic heart disease). CVD is and will be a major burden in most countries whether developed or developing. Preventing or delaying atheroma aims to reduce the burden of CVD. However, the burden of CVD has to be looked at in terms of death and/or incidence and each with its conglomeration of risk factors.

In developed countries, such as the United Kingdom and the United States of America, death from ischemic heart disease (IHD) showed a marked decrease, deemed to be due mainly to primary prevention (reduction of smoking, of high blood pressure and abnormal lipids) rather than as a result of secondary prevention[1,2]. In Asia, it was estimated that the burden for CVD will be increasing[3] despite the lower incidence of coronary heart disease[4], and the marked reduction of

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stroke especially in Japan(5-7). In Japan, the change in incidence of ischemic heart disease (IHD) or myocardial infarction (MI) did not appear consistent in that reports included a rise(5), a no change(7), or a decrease(8). In Taiwan, there was a decrease in incidence but an increase in hospitalization(9). These inconsistent changes in IHD and persistent decrease in stroke occurred while obesity and cholesterol increased, cigarette smoking decreased and hypertension was better controlled(5-9). Urbanisation probably plays a large part. The rate of decrease of death from IHD was shown to be much less in cities such as Tokyo and Osaka when compared to the rest of Japan(8). For similar average age, the concentration of total cholesterol varied among the cities in China(4). The prevalence of hypertension in China depended on urbanization as well as education and body mass index (BMI)(10). The death for ischemic heart and CVD among the different States in the USA can vary by as much as 2 times(11). The INTERHEART evaluated risks related to first acute MI in 52 countries. They reported that Asians showed lower lipid levels when compared to non-Asians but regions in Asia (*e.g.* China, Japan. south vs. southeast Asia) showed different prevalence of lipids which were risks for acute MI(12). These reports strongly suggest the importance of examining variations in risks as functions of geographical distribution.

In Thailand, Faramnuayphol et al(13) had shown marked differences in standardized mortality rate (SMR) for CVD deaths among regions in Thailand. Table 1 was extracted from that report and shows age- and sex- SMR for IHD and stroke in the year 2000.

Table 1. Age and sex standardized mortality rates per 100,000 for ischemic heart disease (IHD) and for stroke for various regions of Thailand from the death registry in 2000

Region	IHD	Stroke
Bangkok	167	158
Central	122	146
Western	118	114
Eastern	120	138
Upper southern	95	68
Lower southern	94	60
Upper northern	123	107
Lower northern	92	118
Upper northeastern	60	51
Lower northeastern	63	78

Deaths, from both components of CVD were most common among the residents of Bangkok and were approximately 3 times those of the upper northeastern region where the rates were the lowest. The correlation in geography of IHD and stroke (Spearman rank correlation coefficient of 0.72) suggested a common set of risk factors.

InterASIA study is an international collaborative survey of CVD risk factors in China and Thailand. In Thailand, the study was stratified into five regions of more or less equal sample size. The overall prevalence of these risk factors(14) and the breakdown of the prevalence by ethnicity and gender in Southern Thailand(15) had been reported. However, cross-regional comparisons which may help explaining mortality pattern for CVD have never been documented.

The objective of the present report was to compare the prevalence of the above CVD risk factors across the five regions of Thailand based on the InterASIA data.

Material and Method

The detailed methodology and the overall results have been previously reported(16). In brief, 5 regions were selected consisting of Bangkok (BKK) and 4 provinces; Chiang Mai representing the north (N), Khon Kaen representing the northeast (NE), SuphanBuri for the central (C), and Songkhla for the south (S). The list of all communities of the selected provinces was obtained from the development office of the particular province. One well-developed and one less-developed areas were randomly chosen from both rural and urban communities in each study province. In each selected community, the list of the households and the residents was obtained from National Statistical Office. This was used as the sampling frame for the study subjects.

All residents who were 35 years old or over were invited to join the present study. The present study protocol was approved by the ethics committee of each institution. The aim for the sample size per each region was 1,000 subjects with uniform age and sex distribution. Such sample size would give a width of the 95% confidence limit being 6% if the prevalence is 50%. It has a power of 80% to detect significant difference between the prevalence of risk factor being 30% in one region and 36% in another.

After an overnight fasting, the subjects were interviewed and had their venous blood taken at the temporary data collection center in the study community. Anthropometric measurements (weight, height, waist and hip circumferences) were obtained. Waist was defined as 2.5 cm above the navel and its circumference was measured with a tape at end-expiration of a normal breathing. Hip circumference utilized the maximum prominence at the gluteal level. Field wxorkers in all the involved regions were simultaneously trained. Right arm blood pressure using Hg manometer was taken three times after at least 5 minutes of quiet sitting.

Definition for risks

A smoker was defined as a person currently smoking or had ever smoked 100 or more cigarettes within his/her life-time. Those considered drinking must have consumed alcohol on $\geq$ 12 occasions in the past 12 months. The blood pressure (BP) in this report was the average of the second and the third measurements. The followings described the cut-off values for risks[15]. Hypertension (HT) was defined as systolic BP $\geq$ 140 mmHg or diastolic BP $\geq$ of 90 mmHg or on medication. Body mass index (BMI) was calculated from body weight in kilograms divided by the square of the height in metres. The BMI risks, in kg/m^2, were partitioned into 25.0-29.9 (overweight) and 30 or above (obese). Abdominal obesity utilized waist circumference (WC) in cm of $\geq$ 90 for men and $\geq$ 80 for women and waist-hip ratio (WHR) of $\geq$ 0.90 for men and $\geq$ 0.85 for women. Levels of fasting plasma glucose (FPG) in mg/dl were separated into impaired fasting glucose (IFG, which is FPG of 110-125 mg/dl) and diabetes mellitus (DM, which is FPG $\geq$ 126 mg/dl) or on medication. Total cholesterol level (TC, in mg/dl) had two cut off values, $\geq$ 200 and $\geq$ 240. Elevated triglyceride (TG, mg/dl) was set at $\geq$ 200. Risk values for high density lipoprotein-cholesterol (HDL-C, mg/dl) were set at $\leq$ 35 for men and $\leq$ 40 for women. High TC/HDL-C ratio was set at $\geq$ 5. Low density lipoprotein cholesterol (LDL-C) was calculated as TC minus TG/5 minus HDL-C using the Friedewald's transformation and only where TG < 400 mg/dl. The cut off value for high LDL-C was $\geq$ 160 mg/dl. Non-HDL-cholesterol (nonHDL-C, in mg/dl) was calculated from TC minus HDL-C among those with TG < 400 mg/dl. (There were 3.2% with TG > 400 mg%). High nonHDL-C was set at $\geq$ 190 mg/dl, which was obtained from the average of the 5 regions plus 1 standard deviation. Other risk factors such as diet and exercise were not included.

Data analysis

Demographic variables are displayed by region. Central tendency and dispersion of variables that are continuous were summarized without testing for statistical significance. Logistic regression model was used to predict the region-specific prevalence of various binary risk factors with adjustment for rural/urban and age effects. This was done separately for men and for women. The region- and sex-specific prevalences and their 95% confidence interval (CI) were adjusted for age and urban/rural residence under generalized linear modeling. Statistical tests for significant difference of the factors across region were first done under likelihood ratio test. When this was significant, a further test between each pair of regions was carried out with Bonferroni adjustment of p-value[17] setting a significant level of < 0.01 instead of < 0.05 to reduce type I error from multiple comparisons using the same model. Regions where the prevalence are not significantly different from one another are marked with the same superscript alphabet for the sake of easy grouping. To further facilitate comparison of these data, bar chart of the adjusted prevalence of risk factors by sex and region were displayed in shades of gray where black represented the highest prevalence and white, the lowest. All analyses were carried out with the statistical software R[18] and the Epical package[19].

Results

Table 2 shows distribution of demographic variables among the five regions. Most regions showed over-representation of women. Subjects from Bangkok were predominantly women, more educated, had a higher income and were more likely to be never married, divorced and unemployed.

Table 3 shows means and standard deviations of various variables for men and women in each region. A pattern can be seen in both men and women. Bangkok and the central region tended towards higher average for blood pressure, obesity indices, glucose and lipids, except for TG. Northeast subjects showed lower average HDL-C but higher TG.

Tables 4.1, 4.2 and Fig. 1, 2 show the adjusted prevalence of relatively high risk subjects which now also include smoking and drinking. Essentially, this reflects what is seen with the general distribution in that Bangkok and a central province, had 2-3 times the prevalence of the 2 provinces in the north and northeast with regard to hypertension, indices of obesity, and elevated LDL-C associated lipids. South and NE had low prevalence of DM, although the south had the highest prevalence of IFG. The Northeast showed 2-2.5 times the prevalence of low HDL-C and

Table 2. Distribution of demographic variables among the five regions

Region*	BKK	N	NE	C	S
n	1,000	1,029	1,280	1,036	1,005
% women	73.3	63.6	54.7	50.6	62.7
Age, mean	52.7	52.0	54.2	55.2	52.9
[SD]	[11.4]	[12.1]	[11.4]	[11.6]	[11.8]
Marital status					
Married/cohabiting	64.0	69.5	76.3	73.3	78.4
Widow	14.4	17.3	17.9	13.9	12.0
Divorced/separated	9.9	7.3	3.5	4.3	6.2
Never married	11.7	5.9	2.3	8.5	3.4
Employment					
Employed	55.2	70.5	68.9	75.4	69.8
Retired	5.8	1.7	4.2	22.9	5.9
Not employed	39.0	27.9	26.9	1.7	24.4
Occupation					
Management	0.7	0.3	0.0	1.1	0.4
Professional	6.5	8.5	0.9	6.9	3.0
Business owner	2.7	4.5	0.6	10.9	3.5
Worker	17.1	38.2	15.2	18.6	15.3
Farmer	1.9	22.0	38.5	40.3	38.6
Self-employed	10.3	22.8	18.5	20.6	14.8
Other	60.7	3.8	26.2	1.6	24.3
Household income x 1,000 Baht per year					
Median	108.0	60.0	43.4	72.0	50.0
[IQR]	[60.0-200.0]	[36.0-120.0]	[24.0-81.1]	[34.3-145.2]	[36.0-96.0]
Education achieved					
Elementary or below	63.3	82.1	93.2	83.2	85.1
Above elementary	36.7	17.9	6.8	16.8	14.9

* BKK = Bangkok, N = north, NE = northeast, C = central, S = south, n = number of subjects. All values are in percentages except those for age which is expressed as mean and standard deviation [SD] while household income is expressed as median and interquartile range [IQR]

high TG for both men and women. The Northeast also showed a very high proportion of men smokers, while the south had the lowest prevalence of drinking.

Discussion

The present report showed 1.5 to 3 times differences in prevalence among regions with high CVD risks such as in Bangkok and SuphanBuri when compared to provinces with lower CVD risks such as those in the northeast and north. The risks for Bangkok appeared to be related to affluences such as less labourers, more with education and higher income. Such affluences perhaps resulted in a higher prevalence of hypertension, elevated BMI, larger waist and waist-hip ratio, diabetes mellitus and LDL associated lipids. The northeast showed a much lower prevalence of many CVD risks except smoking, high triglyceride and low HDL-C. While over one-fifth of the southerners had IFG, this should be less serious as CVD survival among IFG was shown to be close to that of people with normal fasting plasma glucose[20]. The relatively low prevalence of alcohol in the south is likely contributed by subjects who are Muslims.

Table 5 presents the data from the National Health Examination Survey III (NHES-III) in 2004 for men and women aged 35-64 years old[21]. The risks were specifically chosen to allow comparison of provinces to the present InterASIA report. HDL-C was not measured. For the men, a similar pattern is seen with the present report in that Bangkok and a central province showed a higher prevalence of hypertension, obesity, greater waist circumference, DM and high total cholesterol, although the proportional differences were not as marked. The prevalence of DM was lowest

Table 3. Measured variables among the 5 regions in Thailand for men, women and combined

	Men					Women					Both sexes				
	BKK	N	NE	C	S	BKK	N	NE	C	S	BKK	N	NE	C	S
SBP	128.2 [20.3]	121.8 [19.0]	116.9 [16.8]	127.7 [21.7]	125.4 [19.6]	123.6 [21.7]	118.6 [19.1]	118.0 [16.9]	124.4 [21.2]	122.0 [21.0]	124.8 [21.4]	119.7 [19.1]	117.5 [16.8]	126.1 [21.5]	123.3 [20.6]
DBP	83.5 [12.4]	77.6 [12.9]	74.4 [9.9]	80.1 [12.3]	78.8 [12.8]	78.2 [11.9]	74.9 [12.1]	74.0 [10.0]	75.4 [11.5]	76.7 [12.1]	79.6 [12.3]	75.9 [12.4]	74.2 [9.9]	77.7 [12.1]	77.5 [12.4]
BMI	24.4 [4.0]	22.5 [4.1]	22.4 [3.5]	23.7 [3.9]	23.0 [3.6]	26.0 [4.6]	24.2 [4.6]	24.5 [4.6]	24.8 [4.2]	25.3 [4.5]	25.6 [4.5]	23.6 [4.5]	23.5 [4.3]	24.3 [4.1]	24.4 [4.3]
WC	86.4 [10.9]	80.2 [11.8]	77.5 [10.3]	85.2 [11.1]	81.7 [11.3]	85.3 [11.8]	81.0 [12.3]	78.8 [11.7]	84.6 [11.4]	82.6 [12.3]	85.6 [11.6]	80.7 [12.1]	78.2 [11.1]	84.9 [11.2]	82.3 [11.9]
WHR	0.90 [0.07]	0.88 [0.07]	0.87 [0.07]	0.95 [0.08]	0.89 [0.07]	0.86 [0.08]	0.85 [0.08]	0.84 [0.07]	0.92 [0.08]	0.85 [0.08]	0.87 [0.08]	0.86 [0.08]	0.86 [0.07]	0.93 [0.08]	0.86 [0.08]
FPG	111.6 [41.1]	103.3 [33.8]	97.8 [42.5]	108.7 [39.9]	108.3 [24.4]	113.3 [50.4]	98.4 [26.9]	101.6 [43.4]	105.8 [34.7]	109.1 [34.3]	112.8 [48.1]	100.2 [29.7]	99.8 [43.0]	107.2 [37.4]	108.8 [31.0]
TC	228.0 [46.2]	191.4 [45.9]	185.6 [40.5]	207.5 [41.2]	210.1 [45.2]	233.4 [46.9]	207.2 [42.9]	199.1 [43.6]	219.7 [46.2]	223.6 [51.1]	231.9 [46.8]	201.4 [44.7]	192.7 [42.7]	213.7 [44.2]	218.6 [49.4]
HDL-C	46.5 [12.9]	44.7 [11.1]	39.8 [10.3]	45.9 [12.0]	46.2 [11.8]	52.0 [12.4]	49.6 [12.8]	42.1 [10.4]	49.6 [12.4]	49.1 [13.2]	50.6 [12.8]	47.8 [12.4]	41.0 [10.4]	47.8 [12.3]	48.0 [12.7]
TG	127 [90-190]	137 [97-207]	150 [111-231]	124 [89-190]	116 [89-175]	104 [73-151]	115 [83-160]	150 [105-206]	114 [84-166]	108 [80-157]	110 [76-160]	122 [88-179]	150 [107-219]	117 [87-177]	112 [83-161]
TC/HDL	5.2 [1.9]	4.5 [1.5]	4.9 [1.4]	4.8 [1.4]	4.8 [1.3]	4.7 [1.4]	4.4 [1.3]	4.9 [1.4]	4.7 [1.4]	4.8 [1.6]	4.8 [1.6]	4.4 [1.4]	4.9 [1.4]	4.7 [1.4]	4.8 [1.5]
LDL-C	152 [44]	114 [43]	111 [37]	132 [40]	136 [42]	157 [42]	131 [38]	123 [39]	143 [42]	150 [46]	155 [43]	125 [40]	117 [39]	138 [41]	145 [45]
Non HDL-C	180 [44]	146 [46]	144 [37]	160 [41]	163 [42]	180 [46]	157 [40]	156 [40]	170 [44]	174 [48]	180 [45]	153 [42]	150 [39]	165 [43]	170 [46]

SBP, DBP in mmHg = systolic and diastolic blood pressure; BMI in kg/m^2 = body mass index; WC in cm = waist circumference; WHR, unitless = waist hip ratio; FPG in mg/dl = fasting plasma glucose; TC, HDL-C, TG and LDL-C all in mg/dl = total serum cholesterol, high density lipoprotein cholesterol, triglyceride and calculated low density lipoprotein cholesterol (excluded subjects with TG $\geq$ 400 mg/dl); TC/HDL is unitless = total cholesterol divide by high density lipoprotein cholesterol; nonHDL-C in mg/dl = non HDL cholesterol (excluded those with TG $\geq$ 400 mg/dl). Values are mean and [SD], except TG which is expressed as median and [IQR]

Table 4.1. Age-adjusted prevalence (95% CI) and comparison of risk factors in men among the 5 regions

	BKK	N	NE	C	S
Smoker	32.2 [26.8-38.1][a]	31.8 [27.2-36.7][a]	60.5 [56.4-64.5]	46.6 [42.3-51.1][b]	49.8 [44.6-54.9][b]
Drinking	49.3 [43.1-55.5][ab]	59.8 [54.5-64.8][a]	49.2 [44.9-53.4][b]	48.2 [43.7-52.7][b]	35.0 [30.2-40.1]
HT	40.5 [34.7-46.7][a]	26.3 [22.0-31.2][b]	14.0 [11.4-17.0]	35.7 [31.6-40.1][a]	25.7 [21.5-30.4][b]
BMI $\geq$ 30 kg/m^2	7.9 [5.2-11.8][a]	4.7 [3.0-7.3][abc]	2.2 [1.3-3.8][b]	5.4 [3.8-7.8][ac]	2.1 [1.0-4.1][bc]
WC $\geq$ 90 cm	38.1 [32.4-44.1][a]	18.7 [15.1-23.0][b]	10.9 [8.6-13.7]	34.6 [30.5-38.9][a]	22.3 [18.4-26.9][b]
WHR $\geq$ 0.9	54.6 [48.4-60.6]	38.1 [33.1-43.3][a]	29.9 [26.3-33.9][a]	73.4 [69.2-77.1]	37.8 [32.9-43.0][a]
IFG	13.1 [9.5-17.7][b]	6.9 [4.8-10.0][ab]	5.3 [3.7-7.6][a]	11.5 [9.0-14.6][b]	21.4 [17.5-25.8]
DM	16.1 [12.1-21.0][a]	10.5 [7.7-14.0][ab]	8.8 [6.7-11.3][b]	11.0 [8.5-13.9][ab]	8.1 [5.7-11.2][b]
TC $\geq$ 200 mg/dl	71.3 [65.6-76.4]	40.6 [35.7-45.8][a]	32.6 [28.6-36.9][a]	55.4 [51.0-59.8][b]	56.9 [51.7-61.9][b]
TC $\geq$ 240 mg/dl	35.6 [30.1-41.5]	13.3 [10.2-17.1][a]	7.5 [5.5-10.1]	18.6 [15.4-22.2][ab]	22.0 [18.0-26.5][b]
TG $\geq$ 200 mg/dl	22.0 [17.4-27.4][bc]	26.7 [22.5-31.5][ab]	32.2 [28.2-36.4][a]	22.9 [19.4-26.7][bc]	16.3 [12.8-20.4][c]
HDL $\leq$ 35 mg/dl	15.4 [11.5-20.2][a]	16.9 [13.5-21.1][a]	36.2 [32.1-40.5]	17.2 [14.2-20.7][a]	15.7 [12.4-19.8][a]
TC/HDL $\geq$ 5.0	50.3 [44.3-56.2][a]	34.8 [30.1-39.8][b]	42.9 [38.7-47.3][ab]	41.0 [36.8-45.4][ab]	37.7 [32.9-42.8][b]
LDL $\geq$ 160 mg/dl	41.0 [35.2-47.2]	14.9 [11.6-19.1]	8.6 [6.4-11.4]	23.0 [19.4-27.0][a]	26.7 [22.4-31.6][a]
Non HDL-C $\geq$ 190 mg/dl	36.5 [30.8-42.6]	15.7 [12.2-19.8][a]	10.3 [7.9-13.4][a]	23.6 [20.0-27.6][b]	25.8 [21.5-30.6][b]

Table 4.2. Age-adjusted prevalence (95% CI) and comparison of risk factors in women among the 5 regions

	BKK	N	NE	C	S
Smoker	6.5 [5.0-8.6][a]	5.7 [4.2-7.8][ab]	3.3 [2.2-4.9][b]	3.3 [2.1-5.2][ab]	4.3 [3.0-6.1][ab]
Drinking	13.5 [11.2-16.1][b]	14.5 [12.0-17.4][ab]	19.6 [16.7-22.8][a]	13.5 [10.8-16.7][b]	3.2 [2.1-4.7]
HT	27.4 [24.1-30.9][a]	22.8 [19.6-26.4][ab]	11.9 [9.8-14.4]	24.3 [20.8-28.3][ab]	20.9 [17.8-24.4][b]
BMI $\geq$ 30 kg/m^2	17.1 [14.5-20.0][a]	9.5 [7.5-12.0][b]	10.6 [8.5-13.1][b]	10.9 [8.5-13.9][b]	14.0 [11.5-16.9][ab]
WC $\geq$80cm	66.0 [62.5-69.4][a]	54.9 [51.0-58.7][b]	42.5 [38.8-46.3]	64.2 [59.9-68.3][ac]	56.8 [52.8-60.6][bc]
WHR $\geq$ 0.85	55.5 [51.8-59.2][a]	50.4 [46.4-54.4][ab]	38.2 [34.6-42.0]	77.7 [73.8-81.2]	46.4 [42.4-50.5][b]
IFG	10.1 [8.1-12.5][b]	8.1 [6.3-10.5][b]	4.2 [2.9-6.1][a]	7.2 [5.3-9.6][ab]	17.6 [14.8-20.8]
DM	17.0 [14.4-19.9][a]	6.7 [5.1-9.0][b]	10.4 [8.4-12.8][bc]	13.0 [10.4-16.1][ac]	9.7 [7.6-12.3][bc]
TC$\geq$200mg/dl	77.8 [74.6-80.7]	57.9 [53.9-61.7][a]	46.6 [42.4-50.8]	64.8 [60.4-68.9][ab]	67.7 [63.8-71.3][b]
TC$\geq$240 mg/dl	42.7 [39.0-46.4]	18.7 [15.8-21.9]	12.2 [9.8-15.0]	28.0 [24.3-32.1][a]	30.9 [27.3-34.8][a]
TG $\geq$ 200 mg/dl	13.0 [10.7-15.6][a]	15.3 [12.7-18.4][a]	25.8 [22.3-29.6]	15.0 [12.2-18.3][a]	11.4 [9.1-14.1][a]
HDL $\leq$ 40 mg/dl	16.8 [14.3-19.7]	23.8 [20.6-27.3][a]	46.3 [42.1-50.5]	23.5 [20.1-27.4][a]	25.7 [22.4-29.3][a]
TC/HDL $\geq$ 5.0	36.8 [33.3-40.5][a]	26.1 [22.8-29.7]	40.2 [36.1-44.4][a]	34.1 [30.1-38.3][a]	39.0 [35.2-43.0][a]
LDL $\geq$ 160 mg/dl	42.4 [38.7-46.2][a]	21.8 [18.7-25.3]	13.7 [11.1-16.7]	29.6 [25.8-33.8]	37.9 [34.1-42.0][a]
non HDL-C $\geq$ 190 mg/dl	39.4 [35.7-43.1][a]	19.6 [16.6-22.9][b]	14.2 [11.6-17.3][b]	26.8 [23.2-30.9][c]	32.3 [28.7-36.3][ac]

The values are in %
HT = SBP/DBP $\geq$ 140/$\geq$ 90 mmHg or on antihypertensives; IFG, DM = impaired fasting plasma glucose, diabetes mellitus respectively. The other abbreviations are similar to those in Table 2
A similar superscript implies no difference between regions

in the south rather than the northeast. Among the women, the proportional differences among the regions in the NHES-III were less still but showed a similar direction.

The high prevalence of low HDL-C in the present report is of concern and this had been presented and discussed in previous reports(15,22). A search of the publications from Thailand(23-30) showed a very wide range of the prevalence of low HDL-C. This could be related to the cut off values, the ages, and whether the study was done from the rural or urban areas. These ranges from a few percent to as high as 70% in the earlier series from Khon Kaen(26) and using 35 mg% as the cut off values. Later reports from Khon Kaen and using National Cholesterol Education Program cut off values of 40 mg% for men and 50 mg% for women

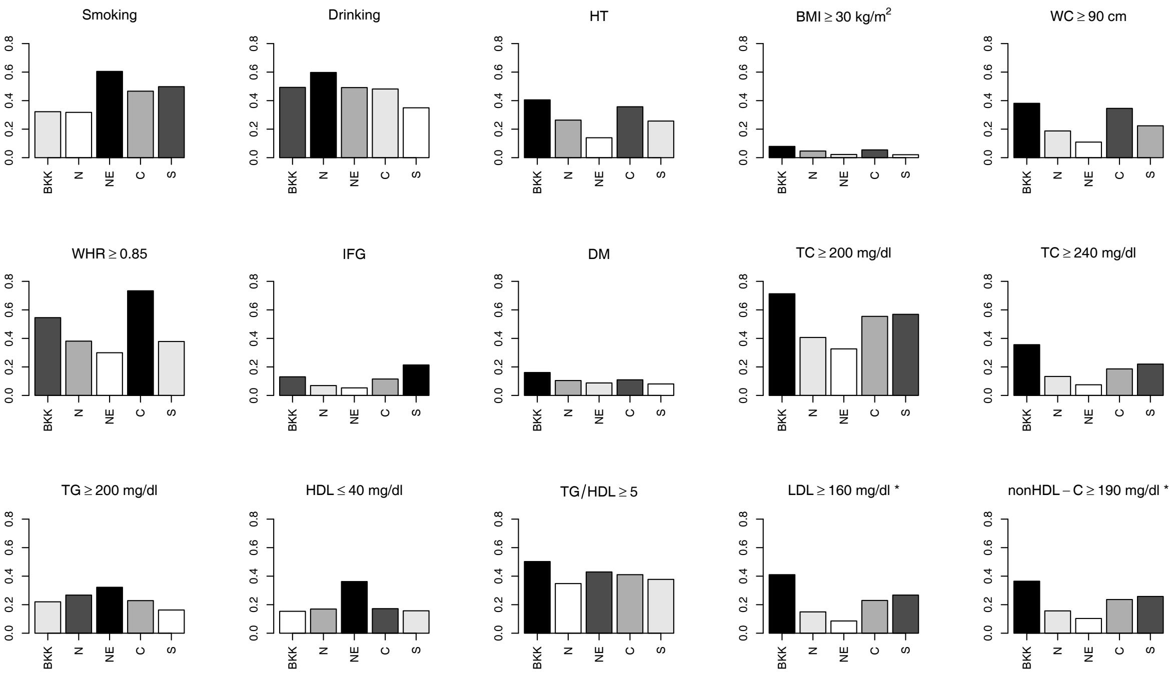

Fig. 1 Age adjusted prevalence of various risk factors among men in different regions

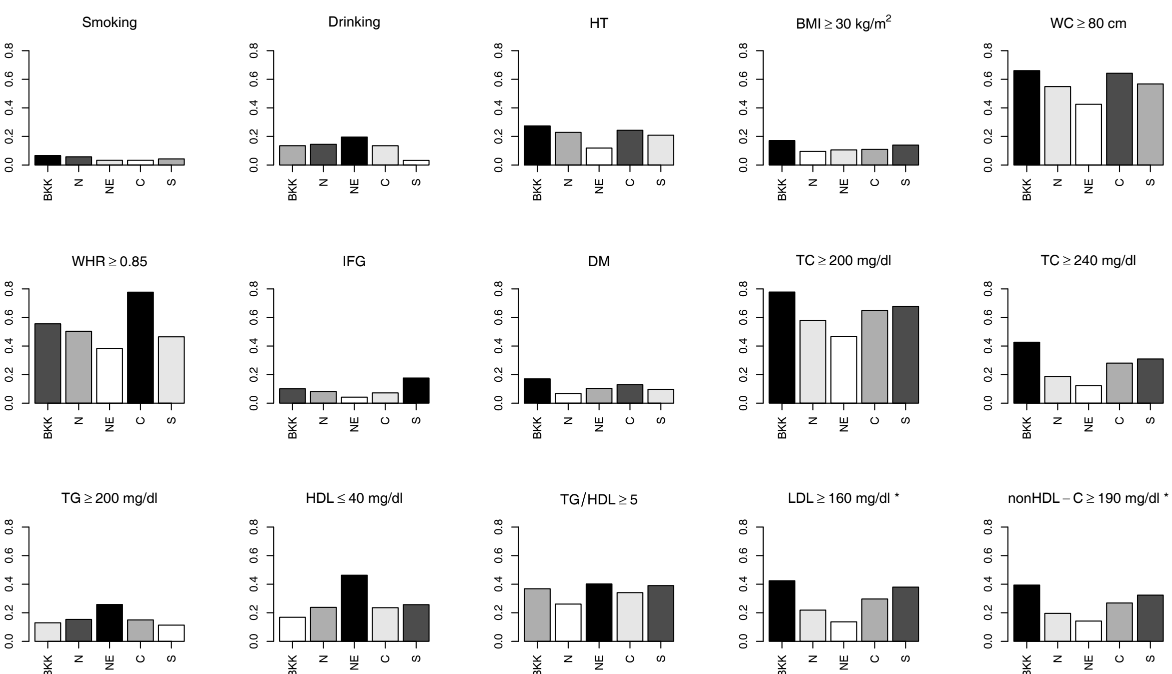

Fig. 2 Age adjusted prevalence of various risk factors among women in different region

Table 5. Age-adjusted prevalence of risk factors (age standardized for 35-64) for cardiovascular diseases as extracted from NHES III in 2004[21]

	BKK	N	NE	C	S
Men (n)	500	2,126	2,368	3,244	1,218
HT	30.9	35.8	26.1	34.4	27.5
BMI $\geq$ 30 kg/m^2	7.9	3.1	5.4	7.1	3.4
WC $\geq$ 90 cm	36.3	18.5	16.6	26.7	20.1
Diabetes	14.7	8.1	8.8	9.1	7.1
TC $\geq$ 240 mg/dl	39.0	16.3	12.0	24.2	23.2
Women (n)	910	2,378	2,449	3,469	1,527
HT	24.2	31.3	27.2	31.6	24.3
BMI $\geq$ 30 kg/m^2	16.1	7.4	9.5	15.1	13.7
WC $\geq$ 80 cm	56.9	41.9	43.5	50.6	47.3
Diabetes	10.5	9.6	12.8	9.6	7.3
TC > 240 mg/dl	37.7	20.9	15.0	27.8	30.6

n = number of subjects. The prevalence is in %

showed a prevalence of 4-23% depending on gender and sites. One would expect a much higher prevalence with such liberal cut-off values. However, these differences could also be related to differing methods or delay that occurred with specimen handling[31]. A similar InterASIA study from China[32] using HDL cutoff of 40 mg% and in men showed a wide range of 18-30% depending on whether these subjects were from rural or urban areas or from North versus South. The ranges for the women using a similar cut-off were 13 to 21%. The INTERHEART which utilised first acute MI as outcome, reported that south Asians differed from southeast Asians (including Thailand) by having a lower average HDL-C and much higher prevalence of lower HDL-C subjects[12].

Assuming that death registration reflects the real situation in each region of Thailand, high SMR for CVD are seen in Bangkok and a central region. The pattern is more consistent with the leading prevalence of hypertension, obesity, diabetes, hypercholesterolemia and high LDL-C. It is in contrast to the reverse pattern of highest prevalence of smoking, high TG and low HDL-C in the northeast, where the CVD- SMR was lowest. The correlation was made from data of the same year 2000. One may interpret that more emphasis in prevention should be given towards rising obesity, DM and LDL-related lipids, hence proper dietary behavior and physical activity. On the other hand, the lapse time from metabolic risk to CVD death may be shorter than that from smoking. In fact, the prevalence of metabolic risk has been on the rise where that of smoking is declining. Further follow-up with adjustment from time lag is needed for further studies.

Overall SMR from Faramnuayphol et al[13] data showed that total death, as contrast to CVD death, was concentrated in upper north region. The former was probably due to the overwhelming problems of HIV/AIDS started in 1990's. It remains to be seen whether the pattern of major cause of death would change in the near future in the face of rising CVD risks and the delay of death from HIV/AIDS from the education and secondary preventive measure.

The present study is however limited by its cross-sectional nature. The sample size was also too small to allow adjustment for socio- economic variables during the cross-region comparison. Each region was also limited to samples from only one province. There is a need for larger and longer term studies.

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References

1. Unal B, Critchley JA, Capewell S. Modelling the decline in coronary heart disease deaths in England and Wales, 1981-2000: comparing contributions from primary prevention and secondary prevention. BMJ 2005; 331: 614.
2. Ford ES, Ajani UA, Croft JB, Critchley JA, Labarthe DR, Kottke TE, et al. Explaining the decrease in U.S. deaths from coronary disease, 1980-2000. N Engl J Med 2007; 356: 2388-98.
3. Reddy KS. Cardiovascular disease in non-Western countries. N Engl J Med 2004; 350: 2438-40.
4. Ueshima H, Sekikawa A, Miura K, Turin TC, Takashima N, Kita Y, et al. Cardiovascular disease and risk factors in Asia: a selected review. Circulation 2008; 118: 2702-9.
5. Kitamura A, Iso H, Iida M, Naito Y, Sato S, Jacobs DR, et al. Trends in the incidence of coronary heart disease and stroke and the prevalence of cardiovascular risk factors among Japanese men from 1963 to 1994. Am J Med 2002; 112: 104-9.
6. Kubo M, Hata J, Doi Y, Tanizaki Y, Iida M, Kiyohara Y. Secular trends in the incidence of and risk factors for ischemic stroke and its subtypes in

Japanese population. Circulation 2008; 118: 2672-8.
7. Kitamura A, Sato S, Kiyama M, Imano H, Iso H, Okada T, et al. Trends in the incidence of coronary heart disease and stroke and their risk factors in Japan, 1964 to 2003: the Akita-Osaka study. J Am Coll Cardiol 2008; 52: 71-9.
8. Okayama A, Ueshima H, Marmot M, Elliott P, Choudhury SR, Kita Y. Generational and regional differences in trends of mortality from ischemic heart disease in Japan from 1969 to 1992. Am J Epidemiol 2001; 153: 1191-8.
9. Cheng Y, Chen KJ, Wang CJ, Chan SH, Chang WC, Chen JH. Secular trends in coronary heart disease mortality, hospitalization rates, and major cardiovascular risk factors in Taiwan, 1971-2001. Int J Cardiol 2005; 100: 47-52.
10. Wu Y, Huxley R, Li L, Anna V, Xie G, Yao C, et al. Prevalence, awareness, treatment, and control of hypertension in China: data from the China National Nutrition and Health Survey 2002. Circulation 2008; 118: 2679-86.
11. Murray CJ, Kulkarni SC, Ezzati M. Understanding the coronary heart disease versus total cardiovascular mortality paradox: a method to enhance the comparability of cardiovascular death statistics in the United States. Circulation 2006; 113: 2071-81.
12. Karthikeyan G, Teo KK, Islam S, McQueen MJ, Pais P, Wang X, et al. Lipid profile, plasma apolipoproteins, and risk of a first myocardial infarction among Asians: an analysis from the INTERHEART Study. J Am Coll Cardiol 2009; 53: 244-53.
13. Faramnuayphol P, Chongsuvivatwong V, Pannarunothai S. Geographical variation of mortality in Thailand. J Med Assoc Thai 2008; 91: 1455-60.
14. InterASIA Collaborative Group. Cardiovascular risk factor levels in urban and rural Thailand-The International Collaborative Study of Cardiovascular Disease in Asia (InterASIA). Eur J Cardiovasc Prev Rehabil 2003; 10: 249-57.
15. Chongsuvivatwong V, YipIntsoi T, Apakupakul N. Gender and ethnic differences in cardiovascular risks in Songkhla province, Thailand: the interASIA-south. J Med Assoc Thai 2008; 91: 464-70.
16. He J, Neal B, Gu D, Suriyawongpaisal P, Xin X, Reynolds R, et al. International collaborative study of cardiovascular disease in Asia: design, rationale, and preliminary results. Ethn Dis 2004; 14: 260-8.
17. Simple and sophisticated Bonferroni adjustment [database on the Internet]. 2004 [cited 2009 Jan 19]. Available from: http://privatewww.essex.ac.uk/~scholp/bonferroni.htm
18. R-project.org [homepage on the Internet]. Development Core Team, R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. 2009 [cited 2009 Jan 19]. Available from: http://www.R-project.org/.
19. CRAN.R-project.org [homepage on the Internet] Chongsuvivatwong V. Epicalc: Epidemiological calculator. R package version 2.8.0.0. 2008 [cited 2009 Jan 19]. Available from: http://CRAN.R-project.org/.
20. O'Keefe JH, Bell DS. Postprandial hyperglycemia/hyperlipidemia (postprandial dysmetabolism) is a cardiovascular risk factor. Am J Cardiol 2007; 100: 899-904.
21. Porapakkham Y, Bunyaratpundu P. Report on National Health Examination Survey III 2004. Nonthaburi: Health System Research Institute and Bureau of Policy and Strategy, Ministry of Public Health; 2006.
22. Tocharoenvanich P, YipIntsoi T, Choomalee K, Boonwanno P, Rodklai A. Risk factors for a five-year death in the interASIA-south cohort. J Med Assoc Thai 2008; 91: 471-8.
23. Viseshakul D, Chularojamontri V, Premwatana P, Chuprasert S, Palachewin K. High-density lipoprotein cholesterol in Thai adults: study in a selected population free of coronary heart diseases and in diabetics. J Med Assoc Thai 1980; 63: 257-66.
24. Report of the study on heart and circulation on personnel of the Electricity Generating Authority of Thailand (EGAT) 1985. Published by the institution as a book. Principle investigator: Lochaya S.
25. Sitthi-Amorn C, Chandraprasert S, Bunnag SC, Plengvidhya CS. The prevalence and risk factors of hypertension in Klong Toey slum and Klong Toey government apartment houses. Int J Epidemiol 1989; 18: 89-94.
26. Bhuripanyo K, Tatsanavivat P, Matrakool B, Muktabhant B, Bhuripanyo P, Harnthaveesompol S. A prevalence survey of lipids abnormalities of rural area in Amphoe Phon, Khon Kaen. J Med Assoc Thai 1993; 76: 101-8.
27. Pongchaiyakul C, Pongchaiyakul C, Pratipanawatr T. Prevalence of dyslipidemia in rural Thai adults: an epidemiologic study in Khon Kaen province.

J Med Assoc Thai 2005; 88: 1092-7.
28. Nillakupt K, Nathalang O, Arnutti P, Aimpun P, Rangsin R, Panichkul S, et al. Dyslipidemia in Thai rural adults. J Med Assoc Thai 2005; 88: 824-8.
29. Pongchaiyakul C, Hongsprabhas P, Pisprasert V, Pongchaiyakul C. Rural-urban difference in lipid levels and prevalence of dyslipidemia: a population-based study in Khon Kaen province, Thailand. J Med Assoc Thai 2006; 89: 1835-44.
30. Pongchaiyakul C, Nguyen TV, Wanothayaroj E, Karusan N, Klungboonkrong V. Prevalence of metabolic syndrome and its relationship to weight in the Thai population. J Med Assoc Thai 2007; 90: 459-67.
31. Musigavon P, YipIntsoi T. Loss of high density lipoprotein cholesterol in serum: effect of storage. J Med Assoc Thai 2005; 88: 1388-94.
32. He J, Gu D, Reynolds K, Wu X, Muntner P, Zhao J, et al. Serum total and lipoprotein cholesterol levels and awareness, treatment, and control of hypercholesterolemia in China. Circulation 2004; 110: 405-11.

ความแตกต่างด้านความเสี่ยงต่อโรคหลอดเลือดและหัวใจระหว่าง 5 ภาคในประเทศไทย: ข้อมูลจากการศึกษา InterASIA

วีระศักดิ์ จงสู่วิวัฒน์วงศ์, ธาดา ยิบอินซอย, ไพบูลย์ สุริยวงศ์ไพศาล, สายัณห์ ชีพอุดมวิทย์, วิชัย เอกพลากร, พินิจ ฟ้าอำนวยผล, ปิยทัศน์ ทัศนาวิวัฒน์, วงสวาท โกศัลวัฒน์, สมศักดิ์ ธรรมธิติวัฒน์, เฉลิมศรี นันทวรรณ

กรุงเทพมหานครและภาคกลางมีอัตราการตายจากโรคหลอดเลือดและหัวใจที่ปรับฐานอายุและเพศสูงกว่าภาคอื่น ๆ ในปี พ.ศ. 2543 ซึ่งอาจเกี่ยวข้องกับความแตกต่างด้านปัจจัยเสี่ยง ระหว่างภาคต่าง ๆ ของประเทศ รายงานนี้เปรียบเทียบความชุกของปัจจัยเสี่ยงต่อการเกิดโรคหลอดเลือดและหัวใจ จากข้อมูลการศึกษา InterASIA ซึ่งสำรวจประชากรในจังหวัดซึ่งถือว่าเป็นตัวแทน 5 ภาคในปีดังกล่าว พบว่ากลุ่มตัวอย่างจากกรุงเทพมหานครและภาคกลาง มีภาวะความดันโลหิตสูง ดัชนีมวลกายสูง ภาวะลงพุง ระดับคอเลสเตอรอลที่อยู่ในไขมันความหนาแน่นต่ำ (low density lipoprotein cholesterol) สูงและโรคเบาหวานชุกกว่าภาคอื่น ๆ ส่วนกลุ่มตัวอย่างจากภาคตะวันออกเฉียงเหนือมีความชุกสูงกว่าภาคอื่นในด้านการสูบบุหรี่ ภาวะคอเลสเตอรอลที่อยู่ในไขมันความหนาแน่นสูง (high density lipoprotein cholesterol) ต่ำและระดับไตรกลีเซอร์ไรด์สูง สรุปแล้วภูมิภาคต่าง ๆ มีความชุกของปัจจัยเสี่ยง และอัตราตายจากโรคหลอดเลือดและหัวใจแตกต่างกันชัดเจน ข้อมูลในปี พ.ศ. 2543 อาจจะบ่งชี้ว่า อัตราตายของโรคหลอดเลือดและหัวใจสัมพันธ์กับความผิดปกติด้านเมตาบอลิกมากกว่าสัมพันธ์กับอัตราการสูบบุหรี่ของประชากรในปีเดียวกัน
