Prevalence of Dyslipidemia in Rural Thai Adults: An Epidemiologic Study in Khon Kaen Province

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Dyslipidemia is an important, modifiable CHD risk factor. Previous studies have reported the prevalence of dyslipidemia particularly in urban populations. However, its prevalence in rural Northeast Thailand has not been well documented since extensive dietary and lifestyle transitions induced by the rapid socio-economic development of the late 1990s and early 2000s. The authors, therefore, conducted a cross-sectional assessment for the prevalence of dyslipidemia among rural Thais (in Khon Kaen province) using the National Cholesterol Education Program (NCEP) Adult Treatment Panel (ATP III) Guidelines. The 325 subjects recruited (136 men; 189 women) averaged 53.8 ± 17.6 years of age (range, 20-88). After having the subjects fast 12 hours, serum samples were collected. Total cholesterol, triglycerides, low-density lipoprotein (LDL-C) and high-density lipoprotein (HDL-C) cholesterols were measured. The prevalence of hypercholesterolemia (> 200 mg/dL), hypertriglyceridemia (> 150 mg/dL), high LDL-C (> 130 mg/dL) and low HDL-C (< 40 mg/dL) was 31, 40, 20 and 14 per cent, respectively. Women had a 2- to 3.5-fold higher prevalence of hypercholesterolemia and high LDL-C than men, while the prevalence of hypertriglyceridemia was comparable. The prevalence of dyslipidemia increased with advancing age and increasing BMI; notwithstanding, a high prevalence of dyslipidemia was observed in the youngest tertile as well. In conclusion, the present study demonstrated a high prevalence of dyslipidemia in rural Thai adults; consequently, primary lipid screening should be considered for all ages.

Keywords: *Dyslipidemia, Epidemiology, Prevalence, Thailand*

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Dyslipidemia is a recognized, major risk factor for the development and progression of coronary heart disease (CHD). Clinical trials clearly demonstrate the public health and economic benefits of cholesterol modification[1-5]. The National Cholesterol Education Program (NCEP), therefore, developed guidelines for the detection, evaluation and treatment of high blood cholesterol in adults. The May 2001 NCEP recommendations, viz. the Adult Treatment Panel III (ATP III) Guidelines, represent a synthesis of the emerging data that reflect the association of dyslipidemia with CHD, and the improved understanding of other CHD risk factors, technical advances, and advances in therapy[6].

Dyslipidemia is sometimes considered a "consequence" of modernization, because prevalence in developed countries and urban areas is usually higher than in developing countries[1,7] and rural regions[8,9]. As urbanization progresses in Thailand, the nation has become less active, and consumes more saturated fat and less fibre- the latter being traditional symbols of affluence. The prevalence of dyslipidemia varies depending on the criteria used for diagnosis. Previous studies reported that the prevalence of dyslipidemia is high in urban Thailand[10-13] and among the elderly[14]. However, dyslipidemia-prevalence data for rural Northeast Thailand is scarce. The present study was designed to examine the prevalence of dyslipidemia among rural Thais using the NCEP (ATP III) guidelines.

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Material and Method

Setting and subjects

This was a cross-sectional, community, population-based investigation in Khon Kaen province, which lies 445 km northeast of Bangkok and has a largely agricultural population of 1.8 million. Participants included 136 men and 189 women between 20 and 88 years of age. The subjects were recruited from 14 villages in two sub-districts (Nongtoom and Koksri) in the Muang (central) district of Khon Kaen province. In each village, a full list of subjects was obtained, from which 40 were randomly selected. Five hundred and sixty letters of invitation were sent and 360 subjects (64.3 per cent) responded and agreed to participate.

The subjects were either farmers or worked at home. Thirty-five subjects were excluded from the analysis because of having a history of: 1) recent acute illness (e.g. myocardial infarction or pneumonia); 2) dyslipidemia or chronic conditions (e.g. cancer, chronic infection, collagen vascular disease, hepatic or renal impairment or diabetes); and/or, 3) medication affecting lipid metabolism (e.g. corticosteroid, statin, fibrate or cholestyramine).

The study was conducted in accordance with the 1975 Helsinki Declaration (revised 1983), approved by the Ethics Committee of Khon Kaen University (Khon Kaen), and with written, informed consent from all of the subjects.

Measurements

Body weight (including light indoor clothing) was measured using an electronic balance (accuracy 0.1 kg) and standing height (without shoes) using a stadiometer (nearest 0.1 cm). The body mass index (weight in kg divided by height in squared m^2) was then calculated.

Specimen collections

Serum samples were collected in the morning after the subjects had fasted 12 hours. Measurements included total cholesterol, triglycerides, high-density lipoprotein cholesterol (HDL-C) and low-density lipoprotein cholesterol (LDL-C). The classification of dyslipidemia was based on the NCEP ATP III Guidelines[6].

Statistical analysis

Statistical analyses were performed using SPSS version 9.0 (SPSS, Inc., Chicago). The results were expressed as means and standard deviations (SD). Descriptive statistics were computed for each sex and the prevalence of dyslipidemia expressed as a percentage. The correlation between the lipid level, age and BMI were determined using Pearson's correlation coefficient. A logistic regression was used to determine the odds ratio and 95% confidence interval (95%CI) between age groups. Statistical significance was set at $p < 0.05$.

Results

The 325 subjects (136 men and 189 women) averaged 51 $\pm$ 18 and 56 $\pm$ 17 years of age, respectively (range, 20-88). Overall, the men were significantly taller and heavier than the women, but had a lower BMI. The women had a significantly higher level of total cholesterol and LDL-C than the men ($p < 0.001$), but no significant difference was found in the triglyceride and HDL-C levels (Table 1).

The prevalence of dyslipidemia in the women was higher than the men, particularly the high total

Table 1. Characteristics of study subjects

	Men	Women	Mean Difference (95%CI)
Number of subjects	136	189	
Age (yr)	51.2±18.1	55.7±17.0	-4.5 (-8.39, -0.65)*
Body weight (kg)	58.3±9.1	55.1±10.7	3.2 (0.94, 5.49)*
Height (cm)	161.1±5.9	150.8±5.4	10.2 (8.97, 11.52)**
Body mass index (kg/m^2)	22.5±3.1	24.2±4.1	-1.7 (-2.55, -0.85)**
Total cholesterol (mg/dL)	169.1±41.9	192.0±53.5	-22.8 (-33.68, -12.02)**
Triglyceride (mg/dL)	163.9±95.0	162.2±113.1	1.7 (-21.7, 25.1)
HDL-cholesterol (mg/dL)	51.0±11.7	50.7±11.4	0.3 (-2.35, 2.76)
LDL-cholesterol (mg/dL)	86.9±35.6	110.9±44.2	-24.0 (-33.15, -14.94)**

All values are shown in mean $\pm$ SD
Statistical significance at $p < 0.05$* and < 0.001**

cholesterol (39.9 vs 19.9 per cent), the high LDL-C (29.3 vs 8.3 per cent) and the low HDL-C (15.5 vs 11.9 per cent). The prevalence of hypertriglyceridemia was very high (~41 per cent) in both the men and women, but there was no difference in the prevalence between the men and women. The prevalence of low HDL-C and hypercholesterolemia with hypertriglyceridemia of the entire groups of subjects was 13.8 and 17.8 per cent, respectively. This abnormality was more pronounced in the women. The overall prevalence of combined hypercholesterolemia/hypertriglyceridemia and low HDL-C was low (2.5-5.5 per cent).

The prevalence of dyslipidemia increased with advancing age. In the present study, subjects were grouped in tertiles. The prevalence of dyslipidemia in the youngest tertile was relatively high (21.4 per cent for hypercholesterolemia and 26.4 per cent for hypertriglyceridemia); while the prevalence of high LDL-C and low HDL-C level were lower (Table 2). Individuals in the oldest tertile (i.e. 72.5 $\pm$ 5.3 of the subjects) had an odds ratio of hypercholesterolemia, hypertriglyceridemia, high LDL-C and low HDL-C of 2.43 (95%CI: 1.34 to 4.39), 2.74 (95%CI: 1.55 to 4.84), 2.51 (95%CI: 1.25 to 5.03), and 2.11 (95%CI: 0.99 to 4.52), respectively, vs individuals in the youngest tertile (32.9 $\pm$ 7.4 of the subjects) (Table 3 and Fig. 1). In the present study, the total cholesterol, LDL-C and triglyceride levels increased with increasing BMI ($r = 0.28, 0.26$ and 0.17, respectively, $p < 0.05$); while the HDL-C level decreased with increasing age ($r = -0.16$, $p < 0.05$), however, these associations were modest.

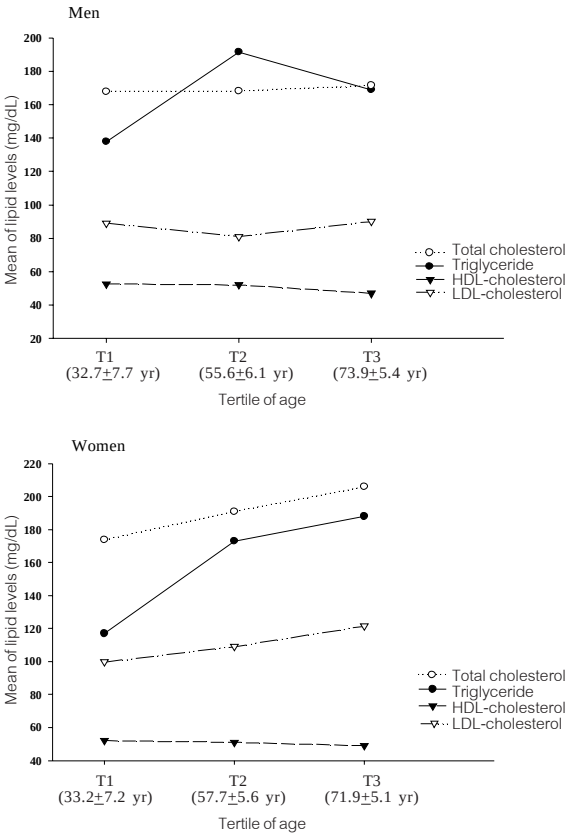

Fig. 1 Lipid levels in men and women

Discussion

The causal relationship between dyslipidemia and atherosclerosis is well-documented. Screening

Table 2. Prevalence of dyslipidemia by age group (tertile)

	Low tertile n (%)	Intermediate tertile n (%)	High tertile n (%)
High total cholesterol	24/112 (21.4)	35/104 (33.7)	43/108 (39.8)
High triglyceride	29/110 (26.4)	49/104 (47.1)	53/107 (49.5)
High LDL-cholesterol	15/110 (13.6)	21/104 (20.2)	29/102 (28.4)
Low HDL-cholesterol	12/112 (10.9)	11/105 (10.5)	22/107 (20.6)
High total cholesterol and triglyceride	12/110 (10.9)	20/103 (19.4)	26/107 (24.3)
High total cholesterol and low HDL-cholesterol	2/110 (1.8)	2/104 (1.9)	4/107 (3.7)
High triglyceride and low HDL-cholesterol	1/112 (0.9)	4/104 (3.8)	13/106 (12.3)
High total cholesterol and triglyceride and low HDL-cholesterol	-	1/103 (1.0)	3/106 (2.8)
High LDL-cholesterol and triglyceride	4/108 (3.7)	8/103 (7.8)	15/101 (14.9)
High LDL-cholesterol and low HDL-cholesterol	2/108 (1.9)	1/104 (1.0)	4/101 (4.0)
High LDL-cholesterol and triglyceride and low HDL-cholesterol	-	-	3/100 (3.0)

High total cholesterol: > 200 mg/dL, High triglyceride: > 150 mg/dL, High LDL-cholesterol: > 130 mg/dL, and Low HDL-cholesterol: < 40 mg/dL. Low tertile: (Mean $\pm$ SD; 32.9 $\pm$ 7.4 yr), Intermediate tertile: (Mean $\pm$ SD; 56.8 $\pm$ 5.9 yr), high tertile: (Mean $\pm$ SD; 72.6 $\pm$ 5.3 yr)

Table 3. Risk of dyslipidemia by age group (tertile)

	T2 vs T1		T3 vs T1		T3 vs T2	
	OR[a]	95%CI	OR[a]	95%CI	OR[a]	95%CI
High total cholesterol	1.86*	1.01-3.41	2.43*	1.34-4.39	1.30	0.75-2.28
High triglyceride	2.48*	1.40-4.41	2.74**	1.55-4.84	1.10	0.64-1.89
High LDL-cholesterol	1.60	0.78-3.31	2.52*	1.26-5.03	1.57	0.83-2.99
Low HDL-cholesterol	0.96	0.40-2.27	2.11	0.99-4.52	2.21*	1.01-4.83
High total cholesterol and triglyceride	1.96	1.65-5.01	2.62	1.24-5.52	1.33	0.69-2.57
High total cholesterol and low HDL-cholesterol	1.06	0.15-7.66	2.10	0.37-11.69	1.98	0.36-11.05
High triglyceride and low HDL-cholesterol	4.28	0.47-38.90	14.95*	1.92-116.42	3.49*	1.10-11.10
High total cholesterol and triglyceride and low HDL-cholesterol	-	-	-	-	2.97	0.30-29.04
High LDL-cholesterol and triglyceride	2.19	0.63-7.51	4.53*	1.45-14.17	2.07	0.84-5.13
High LDL-cholesterol and low HDL-cholesterol	0.51	0.05-5.76	2.19	0.39-12.20	4.25	0.41-38.67
High LDL-cholesterol and triglyceride and low HDL-cholesterol	-	-	-	-	-	-

High total cholesterol: > 200 mg/dL, High triglyceride: > 150 mg/dL, High LDL-cholesterol: > 130 mg/dL, and Low HDL-cholesterol: < 40 mg/dL. T1; low tertile of age, T2; intermediate tertile of age, T3; high tertile of age. [a]Unadjusted Odds ratio
Statistical significance at p value < 0.05* and < 0.001**

for, and appropriate management of, dyslipidemia by healthcare providers is imperative for both primary and secondary prevention of coronary artery disease, peripheral vascular disease and stroke.

Using the NCEP (ATP III) Guidelines, the present study shows that the prevalence of dyslipidemia was high, particularly among the women who had a 2- to 3.5-fold higher prevalence of hypercholesterolemia and a higher LDL-C than the men in the study, while the prevalence of hypertriglyceridemia was equivalent (between the sexes), albeit high (~41 per cent). The prevalence of dyslipidemia was associated with age and obesity in the presented population.

The mean cholesterol level in the present study was higher than a 1993 study conducted in Khon Kaen (i.e. 169 vs 158 and 192 vs 166 mg/dL in men and women, respectively)[15], but lower than a 1998 study (i.e. 169 vs 186 mg/dL in men) and comparable in women (i.e. 192 vs 195 mg/dL)[16]. The mean triglycerides in the present study were higher than a 1998 study (i.e. 164 vs 153 mg/dL in men and 162 vs 128 mg/dL in women). It is difficult to compare the prevalence of dyslipidemia among studies because of the use of differing criteria. Notwithstanding, an epidemiological analysis indicates an increasing prevalence of dyslipidemia in healthy individuals living in rural areas (viz. Khon Kaen), particularly for the cholesterols and triglycerides.

In the present study, age was grouped in tertiles. The prevalence of dyslipidemia was found to be relatively high even in the youngest tertile (mean, 32.9 $\pm$ 7.4 years of age), in both the men and women, perhaps because of the changes in nutrition and health accompanying socio-economic development and westernization of food consumption patterns.

The economy is moving away from an agricultural to an industrial and manufacturing focus. Results from two national surveys among adults in 1991 and 1996 indicated that being overweight and other risk factors for cardiovascular disease have increased significantly[18]. The increased prevalence in hypertriglyceridemia may be partially explained by the high consumption of carbohydrates, as from glutinous rice, while protein and fat consumption were modest[15,16]. Even though the risk of dyslipidemia in the elderly tends to be higher than in the younger tertiles, the difference was modest in the present study. This finding was not consistent with a previous study which demonstrated that the prevalence of dyslipidemia in the elderly was very high (i.e. 70 per cent for hypercholesterolemia)[14]. The small difference in dyslipidemia (low OR) between the elderly and youths, may be explained from its prevalence in the young adult population and its comparatively 'low' rate among the elderly.

The present findings must be interpreted within the context of a number of potential strengths and weaknesses. Although the subjects in the present study were well characterized, they were all rural Thais, whose body size, lifestyles, cultural backgrounds and

environmental living conditions are different from other populations. Thus, care should be taken when extrapolating these results to other populations. Moreover, the measurement error of lipid profiles could result in misclassification of dyslipidemia. This measurement error albeit inevitable, could affect the results. However, such limitations are common in studies of this type.

In conclusion, our study demonstrated the high prevalence of dyslipidemia among rural Thai adults, particularly hypertriglyceridemia and hypercholesterolemia. Primary screening for cholesterols and triglycerides in the adult, rural Thai population is recommended.

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ความชุกของภาวะไขมันในเลือดผิดปกติในประชากรไทยที่อาศัยอยู่ในเขตชนบท จังหวัดขอนแก่น

ชูวงศ์ พงษ์ไชยกุล, ฉัตรเลิศ พงษ์ไชยกุล, ธงชัย ประฏิภาณวัตร

ภาวะไขมันในเลือดผิดปกติเป็นปัจจัยเสี่ยงที่สำคัญของโรคหลอดเลือดหัวใจ ในขณะที่การศึกษาในประชากรที่อาศัยอยู่ในเขตเมืองพบว่าความชุกของภาวะไขมันในเลือดผิดปกติค่อนข้างสูง อย่างไรก็ตามยังขาดข้อมูลการศึกษาความชุกของภาวะไขมันในเลือดผิดปกติในประชากรที่อาศัยในเขตชนบทโดยเฉพาะอย่างยิ่งภายหลังจากการเปลี่ยนแปลงลักษณะการบริโภคอาหาร การเปลี่ยนแปลงวิถีการดำรงชีวิตอันเป็นผลจากการเปลี่ยนแปลงทางเศรษฐกิจที่เกิดขึ้นในประเทศไทย การศึกษานี้มีวัตถุประสงค์เพื่อศึกษาความชุกของภาวะไขมันในเลือดผิดปกติในผู้ที่อาศัยอยู่ในชนบทของประเทศไทยโดยใช้เกณฑ์การวินิจฉัยตาม National Cholesterol Education Program (NCEP), Adult Treatment Panel (ATP III) เป็นการศึกษาแบบตัดขวางในประชากรที่อาศัยอยู่ในเขตชนบท จังหวัดขอนแก่น มีผู้เข้าร่วมการศึกษาจำนวน 325 คน เป็นชายจำนวน 136 คน และหญิงจำนวน 189 คน อายุเฉลี่ย 53.8 $\pm$ 17.6 ปี มีอายุระหว่าง 20-88 ปี ภายหลังอดอาหารเป็นเวลา 12 ชั่วโมงได้ตรวจเลือดวัดระดับโคเลสเตอรอล ไตรกลีเซอไรด์ เอชดีแอล โคเลสเตอรอลและ แอล ดี แอล โคเลสเตอรอล ผลการศึกษาพบว่าความชุกของภาวะไขมันโคเลสเตอรอลสูง (> 200 มก./ดล.) ร้อยละ 31 ภาวะไขมันไตรกลีเซอไรด์สูง (> 150 มก./ดล.) ร้อยละ 40 ภาวะไขมันแอลดีแอล โคเลสเตอรอลสูง (> 130 มก./ดล.) ร้อยละ 20 และภาวะไขมันเอชดีแอล โคเลสเตอรอลต่ำ (< 40 มก./ดล.) ร้อยละ 14 เพศหญิงมีความชุกของภาวะไขมันโคเลสเตอรอลสูงและภาวะไขมันแอลดีแอล โคเลสเตอรอลสูงมากกว่า เพศชาย 2-3.5 เท่า ในขณะที่ภาวะไขมันไตรกลีเซอไรด์สูงระหว่างเพศหญิงและเพศชายไม่มีความแตกต่างกัน พบว่าภาวะไขมันในเลือดผิดปกติสัมพันธ์กับอายุและดัชนีมวลกายที่เพิ่มขึ้น นอกจากนั้นการศึกษานี้ยังพบความชุกของภาวะไขมันในเลือดผิดปกติสูงในประชากรกลุ่มอายุน้อยอีกด้วย โดยสรุปการศึกษานี้พบว่าความชุกของภาวะไขมันในเลือดผิดปกติสูงในประชากรที่อาศัยอยู่เขตชนบท จังหวัดขอนแก่น การตรวจคัดกรองเพื่อหาภาวะไขมันในเลือดผิดปกติควรพิจารณาในทุกกลุ่มอายุ