

Cardiovascular risk factors in a cross-sectional study

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Abstract

This cross-sectional study was aimed to identify risk factors, which were sensitive to cardiovascular risk scores. Data was collected voluntarily from the sample of 1,081 university personnel using three sets of measures: 1) International Physical Activity Questionnaire (IPAQ)-Short form, 2) Cardiovascular riskily dietary behaviors questionnaire , 3) A screening test for the early detection of coronary heart disease (Rama-EGAT heart score) including results of blood chemistry for cholesterol, triglyceride, LDL-C, and HDL-C levels. The Pearson's Product Moment Correlations were used to test the correlation among variables.

It was found that BMI, waist to hip ratio, level of cholesterol, triglyceride and LDL-C were positively and significantly correlated with cardiovascular risk scores while HDL-C had a negative correlation with cardiovascular risk scores ($p < 0.01$) which were according to the research hypotheses. The analyses revealed a statistically significant negative relationship between cardiovascular riskily dietary behaviors and cardiovascular risk scores and a positive relationship between physical activity and cardiovascular risk scores ($p < 0.05$).

The results provide information on suitable variables that could be used for monitoring and establishing a health promotion program to improve healthy behavior.

Keywords : Physical activity, Dietary behaviors, Cardiovascular Risk, Rama-EGAT heart score

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ปัจจัยเสี่ยงต่อการเกิดโรคหัวใจและหลอดเลือด ในการศึกษาภาคตัดขวาง

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บทคัดย่อ

การศึกษาภาคตัดขวางนี้มีจุดประสงค์เพื่อ ระบุปัจจัยเสี่ยงที่ไวต่อคะแนนความเสี่ยงต่อการเกิดโรคหัวใจและหลอดเลือด กลุ่มตัวอย่างประกอบด้วยอาสาสมัครจากบุคลากรของมหาวิทยาลัยแห่งหนึ่ง จำนวน 1,081 คน เครื่องมือที่ใช้ในการวิจัยประกอบด้วย 3 ส่วน 1) แบบสอบถามการมีกิจกรรมทางกายของ IPAQ (International Physical Activity Questionnaire) แบบสั้น 2) แบบวัดพฤติกรรมการบริโภคอาหารที่เสี่ยงต่อการเกิดโรคหัวใจและหลอดเลือด 3) แบบประเมินความเสี่ยงต่อการเกิดโรคหลอดเลือดหัวใจสำหรับคนไทย (Rama-EGAT heart score) และผลการตรวจเลือด ได้แก่ ระดับโคเลสเตอรอล ไตรกลีเซอไรด์ ไขมันเอชดีแอล และไขมันแอลดีแอล การวิเคราะห์ข้อมูลใช้สถิติ Pearson's Product Moment Correlations เพื่อทดสอบความสัมพันธ์ของตัวแปรที่ศึกษา

ผลการศึกษาพบว่าค่าดัชนีมวลกาย ค่าอัตราส่วนเส้นรอบเอวต่อสะโพก ระดับโคเลสเตอรอล ไตรกลีเซอไรด์ และไขมันเอชดีแอล มีความสัมพันธ์ในทางบวกกับคะแนนความเสี่ยงต่อการเกิดโรคหัวใจและหลอดเลือด อย่างมีนัยสำคัญทางสถิติ ($p < 0.01$) ส่วนระดับไขมันเอชดีแอลมีความสัมพันธ์ในทางลบ ซึ่งเป็นไปตามสมมติฐาน นอกจากนี้ยังพบว่าพฤติกรรมการบริโภคอาหารที่เสี่ยงต่อการเกิดโรคหัวใจและหลอดเลือด มีความสัมพันธ์ในเชิงลบอย่างมีนัยสำคัญทางสถิติกับคะแนนความเสี่ยงต่อการเกิดโรคหัวใจและหลอดเลือด และการมีกิจกรรมทางกายมีความสัมพันธ์ในเชิงบวกกับคะแนนความเสี่ยงต่อการเกิดโรคหัวใจและหลอดเลือดอย่างมีนัยสำคัญทางสถิติ ($p < 0.05$)

ผลจากการศึกษานี้สามารถนำไปใช้ในการเลือกตัวแปรที่เหมาะสมสำหรับการติดตามการปรับเปลี่ยนพฤติกรรมและพัฒนาโปรแกรมการการสร้างเสริมสุขภาพเพื่อให้เกิดพฤติกรรมสุขภาพที่ดี

คำสำคัญ: การมีกิจกรรมทางร่างกาย, พฤติกรรมการบริโภคอาหาร, ความเสี่ยงต่อการเกิดโรคหัวใจและหลอดเลือด, คะแนนความเสี่ยงต่อการเกิดโรคหลอดเลือดหัวใจสำหรับคนไทย

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Background and Significance of the Study

The most notable non-communicable disease problems facing Thailand presently are cardiovascular diseases, diabetes, hypertension and hyperlipidemia. A study of causes of deaths during 2005-2008 by verbal autopsy found that the first cause of death among male and female population was cerebral hemorrhage accounted for 23,741 and 21,546 cases respectively¹. Most common cardiovascular diseases i.e. coronary heart disease, cerebrovascular disease and peripheral arterial disease were caused primarily by atherosclerosis². The pathology at coronary arteries will cause ischemic heart disease (IHD). If it occurs at cerebral vessels, cerebrovascular accident (CVA) or stroke will present causing pareses and paralyses. Moreover, the disease can damage kidney vessels causing kidney dysfunction and hypertension. These illnesses can cause family, social and national impacts on caring³⁵. Early detecting and providing advices on behavior change are particularly crucial and required in order to maintain population's quality of life.

Major risk factors of cardiovascular diseases include smoking, diabetes, hypertension, high cholesterol, low in high-density lipoprotein cholesterol (HDL-C), high in low-density lipoprotein cholesterol (LDL-C) and aging⁶. Other contributing factors, which considered as conditional risk factors, include menopause and family history of death due to cardiovascular disease in younger age. Predisposing risk factors that help support

aforementioned risk factors were obesity especially abdominal obesity and physical inactivity⁷.

Considering all risk factors mentioned above, it appears that some factors are unchangeable such as family history or being menopause. However, some factors such as being obese caused by high fat and cholesterol consumption behavior and physical inactivity are able to change personally. It was reported that moderate and high levels of physical activity were associated with decreased cardiovascular mortality in longitudinal studies⁸⁻¹⁰, while the results from cross-sectional studies were inconsistent¹¹⁻¹². Some authors suggested that inconsistencies in their findings could be a result of measurement problems and limited sample sizes¹³. The evaluation of cardiovascular risk were also varied in those studies some used Framingham risk score^{7,14}, others used SCORE (Systematic Coronary Risk Evaluation)¹⁵, which were developed from different populations and different definitions of cardiovascular diseases' end-points.

There is a lack of cross-sectional study on cardiovascular risk factors in Thai population using international standard measure for physical activity and cardiovascular risk score, which is based on data from Thai people. Therefore, this study attempted to examine the relationship of cardiovascular risk scores with some personal risk factors, physical activities and dietary behaviors among Thai population in a cross-sectional study, as shown in the conceptual framework.

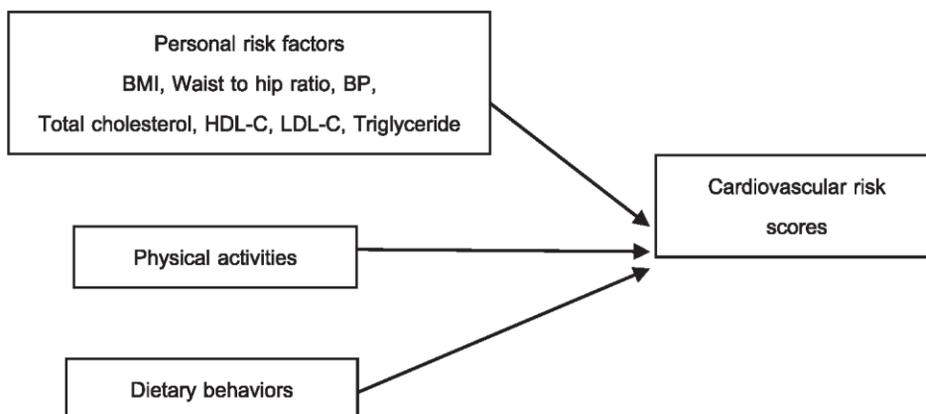


Diagram 1: The conceptual framework of this study

Operational Definitions of Terms Used in the Study

1. Cardiovascular Risks are the risks of having severe cardiovascular diseases such as myocardial infarction and sudden death within the next 10 years. The risks were measured with a screening test for the early detection of coronary heart disease (CHD) in Thai people or “Rama-EGAT heart score.”

2. Physical Activities are any activities that allow body movements in daily activities such as house chores, gardening, car washing, climbing stairs, walking and cycling. The activities include body movements due to occupations and leisure time sport activities. Physical activity is classified as vigorous and moderate intensity; and measured by International Physical Activity Questionnaire-Short Form (IPAQ-Short Form) translated into Thai by Pragai Jirojanakul and an independent translator¹⁶.

3. Levels of Physical Activities There are three levels of physical activities: vigorous, moderate and low physical activity levels based

on IPAQ Research Committee¹⁷:

3.1 Vigorous Physical Activity Level includes any one of the following two criterias

- 1) Vigorous-intensity activity on at least 3 days and accumulating at least 1,500 MET-minutes/week or
- 2) Seven or more days of any combination of walking, moderate-intensity or vigorous intensity activities achieving a minimum of at least 3,000 MET-minutes/week

3.2 Moderate Physical Activity Level includes any one of the following three criteria:-

- 1) Three or more days of vigorous activity of at least 20 minutes per day or
- 2) Five or more days of moderate-intensity activity or walking of at least 30 minutes per day or
- 3) Five or more days of any combination of walking, moderate-intensity or vigorous intensity activities achieving a minimum of at least 600 MET-min/week.

3.3 Low Physical Activity Level :This is the lowest level of physical activity. Those

individuals who not meet criteria for categories 2 or 3 are considered inactive.

4. Vigorous Intensity Activities based on IPAQ¹⁷ definitions are activities that require a high level of energy and can make persons feel exhausted. Persons may breathe more heavily than usual. The activities qualified in this category require the person to perform activities with such intensity for at least 10 minutes.

5. Moderate Intensity Activities according to IPAQ¹⁷, they can be defined as activities that require a moderate level of energy and can make persons feel a little more tired or breathe a little more heavily.

6. Dietary Behaviors include eating behaviors that are both positively and negatively associated with cardiovascular diseases. They concern about types of food, oil used in the cooking process, and food ingredients. The food concerned in this study can come from the main course, snacks, dessert and beverages persons regularly eat during the past 3 months.

Instruments

There were three questionnaires used in this study:

1. A screening test for the early detection of coronary heart disease in Thai people (Rama-EGAT heart score), which was developed by Faculty of Medicine Ramathibodi Hospital with Electricity Generating Authority of Thailand, and National Health Foundation. The instrument has been used and validated with the population of Thai Electricity Generators for more than 17 years¹⁸. The screening test was comprised of 5 risk factors i.e. age, gender, smoking history, blood pressure, and waist circumference made up as a

composite score. The score would be interpreted as the risk of having the severe coronary artery stenosis within 10 years. For example, a man (3 points), aged 48 years (2 points), non-smoker (0 point), has high blood pressure (3 points), with waist circumference of 95 centimeters (4 points) would have a composite score of $3+2+0+3+4=12$ points, interpreted as his chance of having severe coronary disease in the next 10 years is five percent (of persons with the same condition).

2. International Physical Activity Questionnaire-Short Form

The International Physical Activity Questionnaire-Short Form (IPAQ- short form) was developed to measure physical activities among the adult population ages between 15 and 69 years old. The physical activity evaluation covers several dimensions including 1) leisure time activities, 2) housework activities or chores and garden works, 3) physical activity in work settings, 4) travelling physical activities. The IPAQ-short form contains questions asking about 3 types of activities i.e. walking, moderate-level physical activities, and vigorous-level physical activities reflecting the 4 dimensions of physical activities aforementioned.

3. Dietary Behavior Questionnaire

The Dietary Behavior Questionnaire contains 20 questions asking about eating behaviors that associated with cardiovascular diseases. This four-level rating scale questionnaire was developed by the researchers, and it contained 3 positive-statement and 17 negative-statement items. The questions asked the respondents to recall the kind of food they consumed during the past 3 months including types of food, type of oil used in preparing food, and ingredients used

whether they were main meals, snacks, dessert or beverages.

3.1 Meanings of the rating scales

"Eat Regularly" means having that kind of food for more than or equals to 5 times per week "Eat Mostly" means having that kind of food for 3-4 times per week "Eat Sometimes" means having that kind of food for 1-2 times per week "Did Not Eat" means not having that kind of food at all during the past 3 months

3.2 Scoring criteria

For negative statements: "Eat Regularly" was assigned 4 points while "Eat Mostly", "Eat Sometimes" and "Did Not Eat" were assigned 3, 2 and 1 points consecutively. For positive statements, the score will be reversed.

3.3 Interpretation criteria

The interpretation was based on the total score e.g. the total scores of 1-20 were interpreted as having dietary behaviors with a small risk of developing cardiovascular diseases, while the scores of 21-40, 41-60 and 61-80 were interpreted as having dietary behaviors with a moderate, high and extremely high of developing cardiovascular diseases consecutively.

Validation of the Instruments

The first two instruments (Rama-EGAT heart score and IPAQ-short form) were standardized instruments. They have been used and tested for validities and reliabilities in a number of studies^{19,21}. The Dietary Behavior Questionnaire was developed in this study by researchers. The instrument validation process included face validation by having 3 persons reviewed and provided suggestions on the clarity of the questions. After its wording editing, the instrument was sent

to a panel consisted of 5 experts who were physicians, nurses, and cardiovascular nursing instructors. After the panel reviewed for content validity, the content validity index (CVI) was obtained as .95. The instrument was then tested for reliability with 31 sample of population-like characteristics and the test yielded a Chronbach's Alpha coefficient (r) of .73.

Data Collection

Data was collected voluntarily from the sample of 1,081 university personnel during 19-21 March 2009 after informing the objectives of the study, and the informed consents were signed. The participants completed the IPAQ- short form and the Dietary Behavior Questionnaires. The participants' data on body mass index (BMI), waist by hip ratios, blood pressure and blood chemistry for cholesterol, triglyceride, LDL-C, and HDL-C levels were obtained later from the health care clinic. The data from all sources were then analyzed. The results and suggestions regarding physical activities, dietary behaviors and risks for cardiovascular diseases were provided to the participants individually. Health promotion information appropriated to each person was also provided.

Analysis of the Data

The data collected in this study were analyzed using computer's program as follows:-

1. The data obtained from IPAQ-short form were analyzed according to the guidelines for data processing and analysis of the International Physical Activity Questionnaire- Short and Long recommended by the IPAQ Research

Committee^{17,22}. The total physical activity scores (PA) were then calculated.

2. Scores regarding dietary behaviors and cardiovascular risks were calculated.

3. The data of all continuous variables were tested and confirmed for normal distribution using the Kolmogorov-Smirnov Test and Normal Q-Q Plot.

4. The associations between some personal risk factors, physical activities, dietary behaviors and cardiovascular risk were calculated using Pearson's Product Moment Correlations.

Results and discussions

The participants consisted 730 women (67.8%) and 347 men (32.2%) categorized into 4 types of works i.e.:- 1) Service Jobs i.e. cooking, food and bakery sections, vehicle controls, and gardening (n = 552; 53.2%), 2) Academic Jobs i.e. instructors and researchers (n = 302; 29.1%), 3) Clergies and Supporting Jobs (n = 117; 11.3%), and 4) Administrative Jobs (n = 67; 6.5%). The results of the analyses on their levels of physical activities, dietary behaviors and cardiovascular risk scores were reported elsewhere²³.

Table 1: Range, Mean and Standard deviation of health variables of sample

Health Variables	Valid cases	Normal value	Min	Max	Mean	S.D.
Age (year)	1,052		16	69	34.8	9.2
Weight (Kg.)	1,074		37.3	120.9	60.5	13.0
Height (cm.)	1,069		140.0	190.5	160.7	7.8
BMI (Kg./m. ²)	1,068	18.5-22.9	12.8	43.2	23.4	4.4
Waist circumferences (cm.)	1,063		48.0	117.0	78.4	11.4
Hip circumferences (cm.)	1,028		65.5	137.0	94.9	9.3
waist to hip ratio in men	322	≤1.0	0.7	1.2	0.9	0.1
waist to hip ratio in women	698	≤0.8	0.5	1.2	0.8	0.1
Cholesterol (mg/dL)	1,057	≤ 200	110.0	450.0	207.6	40.7
Triglyceride (mg/dL)	1,053	<150	28.0	944.0	115.6	84.6
HDL-C (mg/dL)	1,058	> 40	12.0	102.0	48.8	11.7
LDL-C (mg/dL)	1,058	≤130	22.0	304.0	126.8	35.3
Dietary behavior score-RDB	1,072	≤40	28.0	69.0	43.6	5.8

It was found that BMI, waist to hip ratio, level of cholesterol, triglyceride, LDL-C were positively and significantly correlated with cardiovascular risk scores while HDL-C had a negative correlation with cardiovascular risk scores at $\alpha=0.01$ which were according to the hypotheses and concurrent with other studies e.g. Canoy²⁴; Schroeder, et al²⁵. Anyhow, the results of a

statistically significant negative relationship ($r = -0.09$) between cardiovascular riskily dietary behaviors and cardiovascular risk scores and a positive relationship ($r = 0.17$) between physical activity and cardiovascular risk scores at $\alpha = 0.05$ were neither concurrent with the research hypotheses nor the existing theories.

Table 2: Correlation coefficients among BMI, waist to hip ratio, blood cholesterol level, triglyceride, HDL-C, LDL-C, Physical activity (PA), Risky Dietary Behavior (RDB) and cardiovascular risk scores (RSCORE)

	BMI	Waist to hip ratio	Cholesterol	Triglyceride	HDL	LDL	PA	RDB	RSCORE
BMI	1 (1068)								
Waist to hip ratio	.46** (1015)	1 (1024)							
Cholesterol	.13** (1045)	.13** (1003)	1 (1057)						
Triglyceride	.29** (1041)	.32** (999)	.23** (1052)	1 (1053)					
HDL	-.33** (1046)	-.33** (1004)	.13** (1057)	-.37** (1053)	1 (1058)				
LDL	.20** (1046)	.16** (1004)	.87** (1057)	.08** (1053)	-.10** (1058)	1 (1058)			
PA	.07 (647)	.12** (629)	-.04 (645)	.04 (643)	-.02 (646)	-.05 (646)	1 (659)		
RDB	-.01 (1060)	-.03 (1015)	.02 (1048)	-.03 (1044)	.01 (1049)	.04 (1049)	-.04 (657)	1 (1072)	
RSCORE	.55** (994)	.63** (963)	.22** (981)	.40** (977)	-.30** (982)	.20** (982)	.17** (612)	-.09** (996)	1 (1002)

** Correlation is significant at the 0.01 level (2-tailed).

(n) The numbers in parentheses are the number of valid cases

The unexpected results may due to some confounding factors such as sex and age could be the result of measurement inadequacy. Considering the question asked e.g. "I eat food high in cholesterol i.e. egg yolk, animal's units, squid, shrimp, or shellfish.", "I eat fast food such as pizza, fried chicken, hamburger or sausage.", it could be further explained that, dietary behaviors described through the frequency of having unhealthy or healthy food during the previous 3 months, did not actually reflect the true consumption behaviors. Therefore, amount of food consumed each time and frequency of food consumption should also be added to the questionnaire; not only asking the type of food eaten. Other variables such as body mass index (BMI), waist to hip ratio, cholesterol, triglyceride and LDL cholesterol levels are more sensitive than dietary behaviors.

Regarding physical activity, two observations could be noted. Firstly, physical activity might not be sensitive enough for measuring and testing for association with cardiovascular risk score. In this case, other factors were unable to control such as age and gender. When examining how to calculate for cardiovascular risk score (consisting of age, gender, smoking status, hypertension and abdominal obesity conditions), variables with higher sensitivity and relationship with physical activity in theory were blood pressure, waist by hip ratio and cholesterol level according to Hayes et al.¹¹ and Pescatello, Murphy &

Costanzo¹². Secondly, a cross-sectional study like this study asked the sample to recall physical activities during the past 7 days. It cannot reflect the risks for or protection against cardiovascular disease. To help protect against cardiovascular diseases, ones need to participate in vigorous physical activities regularly for several years. Longitudinal studies done by Yu et al.¹⁰ and Hu et al.⁸ showed no association between having low and moderate levels of physical activities and decreased death rate caused by cardiovascular diseases. On the contrary, participations of vigorous physical activities were known to decrease the risk of dying from cardiovascular diseases including coronary diseases.

In an examination of those observations, the researchers tested the association between times used in physical activities and cholesterol levels which expected to have higher sensitivity in predicting risk of cardiovascular diseases based on a study done by Pescatello, Murphy & Costanzo¹². As shown in table 3, we found a significant negative relationship ($\alpha = 0.05$) between average time spent in vigorous physical activity each day (VIA per day) and LDL-C. No significant relationship was found between cholesterol level and average time spent in moderate physical activity each day (MIA per day); cholesterol level and average time spent in walking each day (WALK per day); and cholesterol level and average time spent in sitting in each day (SIT per day). However, having the negative correlation coefficients among VIA per day, MIA per day, and

WALK per day and cholesterol level mean that as time spent in each activity increases, the lower the cholesterol level. Conversely, the positive correlation coefficients between SIT per day and cholesterol level and between SIT per day and

LDL-C mean that the longer the person sits, the higher the cholesterol and LDL-C. These results were concurrent with the existing theories even though the relationships were not statistically significance at $\alpha = 0.05$.

Table 3: Correlation coefficients among VIA per day, MIA per day, WALK per day, SIT per day and cholesterol and LDL-C

	VIA per day	MIA per day	WALK per day	SIT per day
Cholesterol	-0.06	-0.00	-0.02	0.04
	p-value = 0.09	p-value = 0.95	p-value = 0.59	p-value = 0.22
	(n = 845)	(n = 749)	(n = 752)	(n = 805)
LDL-C	-0.09*	-0.02	-0.05	0.07*
	p-value = 0.01	p-value = 0.56	p-value = 0.17	p-value = 0.05
	(n = 846)	(n = 750)	(n = 753)	(n = 806)

Note: Numbers in parentheses were valid cases, $\alpha = 0.05$

Conclusions

It can be concluded that this cross-sectional study did not show direct association between levels of activities and cardiovascular risk score. However, indirect effects might be found such as lowering cholesterol and LDL-C levels like a study done by Pescatello, Murphy & Costanzo¹². Although the data obtained in this study may not be sufficient to draw such conclusion. Nonetheless, this study confirmed a theoretical notion which said that physical inactivity and abdominal obesity were not direct risk factors. They were predisposing risk factors of cardiovascular diseases⁷.

It can also be assumed from this study that the scores from dietary behaviors may not be sensitive enough to reflect the risk for cardiovascular diseases.

Recommendations for future research studies

Future research studies should examine the relationships between physical activities and other measurable intermediate variables that link to cardiovascular disease such as blood pressure, waist by hip ratio, and blood cholesterol level. The sample size should be increased and should include different groups of participants. Dietary behaviors known as high risk for cardiovascular disease should be further examined among different samples by adjusting the instrument. Thus, the amount of food persons eat each time (not just types of food and frequencies of having it) is added in the instrument. In addition, longitudinal (Cohort) studies examining associations among physical activities, dietary behaviors, and cardiovascular risk, along with other contributing factors should

be done in the future. Quasi-experimental study should be done for an effective control of hyperlipidemia among the working population.

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