



ความสัมพันธ์ระหว่างความรู้ ทักษะ และพฤติกรรมสุขภาพกับความเสี่ยงต่อโรคหัวใจและหลอดเลือด:
การศึกษาในโรงเรียนมัธยมศึกษาจังหวัดนครราชสีมา

Association of Knowledge, Attitude, and Practice on Cardiovascular Disease Risk: A
Study among Secondary School Students in Nakhon Ratchasima Province

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Abstract

Cardiovascular disease (CVD) remains a leading cause of morbidity and mortality worldwide, with increasing prevalence among younger populations due to unhealthy lifestyle behaviors and limited health awareness. Adolescence represents a critical period for establishing lifelong health habits. Understanding adolescents' knowledge, attitudes, and behaviors toward CVD prevention is essential for effective early intervention. This study aimed to assess the levels of knowledge, attitudes, and health behaviors related to CVD risk factors among middle school students in Thailand and to examine the relationships among these factors. A descriptive cross-sectional survey was conducted at Panyaprateep School, Nakhon Ratchasima Province, Thailand. Participants were selected through convenience sampling. Data were collected using a structured, self-administered questionnaire assessing sociodemographic characteristics, CVD knowledge, attitudes, and preventive health behaviors. Descriptive statistics and multiple linear regression analyses. Participants demonstrated moderate knowledge of CVD (40.68%) and good knowledge levels (38.14%). Most students had positive attitudes toward CVD prevention, particularly regarding diet, exercise, and avoidance of smoking and alcohol. However, gaps remained in understanding metabolic and biochemical risk factors, especially those related to diabetes and lipid control. Regression analyses identified that gender, attitude toward early prevention, and parental health information were significantly associated with knowledge ($R^2 = 0.169$, $p < 0.001$). Knowledge regarding blood sugar control and peer-based information were positively associated with attitudes and behaviors ($R^2 = 0.232$, $p < 0.001$). In conclusion, middle school students demonstrated moderate CVD knowledge and favourable attitudes but inconsistent preventive behaviors. Peer influence and digital media emerged as key determinants of health perceptions. School-based, peer-led, and digitally supported educational interventions are recommended to enhance cardiovascular literacy and foster sustainable heart-healthy behaviors among adolescents.

Keywords: cardiovascular disease, heart disease, adolescent, school

บทคัดย่อ

โรคหัวใจและหลอดเลือดเป็นสาเหตุสำคัญของการเจ็บป่วยและการเสียชีวิตทั่วโลก โดยมีแนวโน้มการเพิ่มขึ้นในกลุ่มเยาวชนจากพฤติกรรมการดำเนินชีวิตและความรู้ความเข้าใจด้านสุขภาพที่ไม่เหมาะสม วัยรุ่นเป็นช่วงเวลาสำคัญของการสร้างนิสัยสุขภาพที่คงอยู่ตลอดชีวิต ความเข้าใจเกี่ยวกับความรู้ ทักษะ และพฤติกรรมของวัยรุ่นต่อการป้องกันโรคหัวใจและหลอดเลือดจึงเป็นสิ่งจำเป็นต่อการวางแผนการป้องกันตั้งแต่ระยะเริ่มต้นอย่างมีประสิทธิภาพ การศึกษานี้จึงมีวัตถุประสงค์เพื่อประเมินและเพื่อศึกษาความสัมพันธ์ระหว่างระดับความรู้ ทักษะ และพฤติกรรมสุขภาพที่เกี่ยวข้องกับปัจจัยเสี่ยงของโรคหัวใจและหลอดเลือดในนักเรียนระดับมัธยมศึกษาในประเทศไทย การวิจัยนี้เป็นการศึกษาเชิงพรรณนาแบบภาคตัดขวาง จากโรงเรียนปัญญาประทีป อำเภอปากช่อง จังหวัดนครราชสีมา จากการสุ่มตัวอย่างแบบสะดวก ข้อมูลผลการศึกษได้จากแบบสอบถามที่ผู้ตอบกรอกด้วยตนเอง ประกอบด้วยข้อมูลพื้นฐานทางสังคมประชากร ความรู้เกี่ยวกับโรคหัวใจและหลอดเลือด ทักษะ และพฤติกรรมสุขภาพเพื่อการป้องกันโรค โดยการวิเคราะห์ข้อมูลด้วยสถิติเชิงพรรณนาและการถดถอยพหุเชิงเส้น ผลการศึกษาพบว่า ผู้เข้าร่วมการวิจัยมีระดับความรู้เกี่ยวกับโรคหัวใจและหลอดเลือดในระดับปานกลาง โดยร้อยละ 40.68 มีความรู้ระดับปานกลาง และร้อยละ 38.14 มีความรู้ระดับดี นักเรียนส่วนใหญ่มีทัศนคติเชิงบวกต่อการป้องกันโรคหัวใจ โดยเฉพาะด้านการรับประทานอาหาร การออกกำลังกาย และการหลีกเลี่ยงการสูบบุหรี่และดื่มแอลกอฮอล์ อย่างไรก็ตาม ยังพบช่องว่างด้านความรู้เกี่ยวกับปัจจัยเสี่ยงทางเมตาบอลิซึมและชีวเคมี โดยปัจจัยที่เกี่ยวข้องกับเบาหวานและการควบคุมระดับไขมันในเลือด การวิเคราะห์ถดถอยพบว่า ทัศนคติต่อการป้องกันโรคตั้งแต่วัยรุ่น และแหล่งข้อมูลด้านสุขภาพจากผู้ปกครอง มีความสัมพันธ์กับระดับความรู้ ($R^2 = 0.169$, $p < 0.001$) ความรู้เกี่ยวกับการควบคุมระดับน้ำตาลในเลือดและข้อมูลจากเพื่อน มีความสัมพันธ์เชิงบวกกับทัศนคติ ($R^2 = 0.232$, $p < 0.001$) สรุปผลการศึกษา นักเรียนมีความรู้เกี่ยวกับโรคหัวใจและหลอดเลือดในระดับปานกลาง และมีทัศนคติที่ดี แต่ไม่มีความสม่ำเสมอของพฤติกรรมการป้องกันโรค ปัจจัยด้านอิทธิพลของเพื่อนและสื่อดิจิทัลมีบทบาทสำคัญต่อการรับรู้ด้านสุขภาพ จึงควรส่งเสริมการจัดกิจกรรมให้ความรู้ผ่านโรงเรียน โดยใช้การเรียนรู้แบบมีส่วนร่วม นำโดยเพื่อน และมีการสนับสนุนด้วยสื่อดิจิทัล เพื่อเสริมสร้างความรู้และพฤติกรรมสุขภาพที่ดีอย่างยั่งยืนในกลุ่มเยาวชน

คำสำคัญ: โรคหลอดเลือดหัวใจ, โรคหัวใจ, วัยรุ่น, โรงเรียน

Introduction

Cardiovascular disease (CVD) is a major noncommunicable disease (NCD) and a leading cause of death globally. Approximately 90% of CVD-related deaths occur in low- and middle-income countries, where poverty, limited health literacy, inadequate healthcare infrastructure, and unhealthy lifestyles significantly contribute to the rising prevalence of the disease (Sakboonyarat & Rangsin, 2024). In high-income countries such as the United States, the Centers for Disease Control and Prevention (CDC) reports that heart disease accounts for nearly one in five deaths each year (Ahmadi, 2023). Similarly,



according to the World Health Organization (World Health Organization, 2025), Thailand records age-specific mortality rates of 87.1 and 123 per 100,000 population for coronary heart disease and stroke, respectively. Epidemiological studies further underscore the growing burden of CVD in Thailand. The Thai Epidemiologic Stroke (TES) Study reported a stroke prevalence of 1.88% between 2005 and 2007 (Kongsakol, 2018). Data from the Ministry of Public Health (2012-2021) revealed that while the age-standardized hospital admission rate for ischemic heart disease (IHD) declined by 24.1% among females (from 427.5 to 390.5 per 100,000), it increased among males (from 462.7 to 485.8 per 100,000) during the same period. Notably, mortality from IHD among individuals under 60 years of age has increased over the past decade by 59.6% in males and 36.1% in females (Sakboonyarat & Rangsin, 2024). Despite this, there remains no universally accepted age threshold for defining “young” in the context of premature CVD. Some studies define “young” as between 40 and 55 years, while others use 45 years as the upper limit (Sulaiman & Andsoy, 2024). In recent years, the incidence of CVD among young adults has risen, primarily due to increasing rates of obesity, diabetes, tobacco and electronic cigarette use, consumption of processed foods, and environmental risk factors. These trends suggest that CVD will likely become more prevalent within younger populations. Prevention efforts face significant challenges, as many adults remain unaware of their personal risk factors (Sulaiman & Andsoy, 2024; Yang, 2024). Evidence indicates that the development of CVD and atherosclerosis begins early in life, often during childhood and adolescence. The presence and severity of these conditions are closely associated with established cardiovascular risk factors. Adolescence, particularly the middle school years, represents a crucial developmental stage where lifestyle behaviors are formed and often persist into adulthood (Abrignani, 2019; Yang, 2024). Increasing awareness of CVD risk factors during this stage can influence preventive health behaviors and reduce future disease burden.

CVD is largely preventable through education, early screening, and management of modifiable risk factors. Assessing the knowledge, attitudes, and health behaviors of young adults is therefore critical to promoting healthy lifestyles and preventing premature CVD-related mortality. Furthermore, understanding these factors enables healthcare professionals to design effective educational interventions. Substantial evidence supports the role of coordinated care and professional coaching in mitigating cardiovascular risks (Sulaiman & Andsoy, 2024). In this context, understanding individuals’ knowledge, attitudes, and practices (KAP) toward CVD risk factors is vital for effective prevention and control strategies. KAP studies provide valuable insight into behavioral determinants and serve as a foundation for developing targeted health promotion programs.



Objectives

This study aims to assess the level of knowledge, attitudes, and health behaviors related to CVD risk factors among young populations and to explore the relationships among these factors.

Hypothesis

Adolescents' knowledge and attitudes toward cardiovascular disease risk factors are significantly associated with their preventive health behaviors.

Methods

Design, Participants, and Settings

This descriptive cross-sectional study was conducted in September 2025 at Panyaprateep School, located in Pak Chong District, Nakhon Ratchasima Province, Thailand. Permission to conduct the study was obtained from the school director. Privacy and confidentiality were strictly maintained throughout the data collection process, and all responses were anonymized to protect participants' identities. Participants were selected through a convenience sampling method. The minimum required sample size was determined using an online sample size calculator (Calculator.net), based on a total population of 168 students, a 95% confidence level, and a 5% margin of error, resulting in a required sample size of 118 participants.

Before completing the questionnaire, all participants were provided with detailed information about the study. All participants assented to participate, and parental consent was obtained. The inclusion criteria were: (1) current enrollment as a student at Panyaprateep School; (2) any gender; (3) ability to read and write in Thai and/or English; and (4) not being employed as medical or healthcare personnel. Exclusion criteria were failure to complete the questionnaire.

Data Collection and Measurements

Data collection took place on-site at Panyaprateep School. A structured, self-administered questionnaire-translated from English into Thai-was used to collect data. The translation process followed forward-backward translation procedures to ensure linguistic accuracy, content equivalence and validated by medical scientists. The questionnaire consisted of four sections:

Section 1: Sociodemographic characteristics (4 items), this section collected information on sex, education level, body mass index (BMI), and main sources of health information (step 1).

Section 2: Knowledge of cardiovascular disease (25 items), knowledge was assessed using the Heart Disease Fact Questionnaire (HDFQ), with a Cronbach's alpha of



0.84 (Sulaiman & Andsoy, 2024). Each item was answered as “true,” “false,” or “I don’t know.” Correct responses were scored as 1, while incorrect or “I don’t know” responses were scored as 0. Total knowledge scores ranged from 0 to 100 and were categorized as poor (≤ 50), moderate (51-74), and good (> 75).

Section 3: Attitudes toward cardiovascular disease (11 items), attitudes were measured using a 3-point Likert scale (1 = Neutral, 2 = Agree, 3 = Disagree), adapted from (Yang, 2024).

Section 4: Health behaviors for CVD prevention (13 items), this section evaluated preventive health behaviors using a Likert scale adapted from (Yang, 2024).

Questionnaires were completed in a supervised classroom setting to ensure independent responses and minimize external influence. Upon completion, the questionnaires were collected immediately. All data were double-entered into a database to verify consistency and minimize entry errors.

Statistical Analysis

Data were organized using Microsoft Excel (Microsoft Corp., Redmond, WA, USA) and analyzed with IBM SPSS Statistics version 20 (IBM Corp., Armonk, NY, USA). Descriptive statistics (frequency, percentage, mean, and standard deviation) were used to summarize participants’ sociodemographic characteristics, knowledge, attitudes, and health behaviors. Multiple linear regression analysis was performed to identify factors associated with CVD knowledge, attitudes, and behaviors. A *p-value* of < 0.05 was considered statistically significant.

Results and Discussions

Sociodemographic Characteristics

A total of 118 participants were included in the study. The sociodemographic characteristics of the participants are summarized in Table 1. Among the respondents, 56 (47.46%) were male and 62 (52.54%) were female, indicating a slightly higher proportion of female participants. Participants were drawn from six different secondary school levels. The largest groups were from Secondary 6 (22.88%) and Secondary 3 (20.34%), followed by Secondary 2 (17.80%), respectively. The distribution demonstrates relatively balanced participation across grade levels, with a modest predominance of students in the higher grades.

Regarding nutritional status, the majority of participants (60.17%) had a normal BMI. Meanwhile, 27.12% were classified as underweight, 11.02% as overweight, and 1.69% as obese. These findings suggest that most students maintained a healthy body weight, although underweight remained relatively common.

Regarding sources of health information, the internet and social media were the most frequently cited channels, reported by 38.50% of participants. Other notable sources included parents or relatives (31.70%), friends (18.30%), and television or radio (8.40%), respectively.

However, the quality and accuracy of online health information (OHI) on cardiovascular health vary widely, raising concerns about its reliability. Overreliance on low-quality or misleading OHI may contribute to misinformation and poor health-related decision-making. Lim et al. (2025) reported that OHI derived from credible websites, non-commercial sources, and content free from misinformation was associated with higher levels of appropriate trust among individuals (Lim, 2025).

Table 1 Participants' sociodemographic characteristics and behavioral measurements (n=118)

No.	Characteristics	No. of participants (%) ^{a)}
1	Gender	
	Male	56 (47.46)
	Female	62 (52.54)
2	Participant status	
	Secondary 1	20 (16.95)
	Secondary 2	21 (17.80)
	Secondary 3	24 (20.34)
	Secondary 4	17 (14.41)
	Secondary 5	9 (7.63)
	Secondary 6	23 (22.88)
3	BMI in kg/m²	
	<18.5 (underweight)	32 (27.12)
	18.49-24.9 (normal body)	71 (60.17)
	25.0-29.9 (overweight)	13 (11.02)
	>30.0 (obese)	2 (1.69)
4	Health information sources	
	TV/Radio	22 (8.40)
	News/Magazine	6 (2.30)
	Internet/Social Media	101 (38.50)
	Parent/Relative	83 (31.70)
	Friends	48 (18.30)
	Close friend	1 (0.40)
	Teacher	1 (0.40)

^{a)} Percentages may not total 100 due to rounding.

^{b)} Mean±standard deviation.



Knowledge of Cardiovascular Disease Risk Factors

Participants' knowledge regarding CVDs risk factors was assessed using the HDFQ and summarized in Table 2. The participants demonstrated a moderate level of knowledge about CVD, with a mean score of 16 ± 0.40 points (out of 25) with a score range between 6 and 23 points. Based on the scoring criteria, participants had poor (21.19%), moderate (40.68%) and good (38.14%) knowledge categories.

In terms of specific knowledge items, most participants correctly recognized major and modifiable risk factors for HD. A high proportion correctly identified that elderly individuals are at greater risk of developing HD (90.68%), that high blood pressure (85.59%), high cholesterol (79.66%), obesity (82.20%), smoking (76.27%), and physical inactivity (90.68%) are associated with increased risk. Similarly, 82.20% correctly indicated that controlling blood pressure reduces the risk of HD.

Knowledge of the relationship between diabetes and CVD was moderate. Approximately 77.12% of respondents recognized diabetes as a CVD risk factor, and 70.34% knew that maintaining blood pressure control can reduce CVD risk among diabetic individuals. However, understanding of the specific metabolic implications of diabetes was less consistent. Only 62.71% correctly stated that blood sugar control reduces CVD risk, and 64.41% identified that prolonged high blood sugar increases cholesterol levels and heart disease risk. Fewer respondents (22.88%) were aware that individuals with diabetes do not necessarily have low cholesterol, indicating a gap in knowledge about lipid metabolism in diabetic patients.

Awareness of dietary risk factors was variable. While 52.54% correctly rejected the misconception that fatty meals do not increase blood cholesterol levels, only 35.59% accurately identified that statement as false, showing moderate understanding of diet-related CVD risk.

Misconceptions remained evident in certain areas. Nearly half of the respondents (47.46%) believed or were uncertain whether “a person always knows when they have heart disease,” and more than half (55.93%) did not know that men with diabetes have a higher risk of heart disease compared with women. Additionally, 47.46% of students were unsure whether people with diabetes tend to have low HDL cholesterol, indicating confusion about the role of lipoproteins in CVD.

The results indicate that while most students demonstrated satisfactory knowledge of general and modifiable cardiovascular risk factors-particularly age, hypertension, cholesterol, obesity, and smoking-there remain notable gaps in understanding of the metabolic and biochemical aspects of CVD, especially those related to diabetes and lipid profiles. In addition, The majority correctly identified major modifiable risk factors, consistent with findings from previous adolescent studies in Thailand and other middle-income countries (Abrignani, 2019; Sulaiman & Andsoy, 2024).

Table 2 Knowledge of cardiovascular disease risk factors (n=118)

No.	Heart Disease Fact Questionnaire	No. of participants (%) ^{a)}		
		True	False	Don't know
1	A person always knows when they have HD (F)	35 (29.66)	27 (22.88) ^{b)}	56 (47.46)
2	If you have a family history of HD, you are at risk for developing HD (T)	67 (56.78) ^{b)}	18 (15.25)	33 (27.97)
3	Elderly people are at a higher risk for developing HD (T)	107 (90.68) ^{b)}	5 (4.24)	6 (5.08)
4	Smoking is a risk factor for heart disease (T)	90 (76.27) ^{b)}	19 (16.10)	9 (7.63)
5	A person who stops smoking will lower their risk of developing HD (T)	84 (71.19) ^{b)}	14 (11.86)	20 (16.95)
6	High blood pressure is a risk factor for HD (T)	101 (85.59) ^{b)}	6 (5.08)	11 (9.32)
7	Blood pressure control reduces the risk of HD (T)	97 (82.20) ^{b)}	3 (2.54)	18 (15.25)
8	High cholesterol is a risk factor for HD (T)	94 (79.66) ^{b)}	8 (6.78)	16 (13.56)
9	Fatty meals do not increase the cholesterol level in the blood (F)	42 (35.59)	62 (52.54) ^{b)}	14 (11.86)
10	If your good cholesterol (HDL) is high, you are at risk for HD (F)	17 (14.41)	75 (63.56) ^{b)}	26 (22.03)
11	If your bad cholesterol (LDL) is high, you are at risk for HD (T)	84 (71.19) ^{b)}	7 (5.93)	27 (22.88)
12	Being overweight increases a person's risk for HD (T)	97 (82.20) ^{b)}	7 (5.93)	14 (11.86)
13	Regular physical activity will lower a person's chance of getting HD (T)	107 (90.68) ^{b)}	7 (5.93)	4 (3.39)
14	Only exercising at a gym will help lower a person's chance of developing HD (F)	21 (17.80)	73 (61.86) ^{b)}	24 (20.34)
15	Walking and gardening are considered exercises that will help lower a person's chance of developing HD (T)	92 (77.97) ^{b)}	5 (4.24)	21 (17.80)
16	Diabetes is a risk factor for HD (T)	91 (77.12) ^{b)}	9 (7.63)	18 (15.25)
17	High blood sugar puts a strain on the heart (T)	91 (77.12) ^{b)}	3 (2.54)	24 (20.34)
18	If your blood sugar is high over several months, it can cause your cholesterol level to go up and increase the risk of HD (T)	76 (64.41) ^{b)}	3 (2.54)	39 (33.05)
19	A person who has diabetes can reduce their risk of developing HD if they keep their blood sugar levels under control (T)	74 (62.71) ^{b)}	9 (7.63)	35 (29.66)
20	People with diabetes rarely have high cholesterol (T)	27 (22.88) ^{b)}	41 (34.75)	50 (42.37)
21	If a person has diabetes, keeping their cholesterol under control will help to lower their chance of developing HD (T)	82 (69.49) ^{b)}	9 (7.63)	27 (22.88)
22	People with diabetes tend to have low HDL (good) cholesterol (F)	35 (29.66)	27 (22.88) ^{b)}	56 (47.46)
23	Person who has diabetes can reduce their risk of developing HD if they keep their blood pressure under control (T)	83 (70.34) ^{b)}	8 (6.78)	27 (22.88)
24	A person who has diabetes can reduce their risk of developing HD if they keep their weight under control (T)	82 (69.49) ^{b)}	11 (9.32)	25 (21.19)
25	Men with diabetes have a higher risk of HD than women with diabetes (F)	26 (22.03)	26 (22.03) ^{b)}	66 (55.93)
Correct response: 25 items (points), 100 scores		Total score ranged; n (%) ^{a)}		
- Mean ($\pm$ SEM): 16 $\pm$ 0.40 points		- Poor ($\leq$ 50 scores): 25 (21.19%)		
- Median ($\pm$ SD): 18 $\pm$ 31 points		- Moderate (51-74 scores): 48 (40.68%)		
- Minimum / Maximum, n (%): 6 points, 4 (3.40%) / 23 points, 2 (1.70%)		- Good ($>$ 75 scores): 45 (38.14%)		

HD, heart disease; F, false; T, true; HDL, high-density lipoprotein; LDL, low-density lipoprotein.

^{a)} Percentages may not total 100 due to rounding.

^{b)} Correct response.

Attitudes Toward CVD Prevention and Awareness

The majority of respondents demonstrated positive attitudes toward CVD prevention and awareness (Table 3). Most participants agreed that preventive actions are important for cardiovascular health. Specifically, 61.86% agreed that HD should be

prevented beginning in adolescence. A large majority (88.98%) recognized the importance of maintaining a sensible diet for cardiovascular health, and 93.22% acknowledged that regular physical activity plays a crucial role in preventing CVD. Strong agreement was also observed regarding the harmful effects of lifestyle risk factors. Nearly all participants agreed that smoking (94.07%) and excessive alcohol consumption (94.07%) are dangerous to cardiovascular health. Additionally, 75.42% of respondents agreed that lack of sleep and staying up late negatively impact heart health, while 68.64% perceived anxiety and depression as detrimental to cardiovascular well-being.

In the sedentary behavior, 59.32% agreed that inactivity poses a danger to cardiovascular health, though 34.75% remained neutral, indicating some uncertainty or lack of awareness regarding the role of physical inactivity. Similarly, 90.68% recognized that conditions such as hypertension, hyperglycemia, and hyperlipidemia are dangerous to cardiovascular health, and 89.83% agreed that overweight and obesity increase CVD risk. Regarding preventive health education, 75.42% of respondents agreed that receiving health education on cardiovascular prevention is important, while 22.88% were neutral.

In summary, the results reveal that the participants generally hold favorable attitudes toward CVD prevention, acknowledging the importance of healthy lifestyle behaviors, risk factor control, and early education. However, a proportion of respondents displayed neutral attitudes toward psychological factors, sedentary behavior, and sleep patterns, suggesting areas where health education initiatives could be strengthened to enhance comprehensive CVD awareness among adolescents. These results align with prior studies demonstrating that adolescents generally hold favorable attitudes toward preventive health but may underestimate less visible or indirect risk factors (Yang, 2024).

Table 3 Attitudes toward cardiovascular disease (CVD) (n=118)

No.	Attitude	No. of participants (%) ^{a)}		
		Neutral	Agree	Disagree
1	HD needs to be prevented in adolescence	44.00 (37.29)	73 (61.86)	1 (0.85)
2	A sensible diet is important for cardiovascular health	11 (9.32)	105 (88.98)	2 (1.69)
3	Physical activity is important in preventing CVD	18 (6.78)	110 (93.22)	-
4	Smoking is dangerous for cardiovascular health	5 (4.24)	111 (94.07)	2 (1.69)
5	Excessive alcohol consumption is dangerous for cardiovascular health	7 (5.93)	111 (94.07)	-
6	Lack of sleep and late nights are dangerous for cardiovascular health	27 (22.88)	89 (75.42)	2 (1.69)
7	Anxiety and depression are dangerous for cardiovascular health	32 (27.12)	81 (68.64)	5 (4.24)
8	Being sedentary is dangerous for cardiovascular health	41 (34.75)	70 (59.32)	7 (5.93)
9	Hypertension, hyperglycemia, and hyperlipidemia are dangerous for cardiovascular health	9 (7.63)	107 (90.68)	2 (1.69)
10	Overweight and obesity are dangerous for cardiovascular health	11 (9.32)	106 (89.83)	1 (0.85)
11	Receive health education on cardiovascular prevention	27 (22.88)	89 (75.42)	2 (1.69)

^{a)} Percentages may not total 100 due to rounding.

Health Behaviors on Dietary Patterns

Participants' dietary behaviors related to CVDs prevention are presented in Table 4. The results indicate that while most students consume healthy foods such as fruits and vegetables regularly, the frequent intake of unhealthy foods-including sweets, salty, and high-fat items-remains common among middle school students.

Regarding food consumption frequency, 21.19% of students reported consuming sweets and sugary drinks daily. Similarly, high-fat and oily foods were consumed frequently, with 49.15% eating them 4-6 times per week. In terms of salty food consumption, nearly half of the participants (45.76%) ate salty foods 4-6 times per week, and 32.20% consumed them 1-3 times per week, indicating a high prevalence of sodium-rich dietary habits. These patterns mirror global concerns about adolescent diets and their contribution to early CVD risk (World Health Organization, 2025).

When assessing healthy food intake, vegetables and fruits were the most commonly consumed healthy food group, with 46.61% reporting daily intake and 32.20% consuming them 4-6 times per week. In contrast, whole grains and mixed grains were consumed less frequently, with only 14.41% of students reporting daily consumption, while the majority consumed them 1-3 times per week (43.22%).

Consumption of dairy products was relatively moderate, with 33.05% reporting daily intake. For aquatic products such as fish or seafood, the majority of participants (62.71%) consumed them only 1-3 times per week, and 7.63% ate them daily. Similarly, nuts were consumed infrequently, with nearly half of the students (47.46%) eating them 1-3 times per week and only 12.71% reporting daily intake.

The results suggest that while students demonstrate reasonably good consumption habits regarding fruits, vegetables, and dairy products, the frequent intake of high-fat, sugary, and salty foods remains concerning. This pattern highlights the need for targeted nutritional education and interventions to promote healthier eating behaviors and reduce CVD risk among adolescents.

Table 4 Frequency of daily meals per week among middle school students (n=118)

No.	Features	Times a week (%) ^{a)}			
		0	1-3	4-6	7
1	Sweets and sugary drinks	3 (2.54)	47 (39.83)	43 (36.44)	25 (21.19)
2	High fat and oil food	3 (2.54)	50 (42.37)	58 (49.15)	7 (5.93)
3	Salty food	6 (5.08)	38 (32.20)	54 (45.76)	20 (16.95)
4	Whole grains and mixed grains	10 (43.22)	51 (43.22)	40 (33.90)	17 (14.41)
5	Vegetables and fruits	4 (3.39)	21 (17.80)	38 (32.20)	55 (46.61)
6	Dairy product	10 (8.47)	28 (23.73)	41 (34.75)	39 (33.05)
7	Aquatic product	5 (4.24)	74 (62.71)	30 (25.42)	9 (7.63)
8	Nuts	13 (11.02)	56 (47.46)	34 (28.81)	15 (12.71)

^{a)} Percentages may not total 100 due to rounding.



Daily Life Behaviors for Cardiovascular Disease Prevention

Participants' daily lifestyle behaviors related to CVDs prevention are summarized in Table 5. The findings reveal both positive and concerning lifestyle patterns among middle school students, particularly regarding sleep habits, dietary control, and awareness of personal health indicators. With respect to sleep patterns, only 29.66% of students reported not going to bed late (before midnight) during the past week, indicating that irregular and insufficient sleep is common among adolescents.

Regarding health awareness, fewer than half of the participants (48.31%) reported being concerned about their blood pressure, blood sugar, and lipid levels, while 44.07% indicated no concern. This suggests limited awareness or prioritization of key cardiovascular risk indicators among the students.

In terms of diet and exercise habits, the majority (65.25%) reported "sometimes" maintaining a controlled diet and regular physical activity, while 26.27% practiced these behaviors consistently. These findings highlight a moderate level of engagement in preventive lifestyle behaviors but suggest room for improvement in daily health maintenance.

With respect to sleep duration, most students (60.17%) slept less than 8 hours per night, while 38.98% reported sleeping between 8-10 hours. This indicates that inadequate sleep duration is a common issue within this population.

Breakfast consumption patterns were generally positive. The majority (59.32%) ate breakfast daily, and 24.58% reported eating breakfast on 5-6 days per week.

These results demonstrate that while many students maintain healthy behaviors such as regular breakfast consumption and occasional diet and exercise practices, a substantial proportion exhibit unhealthy habits, including late bedtime, insufficient sleep, and limited concern for cardiovascular health parameters. These behavioral patterns highlight the need for school-based health education programs emphasizing sleep hygiene, self-monitoring of health indicators, and consistent adoption of healthy lifestyle routines to prevent early cardiovascular risks.



Table 5 Daily life behaviors for CVD prevention among middle school students (n=118).

No.	Content of practice	Frequency (%) ^{a)}
1	Frequency of late bedtime (after 12 o'clock) in the last 7days	
	0 day	35 (29.66)
	1-2 days	18 (15.25)
	3-4 days	35 (29.66)
	5-6 days	17 (14.41)
	7 days	13 (11.02)
2	Do you concern your blood pressure, blood sugar, and lipids	
	No concern	52 (44.07)
	Concern	57 (48.31)
	Very much concern	9 (7.63)
3	Daily controlled diet and regular exercise to maintain a healthy weight	
	No	10 (8.47)
	Sometimes	77 (65.25)
	Always	31 (26.27)
4	Daily sleep duration in the last 7days	
	<8 h	71 (60.17)
	8-10 h	46 (38.98)
	>10 h	1 (0.85)
5	Frequency of breakfast in the last 7days	
	0 day	2 (1.69)
	1-2 days	3 (2.54)
	3-4 days	14 (11.86)
	5-6 days	29 (24.58)
	7 days	70 (59.32)

^{a)} Percentages may not total 100 due to rounding.

Association Between Participants' Characteristics, Knowledge, Attitudes, and Health Behaviors

The relationships among participants' demographic characteristics, knowledge, attitudes, and health behaviors toward CVDs prevention were examined using multiple linear regression analysis. The findings are presented in Table 6.

Factors Associated with Knowledge

In the regression model for knowledge, three variables were identified as significant predictors: the attitude that "HD needs to be prevented in adolescence," gender, and obtaining health information from parents or relatives. The model accounted for 16.90% of the variance in knowledge ($p < 0.001$).

Specifically, participants who agreed that HD should be prevented during adolescence had significantly higher knowledge scores ($p < 0.05$). Similarly, female participants exhibited higher knowledge levels than males ($p < 0.05$). Conversely, obtaining health information primarily from parents or relatives was negatively associated with knowledge ($p < 0.05$), suggesting that interpersonal sources may be less effective than other information channels for enhancing CVD-related knowledge among students.



Factors Associated with Attitudes

For attitudes toward CVD prevention, the regression model explained 23.20% of the variance ($p < 0.001$). Two factors were significantly associated with more positive attitudes: the knowledge item “high blood sugar puts a strain on the heart” and obtaining health information from friends.

Participants who correctly identified that high blood sugar increases cardiac strain had significantly more positive attitudes toward CVD prevention ($p < 0.001$). Additionally, students who obtained health information from friends showed higher attitude scores ($p < 0.05$), suggesting that peer influence may play an important role in shaping adolescents’ health perceptions.

Factors Associated with Health Behaviors

The regression analysis for health behaviors revealed that two knowledge variables were significantly associated with preventive practices, explaining 8.40% of the variance ($p = 0.006$). Students who knew that “a person with diabetes can reduce their risk of developing HD by keeping blood sugar under control” were more likely to engage in healthy behaviors ($p < 0.05$). However, unexpectedly, knowledge that “blood pressure control reduces the risk of heart disease” was negatively associated with health behaviors ($p < 0.05$), possibly reflecting a gap between theoretical knowledge and practical application among adolescents.

These findings indicate that students’ attitudes and gender significantly influence their level of CVD knowledge, while specific health knowledge and social sources of information-particularly peers-play a key role in shaping positive attitudes and preventive behaviors. This discrepancy highlights a gap between theoretical knowledge and practical application, a common challenge in adolescent health behavior research (Sulaiman & Andsoy, 2024).

Nonetheless, the relatively low R^2 values suggested that other unmeasured factors, such as environmental, familial, or psychosocial influences, may also affect adolescents’ cardiovascular health practices. According to Shakya (2025), adolescents place greater emphasis on their personal ability to prevent CVD through digital platforms than on parental permission.



Table 6 Association between participants' characteristics, knowledge, attitudes, and health behaviors of participants.

Dependent variable: Knowledge (Y)	B (95% CI)	SE	β	R ²	ΔR^2
Factor associated knowledge: Model	-	-	-	0.169	0.147
Constant	0.444 (0.305 to 0.582)	0.070	-	-	-
- Attitude: 1) HD needs to be prevented in adolescence	0.103 (0.044 to 0.162)	0.030	0.297	-	-
- Gender	0.073 (0.014 to 0.132)	0.030	0.212	-	-
- Health information sources: Parent/Relative	-0.104 (-0.169 to -0.040)	0.033	-0.277	-	-
R=0.411, R ² =0.169, F=7.738, P=<0.001, Durbin-Watson=2.176					
Factor associated attitudes: Model	-	-	-	0.232	0.219
Constant	1.662 (1.591 to 1.734)	0.036	-	-	-
- Knowledge: 17) High blood sugar puts a strain on the heart (T)	0.185 (0.108 to 0.263)	0.039	0.389	-	-
- Health information sources: Friends	0.104 (0.038 to 0.170)	0.033	0.255	-	-
R=0.482, R ² =0.232, F=17.394, P=<0.001, Durbin-Watson=1.788					
Factor associated health behaviors: Model	-	-	-	0.084	0.068
Constant	2.644 (2.515 to 2.773)	0.065	-	-	-
- Knowledge:					
19) A person who has diabetes can reduce their risk of developing HD if they keep their blood sugar levels under control	0.122 (0.022 to 0.223)	0.051	0.215	-	-
7) Blood pressure control reduces the risk of HD	-0.148 (-0.276 to -0.021)	0.064	-0.026	-	-
R=0.290, R ² =0.084, F=5.283, P=0.006, Durbin-Watson=1.892					

CI, confidence interval; SE, standard error; Δ , difference; HD, heart disease.

Summary

This study provides important insights into the knowledge, attitudes, and health behaviors related to CVDs prevention among middle school students in Thailand. Overall, the participants demonstrated a moderate level of CVD knowledge and generally positive attitudes toward cardiovascular health. Regression analyses revealed that gender, attitudes, and sources of health information significantly influenced CVD knowledge, while specific knowledge items and peer-based information shaped attitudes and preventive behaviors. These findings emphasize that improving cardiovascular literacy alone may not be sufficient; fostering motivation, peer engagement, and accessible health education is equally critical to promoting behavioral change. In conclusion, early educational interventions targeting adolescents are vital to strengthening CVD prevention efforts. Schools represent an ideal platform for implementing comprehensive, peer-led, and digitally supported health promotion programs. By addressing existing knowledge gaps and reinforcing practical behavioral skills, such initiatives can cultivate lifelong heart-healthy habits and reduce the long-term burden of cardiovascular disease.



Implications

The findings underscore the importance of school-based interventions to enhance adolescent CVD knowledge and translate it into healthier behaviors. Digital media platforms, which are the primary source of health information, may be leveraged to deliver targeted, engaging, and interactive educational programs. Furthermore, peer-led education could be a strategic approach to positively influence attitudes and behavior, given the observed role of friends in shaping health perceptions. Interventions should also address gaps in metabolic and dietary knowledge and promote consistent healthy lifestyle behaviors, including adequate sleep, balanced diet, and regular physical activity. This study is appropriate for the context of local prevention to support long-term follow-up research.

Limitations

This study has several limitations. First, the relatively small sample size and single-school setting limit the generalizability of the findings. Second, the use of self-administered questionnaires may introduce recall bias or social desirability bias, potentially affecting the accuracy of reported behaviors and attitudes. Third, the principal limitation of convenience sampling is sampling bias, as selecting participants based on availability typically produces a sample that fails to represent the target population.

Suggestions

Future studies should employ larger, multi-site samples to strengthen the generalizability of the findings to the broader population, and should incorporate objective assessments of diet, physical activity, and anthropometric indicators to corroborate self-reported data.

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