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Original Research

Prevalence of Dyslipidemia and Associated Factors among Adults in Rural Vietnam

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ABSTRACT
Background: Dyslipidemia is a well-recognized cardiovascular risk factor, especially among obese subjects. The aim of this study is to determine the prevalence of dyslipidemia and its risk factors among adults in the rural area of Thai Binh, Vietnam, and assess their relationship to waist circumference (WC) and body mass index (BMI).
Methods: This cross-sectional study was conducted among 1910 adults in Thai Binh Province, Vietnam. Anthropometric (WC and BMI) and biochemical parameters (lipid profile, fasting blood glucose) were measured at Thai Binh General Hospital. Dyslipidemia was diagnosed using National Cholesterol Education Programme (NCEP) guidelines. Moreover, the prevalence of different risk factors was assessed in all participants.
Results: Overall, the prevalence of dyslipidemia was 56.1% in study subjects. Among these participants, 32.1%, 28.7%, 14%, and 24.7% had high serum cholesterol, high triglycerides, low high-density lipoprotein cholesterol (HDL-C), and high low-density lipoprotein cholesterol (LDL-C), respectively. One-tenth of the study subjects were overweight (9.6%). Among the age group, BMI, waist circumference, waist/hip ratio, hypertension level 1, history of hypertension, cardiovascular, gout, metabolic syndrome, and menopause in women were high risk factors for dyslipidemia with OR> 1 and p<0.05.
Conclusions: There were a high prevalence of dyslipidemia among adults in the rural area of Thai Binh, Vietnam. Therefore, screening programs should be carried out in the rural area to detect dyslipidemia early. There is no doubt that lifestyle-based knowledge, education, and interaction services are needed to promote such changes as healthy eating habits, regular exercise, and nicotine cessation in rural communities.
Keywords: cardiovascular disease, cholesterol, epidemiology, lipoprotein, risk factors, Vietnam.
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INTRODUCTION
Dyslipidemia refers to an elevation of plasma cholesterol, triglycerides (TG), or both, and it can worsen atherosclerosis through low high-density lipoprotein (HDL-C) or high low-density lipoprotein (LDL-C) levels. As such, dyslipidemia is a significant risk factor for coronary heart disease (CHD) and stroke.[1,2] Many cases of dyslipidemia in industrialized countries are hyperlipidemia - that is, an accumulation of lipids in the blood, often due to diet and lifestyle.[3]
Economic development and improvements to the standard of living have led to changes in eating habits and lifestyles, which in turn have led to increased hyperlipidemia. These changes have contributed to an increase in the number of people suffering from dyslipidemia and atherosclerotic cardiovascular diseases (ASCVD). Studies have shown that LDL-C appears responsible for for ASCVD, while HDL-C protects from ASCVD. A high level of cholesterol, namely low HDL-C and high LDL-C, is an underlying cause of atherosclerosis; according to National Cholesterol Education Programme (NCEP) recommendations (adult care panel III), high cholesterol is the primary underlying mechanism of a majority of clinical ASCVD cases.[4] Chronic and abnormal increases in TG and total cholesterol concentration lead, for example, to constriction and abstraction of vessels in various parts of the body, especially in the heart.[5] The role of hypercholesterolemia as a major contributing factor for coronary artery disease has been proven; however, the role of TG is controversial,[6] while HDL-C is as a protective factor.[7]
Epidemiological inquiries into dyslipidemias in youth, which emphasize high concentrations of total cholesterol and LDL-C and low levels of HDL-C, provide a foundation for atherosclerotic disease prevention and a decrease in high death rates.[8,9]
The prevalence of dyslipidemia is strong in developed countries. In 2000, about 25% of adolescents in the Americas had a total cholesterol of over 239.4 mg/dL (6.20 mmol/l) or were receiving lipid-lowering drugs. There is a constant, proven association between the total concentration of plasma cholesterol and ischemic cardiac diseases and deaths. Ischemic heart disease is the major cause of mortality in high-income nations and the second in low- and middle-income nations.[10]
A potential association between total cholesterol levels and the risk of cardiovascular diseases (CVD) has been indicated.
This relationship has been found in many populations, including young and elderly, male and female, and patients with or without CVD.[11] In addition, the elevation of LDL-C levels leads to arteriosclerosis.[7] Recent studies have shown that the main blood cholesterol is LDL-C. When the concentration of LDL-C elevates, it accumulates in the intima-media of the artery that feeds the brain and heart, eventually producing plaque.[12] On the other hand, HDL-C is a protective factor in CVD. Low HDL-C levels in conjunction with high TG levels may cause a higher incidence of CVD.[7] An effective approach for the primary prevention of atherosclerosis is detecting dyslipidemia at a young age. Laboratory tests can diagnose dyslipidemia as a component of lipid profile assessment, and

computational modeling can reliably evaluate total body fat and its allocation. However, such methods are intrusive and expensive, and they have restricted access. Thus, for the epidemiological screening of persons at risk of developing dyslipidemia, it is necessary to determine simple-to-use and low-cost approaches. In clinical practice, anthropometric tests remain relevant. Body mass index (BMI), waist circumference (WC), waist-to-hip ratio (WHR), and waist-to-height ratio can be calculated to classify participants' lipid profile relationships, including total cholesterol, triglycerides, high density lipoprotein cholesterol, low density lipoprotein density, lipoprotein cholesterol, and the ratio of total cholesterol to high density lipoprotein cholesterol.[13,14]

In Vietnam, although several studies have focused on dyslipidemia,[15,16,17] there is an overall paucity of studies investigating dyslipidemia in the community, especially in rural areas. Therefore, the aim of the present study is to determine the prevalence of dyslipidemia and its risk factors (especially BMI, WC, WHR) among adults in the rural area of Thai Binh, Vietnam.

METHODS

Study subjects

This is a cross-sectional survey of 1910 adults aged 30 years and older in the rural area of Thai Binh, Vietnam. The research methodology and participant characteristics were previously published.[18,19] All subjects were Kinh, the major ethnic group of Vietnam. The participants gave informed consent to engage in the analysis.

Laboratory analyses

Samples from all participants (n=1910) were obtained through a fasting venous examination and lipid assessment. Samples were solubilized at the survey site within one hour, and the resulting serum was poured into separate tagged bottles and temporarily placed in cold containers until relocated to -80° Celsius freezers in the Thai Binh General Hospital's central laboratory. All biochemical tests were conducted across the study period, using the same process, by the same team of laboratory staff. Total cholesterol, TG, and HDL-C were assessed. The Beckman Coulter AU 2700/480 Autoanalyser (Beckman AU [Olympus], Ireland) was used to test serum triglycerides (glycerol phosphate oxidase-peroxidase-amidopyrine method), serum cholesterol (cholesterol esterase oxidase-peroxidase-amidopyrine method), and high-density lipoprotein cholesterol (direct polyethylene-glycol pretreated enzymes). For biochemical tests, the intra- and inter-assay coefficients of variants varied between 3.1% and 7.6%.

NCEP guidelines were used to determine patients with dyslipidemia, including the following types.[4] Patients with serum cholesterol levels at least 200 mg/dl (5.2 mmol/l) were diagnosed with hypercholesterolemia. The cut-off point of hypertriglyceridemia was 150 mg/dl (1.7 mmol/l). Patients were identified with low HDL-C cholesterol if the serum level was under 40 mg/dl (1.04 mmol/l) or 50 mg/dl (1.3 mmol/l) for males and females, respectively. LDL-C levels were determined by the Friedewald formula, with a cut-off point equal to or higher than 130 mg/dl (3.4 mmol/l).

Anthropometric measurement

Anthropometric measures included height, weight, and the diameters of the waist and hips. BMI was determined using reference body weight and height ratios (kg/m^2). Body fat was assessed on an analyzer using a bioelectric impedance tool (TBF-511, Tanita Co., Ltd., Tokyo, Japan).

Body weight: Body weight was measured using an electronic weighing scale (TBF-511, Tanita Co., Ltd., Tokyo, Japan) with a precision of 100 g.

Body height: Body height was measured among older using locally made wooden boards (stadiometer) with a precision of 1 mm.

Waist and hip circumference: WC and hip circumference were calculated three ways: at the middle point between the bottom of the rib cage, at the tip of the iliac crest, and through average buttock protrusion (hip circumference). The average value of these three measurements was determined for the overall waist-and-hip circumference. The WHR was determined by hip circumference divided by WC.

Body mass index: BMI was determined on the basis of kilogram weight divided by height in square meters (kg/m^2). We used absolute BMI to measure underweight, obese, and overweight. BMI has been frequently used to categorize the fitness condition of adults. Absolute BMI parameters were used to categorize the state of individual nutrition as follows: <16.0 (severe underweight), 16 to <17 (moderate underweight), 17 to 18.5 (mild underweight), 18.5 to 25 (normal), 25 to <30 (overweight), and ≥30 (obese).

WHR about 0.9 or WC about 90 cm in men and WHR about 0.80 or WC about 80 cm in women were used as the cut-offs for abdominal obesity, as indicated by the World Health Organization (WHO) guidelines for the Asia-Pacific Region.

Statistical analyses

For analysis of continuous variables, we used the t-test. Exact percentages and frequencies were used to convey categorical results. Regarding categorical variables, we used Fisher's exact test and the Chi-squared method. To describe statistically significant results, a two-sided p-value of <0.05 was used. Research was carried out using SPSS 13.0 (SPSS Inc, Chicago, IL, United States).

Ethical consideration

The research procedure was approved by the ethical commission of the Thai Binh University of Medicine and Pharmacy, Vietnam (No. 584.1/QĐ-YTB). Written informed consent was provided by each participant before entering the study.

RESULTS

Table 1 shows that the average age of the study participants was 56.4 years, with no difference between men and women. The average BMI of males was 21.2, higher than that of females. Similarly, the average WC and WHR of men were also higher than for women. This difference was statistically significant with p<0.001. In men, biochemical indices such as

Table 1. Average values of several anthropometric and laboratory indicators

Variables	Average values according to sex (mean±SD)		P-value
	Male (n=935)	Female (n=975)	
Age (year)	56.5±12.9	56.2±12.9	>0.05
BMI (kg/m^2)	21.2±2.7	20.9±2.7	<0.05
Waist circumference (cm)	75.0±7.5	72.0±7.5	<0.001
WHR (cm)	0.86±0.05	0.83±0.06	<0.001
Glucose (mmol/l)	5.1±1.4	4.9±1.3	0.002

Triglyceride (mmol/l)	2.2±2.1	1.96±1.5	0.15*
Cholesterol (mmol/l)	4.7±1.2	4.9±1.2	< 0.01
HDL-C (mmol/l)	1.14±0.3	1.15±0.24	0.46
LDL-C (mmol/l)	2.7±1.0	2.9±1.14	<0.01
Systolic blood pressure (mmHg)	130.8±22.3	125.8±22.8	<0.01
Diastolic blood pressure (mmHg)	80.4±12.1	78.1±12.2	<0.01

: Mann-Whitney U test

Table 2. Characteristics of nutritional status, physical activity, and prevalence and history of some related diseases

	Prevalence of risk factors according to gender		P-value
	Male (n=935)	Female (n=975)	
Body mass index (BMI)			
Underweight	162 (17.3)	187 (19.2)	
Normal	666 (71.2)	712 (73.0)	<0.05
Overweight - Obesity	107 (11.4)	76 (7.8)	
High waist circumference	25 (2.7)	141 (14.5)	<0.001
High WHR	205 (21.9)	525 (53.8)	<0.001
Physical activity			
Static	162 (17.3)	164 (16.8)	
Low	142 (15.2)	158 (16.2)	<0.001
Moderate	531 (56.8)	619 (63.5)	
High	100 (10.7)	34 (3.5)	
Prevalence of some related diseases			
Hypertension	219(23.4)	188 (19.3)	<0.05
Hypertension and history of hypertension	310 (33.2)	280 (28.7)	<0.05
Hypercholesterolemia	266 (28.4)	348 (35.7)	<0.05
Hypertriglyceridemia	291(31.1)	257 (26.4)	<0.05
Low HDL	168 (18.0)	99 (10.2)	<0.05
High LDL	186 (19.9)	286 (29.3)	<0.05
Dyslipidemia	528 (56.5)	543 (55.7)	>0.05
Personal history			
Hypertension	224(24.0)	199 (20.4)	>0.05
Cardiovascular diseases	124 (13.3)	155 (15.9)	>0.05
Dyslipidemia	68 (7.3)	77 (7.9)	>0.05
Diabetes mellitus	48 (5.1)	28 (2.9)	<0.05
Family history			
Cardiovascular diseases	108 (11.6)	117 (12.0)	>0.05
Dyslipidemia	120 (12.8)	60 (6.2)	<0.05
Diabetes mellitus	16 (1.7)	32 (3.3)	<0.05

cholesterolemia, blood glucose, LDL-C, blood pressure index were significantly higher than in women. The study subjects had an average BMI of 21.1 kg/m^2, an average waistline of 73.6 cm, an average blood glucose level of 5.0 mmol/l, and an average cholesterolemia content of 4.8 mmol/l.

Table 2 shows that the rate of underweight participants was 18.3% and the rate of overweight and obese participants was 8.7%, both of which were higher in males than in females. However, when nutritional status was evaluated according to WC and WHR, the incidence poor nutrition in women was significantly higher than that in men. The level of physical activity for males was 10.7%, or 3.5% higher than for females, which was a significant difference (p<0.001). Prevalence of hypertension was 21.3%, which was higher in males than in females. Among dyslipidemia, the ratio of hypercholesterolemia and low HDL-C in males was higher than those in females. The differences in the incidence of dyslipidemia were statistically significant. More than 20% of the study participants had a history of hypertension; 14.6% had a history of cardiovascular disease; and 7.6% had a history of dyslipidemia, while the prevalence of participants suffering from dyslipidemia was over 50%. Family history of hypertension and dyslipidemia were 10%, approximately.

Table 3 shows the rate of dyslipidemia according to age group and gender. The average cholesterolemia level was 4.82 µmol/l, with an average of 4.72 µmol/l for males and 4.92 µmol/l for females. The average cholesterolemia concentration for the 30–39 and 40–49 age groups in male participants were higher than in females. However, in the 50–59, 60–69, and 70–79 age groups, female participants were higher than males. Cholesterolemia levels increased gradually with age in both men and women. Correspondingly, the average of hypercholesterolemia in males was 28.4% with an estimated 95% confidence interval (CI) of 25.5–31.3%. For females, the prevalence rate was 35.7% with an estimated 95% CI of 32.7–38.7%. The overall incidence was 32.1% (95% CI: 30.0–34.2%) with incidence in females significantly higher than in males (p<0.05).

The average triglyceridemia concentration was 2.06 µlmol/l. The average concentration in the 70–79 age group in females was higher than in males, but in the remaining age groups, the concentration was higher in males. Correspondingly, the rate of hypertriglyceridemia in males was 31.1% with an estimated 95% CI of 28.1–34.1%. The rate of hypertriglyceridemia in females was 26.4% with an estimated 95% CI of 23.6–29.2%. The overall incidence was 28.7% (95% CI: 26.7–30.7%). In age groups under 70 years, the rate of hypertriglyceridemia in females was lower than in males, but in age groups over 70 years, the rate in females was higher than in males.

Table 4 shows that the average HDL concentration was 1.14 µmol/l, with no difference between males and females. The rate of overall low HDL was 14.0% (95% CI: 12.4–15.6%). In particular, the rate of low HDL in males was higher than in females: in males, it was 18.0% with an estimated 95% CI of 15.5–20.5%; in women, it was 10.2% with an estimated 95% CI of 8.3–12.1% (with p<0.05). In the age group <80 years, the rate of low HDL in males was higher than in females. The average LDL concentration was 2.79 µmol/l, with the rate in females higher than in males (p <0.05).

The average concentration of the age group 30–39 years was higher in males than in females, but in the remaining age groups, females were higher than males. LDL concentrations

Table 3. Average concentration and rate of dyslipidemia by age group and gender

Age group and gender	n	Cholesterolemia		Triglyceridemia	
		Average concentration [Mean±SD (μmol/l)]	Hypercholesterolemia [% (95%CI)]	Average concentration [Mean±SD (μmol/l)]	Hypertriglyceridemia [% (95%CI)]
Men group					
30-39	118	4.56±1.42	19.5 (12.4-26.7)	2.45±3.69	30.5 (22.2-38.8)
40-49	165	4.68±0.91	22.4 (16.0-28.7)	2.14±1.78	29.1 (22.2-36.0)
50-59	246	4.68±1.38	26.4 (20.9-31.9)	2.16±2.14	31.3 (25.5-37.1)
60-69	245	4.79±1.06	34.7 (28.7-40.7)	2.23±1.66	35.5 (29.5-41.5)
70-79	124	4.72±1.02	29.8 (21.7-37.9)	1.93±1.33	29.8 (21.7-37.9)
80 +	37	5.08±1.18	51.4 (35.3-67.5)	1.94±1.67	16.2 (4.3-28.1)
P-value		*p>0.05*	*p<0.05*	*p>0.05*	*p>0.05*
Women group					
30-39	121	4.20±1.03	10.7 (5.2-16.2)	1.49±1.24	13.2 (7.2-19.2)
40-49	178	4.59±1.03	24.2 (17.9-30.5)	1.81±1.22	21.3 (15.3-27.3)
50-59	254	5.08±1.21	39.4 (33.4-45.4)	2.02±1.36	29.5 (23.9-35.1)
60-69	254	5.18±1.19	46.1 (40.0-52.2)	2.20±2.01	31.5 (25.8-37.2)
70-79	127	5.21±1.26	46.5 (37.8-55.2)	2.02±1.19	32.3 (24.2-40.4)
80 +	41	5.08±1.39	39.0 (24.1-53.9)	1.87±1.13	17.1 (5.6-28.6)
P-value		*p<0.001*	*p<0.05*	*p<0.05*	*p<0.05*
Gender					
Men	935	4.72±1.18	28.4 (25.5-31.3)	2.17±2.13	31.1 (28.1-34.1)
Women	975	4.92±1.22	35.7 (32.7-38.7)	1.96±1.51	26.4 (23.6-29.2)
Total	1910	4.82±1.20	32.1 (30.0-34.2)	2.06±1.84	28.7 (26.7-30.7)
P-value		*p<0.001*	*p<0.05*	*p<0.05*	*p<0.05*

Table 4. Average concentration and rate of HDL and LDL in age groups and gender

Age group and gender	n	Low HDL		High LDL	
		Average concentration [Mean±SD (μmol/l)]	Hypercholesterolemia [% (95%CI)]	Average concentration [Mean±SD (μmol/l)]	Hypertriglyceridemia [% (95%CI)]
Male group					
30-39	118	1.10±0.30	24.6(16.8-32.4)	2.45±0.90	13.6(7.4-19.8)
40-49	165	1.18±0.32	12.1(7.1-17.1)	2.62±1.00	20.0(13.9-26.1)
50-59	246	1.10±0.27	20.7(15.6-25.8)	2.66±0.95	17.9(13.1-22.7)
60-69	245	1.15±0.31	18.4(13.6-23.3)	2.70±1.02	22.9(17.6-28.2)
70-79	124	1.14±0.28	15.3(8.9-21.6)	2.72±0.95	17.7(11.0-24.4)
80 +	37	1.19±0.29	10.8(0.8-20.8)	3.16±1.08	40.5(24.7-56.3)
P-value		*p>0.05*	*p>0.05*	*p<0.05*	*p<0.05*
Female group					
30-39	121	1.14±0.24	9.1(3.9-14.2)	2.40±0.94	9.9(4.6-15.2)
40-49	178	1.16±0.24	7.9(3.9-11.9)	2.63±1.00	20.2(14.3-26.1)
50-59	254	1.14±0.24	10.6(6.8-14.4)	3.04±1.14	35.4(29.5-41.3)
60-69	254	1.16±0.25	9.4(5.8-13.0)	3.09±1.09	35.0(29.1-40.9)
70-79	127	1.12±0.24	12.6(6.8-18.4)	3.19±1.23	36.2(27.8-44.6)
80 +	41	1.12±0.27	17.1(5.6-28.6)	3.15±1.43	31.7(17.5-45.9)
P-value		*p<0.05*	*p>0.05*	*p<0.001*	*p<0.05*
Gender					
Men	935	1.14±0.30	18.0(15.5-20.5)	2.66±0.98	29.3(26.4-32.2)
Women	975	1.15±0.24	10.2(8.3-12.1)	2.92±1.14	19.9(17.3-22.5)
General	1910	1.14±0.27	14.0(12.4-15.6)	2.79±1.07	24.7(22.8-26.6)
P-value		*p>0.05*	*p<0.05*	*p<0.001*	*p<0.05*

increased with age in both males and females. The high LDL concentration in males was 29.3% with an estimated 95% CI of 26.4–32.2%. The prevalence for high LDL concentration in females was 19.9% with an estimated 95% CI of 17.3–22.5%. The overall incidence of hypertriglyceridemia was 24.7% (95% CI: 22.8–26.6%).

Table 5 shows the average concentration and rate of hypercholesterolemia according to nutritional status. The average concentration and rate of hypercholesterolemia were the lowest in the underweight group (4.74 μmol/l and 28.9%, respectively) and the highest in overweight-obesity group (5.05 μmol/l and 43.2%, respectively). Hypercholesterolemia in abnormal WC and WHR groups were higher than in normal groups. The difference was statistically significant with p <0.05.

Table 6 shows that the average dyslipidemia rate of overweight-obesity participants was 70.5%, which was 1.9 times higher than that of the normal groups. Similarly, the dyslipidemia rate of abnormal WC was 3.3 times higher than that of the normal group. The risk of dyslipidemia in abnormal WHR was 1.9 times higher than that of the normal group.

Table 5. Average concentration and rate of dyslipidemia according to anthropometric indicators

Anthropometric indicator	n	Cholesterolemia		Triglyceridemia	
		Average concentration [Mean±SD (μmol/l)]	Hypercholesterolemia [% (95%CI)]	Average concentration [Mean±SD (μmol/l)]	Hypertriglyceridemia [% (95%CI)]
BMI					
Underweight	349	4.74±1.24	29.8(25.0-34.6)	1.74±2.24	17.8(13.8-21.8)
Normal	1378	4.82±1.21	31.3(28.8-33.7)	2.09±1.74	29.6(27.2-32.0)
Overweight-Obesity	183	5.05±1.06	43.2(36.0-50.4)	2.47±1.67	42.6(35.4-49.7)
P-value		*p<0.05*	*p<0.05*	*p<0.001*	*p<0.05*
Waist circumference					
Normal	1744	4.76±1.17	30.0(27.8-32.1)	2.00±1.82	27.0(24.9-29.1)
Abnormal	166	5.45±1.32	54.8(47.2-62.4)	2.73±1.91	46.4(38.8-54.0)
P-value		*p<0.05*	*p<0.05*	*p<0.05*	*p<0.05*
WHR					
Normal	1180	4.69±1.17	26.9(24.4-29.4)	1.87±1.87	22.4(20.0-24.8)
Abnormal	730	5.03±1.23	40.9(37.3-44.5)	2.38±1.75	38.9(35.4-42.4)
P-value		*p<0.001*	*p<0.05*	*p<0.001*	*p<0.05*

Table 6. Relationship between dyslipidemia according to anthropometric indicators

Anthropometric indicators		n	Dyslipidemia (%)	OR 95% CI	p-value
BMI	Normal	1378	55.4	1	<0.05
	Overweight-Obesity	183	70.5	1.9(1.4-2.7)	
Waist circumference	Normal	1744	53.8	1	<0.05
	Abnormal	166	79.5	3.3(2.3-4.9)	
WHR	Normal	1180	49.9	1	<0.05
	Abnormal	730	66.0	1.9(1.6-3.4)	

DISCUSSION

Our study was conducted in four communes in the Vu Thu District, Thai Binh Province, a rural area in the Northern Delta region, and in the context of WHO's recommendations for non-communicable diseases that are seriously affecting household incomes and national economy, especially in middle- and low-income countries. BMI is used to assess nutritional status in adults, especially to identify overweight and obese adults. Being overweight or obese is a major risk factor for cardiovascular diseases (such as ischemic stroke, ischemic heart disease, hypertension), gastrointestinal and other types of cancer, chronic kidney disease, rheumatism, and lower back pain. In this study, the category "overweight and obesity" comprises 8.7% of participants, with more males than females. Another study in the Vu Thu District showed even greater results: the rate of overweight and obese accounted for 9.8%, of which males were higher than females.[20,21] About 1% of total deaths are caused by being overweight/obese, and this category represents 0.9% of the burden of disease calculated by disability-adjusted life year in Vietnam in 2010. Diabetes and cardiovascular diseases are the main health problems connected to being overweight/obese.

Excessive weight is a health problem not only in Vietnam but also in countries around the world. In China, from 1992 to 2002, the rate of overweight/obese adults increased in both men and women of all ages and in both rural and urban areas, specifically the excess rate: obesity increased from 16.4% and 3.6% in 1992 to 22.8% and 7.1% in 2002, and this research also showed that an increase in obesity played an important part in cardiovascular risk.[22] In Thailand, the second National Health Survey described overweight and obesity rates and the relationship with demographic and social factors for 3220 adults aged 20–59: the overall rate of overweight and obesity (BMI ≥25) was 28.3%, which varied by region and was related to age, gender, and smoking status.[23] WHO suggests using BMI to classify overweight/obese individuals. However, BMI does not fully reflect the distribution of body fat or risks to health. A high waist-to-waist ratio was accepted as a measurement to identify subjects who had accumulated abdominal fat and were at a greater risk of cardiovascular disease. The results of Table 3 show that when using the high waist and high waist-to-butt ratios to assess abdominal obesity, the ratios are 8.7% and 38.2%, respectively, with females significantly higher than males.

High WHR rates are associated with obesity rates as measured by BMI, both in Vietnam and in other countries. According to a study of urban areas in Pakistan, obesity rates were 34% in males and 49% in females, whereas high abdominal obesity (VE/VM) was 41% in males and 72% in females, and increasing in proportion with age.[24]

The relationship between assessing obesity by BMI, WC, and WHR with at least one cardiovascular risk factor was also noted in a study of adults in Singapore.[25] Thus, overweight and obesity are emerging health problems, which tend to increase rapidly, especially in urban areas; their associated health consequences are non-communicable chronic diseases, which have been and continue to be problematic. The problem is faced in many developing countries, as well as Vietnam. Because of this, in 2012, the Prime Minister issued Decision 226/QD-TTg, approving the National Strategy on Nutrition for the period of 2011–2020 and a vision statement for 2030, which included the goal of "Step by step checking [to] effectively control overweight-obesity and risk factors of some non-communicable chronic diseases related to adult nutrition".[26]

Non-communicable diseases are a global challenge and a huge burden on society and the health system. According to WHO estimates in 2010, 36 out of a total of 57 million global deaths were related to obesity, accounting for nearly two-thirds of non-communicable disease.[27] At present, non-communicable diseases are often misunderstood as health problems limited to high-income countries, but the greatest burden of non-communicable diseases is felt in low- and middle-income countries.

CONCLUSION

Our research indicated that the characteristics of dyslipidemia among adults aged 30 and older in rural Thai Binh increased with nutritional status (underweight, normal, overweight, and obese). Groups with high WC and WHR also had higher cholesterol, TG, LDL-C, and HDL-C compared to normal groups. Age, BMI, WC, and WHR are all risk factors for dyslipidemia with OR>1 and $p<0.05$. Therefore, weight control, especially for abdominal obesity, will be an important contribution to the prevention of dyslipidemia and coronary artery disease.

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CONFLICT OF INTEREST

The authors had no conflicts of interest to declare in this work.

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