Prevalence and Related Factors of Dyslipidemia among Adults Aged 35 to 79 years in Southwest China

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Abstract

This study aimed to investigate the prevalence of dyslipidemia and its related factors among adults aged 35 to 79 years in southwest China. From September 2013 to March 2014, a multi-stage, stratified sampling was conducted on 10221 people aged 35–79 years living in Chengdu and Chongqing by using the method of field questionnaire survey and measurement. The prevalence of high triglycerides (≥ 2.3 mmol/L), high total cholesterol (≥ 6.2 mmol/L), high low-density lipoprotein cholesterol (≥ 4.1 mmol/L), low high-density lipoprotein cholesterol (< 1.0 mmol/L), and dyslipidemia were 15.7%, 5.4%, 2.5%, 5.7%, and 27.4%, respectively. The prevalence of dyslipidemia was positively correlated with higher education level, monthly income over 2000 yuan, smoking, hypertension, diabetes, overweight and obesity, and central obesity, and negatively correlated with daily physical exercise. The prevalence of dyslipidemia in southwest China is lower than the national average level, but on the rise, with high triglycerides as the main type of dyslipidemia.

Introduction

Arteriosclerotic cardiovascular disease(ASCVD)is the leading cause of death in both developed countries[1,2]and most developing countries, including China[3].The 2007 overall death rate[2] from CVD was 251.2 per 100 000. Dyslipidemia is one of the most important risk factors for ASCVD[4], leading to atherosclerosis[5], increased morbidity, and mortality from coronary heart disease[6] and ischemic stroke[7].In recent years, with the rapid growth of the social economy, the prevalence of dyslipidemia in Chinese adults has been increasing gradually[6,8,9,10]. As representatives of southwest China, Chengdu and Chongqing, with the title of Chengdu-Chongqing economic circle, have also been faced with rapid economic development in recent years. However, there have been almost no epidemiological investigations related to dyslipidemia in southwest China. We, therefore, conducted this cross-sectional survey to provide advice on dyslipidemia management.

Results

Demographic and clinical characteristics of the study participants

The basic characteristics of this study are shown in Table 1. Among the 10,221 respondents, 3,474 were men and 6,747 were women. The mean age was 55.0 ± 10.7 years, and the mean age of men was higher than that of women. Men have higher rates of monthly income over 2000 yuan, smoking, drinking, and daily exercise. The 2 h blood glucose, triglycerides, TC, HDL-C, and LDL-C levels were lower in men, and there was no significant difference in fasting blood glucose levels. Men had higher WC, SBP, DBP levels, and lower BMI levels. The prevalence of hypertension in men was slightly higher than that in women, and there was no significant difference in the prevalence of diabetes.

Table 1
Demographic and clinical characteristics of the study participants

Variables	Total (n = 10221)	Male (n = 3474)	Female (n = 6747)	*P*
Age (years old), mean (SD)	55.0(10.7)	56.2(10.9)	54.3(10.5)	< 0.001
Married (%)	9321(91.2)	3311(95.3)	6010(89.1)	< 0.001
High school education or above (%)	2424(23.7)	1116(32.1)	1308(19.4)	< 0.001
Monthly income (≥ 2000 yuan) (%)	1925(18.8)	831(23.9)	1094(16.2)	< 0.001
Current cigarette smoking (%)	2288(22.4)	2082(59.9)	206(3.1)	< 0.001
Alcohol drinking (%)	205(2.0)	199(5.7)	6(0.1)	< 0.001
Regular physical exercise (%)	428(4.2)	194(5.6)	234(3.5)	< 0.001
Hypertension (%)	3780(37.0)	1348(38.8)	2432(36.0)	0.006
Diabetes mellitus (%)	2111(20.7)	701(20.2)	1410(20.9)	0.395
BMI (kg/m^2), mean (SD)	23.9(3.5)	23.6(3.2)	24.0(3.6)	< 0.001
WC (cm), mean (SD)	81.1(10.4)	82.6(10.3)	80.3(10.4)	< 0.001
SBP (mmHg), mean (SD)	130.8(21.2)	132.7(19.9)	129.8(21.8)	< 0.001
DBP (mmHg), mean (SD)	78.4(11.3)	80.4(11.2)	77.4(11.2)	< 0.001
Fast glucose (mmol/L), mean (SD)	5.7(1.8)	5.7(1.9)	5.6(1.7)	0.239
2-h plasma glucose (mmol/L), mean (SD)	7.9(3.8)	7.7(3.8)	8.0(3.8)	< 0.001
Triglyceride (mmol/L), median (interquartile range)	1.3(0.9–1.9)	1.2(0.9–1.9)	1.3(0.9–1.9)	0.010
Total cholesterol (mmol/L), mean (SD)	4.6(0.9)	4.5(0.9)	4.7(0.9)	< 0.001

BMI, body mass index; WC, waist circumference; SBP, systolic blood pressure; DBP, diastolic blood pressure;

Variables	Total (n = 10221)	Male (n = 3474)	Female (n = 6747)	*P*
HDL cholesterol (mmol/L), mean (SD)	1.4(0.4)	1.3(0.4)	1.4(0.3)	< 0.001
LDL cholesterol (mmol/L), mean (SD)	2.5(0.8)	2.5(0.8)	2.6(0.8)	< 0.001

BMI, body mass index; WC, waist circumference; SBP, systolic blood pressure; DBP, diastolic blood pressure;

Age-specific prevalence of dyslipidemia

Figure 1 shows the relationship between age, gender, and the prevalence of different types of dyslipidemia. High TG: In men, compared with those in the 35–44 years stratum, it reached the highest in the 45–54 years stratum, and then decreased again in the 55–64 and 65–79 years. In women, the prevalence of high TG increased with age. High TC: In men, there was no significant change with age, while in women, the incidence of high TC increased with age. High LDL-C: In men, the prevalence increased with age, reaching the highest in the 55–64 age group, and then decreased. In women, the prevalence fluctuated with age. Low HDL-C: In men, the prevalence was highest in the 35–44 age group and then declined. Among women, there was no significant change. Dyslipidemia: Prevalence decreased with age in men and increased with age in women.

Sex- and age-specific mean of dyslipidemia

Table 2 shows the lipid levels of different genders and ages. In men, triglyceride levels showed a downward trend with age, while LDL-C and HDL-C levels showed an upward trend, with no significant change in TC levels. In women, triglycerides, TC, and LDL-C levels showed an upward trend, while HDL-C levels showed no significant trend.

Table 2
Sex- and age-specific mean (95% confidence interval) of serum total cholesterol, HDL cholesterol, LDL cholesterol, and triglyceride levels among adults aged ≥ 35 years in southwest China

Variables	TG†(mmol/L)	TC(mmol/L)	LDL-C(mmol/L)	HDL-C(mmol/L)
Sex- and age-specific				
Male, age (years old)				
35–44	1.40 (1.34–1.46)	4.48 (4.42–4.55)	2.40 (2.34–2.45)	1.28 (1.26–1.30)
45–54	1.47 (1.41–1.54)	4.52 (4.46–4.58)	2.43 (2.38–2.49)	1.40 (1.36–1.44)
55–64	1.28 (1.24–1.32)	4.48 (4.43–4.53)	2.48 (2.43–2.52)	1.35 (1.33–1.36)
65–79	1.22 (1.17–1.26)	4.52 (4.46–4.58)	2.56 (2.51–2.62)	1.35 (1.33–1.38)
P value for linear trend‡	< 0.001	0.669	< 0.001	0.013
Female, age (years old)				
35–44	1.24 (1.20–1.27)	4.48 (4.44–4.53)	2.36 (2.33–2.40)	1.40 (1.38–1.41)
45–54	1.31 (1.28–1.34)	4.69 (4.65–4.73)	2.55 (2.51–2.58)	1.50 (1.48–1.52)
55–64	1.44 (1.41–1.47)	4.81 (4.77–4.85)	2.66 (2.63–2.70)	1.45 (1.44–1.47)
65–79	1.50 (1.45–1.55)	4.87 (4.82–4.93)	2.66 (2.61–2.71)	1.42 (1.40–1.43)
P value for linear trend‡	< 0.001	< 0.001	< 0.001	0.491

TG, triglyceride; TC, total cholesterol; LDL-C, low density lipoprotein cholesterol; HDL-C, high density lipoprotein cholesterol.

†Serum triglyceride measurements have a right-skewed distribution, so geometric mean and 95% confidence interval are calculated.

‡*P* value from linear regression.

Prevalence of dyslipidemia by selected characteristics

Table 3 shows the relationship between different factors and the prevalence of dyslipidemia. The prevalence rates of high TG, high TC, high LDL-C, low HDL-C, and dyslipidemia were 15.7%, 5.4%, 2.5%, 5.7%, and 27.4%, respectively. The prevalence of dyslipidemia increased with age, and the prevalence of

dyslipidemia was higher in men (30.2%) than in women (25.9%). Elevated TG was related to daily exercise, hypertension, diabetes, overweight, and central obesity. TC increased with age, gender, marital status, education level, smoking status, high blood pressure, diabetes, overweight, and central obesity. Elevated LDL-C was associated with age and diabetes. Lower HDL-C was associated with gender, education level, income, smoking status, high blood pressure, overweight, and central obesity. Dyslipidemia was associated with age, sex, education, monthly income, smoking status, daily exercise, hypertension, diabetes, overweight, and central obesity.

Table 3
Prevalence of dyslipidemia by selected characteristics

Variables	Characteristics	High TG	High TC	High LDL-C	Low HDL-C	Dyslipidemia
All		1601 (15.7)	548 (5.4)	257 (2.5)	582 (5.7)	2796 (27.4)
Age (years old)	35–44	322 (14.3)	97 (4.3)	27 (1.2)	160 (7.1)	531 (23.6)
	45–54	436 (16.8)	122 (4.7)	63 (2.4)	112 (4.3)	683 (26.3)
	55–64	510 (15.4)	181 (5.5)	94 (2.8)	180 (5.4)	955 (28.8)
	65–79	333 (16.2)	148 (7.2)	73 (3.6)	130 (6.3)	627 (30.5)
	P_{Trend}	0.264	< 0.001	< 0.001	0.544	< 0.001
Gender	Female	1043 (15.5)	409 (6.1)	176 (2.6)	214 (3.2)	1748 (25.9)
	Male	558 (16.1)	139 (4.0)	81 (2.3)	368 (10.6)	1048 (30.2)
	P	0.427	< 0.001	0.397	< 0.001	< 0.001
Married	No	135 (15.0)	64 (7.1)	27 (3.0)	40 (4.4)	230 (25.6)
	Yes	1466 (15.7)	484 (5.2)	230 (2.5)	542 (5.8)	2566 (27.5)
	P	0.566	0.015	0.330	0.090	0.205
High school education or above	No	1203 (15.4)	466 (6.0)	201 (2.6)	383 (4.9)	2062 (26.4)
	Yes	398 (16.4)	82 (3.4)	56 (2.3)	199 (8.2)	734 (30.3)
	P	0.241	< 0.001	0.462	< 0.001	< 0.001
Monthly income (≥ 2000 yuan)	No	1286 (15.5)	456 (5.5)	205 (2.5)	425 (5.1)	2179 (26.3)
	Yes	315 (16.4)	92 (4.8)	52 (2.7)	157 (8.2)	617 (32.1)
	P	0.348	0.208	0.561	< 0.001	< 0.001

Variables	Characteristics	High TG	High TC	High LDL-C	Low HDL-C	Dyslipidemia
Current cigarette smoking	No	1215 (15.3)	462 (5.8)	212 (2.7)	331 (4.2)	2092 (26.4)
	Yes	386 (16.9)	86 (3.8)	45 (2.0)	251 (11.0)	704 (30.8)
	P	0.071	< 0.001	0.058	< 0.001	< 0.001
Alcohol drinking	No	1566 (15.6)	540 (5.4)	253 (2.5)	567 (5.7)	2738 (27.3)
	Yes	35 (17.1)	8 (3.9)	4 (2.0)	15 (7.3)	58 (28.3)
	P	0.575	0.349	0.603	0.311	0.761
Regular physical exercise	No	1567 (16.0)	526 (5.4)	251 (2.6)	557 (5.7)	2709 (27.7)
	Yes	34 (7.9)	22 (5.1)	6 (1.4)	25 (5.8)	87 (20.3)
	P	< 0.001	0.835	0.133	0.893	0.001
Hypertension	No	828 (12.9)	302 (4.7)	157 (2.4)	328 (5.1)	1483 (23.0)
	Yes	773 (20.4)	246 (6.5)	100 (2.6)	254 (6.7)	1313 (34.7)
	P	< 0.001	< 0.001	0.517	0.001	< 0.001
Diabetes mellitus	No	1055 (13.0)	363 (4.5)	176 (2.2)	445 (5.5)	1953 (24.1)
	Yes	546 (25.9)	185 (8.8)	81 (3.8)	137 (6.5)	843 (39.9)
	P	< 0.001	< 0.001	< 0.001	0.077	< 0.001
Overweight or obesity	No	563 (10.1)	266 (4.8)	146 (2.6)	231 (4.2)	1133 (20.4)
	Yes	1038 (22.3)	282 (6.0)	111 (2.4)	351 (7.5)	1663 (35.7)
	P	< 0.001	0.005	0.430	< 0.001	< 0.001
Central obesity	No	818 (11.5)	357 (5.0)	177 (2.5)	334 (4.7)	1611 (22.7)

Variables	Characteristics	High TG	High TC	High LDL-C	Low HDL-C	Dyslipidemia
	Yes	783 (25.0)	191 (6.1)	80 (2.6)	248 (7.9)	1185 (37.8)
	P	< 0.001	0.028	0.864	< 0.001	< 0.001

Multivariable-adjusted ORs and 95%CI for dyslipidemia

In Table 4, through multivariate logistic regression analysis, we found that the relationship between each factor and the prevalence of different types of dyslipidemia was as following. High TG was positively correlated with high school education, smoking, hypertension, diabetes, overweight and obesity, central obesity, but negatively correlated with daily physical exercise. Compared with 35–44 years old, TG elevation was higher in 45–54 years old but lower in 65–79 years old. For high TC, there was a positive correlation with diabetes, and a negative correlation was found for women with high school education or above. Compared with 35–44 years old, 65–79 years old group had a higher incidence of TC elevation. Elevated LDL-C was positively correlated with age and diabetes. Decreased HDL-C was positively correlated with female, high school education, monthly income over 2000 yuan, smoking, overweight and obesity, and central obesity but negatively correlated with age (35–44 years of age as a reference). Dyslipidemia was positively correlated with high school education, monthly income over 2000 yuan, smoking, hypertension, diabetes, overweight and obesity, central obesity, but negatively correlated with daily physical exercise.

Table 4
Multivariable-adjusted *OR*s and 95% *CI* for dyslipidemia among adults aged 35 years or older in southwest China

Variables	Characteristics	High TG	High TC	High LDL-C	Low HDL-C	Dyslipidemia
Age (years old)	35–44	1	1	1	1	
	45–54	1.19 (1.01–1.39)	1.10 (0.83–1.44)	2.05(1.30–3.24)	0.60 (0.47–0.78)	
	55–64	0.88 (0.75–1.03)	1.13 (0.87–1.47)	2.27 (1.47–3.50)	0.71 (0.56–0.89)	
	65–79	0.76 (0.64–0.91)	1.46 (1.12–1.92)	2.70 (1.72–4.24)	0.74 (0.58–0.95)	
Gender	Female		1		1	
	Male		0.67 (0.55–0.82)		2.80 (2.23–3.52)	
High school education or above	No	1	1		1	1
	Yes	1.30 (1.14–1.48)	0.64 (0.50–0.82)		1.51 (1.24–1.84)	1.40 (1.25–1.56)
Monthly income (≥ 2000 yuan)	No				1	1
	Yes				1.27 (1.03–1.56)	1.23 (1.10–1.38)
Current cigarette smoking	No	1			1	1
	Yes	1.33 (1.17–1.52)			1.54 (1.23–1.92)	1.38 (1.24–1.54)
Alcohol drinking	No					
	Yes					
Regular physical exercise	No	1				1

Variables	Characteristics	High TG	High TC	High LDL-C	Low HDL-C	Dyslipidemia
	Yes	0.49 (0.34–0.71)				0.72 (0.56–0.92)
Hypertension	No	1				1
	Yes	1.34 (1.19–1.51)				1.38 (1.26–1.52)
Diabetes mellitus	No	1	1	1		1
	Yes	2.03 (1.79–2.30)	1.86 (1.54–2.25)	1.61 (1.22–2.12)		1.77 (1.59–1.97)
Overweight or obesity	No	1			1	1
	Yes	1.76 (1.54–2.01)			1.65 (1.35–2.03)	1.71 (1.54–1.90)
Central obesity	No	1			1	1
	Yes	1.78 (1.56–2.03)			1.66 (1.35–2.04)	1.43 (1.28–1.60)

Discussion

This study investigated hyperlipidemia and related risk factors in urban adults aged 35–79 years in Chengdu and Chongqing from September 2013 to March 2014, based on a population in southwest China. In general, the average prevalence of dyslipidemia was 27.4%, which increased with age, and the prevalence of dyslipidemia was higher in men (30.2%) than in women (25.9%). The higher prevalence rate in men may be related to the higher income, smoking rate, drinking rate, WC, hypertension prevalence rate, SBP, and DBP level. But interestingly, the prevalence in women was lower than that in men under the age of 55, and it was higher in women later in life than in men. Moreover, with the increase of age, TG, TC, and LDL-C levels in women showed a significant increasing trend. This result was consistent with other studies[9,12]. This may be related to differences in estrogen levels in women before and after menopause[12]. However, in Table 4, multivariable analysis showed that dyslipidemia was unrelated to age and gender. This may be due to controlling for other factors, including mediators, to block the effect of age and sex on dyslipidemia.

From January 2007 to October 2010, China's national chronic kidney Disease survey[13] showed that the prevalence of dyslipidemia in Chinese adults was 34.0%[9], 13753/40486. It can be seen that the

prevalence of dyslipidemia in southwest China is slightly lower than the average level of Chinese adults. Besides, the prevalence of dyslipidemia (27.4%) and lipid levels (TG1.3 mmol/L and TC4.6 mmol/L) in southwest China were relatively low compared with other regions in China as previously reported. For example, the cities with relatively developed economy,such as Beijing[14](prevalence of dyslipidemia 35.4%, TG1.53 mmol/L, TC5.05 mmol/L), Shanghai[12] (prevalence of dyslipidemia 36.5%), Shenzhen[15] (prevalence of dyslipidemia 34.72%, TG1.44 mmol/L, TC4.77 mmol/L), as well as Jilin[16] (prevalence of dyslipidemia 62.1%) and Shandong[17] (prevalence of dyslipidemia 45.8%) in the north. The distribution of dyslipidemia has obvious economic and regional differences. This may be related to the following reasons: 1) The economically developed Regions of Beijing[14], Shanghai[12] and Guangzhou[15] have higher living standards, and their lifestyles and consumption of western food are close to those of developed countries; 2) The cold climate in the northern region leads to an increase in the intake of animal fats and a decrease in the intake of fresh fruits and vegetables, while the cold weather restricts people's outdoor physical activity, thus increasing the risk of obesity or overweight and related metabolic abnormalities[16,17]. Also, Chengdu is the capital of Sichuan Province, compared with the epidemiological survey of dyslipidemia in Sichuan[18] in 2002, the prevalence of dyslipidemia was increased to a certain extent (22.49, 484/2152% VS 27.4%, 2796/10221), and the lipid levels were also increased, TG and TC levels were 1.14, 3.76 mmol/L VS1.3 and 4.6 mmol/L, respectively. These increases are consistent with the rapid economic development and lifestyle changes in the southwest region in recent years. We found that the current prevalence of dyslipidemia and lipid levels in the southwest people aged 35-79were relatively low compared to the rest of the country. Dyslipidemia is the main pathogenic factor of atherosclerosis and one of the independent risk factors of cardiovascular diseases such as coronary heart disease[6]and stroke[7]. This also indicates that the prevention and treatment of dyslipidemia in southwest China will face challenges in the future.

At the same time, we found that the prevalence rates of high TG, high TC, low HDL-C, and high LDL-C in people aged 35–79 years in southwest China were 15.7%, 5.4%, 5.7%, and 2.5%, respectively, while the prevalence rates of high TG, high TC, low HDL-C and high LDL-C in Chinese adults[9] were 12.17%, 7.50%, 15.31%, and 7.96%, respectively. Therefore, high TG was the main type of dyslipidemia in southwest China. The prevalence of high LDL-C was much lower in southwest China. Previous studies have shown that the LDL-C level is the indicator most closely related to ASCVD risk[19,20]. One research[21] analyzed data of 219,522 Chinese patients with type 2 diabetes and found that there were large regional variations in the prevalences and risks of coronary heart disease and stroke in T2DM in China. Southwest China had the lowest prevalence of both CHD and stroke in Chinese adults with type 2 diabetes. Another nationally representative survey[22] included 480687 adults aged ≥ 20 years demonstrated the lower prevalence of stroke in Southwest China. Despite its large population and high GDP, Southwest China had a low-ranking number of percutaneous coronary intervention[23]. Interestingly, contemporaneous studies[24,25] showed that the prevalence of hypertension(38.4%) and diabetes（19.5% ）in the Southwest was no lower than the national average（hypertension 32.5%[26],diabetes 9.7%[27]）. Therefore, it is reasonable to speculate that the low prevalence of dyslipidemia and low LDL-C contribute to the lower ASCVD prevalence in southwest

China. However, due to the diversity of ASCVD risk factors and the limitations of cross-sectional studies, further studies should be expected.

This study also analyzed the correlation between dyslipidemia and various factors. In addition to the common risk factors associated with dyslipidemia[10,24], such as smoking, hypertension, and diabetes, this study also showed a positive correlation between a high school degree or above, a monthly income of more than 2000 yuan, and the prevalence of dyslipidemia. This may be due to the better economic and nutritional status of people with higher education and income[25]. Overweight, obesity and central obesity are correlated with dyslipidemia, suggesting that BMI and waist circumference can be used as screening indicators for dyslipidemia, and weight control is an important prevention and control method[26,27]. Besides, dyslipidemia was negatively correlated with daily physical exercise, suggesting that strengthening physical exercise is also an important method for the prevention and control of dyslipidemia.

In conclusion, our study provides the latest and reliable information for dyslipidemia in southwest China. The results show that the prevalence of dyslipidemia in southwest China was lower than the national average but on the rise. High TG was the main type of dyslipidemia, and the prevention and control of dyslipidemia are faced with challenges. Dyslipidemia is closely related to smoking, hypertension, diabetes, higher education, higher income, obesity, and central obesity. Only by strengthening public health education and intervening in risk factors can we face the challenge.

Methods

Study population

From September 2013 to March 2014, a multi-stage, stratified sampling was conducted on 13378 people aged 35–79 years living in Chengdu and Chongqing by using the method of field questionnaire survey and measurement. In the first stage of this study, Jinjiang, Longquanyi, and Chenghua districts were randomly selected in Chengdu urban area, and Yubei district and Jiangbei district were randomly selected in Chongqing urban area. In the second stage, a street is randomly selected from each major area; in the third stage, a community is randomly selected from each street to form a sample composed of five random communities. The ethics committee of the Second People's Hospital of Chengdu approved this study protocol (NO 2013015). All participants provided written informed consent.

Inclusion and exclusion criteria

From September 2013 to March 2014, residents aged 35 to 79 years who had lived in selected communities for more than five years were included in the study. People with secondary hypertension, mental illness, malignancy, renal failure requiring dialysis, or refusal to participate were excluded. Due to the lack of demographic information and weight, blood pressure, waist circumference, or body mass index (BMI) data, and lipid measurements, 10,221 participants were included in the final analysis.

Data collection

More than 30 investigators were trained in data collection. According to the cardiovascular survey methodology developed by the World Health Organization[11], subjects filled out the same field questionnaire, including demographic characteristics; lifestyle, personal and family history of the disease; measurements of height, weight, waist circumference, and blood pressure; fasting glucose, triglycerides (TG) and total cholesterol (TC) levels were also included. BMI was calculated by dividing weight in kilograms by height in meters squared, and subjects were asked to go barefoot and wear only light clothing when measuring height and weight. The researchers measured the minimum circumference between the lower edge of the rib and the iliac spine to get a waist measurement. Thirty minutes before the measurement of blood pressure, the subjects were told not to drink coffee, tea, or alcohol, and not to smoke or exercise. The subjects sat for a five-minute break, then had their blood pressure measured while they sat with a mercury sphygmomanometer. Systolic blood pressure (SBP) and diastolic blood pressure (DBP) recorded the first occurrence of Korotkoff sound (stage I) and the disappearance of Korotkoff sound (stage V), respectively, and averaged the blood pressure readings of the two measurements. All anthropometric measurements and blood biomarkers testing were carried out in accordance with relevant guidelines and regulations.

Index definition

Smoking now is defined as having smoked more than 100 cigarettes in a lifetime. Drinking is defined as consuming more than 30 grams of alcohol per week for more than a year. Regular physical activity refers to moderate or vigorous activity of 30 minutes or more on at least 3 days a week[8]. Hypertension is defined as having a clear medical history, and/or systolic blood pressure greater than or equal to 140 mmHg, and/or diastolic blood pressure greater than or equal to 90 mmHg. Diabetes is defined as having a clear medical history, and/or fasting glucose greater than or equal to 7.0 mmol/L, and/or a 2-hour glucose tolerance test greater than or equal to 11.1 mmol/L. According to the guidelines for Prevention and Treatment of Dyslipidemia in Chinese Adults (2016 Revision), dyslipidemia is defined as TC ≥ 6.2 mmol/L, low-density lipoprotein cholesterol (LDL-C) ≥ 4.1 mmol/L, high-density lipoprotein cholesterol (HDL-C) < 1.0 mmol/L, and/or TG ≥ 2.3 mmol/L, and/or self-reported history of dyslipidemia[12].

Diagnostic criteria

Dyslipidemia was defined as total cholesterol ≥ 6.2 mmol/L, and/or LDL cholesterol ≥ 4.1 mmol/L, and/or HDL cholesterol < 1.0 mmol /L, and/or TG ≥ 2.3 mmol /L, and/or self-reported history of dyslipidemia, following Chinese Guidelines for Prevention and Treatment of Dyslipidemia in Adults (2016 Revision)[12]

Statistical analysis

Absolute number (percentage, %) was used to describe the categorical data, and a Chi-Square test was used to compare the difference between different groups. The data subject to or close to the normal

distribution were described by means + standard deviation, and the difference between different groups was compared by Student's t-test. The data of skewed distribution were described by the median with the interquartile range, and the comparison between different groups was performed by Wilcoxon rank sum test. Trend analysis was done by Chi-Square trend test or linear regression analysis. Both univariate and multivariate analyses were performed using an unconditional Logistic regression model, and the OR value and its 95% confidence interval were calculated. All statistical analyses were performed with SPSS 23.0 software, and $P < 0.05$ was considered statistically significant.

Declarations

Competing interests

The authors declare no competing interests.

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Author contributions

C.H. and W.Q.Z. conceived and designed the study, analysed the data and drafted the manuscript. W.W.T. analysed the data and advised on the interpretation of results. Y.L., J.X.L., R.H.X., and X.B.H. participated in the data collection and checking. S.P.Z., and T.D.W., and X.B.H., advised on the interpretation of results and were responsible for the research.

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Figures

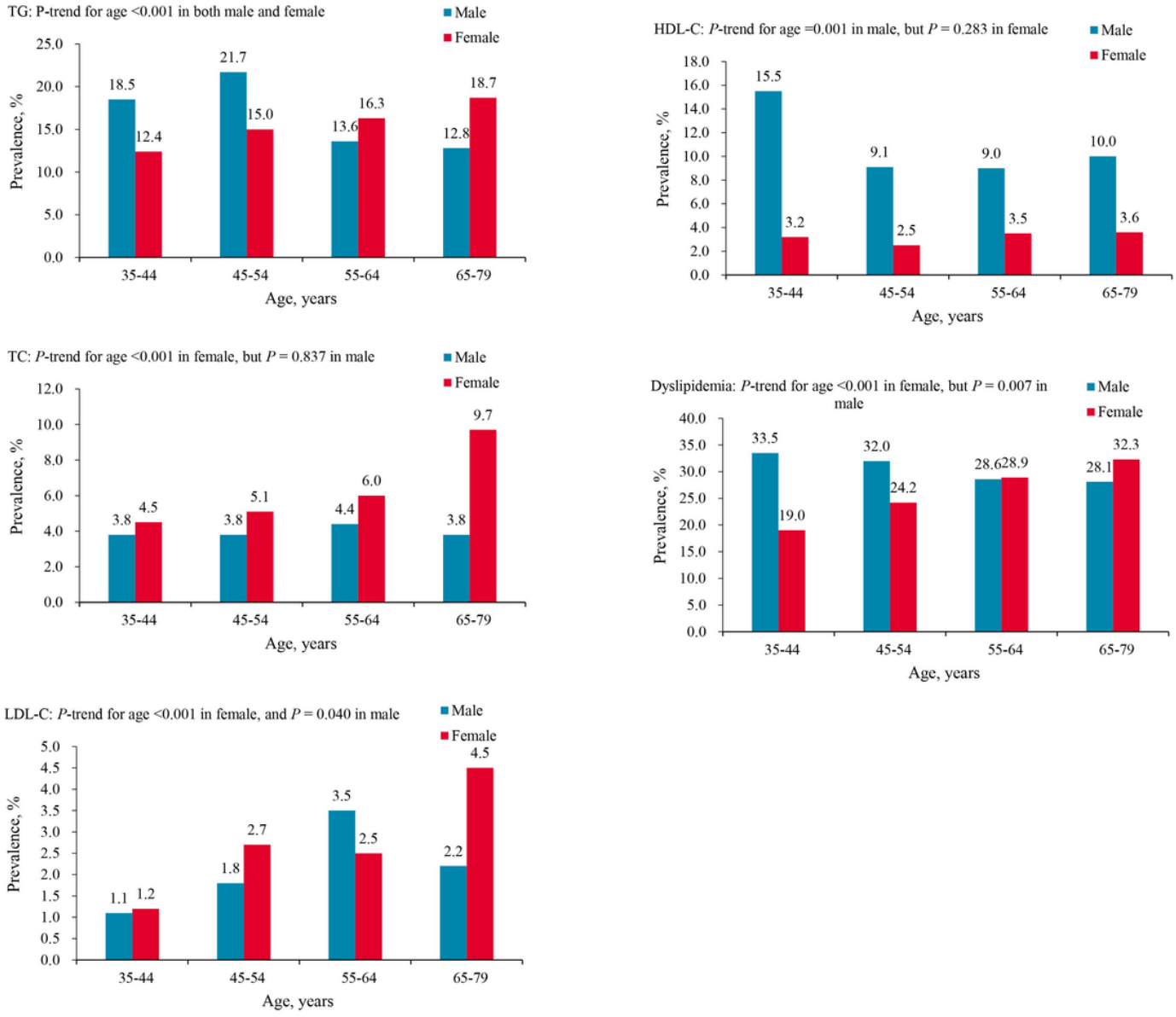

Figure 1

Age-specific prevalence of high triglyceride, high total cholesterol, high low-density lipoprotein cholesterol, low high-density lipoprotein cholesterol, and dyslipidemia among the adults aged ≥ 35 years in southwest China