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RESEARCH

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Prevalence and clustering of modifiable cardiovascular disease risk factors among elderly adults in Yuexiu district, Guangzhou City, China: a cross sectional study

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Abstract

Background Cardiovascular disease has a high prevalence and mortality rate, which are mainly due to the aging population and the high prevalence and clustering of modifiable cardiovascular risk factors (CRFs); however, studies on the aging Chinese population are limited. The study aimed to investigate the prevalence and clustering of CRFs among the elderly population to provide evidence for the overall planning of medical resources and disease management.

Methods In this cross-sectional study, 41,517 participants aged ≥ 65 years were recruited from January 2020 to April 2021 in the Yuexiu district, Guangzhou city, China. Sociodemographic and health examination data were collected.

Results Among the 41,517 participants, 42.2% were male. The prevalence rates of hypertension, diabetes, dyslipidemia, overweight/obesity, and smoking were 87.1%, 33.3%, 47.6%, 45.5%, and 7.6%, respectively. Participants with ≥ 1, ≥2, and ≥ 3 CFRs accounted for 96.3%, 75.0%, and 38.7% of the study population, respectively. After adjusting for sex, education level, marital status, and physical activity level, older age and drinking were independent risk factors for CRF clustering.

Conclusions Excluding smoking, there is a high prevalence of CRFs in the elderly population of Southern China, especially hypertension. In addition, the clustering of CRFs was high. In the future, a healthy lifestyle should be promoted in the elderly, and the prevention and management of CRFs should be optimized according to the prevalence and cluster characteristics.

Keywords Cardiovascular disease, Risk factors, Prevalence, Clustering, Aged

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Introduction

Cardiovascular disease (CVD) is the leading cause of death from non-communicable diseases worldwide, accounting for 32% of all global deaths [1]. In China, CVD also leads to a huge burden. Data from the Report on Cardiovascular Health and Diseases in China 2021 shows that there are approximately 330 million patients with CVD in China, and that the burden caused by CVD will continue to increase [2]. According to the China Statistical Yearbook 2022, CVD is the leading cause of death among Chinese residents, accounting for more than 40% [3]. Two out of every five deaths in China are caused by CVD [2]. Therefore, CVD has become a serious public health problem in China [2].

There are two main reasons for the increased prevalence of CVD in China. On the one hand, population aging is accelerating [3, 4]. With improved prevention and treatment techniques, the increased life expectancy of patients with CVD has led to a concurrent rise in the epidemiology of CVD [4, 5]. From 2016 to 2021, the elderly population (residents ≥ 65 years of age) has grown from 10.8 to 14.2% in China [3]. CVD is the most common chronic disease in the elderly population [6]. More than 70% of people > 70 years of age have CVD, and the prevalence of CVD in people > 80 years of age is as high as 85% [7, 8]. Because the elderly population has a great contribution to the burden of CVD, more attention should be paid to this population.

On the other hand, the prevalence of cardiovascular risk factors (CRFs) in the elderly has increased gradually and has shown a clustering distribution [9–11]. A clustered distribution refers to the simultaneous presence of multiple risk factors in an individual [10, 11]. Individuals with more than one CRF are at a greater risk of developing CVD than individuals with a single CRF [10, 11]. Excluding non-modifiable factors, such as age, sex, and genetics, CVD is mainly caused by some modifiable metabolic risk factors and an unhealthy lifestyle. The top five modifiable CRFs are hypertension, diabetes, dyslipidemia, overweight/obesity, and smoking [2, 12]. These five CRFs have a high prevalence in Chinese adults, but the rates of awareness, treatment, and control are low [2, 4].

Clarifying the prevalence and clustering of modifiable CRFs in the elderly population, as well as the impact of different sociodemographic and clinical characteristics on the clustering of CRFs, is important for coordinating healthcare resources and developing disease prevention and management strategies. However, relevant data among the elderly population is limited in China. So far, only two studies, located in the Xinjiang area and Shenzhen city of China, have investigated the prevalence and clustering of CRFs in the elderly population [13, 14]. Xinjiang area is located in the northwest of China. The prevalence and mortality of CVD varies greatly in different areas of China, and is significantly lower in Southern China than in Northern China [4, 15]. Therefore, the results of the elderly population in Southern China may be different from those in the Xinjiang area. Although Shenzhen city is located in Southern China, the modified CRFs in this study only included biological CRFs and did not include smoking as a modifiable factor [14].

Therefore, this study investigated the prevalence and clustering of these five modifiable CRFs in people ≥ 65 years of age in Guangzhou city, which is located in Southern China, to provide a basis for the prevention and management of CVD in the elderly population.

Materials and methods

Study design and population

Considering that Guangzhou, located in Southern China, is the third largest super city in China, and among the 11 districts in Guangzhou, Yuexiu District has the most serious aging degree (residents ≥ 65 years of age account for 15.88% of the total population) [3], we conducted cluster sampling in the Yuexiu district of Guangzhou. Health examination data from January 2020 to April 2021 was collected from the National Basic Public Health Service Program database for all residents who were ≥ 65 years of age in Yuexiu district, Guangzhou city, China. Community hospitals in Yuexiu district sent notices about health exam programs to residents ≥ 65 years of age based on the National Medical registration system. To ensure that most residents received healthcare, those who are unable to reach a community hospital could make appointments with a primary care physician for an in-home health exam. Among 57,084 residents aged ≥ 65 years, a total of 41,517 participants were included in the study.

Data collection and measurement

Primary care physicians in each community region conducted relevant health exams and collected data using the content and requirements of the National Health Department's Elderly Health Examination and Health Management Registration Form. Data from five components of the form were selected for this study:

(1) Demographic information completed by participants, including age, sex, educational level, and marital status.
(2) Disease information obtained by physicians based on medical records, including history of CRFs and medications.
(3) Physical exams were completed by physicians, including blood pressure (BP) and body mass index (BMI). Before BP was measured, each participant was asked to avoid smoking, drinking alcohol, drinking tea or coffee, or being physically active for at least 30 min, and to rest in a seated position for

at least 5 min. BP was measured on the right arm with a mercury sphygmomanometer and the average of three measurements was recorded. The weight measurement required participants to stand relaxed in the middle of the scale on an empty stomach, take off their shoes, and wear only light clothing. Physicians used a uniform scale to perform the measurements. The result was accurate to 0.1 kg.

(4) Blood glucose and serum lipid levels were measured using the Hitachi LST008AS automatic biochemical analyzer after ≥ 8 h overnight fasting.

(5) A lifestyle survey, including questions about smoking, drinking, dietary habits, and physical activity, was completed by all patients.

Definition of cardiovascular risk factors

(1) Hypertension was defined as a systolic BP ≥ 140 mmHg and/or diastolic BP ≥ 90 mmHg and/or a previous diagnosis of hypertension with the use of antihypertensive medication [2].

(2) Diabetes was defined as fasting blood glucose (FBG) ≥ 7.0 mmol/L and/or a previous diagnosis of diabetes with use of insulin or hypoglycemic agents [2].

(3) Dyslipidemia was defined as total cholesterol (TC) ≥ 6.22 mmol/L and/or triglycerides (TG) ≥ 2.26 mmol/L and/or low-density lipoprotein cholesterol (LDL-C) ≥ 4.14 mmol/L and/or high-density lipoprotein cholesterol (HDL-C) < 1.04 mmol/L and/or a previous diagnosis of dyslipidemia with the use of lipid-lowering drugs [2].

(4) BMI was defined as weight (kg)/height^2 (m), with < 18.5 kg/m^2 considered underweight, 18.5 kg/m^2 ≤ BMI < 24.0 kg/m^2 considered normal body weight, 24.0 kg/m^2 ≤ BMI < 28.0 kg/m^2 considered overweight, and BMI ≥ 28.0 kg/m^2 defined as obese [2].

(5) Current smoker was defined as continuous smoking of at least one cigarette per day or a total of ≥ 18 packs of cigarettes per year [2]. Participants who had quit smoking and those who had never smoked were non-smokers.

(6) Drinking was classified as habitual drinkers (once a day or more), non-habitual drinkers (6 times a week to once a month), or non-drinkers (almost never) [14].

(7) The intensity of physical activity was categorized using The Compendium of Physical Activity after patients filled out specific types [16]. Sufficient physical activity was defined as no less than 150 min of moderate or higher intensity physical activity per week [17].

Statistical analysis

All data were analyzed using IBM SPSS Statistics version 25.0 (SPSS Inc., Chicago, IL, USA). The mean ± standard deviation was used to describe continuous variables and percentages were used to describe categorical variables. The Student's t-test was used to compare the differences among continuous variables, and the chi-square test was used to compare the differences among categorical variables. There were no significant differences in sex, educational level, marital status, and physical activity level in the univariate analysis of CRF clustering; therefore, after adjusting for these variables, a multivariate logistic regression model was used to describe the association between the demographic characteristics and clustering of five major modifiable CRFs (hypertension, diabetes, dyslipidemia, overweight/obesity, and smoking). The number of modifiable CRFs (≥ 1, ≥ 2, and ≥ 3) were defined as dependent variables, respectively, and demographic characteristics were defined as independent variables. All statistical tests were two-sided. $P < 0.05$ was considered statistically significant.

Results

Patient sociodemographic and clinic characteristics, and the prevalence of modifiable cardiovascular risk factors

As shown in Table 1, among 41,517 participants (mean age 73.5 ± 7.1 years), 57.8% were female, 15.4% had a college or higher education, and 16.0% were single/ divorced/ widowed. Non-habitual drinkers and habitual drinkers accounted for 7.8% of participants, and 30.8% had an insufficient level of physical activity. The prevalence rates of hypertension, diabetes, dyslipidemia, overweight/obesity, and smoking were 87.1%, 33.3%, 47.6%, 45.5%, and 7.6%, respectively.

Clustering of modifiable cardiovascular risk factors

Participants with ≥ 1, ≥2, and ≥ 3 modifiable CFRs accounted for 96.3%, 75.0%, and 38.7%, respectively. Participants who were older and had a lower level of education had a higher number of modifiable CFRs. Single/ divorced/ widowed participants were more likely to have a combination of more than two CRFs than those who were married. Non-habitual drinkers and habitual drinkers were more likely to have ≥ 2 or ≥ 3 modifiable CRFs compared to non-drinkers (Table 2).

Independent risk factors for clustering of modifiable cardiovascular risk factors

In the multivariate logistic regression analysis, after adjusting for sex, education level, marital status, and physical activity level, older age and drinking were independent risk factors for the clustering of modifiable CRFs. Compared to adults aged 65–69, those aged 70–74, 75–79, 80–84, and ≥ 85 had 1.34-, 1.64-, 1.52-, and

Table 1 Sex differences in sociodemographic, clinical characteristics, and the prevalence of CRFs among elderly adults in Guangzhou City, China

Variable	Overall (*n*=41517)	Male (*n*=17517)	Female (*n*=24000)	t / X^2	*P*
Age[a], years	73.5±7.1	73.3±6.9	73.7±7.2	−6.632	<0.001
Age group, n (%)				68.788	<0.001
65–69	15,394 (37.1)	6559 (37.4)	8835 (36.8)		
70–74	11,083 (26.7)	4885 (27.9)	6198 (25.8)		
75–79	5978 (14.4)	2537 (14.5)	3441 (14.3)		
80–84	5032 (12.1)	2051 (11.7)	2981 (12.4)		
≥85	4030 (9.7)	1485 (8.5)	2545 (10.6)		
Educational level, n (%)					
Primary school and lower	8994(21.7)	2250(12.8)	6744(28.1)	1813.641	<0.001
Middle school	12,826(30.9)	5451(31.1)	7375(30.7)		
High school	13,292(32.0)	6107(34.9)	7185(29.9)		
College or higher	6405(15.4)	3709(21.2)	2696(11.2)		
Marriage, n (%)				1932.187	<0.000
Married	34,887(84.0)	16,340(93.3)	18,547(77.3)		
Single/divorced/ widowed	6630(16.0)	1177(2.8)	5453(22.7)		
BMI kg/m^2	23.8±3.3	23.8±3.3	23.8±3.3	-0.276	0.782
SBP, mmHg	135.2±16.6	135.2±16.6	135.2±16.7	0.166	0.869
DBP, mmHg	76.8±11.6	76.9±13.8	76.7±9.7	0.062	0.047
FBG, mmol/L	6.1±1.9	6.1±1.8	6.1±1.9	-1.438	0.151
TC, mmol/L	5.4±2.3	5.4±3.2	5.4±1.2	0.323	0.747
TG, mmol/L	1.6±1.1	1.6±1.1	1.6±1.1	-0.617	0.537
HDL-C, mmol/L	1.5±0.4	1.5±0.4	1.5±0.4	-1.012	0.311
LDL-C, mmol/L	3.2±1.0	3.2±1.0	3.2±1.0	-0.375	0.708
Hypertension, n (%)	36,142(87.1)	15,209(86.8)	20,933(87.2)	1.413	0.235
Diabetes, n (%)	13,836(33.3)	5828(33.3)	8008(33.3)	0.042	0.837
Dyslipidaemia, n (%)	19,757(47.6)	8304(47.4)	11,453(47.7)	0.404	0.525
Overweight/obesity, n (%)	18,872(45.5)	7959(45.4)	10,913(45.5)	0.087	0.768
Smoking, n (%)	3159(7.6)	1325(7.6)	1834(7.6)	0.005	0.944
Drinking status, n (%)					
Non-drinker	38,291(92.2)	16,125(92.1)	22,166(92.4)	1.845	0.398
Non-habitual drinker	2628(6.3)	1142(6.5)	1486(6.2)		
Habitual drinker	597(1.4)	250(1.4)	347(1.4)		
Physical activity, n (%)					
Insufficient	12,718(30.8)	5439(31.2)	7279(30.4)	2.624	0.105
Sufficient	28,635(69.2)	12,002(68.8)	16,633(69.6)		
Number of CRFs, n (%)				1.347	0.930
0	1526(3.7)	657(3.8)	869(3.6)		
1	8874(21.4)	3761(21.5)	5113(21.3)		
2	15,049(36.2)	6358(36.3)	8691(36.2)		
3	11,754(28.3)	4936(28.2)	6818(28.4)		
4	4038(9.7)	1685(9.6)	2353(9.8)		
5	276(0.7)	120(0.7)	156(0.7)		

[a]Mean ± standard deviation

Abbreviations: BMI, Body mass index; CRFs, cardiovascular risk factors; DBP, diastolic blood pressure; FBG, fasting blood glucose; HDL-C, high density lipoprotein cholesterol; LDL-C, low density lipoprotein cholesterol; SBP, systolic blood pressure; TC, total cholesterol; TG, triglyceride

Table 2 Sociodemographic and lifestyle characteristics differences in the clustering of CRFs among the elderly population in Guangzhou City, China

Variable	None (0) *n* (%)	≥ 1 risk factors *n* (%)	≥ 2 risk factors *n* (%)	≥ 3 risk factors *n* (%)
Overall	1526 (3.7)	39,991 (96.3)	31,117 (75.0)	16,068 (38.7)
Sex, n (%)				
Male	657 (3.8)	16,860 (96.2)	13,099 (74.8)	6741 (38.5)
Female	869 (3.6)	23,131 (96.4)	18,018 (75.1)	9327 (38.9)
X^2-value		0.482	0.473	0.616
P-value		0.488	0.492	0.433
Age group, n (%)				
65–69	713(4.6)	14,681(95.4)	11,158(72.5)	5636(36.6)
70–74	390(3.5)	10,693(96.5)	8331(75.2)	4293(38.7)
75–79	173(2.9)	5805(97.1)	4629(77.4)	2452(41.0)
80–84	155(3.1)	4877(96.9)	3884(77.2)	2058(40.9)
≥ 85	95(2.4)	3935(97.6)	3115(77.3)	1629(40.4)
X^2 value		75.647	95.045	57.119
P value		<0.001	<0.001	<0.001
Educational level, n (%)				
Primary school and lower	286(3.2)	8708(96.8)	6878(76.5)	3631(40.4)
Middle school	491(3.8)	12,335(96.2)	9574(74.6)	4921(38.4)
High school	500(3.8)	13,792(96.2)	9911(74.60	5063(38.1)
College or higher	249(3.9)	6156(96.1)	4754(74.2)	2453(38.3)
X^2 value		8.176	14.607	13.705
P value		0.043	0.002	0.003
Marriage, n (%)				
Married	1306(3.7)	33,581(96.3)	26,078(74.7)	13,441(38.5)
Single/divorced/widowed	220(3.3)	6410(96.7)	5039(76.0)	2627(39.6)
X^2 value		2.846	4.660	2.819
P value		0.092	0.031	0.093
Drinking status, n (%)				
Non-drinker	1425(3.7)	36,866(96.3)	28,490(74.4)	14,539(38.0)
Non-habitual drinker	89(3.4)	2539(96.6)	2121(80.7)	1217(46.3)
Habitual drinker	12(2.0)	585(98.0)	505(84.6)	312(52.3)
X^2 value		5.525	82.032	119.021
P value		0.063	<0.001	<0.001
Physical activity, n (%)				
Insufficient	480(3.8)	12,238(96.2)	9514(74.8)	4895(38.5)
Sufficient	1040(3.6)	27,595(96.4)	21,486(75.0)	11,106(38.8)
X^2 value		0.503	0.241	0.325
P value		0.478	0.623	0.569

Abbreviations: CRFs, cardiovascular risk factors

1.99-fold higher risks, respectively, of having ≥ 1 modifiable CRF. The likelihood of having ≥ 2 or ≥ 3 modifiable CRFs also increased with age, reaching up to 1.28- and 1.20-fold in the oldest group ($P < 0.001$ for all). Habitual drinkers had a 1.89-fold higher risk of ≥ 1 modifiable CRF than non-drinkers. Similarly, the risk of having ≥ 2 or ≥ 3 modifiable CRFs was 1.44- and 1.41-fold higher for non-habitual drinkers, and 1.89- and 1.80-fold higher for habitual drinkers ($P < 0.001$ for all). (Table 3).

Discussion

The main findings of the study are as follows: (1) Among the five main modifiable CRFs in the elderly population of Southern China, hypertension had the highest prevalence (87.1%) and smoking had the lowest prevalence (7.6%); the other CRFs ranged from 33.3 to 47.6%. (2) There was a high clustering of CRFs, with 96.3% of the elderly having ≥ 1 CRF, three quarters having ≥ 2 CRFs, and more than one third (38.7%) having ≥ 3 CRFs. (3) After adjusting for sex, education level, marital status, and physical activity level, age and drinking were independent risk factors for the clustering of modifiable CRFs.

In this study, the elderly population had a higher prevalence of hypertension, diabetes, and dyslipidemia compared to those in Xinjiang area and Shenzhen city, China [13, 14]. Specifically, 87.1% had hypertension (vs. 52.1% in Xinjiang area, 51.9% in Shenzhen city), 33.3% had diabetes (vs. 16.8% and 18.0%), and 47.6% had dyslipidemia (vs. 28.6% and 40.2%). This may be due to the higher degree of aging in this study, with 21.8% of the subjects aged ≥ 80 years (vs. 13.99% in Xinjiang area; vs. Shenzhen city12.5%) [13, 14]. The prevalence of hypertension increases with age. On the other hand, the data included in this study came from the National Essential Public Health Service Program database. Community hospitals in Yuexiu District of Guangzhou took physical examinations for all residents and recorded the results in the database. Information on hypertension, diabetes, and dyslipidemia in this database is updated every 3 months. Therefore, the disease information record is relatively complete. However, the survey data in Xinjiang area and Shenzhen city of China were obtained from on-site measurements and patient self-reported questionnaires [13, 14]. According to the China Cardiovascular Health and Disease Report in 2021 and 2022, the awareness rates of hypertension, diabetes, and dyslipidemia were only 41%, 36.7%, and 16.1%, respectively [18, 19]. Patients who were unaware of their illness may not have self-reported the relevant illness on the questionnaire. Furthermore, with the development of urbanization, the prevalence of hypertension, diabetes, and dyslipidemia is still steadily increasing [20–22]. Previous studies have also shown that these are the three CRFs strongly associated with cardiovascular death [23]. Management strategies for primary

Table 3 Independent factors influencing clustering of CRFs among the elderly population in Guangzhou City, China

Variable	≥ 1 risk factors		≥ 2 risk factors		≥ 3 risk factors	
	OR (95% CI)	***P***	**OR (95% CI)**	***P***	**OR (95% CI)**	***P***
Sex, n (%)						
Male	1.00		1.00		1.00	
Female	1.02 (0.92–1.14)	0.690	1.00 (0.96 to 1.06)	0.792	1.01 (0.97 to 1.05)	0.717
Age group, n (%)						
65–69	1.00		1.00		1.00	
70–74	1.34 (1.18 to1.52)	<0.001	1.15 (1.09 to 1.22)	<0.001	1.10 (1.04 to 1.15)	<0.001
75–79	1.64 (1.38 to 1.94)	<0.001	1.30 (1.21 to 1.40)	<0.001	1.20 (1.13 to 1.28)	<0.001
80–84	1.52 (1.27 to 1.83)	<0.001	1.28 (1.18 to 1.38)	<0.001	1.19 (1.11 to 1.27)	<0.001
≥ 85	1.99 (1.59 to 2.49)	<0.001	1.28 (1.18 to 1.40)	<0.001	1.16 (1.07 to 1.24)	<0.001
Educational level, n (%)						
Primary school and lower	1.00		1.00		1.00	
Middle school	0.95(0.81 to 1.10)	0.477	0.96(0.90 to 1.03)	0.230	0.95(0.90 to 1.01)	0.954
High school	1.00(0.86 to 1.17)	0.981	0.98(0.91 to 1.04)	0.488	0.96(0.90 to 1.01)	0.956
College or higher	0.91(0.76 to 1.09)	0.324	0.93(0.86 to 1.00)	0.062	0.94(0.88 to 1.01)	0.090
Marriage, n (%)						
Single/divorced/ widowed	1.00		1.00		1.00	
Married	1.00(0.86 to 1.17)	0.981	0.99(0.93 to 1.06)	0.784	1.00(1.95 to 1.06)	0.966
Drinking status, n (%)						
Non-drinker	1.00		1.00		1.00	
Non-habitual drinker	1.10(0.86 to 1.37)	0.389	1.44(1.30 to 1.59)	<0.001	1.41(1.30 to1.52)	<0.001
Habitual drinker	1.89(1.06 to 3.35)	0.030	1.89(1.51 to 2.36)	<0.001	1.80(1.53 to 2.11)	<0.001
Physical activity, n (%)						
Insufficient	1.00		1.00		1.00	
Sufficient	0.96(0.87 to 1.08)	0.535	1.00(0.95 to 1.05)	0.911	1.00(0.96 to 1.04)	0.887

Abbreviations: CRFs, cardiovascular risk factors

and secondary prevention should continue to be optimized in the future.

The prevention and control of hypertension is particularly noteworthy. In this study, hypertension has the highest prevalence, with approximately 90% of elderly individuals affected. Hypertension is the primary cause of stroke incidence and mortality, which is why stroke ranks first among cardiovascular disease endpoints in China [18, 19]. The main risk factors for hypertension include high sodium intake, overweight/obesity, smoking, drinking, and stress [18, 19]. Therefore, in primary and secondary prevention of hypertension, health education on the above hypertension-related risk factors should be particularly emphasized.

The prevalence of overweight/obesity and smoking in the study was lower than that in the Xinjiang area (45.5% vs. 62.7%, 7.6% vs. 9.4%), but similar to that in Shenzhen city (45.5% vs. 48.2%, 7.6% vs. 7.7%) [13, 14]. On the one hand, this may be due to ethnic and geographical differences. Xinjiang area is located in Northwest China, which has relatively low temperatures and few vegetables and seafood. In addition, 57.8% of the population in Xinjiang region are ethnic minorities, such as Uygur and Kazak, who have nomadic living habits of drinking alcohol and eating meat [24]. Both Guangzhou city and Shenzhen city are located in the coastal areas of Southern China, with relatively high temperatures and abundant fruits, vegetables, and seafood [25]. In addition, the culture of smoking and drinking is not as strong in Southern China as in Northern China [26]. On the other hand, Guangzhou city and Shenzhen city are China's megacities, while the urbanization development of Xinjiang area is not as advanced as Guangzhou city and Shenzhen city. Urban residents had increased health literacy and paid more attention to healthy dietary structure and lifestyle [27].

In the present study, participants with ≥ 1, ≥2, and ≥ 3 modifiable CFRs accounted for 96.3%, 75.0%, and 38.7%, respectively. These values were higher than that of the elderly population in Xinjiang area and Shenzhen city (85.2%, 55.8%, and 23.6%, respectively) [13, 14]. This is mainly because the prevalence of hypertension, diabetes, and dyslipidemia in the study population is much higher than that in Xinjiang area and Shenzhen City. In addition, the study in Shenzhen city did not include smoking in the cluster analysis of CFRs [14]. Clustering of multiple CRFs has greater cardiovascular hazards than single CRFs [15]. More than 50% of the incidence of coronary heart disease, stroke, and all-cause mortality could be attributed to having one CRF, while participants who had three CRFs could be attributed to more than 70% [28]. Therefore, it is very necessary to adopt an integrated management strategy to modify CRFs according to the population and disease characteristics in different regions.

Consistent with most other studies [13–15, 29], older age was found to be an independent risk factor for the clustering of modifiable CRFs. It is not difficult to understand that the prevalence of metabolism-related CRFs increases gradually as the body's function and metabolic capacity decline [5]. As a result, the risk of CRF clusters also increases with age. This is a challenge for the management of CVD in the aging society, and the allocation of medical resources should also be adjusted.

Drinking is an independent risk factor for the clustering of modifiable CRFs. Habitual drinkers had a 1.89, 1.89, and 1.80-fold higher risk of ≥ 1, ≥2, and ≥ 3 modifiable CRFs compared with non-drinkers. Non-habitual drinkers had a 1.44 and 1.44-fold greater risk of ≥ 2 and ≥ 3 modifiable CRFs than non-drinkers. This is consistent with other studies [14, 30], and may be because smoking and drinking tend to occur together in people with poor lifestyles [30]. Drinkers will also have a higher risk of smoking, thus increasing the clustering of modifiable CRFs [30]. In addition, drinkers may participate in more social situations and consume more foods high in salt, fat, and calories, thereby increasing the risk of high blood pressure, diabetes, dyslipidemia, and overweight/obesity. An increased promotion of healthy lifestyles would be beneficial. Primary healthcare services should further enhance health education on healthy lifestyles in routine health promotion efforts, with the goal of comprehensively improving the health literacy of the entire population regarding health-promoting behaviors and lifestyles.

Limitations

There are several limitations to this study. First, there are differences in the prevalence and clustering of CRFs in different areas and ethnic groups. This study only investigated the CRFs of the elderly population in Guangzhou city, China; therefore, the results may be not applicable to other regions. Second, the study site is highly urbanized with an aging population, and the survey results may be slightly higher than those in other southern regions. Finally, we obtained lifestyle-related information through a questionnaire, which may be affected by recall bias. In addition, only 72.7% of residents participated in this study, which may introduce some selection bias. The generalizability of the conclusions should be approached with caution.

Conclusion

Among the five modifiable CRFs in the elderly population in Southern China, the highest prevalence was hypertension (87.1%), followed by dyslipidemia (47.6%), overweight/obesity (45.5%), and diabetes (33.3%), with a relatively lower prevalence of smoking(7.6%). Prevention and management of hypertension, diabetes, and dyslipidemia should be emphasized, and education on leading a healthy lifestyle should be strengthened. These CRFs had a high clustering in the elderly population in Southern China, and old age and drinking were independent factors influencing CRFs clustering. In the future, prevention and management strategies of CRFs should be continuously optimized according to the epidemiological and cluster characteristics.

Abbreviations

BMI	Body mass index
CI	Confidence interval
CRFs	Cardiovascular risk factors
CVD	Cardiovascular disease
DBP	Diastolic blood pressure
FBG	Fasting blood glucose
HDL-C	High density lipoprotein cholesterol
LDL-C	Low density lipoprotein cholesterol
SBP	Systolic blood pressure
TC	Total cholesterol
TG	Triglyceride

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Author contributions

Xiaomin Zhang, Xiaoyan Gu, Jun Huang and Kun Li conceived and designed the study. Xiaomin Zhang, Xiaoyan Gu, Yongneng Xu, Xiaoxia Wang, Fan Weng, Yanting Wen, Jun Huang and Kun Li. performed the study. Xiaomin Zhang, Xiaoyan Gu, Yongneng Xu and Xiaoxia Wang analyzed the data. Xiaomin Zhang and Xiaoyan Gu wrote the manuscript and interpreted the results. Jun Huang and Kun Li revised the manuscript. All authors read and approved the final manuscript.

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Data availability

The datasets used and/or analysed during the current study available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

This study was conducted in accordance with the ethical standards of the Declaration of Helsinki. The study was approved by the Ethics Committee of Guangdong Provincial People's Hospital, China (Approval number: KY2023-080-01). All participants were informed of the content and objectives of the study and personal information was protected. Informed consent was obtained from all patients.

Consent for publication

Not Applicable.

Competing interests

The authors declare no competing interests.

Conflict of interest

All authors declare that there is no conflict of interest.

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