Epidemiological Status and Risk Factors of Dyslipidemia in Community-Dwelling Elderly Residents in Yuexiu District, Guangzhou: A Postprint

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Abstract

Background Dyslipidemia is the most important and causally related independent risk factor for atherosclerotic cardiovascular disease. The prevalence of dyslipidemia among elderly residents in Guangdong Province is high, making it urgent to analyze the specific prevalence and influencing factors of dyslipidemia in the elderly population for targeted prevention and control. Objective To investigate the epidemiological status and risk factors of dyslipidemia among elderly residents in Yuexiu District, Guangzhou, who are enrolled in the National Essential Public Health Services. Methods A total of 41,469 elderly residents aged 65 years in Yuexiu District, Guangzhou, with complete key variables in the 2020 community health service center information system were selected. The 2020 health examination data were used to describe epidemiological characteristics including basic patient information, BMI, and lipid levels. Restricted cubic spline (RCS) was used to fit a Logistic regression model to analyze the non-linear relationship between age, BMI, and dyslipidemia prevalence. Results Among the 41,469 elderly residents included, the prevalence of dyslipidemia was 53.65%, with a standardized prevalence of 53.89%. The prevalence of hypercholesterolemia, hypertriglyceridemia, mixed hyperlipidemia, and low HDL-Cemia were 21.43%, 16.50%, 14.51%, and 3.80%, respectively, with standardized prevalences of 21.57%, 16.53%, 14.61%, and 3.78%, respectively. Univariate ^{2} analysis showed that gender, age, education level, exercise status, and BMI were influencing factors for dyslipidemia ($P<0.05$). Multivariate Logistic regression analysis revealed that dyslipidemia prevalence was mainly associated with female gender (OR=1.72, 95%CI 1.65~1.79), high BMI (OR=1.04, 95%CI 1.04~1.05), and low age (OR=0.97, 95%CI 0.97~0.98). Age and BMI showed a

non-linear relationship with dyslipidemia prevalence in elderly residents over 65 years. The overall trend between age and dyslipidemia prevalence was decreasing; as BMI levels increased, the risk of dyslipidemia prevalence showed a trend of first increasing then decreasing, with OR increasing significantly at low BMI, while decreasing at high BMI, with fluctuations not being statistically significant. Conclusion The prevalence of dyslipidemia is high among elderly residents over 65 years in Yuexiu District, Guangzhou, who are enrolled in the National Essential Public Health Services. In this elderly population, the prevalence of dyslipidemia decreases with age, and the risk of dyslipidemia prevalence shows a trend of first increasing then decreasing with BMI levels. This suggests that dyslipidemia management in the elderly has certain particularities, and attention should be focused on analyzing risk factors for dyslipidemia in the elderly population and conducting early prevention and control.

Full Text

Preamble

Analysis of Epidemiological Status and Risk Factors of Dyslipidemia in Elderly Community Residents

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Abstract

Background: Dyslipidemia is the most important and causally independent risk factor for atherosclerotic cardiovascular disease (ASCVD). The prevalence

of dyslipidemia among elderly residents in Guangdong Province is high, necessitating urgent analysis of the specific prevalence and influencing factors of dyslipidemia in this population to enable targeted prevention and control.

Objective: To investigate the epidemiological status and risk factors of dyslipidemia among elderly residents in Yuexiu District, Guangzhou, who are enrolled in the national basic public health service program.

Methods: A total of 41,469 elderly residents aged 65 years from Yuexiu District, Guangzhou, with complete key variables in the 2020 community health service center information system were selected. Using 2020 health examination data, we described the epidemiological characteristics of participants' basic conditions, BMI, and lipid levels. Restricted cubic spline (RCS) models fitted with logistic regression were used to analyze the non-linear relationships between age, BMI, and dyslipidemia prevalence.

Results: Among 41,469 elderly residents included, the prevalence of dyslipidemia was 53.65%, with an age-standardized prevalence of 53.89%. The prevalence rates of hypercholesterolemia, hypertriglyceridemia, mixed hyperlipidemia, and low HDL-Cemia were 21.43%, 16.50%, 14.51%, and 3.80%, respectively, with standardized rates of 21.57%, 16.53%, 14.61%, and 3.78%. Univariate ^{2} analysis showed that gender, age, education level, exercise frequency, and BMI were influencing factors ($P<0.05$). Multivariate logistic regression analysis revealed that dyslipidemia was significantly associated with female gender (OR=1.72, 95%CI 1.65~1.79), higher BMI (OR=1.04, 95%CI 1.04~1.05), and younger age (OR=0.97, 95%CI 0.97~0.98). Non-linear relationships were observed between age, BMI, and dyslipidemia prevalence in residents over 65. Overall, dyslipidemia prevalence decreased with age. As BMI increased, the risk of dyslipidemia initially rose then declined, with OR values increasing significantly at low BMI levels but decreasing at high BMI levels without statistical significance.

Conclusion: The prevalence of dyslipidemia is high among elderly residents aged 65 and above in Yuexiu District, Guangzhou, enrolled in the national basic public health services. In this elderly population, dyslipidemia prevalence decreases with advancing age, while the risk shows an initial increase followed by a decrease with rising BMI levels. These findings suggest that dyslipidemia management in the elderly has unique characteristics, emphasizing the need for focused analysis of risk factors and early preventive measures in this population.

Keywords: Dyslipidemia; Prevalence; Epidemiological study; Risk factors; Restricted cubic spline model

Introduction

China has entered an aging society, and the elderly population will continue to grow rapidly in the future. Yuexiu District in Guangzhou has reached a stage of moderate aging, with an aging rate of 17.46% [1]. As age increases,

the risk of cardiovascular disease rises due to physiological decline and organ dysfunction. Dyslipidemia is the most important and causally independent risk factor for atherosclerotic cardiovascular disease [2], and the increasing prevalence of dyslipidemia will lead to a growing disease burden. In recent years, the prevalence of dyslipidemia among the elderly has been significantly higher than in other age groups. However, as the body undergoes numerous changes with age, dyslipidemia management in the elderly appears to have certain particularities. Currently, evidence for dyslipidemia management in elderly populations is relatively insufficient. Therefore, this study investigates the epidemiological status and risk factors of dyslipidemia among elderly residents in Yuexiu District, Guangzhou, who are enrolled in the national basic public health services, aiming to provide a scientific basis for prevention and control strategies for dyslipidemia and cardiovascular disease in this population.

1.1 Study Subjects

According to the National Basic Public Health Service Standards, eligible elderly residents aged 65 and above receive one free health examination and health assessment annually, with follow-ups every six months. The examination data were obtained from the information system of Guangzhou Yuexiu District Community Health Service Centers, covering 18 streets and 18 community health service centers across the district. In 2020, a total of 54,443 eligible elderly residents aged 65 and above participated in the examination in Yuexiu District, Guangzhou. This study included 41,469 participants based on the following criteria: **Inclusion criteria:** (1) subjects with clear examination information; (2) subjects with complete basic information. **Exclusion criteria:** (1) subjects with incomplete lipid test items; (2) subjects with abnormal values in lipid test items according to the detection range of the reagent, with Roche original detection reagent range used as the exclusion standard. For subjects who participated in multiple examinations, only the first examination results were used. This study was approved by the Medical Ethics Committee of the School of Public Health, Sun Yat-sen University (Ethics Approval No.: 中大公卫医伦〔2019〕第 123 号).

1.2 Survey Methods and Content

Data were collected through direct integration between the district-level "Winning" laboratory system and the Yuexiu District "Wanda" information platform. The collected data included demographic characteristics (age, gender, education level, marital status), lifestyle behaviors (exercise frequency, medical history), and physical examinations (height, weight, BMI). For laboratory testing, participants were required to fast after 10 PM the night before the examination. Fasting venous blood was collected in procoagulant tubes in the early morning. Lipid testing used Roche original reagents: triglycerides (TG) were measured using the glycerol phosphate oxidase-peroxidase method, total cholesterol (TC) using the cholesterol oxidase method, high-density lipoprotein cholesterol (HDL-C)

using homogeneous enzymatic colorimetry, and low-density lipoprotein cholesterol (LDL-C) using homogeneous enzymatic colorimetry. TG and TC reagents were single reagents, while others were double reagents. Chol calibrator was cfas, and HDL-C and LDL-C calibrators were cfas lipids.

1.3 Diagnostic Criteria

(1) **Dyslipidemia:** Diagnosed according to the 2018 Chinese dyslipidemia diagnostic criteria [3], classified into four types: Hypercholesterolemia (HTC): TC>5.72 mmol/L, TG<1.70 mmol/L; Hypertriglyceridemia (HTG): TG>1.70 mmol/L, TC<5.72 mmol/L; Mixed hyperlipidemia: TC>5.72 mmol/L, TG>1.70 mmol/L; Low HDL-Cemia: HDL-C<0.90 mmol/L. Any one of these criteria defined dyslipidemia, also known as hyperlipidemia. (2) **Body Mass Index (BMI):** According to Chinese health industry standards [4], BMI<18.5 kg/m^2 was defined as underweight, 18.5-24.0 kg/m^2 as normal weight, 24.0-28.0 kg/m^2 as overweight, and $ 28.0kg/m^{2} as obese. (3) **Education Level:** Primary: elementary school and below; Intermediate: junior high school, technical secondary school, and high school; Advanced: university (including junior college) and above. (4) **Marital Status:** With spouse: married and living with spouse, married but temporarily not living with spouse due to work, cohabiting; Without spouse: unmarried, widowed, divorced.

1.4 Statistical Methods

Data cleaning and analysis were performed using R software (Version 4.1.2). Age-standardized prevalence was calculated based on data from China's seventh national census. Measurement data were expressed as ($\pm$), and comparisons between two groups were performed using independent samples t-tests. Count data were expressed as frequency and percentage, with comparisons between two groups using ^{2} tests. Trend ^{2} tests were used to analyze the trend of dyslipidemia prevalence with age. Statistical significance was set at P<0.05. To avoid information loss from categorizing age and BMI, restricted cubic spline (RCS) models were used to fit logistic regression analysis. The rcs function in the rms package of R was used to fit spline functions rcs(X, knots) to assess the relationship between continuous age and BMI variables and dyslipidemia. Four percentiles (P5, P25, P75, P95) of age and BMI were selected as knots to plot the relationship between age, BMI, and dyslipidemia. If P(for all)<0.05 and P(for non-linearity)<0.05, a non-linear relationship was indicated. All analyses used two-sided tests with α=0.05, and P<0.05 was considered statistically significant.

Results

2.1 Basic Characteristics of Study Subjects

A total of 41,469 elderly residents were included in this study, comprising 16,721 males (40.32%) and 24,748 females (59.68%), with a mean age of

(72.88$\pm$6.73)$years.Educationalattainmentwasprimaryin8,805participants(21.23\pm1.18mmol/L),triglyceria$
$densitylipoproteincholesterol(LDL - C)(3.21\pm1.00mmol/L),andhigh -$
$densitylipoproteincholesterol(HDL-C)$(1.46$\pm$\$0.39 mmol/L).

2.2 Prevalence of Dyslipidemia

Among the 41,469 elderly residents, the prevalence of dyslipidemia was 53.65% (22,247/41,469), with an age-standardized prevalence of 53.89%. The prevalence rates of hypercholesterolemia, hypertriglyceridemia, mixed hyperlipidemia, and low HDL-Cemia were 21.43% (8,887/41,469), 16.50% (6,843/41,469), 14.51% (6,017/41,469), and 3.80% (1,577/41,469), respectively, with standardized rates of 21.57%, 16.53%, 14.61%, and 3.78% (see Table 1). The prevalence of dyslipidemia was significantly higher in females at 58.71% (14,529/24,748) compared to males at 46.16% (7,718/16,721) (^{2}=193.82, P<0.01). In males, the prevalence rates of hypercholesterolemia, hypertriglyceridemia, mixed hyperlipidemia, and low HDL-Cemia were 16.15% (2,701/16,721), 17.60% (2,943/16,721), 10.23% (1,710/16,721), and 6.30% (1,053/16,721), respectively. In females, the corresponding rates were 25.00% (6,186/24,748), 15.76% (3,900/24,748), 17.40% (4,307/24,748), and 2.12% (524/24,748). Hypertriglyceridemia was the main type of dyslipidemia in males (17.60%), while hypercholesterolemia was predominant in females (25.00%).

2.3 Univariate and Multivariate Logistic Regression Analysis of Dyslipidemia Risk Factors

Univariate analysis revealed statistically significant differences in dyslipidemia prevalence across different genders, age groups, education levels, BMI categories, and exercise frequencies (P<0.05). No significant difference was observed across marital status groups (P>0.05) (see Table 2).

Based on univariate analysis results, variables with P<0.05 were included in a stepwise multivariate logistic regression model to analyze risk factors for dyslipidemia in Yuexiu District elderly residents. The presence of dyslipidemia was used as the dependent variable (0=non-dyslipidemia, 1=dyslipidemia). Male gender, primary education, and daily exercise were assigned as reference groups (value=1) for comparison with other groups. Age group and BMI were analyzed as continuous variables. Variable assignments are shown in Table 3 . Table 4 shows that female gender, younger age, and higher BMI were risk factors for dyslipidemia.

2.4 Non-linear Relationship Between Age, BMI, and Dyslipidemia

After adjusting for gender, education level, and marital status using RCS models, the P(for all) value for the relationship between age and dyslipidemia prevalence was <0.001, and the P(for nonlinearity) value was 0.045. For BMI and dyslipidemia prevalence, the P(for all) value was <0.001 and the P(for nonlinearity) value was <0.001, indicating non-linear relationships. Dyslipidemia prevalence

declined rapidly among elderly residents aged 65–70 years, then decreased slowly after age 70. As BMI increased, dyslipidemia prevalence initially rose then declined, peaking at a BMI of 29.8 kg/m^2.

[Figure 1: see original paper] shows the relationship between age and dyslipidemia based on RCS model analysis. [Figure 2: see original paper] shows the relationship between BMI and dyslipidemia based on RCS model analysis.

Discussion

Previous studies have primarily focused on adult populations aged 18 and above [5-7]. The 2015 Chinese Residents' Nutrition and Chronic Disease Report indicated that the prevalence of dyslipidemia among national adults was 40.40%. However, specific reports on dyslipidemia prevalence in elderly populations remain limited in China. This study found that the prevalence of dyslipidemia among elderly residents in Yuexiu District, Guangzhou, enrolled in the national basic public health services was 53.65%, with an age-standardized prevalence of 53.89%. Although this is lower than the 60.30% prevalence reported internationally [8], it exceeds the 47.0% overall prevalence reported in a meta-analysis of dyslipidemia among Chinese elderly [9]. These results indicate that dyslipidemia prevalence among elderly residents in Guangzhou' s Yuexiu District is at a relatively high level, necessitating strengthened prevention, control, and management to reduce the incidence of atherosclerotic cardiovascular disease and promote the goal of "healthy aging."

This study identified hypercholesterolemia and hypertriglyceridemia as the main types of dyslipidemia among elderly residents in Yuexiu District, Guangzhou. This finding differs from the national pattern among Chinese elderly, where hypertriglyceridemia and low HDL-Cemia predominate [9], but aligns with reports by Wen Jian et al. [10] on the main dyslipidemia types among urban elderly residents over 65 in Guangdong Province in 2014, though the current prevalence rates are lower. Hypertriglyceridemia was the primary type in males (17.60%), while hypercholesterolemia was predominant in females (25.00%). Despite variations in survey methods across studies, these comparisons reflect both a high prevalence and distinct patterns of dyslipidemia types among elderly residents in Yuexiu District, Guangzhou.

Multivariate logistic regression analysis revealed that gender, age group, education level, and BMI were influencing factors for dyslipidemia prevalence, consistent with findings from the Chinese Residents' Nutrition and Chronic Disease Status Report [11]. The overall dyslipidemia prevalence was higher in elderly females than males, aligning with reports by Huang Liping [12] (50.57% vs. 42.50%) and Li Yanna [13] (25.45% vs. 21.44%). This may be related to decreased estrogen levels after menopause, which enhances hepatic 3-hydroxy-3-methylglutaryl-coenzyme A reductase (HMGR) activity, leading to elevated plasma cholesterol levels and metabolic disturbances in glucose and lipids [14]. These results suggest that community-based elderly health management should

shift the focus of dyslipidemia prevention and treatment to primary and secondary prevention levels, and implement targeted monitoring and personalized interventions based on gender differences, dyslipidemia types, and health status.

This study used RCS models to continuously present dose-response relationships, enhancing the practical guidance of findings. The results demonstrate non-linear relationships between age and dyslipidemia, as well as between BMI and dyslipidemia prevalence. Among individuals over 65, dyslipidemia prevalence generally decreased with age, consistent with observations by Yi Qiang in Shanghai' s Huacao community elderly over 60 [15], Zhao Yingying in Bengbu City elderly residents [16], and Erem' s report on Turkish elderly aged 65 and above [17]. Epidemiological studies reveal a "cholesterol paradox" phenomenon in elderly populations. In a prospective cohort study of 2,556 Medicare beneficiaries aged 65–103, higher LDL-C was associated with survival advantages in white participants [18]. Dyslipidemia prevalence decreases with age among the elderly, and low serum cholesterol shows a paradoxical association with mortality risk [19]. Potential mechanisms include: (1) Age-related frailty, with declining gastrointestinal absorption and reduced activity of lipid metabolism-related enzymes [20]; (2) Survival selection, where individuals reaching advanced age represent a selected population with genetic protection against fatal diseases [21]; (3) Polypharmacy, as elderly individuals often have multiple comorbidities requiring multiple medications that may cause or worsen dyslipidemia [22]; and (4) Reduced cholesterol absorption and synthesis due to decreased food intake, leading to lower serum total cholesterol and LDL-C levels [19].

Dyslipidemia prevalence initially increased then decreased with rising BMI. At low BMI levels, prevalence increased rapidly with BMI, while at high BMI levels, the association was not significant. These findings align with the Expert Consensus on Dyslipidemia Management in Elderly Patients Aged 75 and Above [23], which does not recommend active exercise and weight loss as routine treatment for elderly and obese older adults. The Expert Consensus on Dyslipidemia Management in Very Elderly Patients also notes that weight loss has very limited lipid-lowering effects in very old adults compared to younger individuals [24]. Possible explanations include that BMI, as an indirect risk factor, may influence cardiovascular outcomes through control of other risk factors. For example, weight loss improves insulin sensitivity [25], which benefits blood pressure control and subsequently affects lipid metabolism. Current intervention thresholds and target levels for traditional risk factors like BMI based on younger populations may not be applicable to obese elderly individuals. Risk factor criteria and control standards derived from younger populations may not suit elderly populations, warranting in-depth exploration of dyslipidemia risk factor thresholds specifically for the elderly.

In summary, the prevention and treatment of dyslipidemia among elderly residents in Yuexiu District, Guangzhou, remains a formidable task. As China' s population aging intensifies, the focus of cardiovascular disease prevention must shift toward elderly populations. Effectively reducing and delaying the

onset and progression of dyslipidemia while improving physical function and health status among the elderly represents a major challenge for China' s healthcare system. Countries worldwide have prioritized dyslipidemia management in national health agendas, developing prevention and management guidelines. The 2019 American College of Cardiology (ACC)/American Heart Association (AHA) Guideline on the Primary Prevention of Cardiovascular Disease and the 2019 European Society of Cardiology (ESC)/European Atherosclerosis Society (EAS) Dyslipidemia Management Guidelines provide international frameworks. China has also accumulated new epidemiological data and clinical intervention research, releasing the 2016 Chinese Adult Dyslipidemia Prevention and Treatment Guidelines (Revised Edition) in October 2016. To implement effective prevention and intervention measures that reduce dyslipidemia prevalence and promote healthy aging, we recommend: (1) Strengthening comprehensive community interventions, which require long-term, population-wide programs with broad participation to effectively control lipid levels; (2) Integrating dyslipidemia management into primary healthcare institutions' elderly health management services, using electronic health records to identify elderly individuals with dyslipidemia and promote monitoring and health assessment for primary and secondary prevention; and (3) Building an integrated medical service system that combines chronic disease prevention, treatment, and rehabilitation to provide high-quality, continuous medical services for elderly individuals with dyslipidemia, ultimately improving their physical function and quality of life [26].

This study has several limitations: (1) As a cross-sectional study, exposure factors and outcomes were collected simultaneously, limiting causal inference and preventing calculation of incidence rates and risk; (2) The included participants were unselected, comprising a substantial proportion of individuals with dyslipidemia and cardiovascular disease, many of whom were taking lipid-lowering medications that could affect test results; and (3) The target population was elderly, and over time, survivor bias is inevitable, as individuals with poorly controlled dyslipidemia and severe underlying diseases may have died, while survivors in the oldest age groups often had relatively better lipid control.

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Note: Figure translations are in progress. See original paper for figures.