Postprint: Prevalence of Dyslipidemia and Its Influencing Factors Among Community Elderly Residents

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Abstract

Background Dyslipidemia is the most important independent risk factor with a causal relationship for atherosclerotic cardiovascular disease. The prevalence of dyslipidemia among elderly residents in Guangdong Province is relatively high, necessitating an 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 included in the National Basic Public Health Services in Yuexiu District, Guangzhou. Methods A total of 41,469 elderly residents aged $ $65 years with complete key variables were selected from the information system of community health service centers in Yuexiu District, Guangzhou in 2020 as the study subjects. The 2020 health examination data were used to describe the epidemiological characteristics including basic demographic information, BMI, and lipid levels. Restricted cubic spline (RCS) was used to fit a Logistic regression model to analyze the relationship between age, BMI, and the prevalence of dyslipidemia. Results The prevalence of dyslipidemia among the 41,469 elderly residents was 53.65% (22,247/41,469), with a standardized prevalence of 53.89%. Specifically, the prevalence of hypercholesterolemia was 21.43% (8,887/41,469), with a standardized prevalence of 21.57%; hypertriglyceridemia was 16.50% (6,843/41,469), with a standardized prevalence of 16.53%; mixed hyperlipidemia was 14.51% (6,017/41,469), with a standardized prevalence of 14.61%; and low high-density lipoprotein cholesterol (HDL-C) was 3.80% (1,577/41,469), with a standardized prevalence of 3.78%. Multivariate Logistic regression analysis showed that gender, age, education level, BMI, and exercise status were all influencing factors for dyslipidemia in elderly residents, among which female sex, younger age groups, and high BMI were risk factors

for dyslipidemia (P<0.05). RCS fitting results indicated a non-linear relationship between age, BMI, and the prevalence of dyslipidemia in elderly residents; with increasing age, the prevalence of dyslipidemia showed an overall decreasing trend; as BMI levels increased, the risk of dyslipidemia first increased and then decreased, with OR increasing significantly at low BMI and decreasing slightly at high BMI. Conclusion The prevalence of dyslipidemia is relatively high among elderly residents aged $ $65 years included in the National Basic Public Health Services in Yuexiu District, Guangzhou. In this elderly population, the prevalence of dyslipidemia decreases with age, while the risk of dyslipidemia shows a trend of first increasing and then decreasing with rising BMI levels. This suggests that dyslipidemia management in the elderly has certain particularities, and specific risk factors for dyslipidemia in this population should be prioritized for early prevention and control.

Full Text

Preamble

Prevalence of Dyslipidemia and Its Influencing Factors among Elderly Community Residents

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Abstract

Background: Dyslipidemia is the most important and causal 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 to implement targeted prevention and control measures.

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

Methods: A total of 41,469 elderly residents aged $ $65 years with complete key variables were selected from the information system of community health service centers in Yuexiu District, Guangzhou, in 2020. The 2020 health examination data were used to describe epidemiological characteristics including basic information, BMI, and blood lipid levels. Restricted cubic spline (RCS) fitting Logistic regression models were employed to analyze the relationship between age, BMI, and dyslipidemia prevalence.

Results: The prevalence of dyslipidemia among the 41,469 elderly residents was 53.65% (22,247/41,469), with a standardized prevalence of 53.89%. Specifically, hypercholesterolemia prevalence was 21.43% (8,887/41,469), standardized at 21.57%; hypertriglyceridemia was 16.50% (6,843/41,469), standardized at 16.53%; mixed hyperlipidemia was 14.51% (6,017/41,469), standardized at 14.61%; and low HDL-C cholesterolemia was 3.80% (1,577/41,469), standardized at 3.78%. Multivariate Logistic regression analysis revealed that gender, age, education level, BMI, and exercise status were all influencing factors, with female sex, younger age groups, and high BMI identified as risk factors ($P<0.05$). RCS fitting demonstrated non-linear relationships between age, BMI, and dyslipidemia prevalence. Overall, dyslipidemia prevalence decreased with age. The risk of dyslipidemia initially increased then decreased with rising BMI, with OR values rising significantly at low BMI and declining slightly at high BMI.

Conclusion: The prevalence of dyslipidemia is relatively high among elderly residents aged $ $65 years included in the national basic public health services in Yuexiu District, Guangzhou. Dyslipidemia prevalence decreases with age, while the risk exhibits an initial increase followed by a decrease with rising BMI. These findings suggest that dyslipidemia management in the elderly has unique characteristics, emphasizing the need to focus on specific risk factors and implement early prevention and control measures.

Keywords: Dyslipidemias; Aged; Epidemiology; Root cause analysis; Restricted cubic spline model

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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 moderate aging stage, with an aging rate of 17.46% [1]. As age increases, the decline in physiological function and organ capacity raises the risk of cardiovascular disease among older adults. Dyslipidemia is the most important and causal independent risk factor for atherosclerotic cardiovascular disease [2], and its rising prevalence increasingly burdens healthcare systems.

In recent years, the prevalence of dyslipidemia among the elderly has been significantly higher than in other age groups. Moreover, the physical condition of older adults undergoes numerous changes with age, suggesting that dyslipidemia management in this population has unique characteristics. Based on this context, this study investigates the epidemiological status and risk factors of dyslipidemia among elderly residents included in the national basic public health service in Yuexiu District, Guangzhou, aiming to provide a scientific basis for dyslipidemia prevention and cardiovascular disease control strategies.

Methods

Study Design and Data Source

According to national basic public health service requirements, Yuexiu District provides free annual physical examinations and health assessments for eligible residents aged $ $65 years, with follow-ups every six months. This study utilized examination data from the Yuexiu District community health service center information system, covering 18 streets and 18 community health service centers across the district. In 2020, a total of 54,443 elderly residents aged $ $65 years participated in physical examinations. Based on inclusion and exclusion criteria, 41,469 subjects were included in this study.

Inclusion criteria: (1) Complete data for lipid testing items [total cholesterol (TC), triglycerides (TG), low-density lipoprotein cholesterol (LDL-C), high-density lipoprotein cholesterol (HDL-C)]; (2) Complete basic information.

Exclusion criteria: Subjects with abnormal values in lipid testing items were excluded based on the measurement range of the detection reagents (using Roche original detection reagent range as the standard). For subjects with multiple examination records, only the first examination results were used. This study was approved by the Medical Ethics Committee of Sun Yat-sen University School of Public Health (Approval No.: 中大公卫医伦〔2019〕第 123 号).

Data Collection

Basic information (age, gender, education level, marital status, etc.), physical examination data (height, weight, BMI), and laboratory test results (lipid profiles) were collected through direct data integration between the district-level "Weining" laboratory system and the Yuexiu District "Wanda" information platform. For laboratory testing, subjects were required to fast after 10 PM the night before the examination. Fasting venous blood was collected in the morning using procoagulant tubes, and lipid detection was performed using Roche original reagents.

Diagnostic Criteria

(1) Dyslipidemia: According to China's 2018 dyslipidemia diagnostic standards, four types were defined: hypercholesterolemia (TC >5.72 mmol/L, TG

<1.70 mmol/L); hypertriglyceridemia (TG >1.70 mmol/L, TC <5.72 mmol/L); mixed hyperlipidemia (TC >5.72 mmol/L, TG >1.70 mmol/L); and low HDL-C cholesterolemia (HDL-C <0.90 mmol/L) [3]. Presence of any one criterion was classified as dyslipidemia, also known as hyperlipidemia.

(2) Education level: Primary education (elementary school and below), secondary education (middle school, technical secondary school, and high school), and higher education (university including junior college and above).

(3) Marital status: "With spouse" included married and living with spouse, or married but temporarily not living with spouse due to work reasons, or cohabiting; "without spouse" included unmarried, widowed, or divorced.

Statistical Analysis

Prevalence was standardized according to data from China's seventh population census to calculate the total number and standardized prevalence of dyslipidemia among the national population aged $ 65 $years. Continuous variables were expressed as $(x \pm s)$ and compare
tests. Categorical variables were expressed as frequencies and percentages, compared using $\chi^{2}
tests. Trend ^{2} tests were used to assess age-related trends in dyslipidemia prevalence.

To avoid information loss from categorizing age and BMI, restricted cubic spline (RCS) fitting Logistic regression models were employed. The rcs function in the rms package of R software was used to fit spline functions rcs(X, knots) to evaluate relationships between continuous age and BMI variables and dyslipidemia. Knots were set at the 5th, 25th, 75th, and 95th percentiles for age and BMI. Relationship plots were generated. 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.

Results

Basic Characteristics of Participants

Among the 41,469 elderly residents, 16,721 (40.32%) were male and 24,748 (59.68%) were female. The mean age was (72.9$\pm$6.7) $years. Education levels were$: $8,805 (21.23 \pm 1.18) mmol/L, TG (1.57 \pm 0.94) mmol/L, LDL-C (3.21 \pm 1.00) mmol/L,$ and $HDL-C$ (1.46$\pm$$0.39) mmol/L.

Prevalence of Dyslipidemia

The overall prevalence of dyslipidemia was 53.65% (22,247/41,469), with a standardized prevalence of 53.89%. Specific types included: hypercholesterolemia 21.43% (8,887/41,469), standardized at 21.57%; hypertriglyceridemia 16.50% (6,843/41,469), standardized at 16.53%; mixed hyperlipidemia 14.51% (6,017/41,469), standardized at 14.61%; and low HDL-C cholesterolemia 3.80% (1,577/41,469), standardized at 3.78%.

Male elderly residents had higher prevalence of hypertriglyceridemia and low HDL-C cholesterolemia, while females had higher prevalence of overall dyslipidemia, hypercholesterolemia, and mixed hyperlipidemia (P<0.001). Dyslipidemia, hypercholesterolemia, hypertriglyceridemia, mixed hyperlipidemia, and low HDL-C cholesterolemia prevalence all differed significantly across age groups (P<0.05) .

Prevalence Comparisons by Characteristics

Dyslipidemia prevalence differed significantly by gender, education level, and exercise status (P<0.05) . The mean age of elderly residents with dyslipidemia was (72.2$±6.3)$years versus$(73.7±7.1)$years for those without$(t = 22.54, P < 0.001)$. The mean BMI was$(24.03±3.25)$kg/m^{2}$ in those with dyslipidemia versus (23.56$±3.33)$kg/m^{2}$ in those without (t=-14.52, P<0.001).

Multivariate Logistic Regression Analysis

Using dyslipidemia status as the dependent variable (0=normal, 1=dyslipidemia) and factors showing statistical significance in univariate analysis as independent variables, multivariate Logistic regression revealed that gender, age, education level, BMI, and exercise status were all influencing factors. Female sex, younger age groups, and high BMI were identified as risk factors for dyslipidemia in elderly residents (P<0.05) .

RCS Model Results

After adjusting for gender, education level, and marital status using the RCS model, the relationship between age and dyslipidemia prevalence showed P(for all) <0.001 and P(for nonlinearity) =0.045; for BMI and dyslipidemia prevalence, P(for all) <0.001 and P(for nonlinearity) <0.001, indicating non-linear relationships. Dyslipidemia prevalence declined rapidly between ages 65-70, then decreased slowly after age 70. With increasing BMI, dyslipidemia prevalence initially rose then fell, peaking at a BMI of 29.8 kg/m^2 [FIGURE:1, FIGURE:2].

Discussion

Previous studies on dyslipidemia prevalence have primarily focused on adult populations aged $ $18 years [4-6], including the “Report on Nutrition and Chronic Diseases of Chinese Residents (2015)” which reported a national adult dyslipidemia prevalence of 40.40% [7]. Few studies have specifically reported on dyslipidemia prevalence in elderly populations. This study found that the prevalence of dyslipidemia among elderly residents in Yuexiu District receiving national basic public health services was 53.65% (standardized: 53.89%). While lower than the prevalence in foreign populations (60.30%) [8], this exceeds the meta-analysis result for Chinese elderly populations (47.0%) [9], indicating a rel-

atively high burden in Yuexiu District that warrants strengthened prevention and management to reduce ASCVD risk and promote healthy aging.

Hypercholesterolemia and hypertriglyceridemia were the main dyslipidemia types among Yuexiu District's elderly residents. This differs from national elderly population studies showing hypertriglyceridemia and low HDL-C cholesterolemia as predominant [9], but aligns with Wen et al.'s report on Guangdong urban elderly residents aged $ $65 in 2014, where hypertriglyceridemia was the main type in males (17.60%) and hypercholesterolemia in females (25.00%) [10]. Despite methodological differences across studies, these comparisons suggest elevated dyslipidemia prevalence in Yuexiu District's elderly population.

Multivariate analysis identified gender, age, education level, BMI, and exercise status as influencing factors, consistent with the "Report on Nutrition and Chronic Diseases of Chinese Residents (2015)" [7]. Female elderly residents had higher overall dyslipidemia prevalence than males, corroborating findings from Huang et al. (50.57% vs. 42.50%) [11] and Li et al. (25.45% vs. 21.44%) [12]. This may be attributed to decreased estrogen levels post-menopause, which enhances hepatic 2-hydroxy-3-methylglutaryl-coenzyme A reductase (HMGR) activity, leading to elevated plasma cholesterol and metabolic disturbances [13]. These findings suggest that community-based elderly health management should: (1) advance dyslipidemia prevention to primary and secondary levels, and (2) implement personalized monitoring and early interventions based on gender-specific patterns and health status.

The RCS model enabled continuous presentation of dose-response relationships between age, BMI, and dyslipidemia, enhancing practical guidance. Both age and BMI showed non-linear relationships with dyslipidemia prevalence. For the $ $65 population, dyslipidemia prevalence decreased with age, consistent with findings from Shanghai [14], Bengbu [15], and Turkish elderly populations [16]. This reflects the "cholesterol paradox" phenomenon in elderly populations, where a prospective cohort study of 2,556 Medicare beneficiaries aged 65-103 found higher LDL-C associated with survival advantages in Caucasians [17]. The age-related decline may be explained by: (1) frailty reducing gastrointestinal absorption and lipid metabolism enzyme activity [19]; (2) survival selection favoring individuals with protective genetic factors [20]; (3) polypharmacy from multimorbidity exacerbating lipid disorders [21]; and (4) reduced cholesterol absorption from decreased food intake [18].

RCS results also showed dyslipidemia prevalence initially rising then falling with increasing BMI, with rapid increases at low BMI and minimal association at high BMI. This aligns with expert consensus that "active exercise and weight loss should not be routinely recommended for very old, obese elderly" [22] and that "weight loss has limited lipid-lowering effects in very old adults compared to younger individuals" [23]. Elevated BMI may be an indirect risk factor, with cardiovascular benefits of BMI control potentially mediated through other risk factors like improved insulin sensitivity [24]. Current intervention thresholds and targets based on younger populations may not apply to obese elderly, ne-

cessitating elderly-specific dyslipidemia risk factor definitions.

Conclusion

Dyslipidemia prevention and control among elderly residents in Yuexiu District faces significant challenges. With China's increasingly severe population aging, cardiovascular disease prevention must shift focus to elderly populations. Effectively reducing and delaying dyslipidemia onset while improving physical function and health status represents a critical challenge for China's healthcare system. Countries worldwide have prioritized dyslipidemia in national health agendas, releasing guidelines including the 2019 ACC/AHA Guideline on Primary Prevention of Cardiovascular Disease [25], 2019 ESC/EAS Guidelines for Dyslipidemia Management [26], and China's 2016 revised guidelines [27].

To reduce dyslipidemia prevalence and achieve healthy aging, we recommend: (1) strengthening comprehensive community interventions with long-term public participation; (2) integrating dyslipidemia management into primary care elderly health services through electronic health records for identification, monitoring, and health assessment; and (3) building integrated healthcare service chains combining prevention, treatment, and rehabilitation to provide high-quality, continuous care that improves functional status and quality of life [28].

Limitations

This study has several limitations: (1) As a cross-sectional study, exposure and outcome data were collected simultaneously, limiting causal inference; (2) The unselected cohort included many dyslipidemia and cardiovascular disease patients using lipid-lowering medications, affecting lipid levels; (3) The elderly target population is subject to survivor bias over time and through mortality.

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