Association Between Dietary Patterns and Dyslipidemia Among Gannan Residents: A Postprint

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Abstract

Background Diet is closely associated with dyslipidemia. Traditional nutritional epidemiology focuses on single foods or food categories; however, daily life does not involve consumption of single nutrients or foods alone. This makes it more difficult to distinguish the effects of individual dietary components on dyslipidemia. Currently, there are no studies domestically or internationally exploring the association between dietary patterns and dyslipidemia among residents in the Gannan region.

Objective To analyze the association between dietary patterns and the risk of dyslipidemia among residents aged $ $35 years in the Gannan region, and to provide scientific evidence and theoretical basis for formulating nutritional policies for dyslipidemia prevention and control.

Methods From July to August 2020, survey subjects were selected from permanent residents aged $ $35 years in the Gannan region using a multistage random sampling method. Questionnaires and physical examinations were used to collect basic information (general demographics, behavioral habits, disease history, etc.), fasting blood glucose and lipid levels were measured, and the prevalence of dyslipidemia among residents with different characteristics was analyzed and compared. A simplified food frequency questionnaire was used for dietary surveys, and factor analysis was employed to extract dietary patterns. Each dietary pattern was divided into four subgroups (Q1, Q2, Q3, Q4) based on quartiles of factor scores from low to high. Logistic regression analysis was used to explore the correlation between dietary patterns and the risk of dyslipidemia.

Results A total of 1,508 residents aged $ $35 years in the Gannan region were included in this study, with a dyslipidemia prevalence rate of 36.07% (544/1508). Residents with adequate water intake, no history of hypertension, and a history of diabetes had higher prevalence of dyslipidemia ($P<0.05$). Four

dietary patterns were extracted for the Gannan region through factor analysis: carbohydrate-vegetable-aquatic products, coarse grain-fruit-dairy, poultry/livestock meat-preserved foods, and egg-soy products. After adjusting for confounding factors, logistic regression analysis results showed that, compared with the Q1 level, residents at Q2 and Q3 levels of the egg-soy products dietary pattern in the Gannan region had lower risk of dyslipidemia (Q2: OR=0.648, 95%CI=0.478~0.879, P=0.005; Q3: OR=0.616, 95%CI=0.454~0.836, P=0.002).

Conclusion The prevalence of dyslipidemia is relatively high among residents aged $ $35 years in the Gannan region, and a high-level egg-soy products dietary pattern can reduce the risk of dyslipidemia; residents in the Gannan region should be encouraged to maintain a reasonable diet with appropriate increases in egg and soy product consumption.

Full Text

Study on the Relationship Between Dietary Patterns and Dyslipidemia Among Residents Aged $ $35 Years in Southern Jiangxi

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Abstract

Background: Dyslipidemia, characterized by elevated serum total cholesterol (TC) and/or triglyceride (TG) levels, represents a major risk factor for cardiovascular disease. With China' s rapid economic development, population blood lipid levels have risen significantly—the prevalence of dyslipidemia among adults over 35 increased from 18.6% in 2002 to 33.8% in 2014-2019. While traditional nutritional epidemiology has focused on individual foods or nutrients, this approach is limited because people consume complex dietary combinations rather than isolated components, making it difficult to discern specific effects. To date, no studies have examined the relationship between dietary patterns and dyslipidemia in Southern Jiangxi (Gannan).

Objective: To analyze associations between dietary patterns and dyslipidemia risk among residents aged $ $35 years in Gannan, providing scientific evidence for nutrition policies aimed at dyslipidemia prevention and control.

Methods: Using multi-stage random sampling, we recruited permanent residents aged $ $35 from Gannan during July-August 2020. Questionnaires and physical examinations collected demographic and behavioral data, while fasting blood glucose and lipid levels were measured. Dietary intake was assessed via a food frequency questionnaire, and factor analysis identified dietary patterns. Each pattern was divided into quartiles (Q1-Q4) based on factor scores. Logistic regression analyzed relationships between dietary patterns and dyslipidemia risk.

Results: Among 1,508 participants, the dyslipidemia prevalence was 36.07% (544/1,508). Residents with adequate water intake, no hypertension history, and diabetes history showed higher dyslipidemia prevalence ($P<0.05$). Factor analysis identified four dietary patterns: carbohydrate-vegetable-seafood, coarse grain-fruit-dairy, poultry meat-preserved products, and egg-soy products (cumulative variance contribution: 48.576%). After adjusting for confounders, the egg-soy product pattern was associated with lower dyslipidemia risk at Q2 and Q3 levels compared to Q1 (Q2: OR=0.648, 95%CI=0.478-0.879, P=0.005; Q3: OR=0.616, 95%CI=0.454-0.836, P=0.002).

Conclusion: Dyslipidemia prevalence is high among Gannan residents aged $ $35. The egg-soy product dietary pattern reduces dyslipidemia risk, suggesting that promoting balanced diets with moderate egg and soy product intake could benefit this population.

Keywords: Dyslipidemia; Dietary pattern; Factor analysis; Southern Jiangxi; $ $35 years old; Root cause analysis

Introduction

Dyslipidemia typically refers to elevated serum total cholesterol (TC) and/or triglyceride (TG) levels and represents one of the primary risk factors for cardiovascular disease [1-2]. With rapid national economic development, blood lipid levels among Chinese populations are progressively increasing. The Million Persons Project on early screening and comprehensive intervention for high-risk cardiovascular populations in China (2014-2019) found a dyslipidemia prevalence of 33.8% among individuals over 35, significantly higher than the 18.6% reported in the 2002 China Health and Nutrition Survey [3-4]. One study projected 9.2 million cases by 2010 [5]. Dyslipidemia is influenced not only by genetic factors but also closely associated with diet [2,6-7].

Traditional nutritional epidemiology has focused on relationships between individual foods or nutrients and dyslipidemia [8-10]. However, since daily consumption involves complex dietary combinations rather than isolated nutrients, dis-

tinguishing the specific impact of individual dietary components becomes challenging. Consequently, recent research has increasingly examined diet-disease relationships from a holistic dietary pattern perspective [7,11-12]. Given China' s vast territory and diverse economic development and traditional food cultures, regional dietary patterns vary considerably [13]. This study analyzes baseline data from the Gannan Chronic Disease Cohort to characterize current dietary patterns and their relationship with dyslipidemia among residents aged $ $35, providing evidence for targeted nutrition policies and cardiovascular disease prevention.

Methods

Study Design and Participants Data were derived from the 2020 Gannan Chronic Disease Cohort survey. Using multi-stage random sampling: Ganzhou was divided into 18 primary sampling units, from which 7 were selected; communities, townships, and towns under selected primary units formed secondary sampling units, from which 21 were chosen; random sampling from these secondary units yielded 1,837 participants. Inclusion criteria: (1) local residents aged $ $35; (2) no psychiatric disorders, able to cooperate. Exclusion criteria: (1) missing dietary data; (2) incomplete physical or biochemical measurements. The final sample included 1,508 participants (effective response rate: 82.09%). The study followed Helsinki Declaration principles, was approved by the Gannan Medical University Ethics Committee (NO.2019129), and all participants provided informed consent.

Data Collection Questionnaire Survey: A self-designed questionnaire administered through face-to-face interviews collected data on demographics, smoking, alcohol consumption, physical activity, dietary habits, and medical history.

Dietary Survey: The food frequency questionnaire was adapted based on Gannan dietary habits, collecting consumption frequency and amounts of 11 food categories over the past year to calculate daily average intake: grains (rice, flour), poultry/meat products, aquatic products (fish, shrimp, crab), dairy, fresh vegetables, fresh fruits, preserved foods, sweets, coarse grains (corn, oats, tubers), soy products, and eggs.

Physical Examination and Laboratory Tests: Fasting venous blood was collected to measure TC, TG, high-density lipoprotein cholesterol (HDL-C), low-density lipoprotein cholesterol (LDL-C), fasting plasma glucose (FPG), and glycated hemoglobin A1c (HbA1c). Biochemical testing was conducted by Ganzhou Renxin Medical Examination Center.

Variable Definitions Dyslipidemia: According to the 2016 Chinese Guidelines for the Prevention and Treatment of Dyslipidemia in Adults [2], defined as: TC $ $6.22 mmol/L (hypercholesterolemia), TG $ $2.26 mmol/L (hypertriglyc-

eridemia), LDL-C $ $4.14 mmol/L (high LDL-C), HDL-C $ $1.04 mmol/L (low HDL-C), or current lipid-lowering medication use.

BMI Classification: Based on the Chinese Expert Consensus on Obesity Prevention and Treatment [14]: <18.5 kg/m^2 (underweight), 18.5-23.9 kg/m^2 (normal), 24-27.9 kg/m^2 (overweight), $ 28$kg/m\^{}\{2\}$ (obese).

Disease History: (1) Diabetes: FPG $ $7.0 mmol/L or HbA1c $ $6.5%, or current anti-diabetic medication use [15]; (2) Hypertension: systolic $ $140 mmHg and/or diastolic $ $90 mmHg without medication, or current antihypertensive use [16]; (3) Heart disease: structural or functional cardiac abnormalities [17].

Behavioral Factors: Smoking defined as $ $1 cigarette daily for $ $6 months; smoking cessation as $ $3 months abstinence [18]. Alcohol consumption defined as regular intake equivalent to $ $50g white wine; abstinence as <6 months of minimal/no intake [18]. Physical activity frequency measured as weekly sessions of $ $30 minutes causing accelerated heartbeat and mild sweating [19]. Water intake adequacy defined as >1 L/day; food portion size self-reported relative to peers; taste preference for saltiness self-reported relative to typical family diets.

Quality Control Pilot surveys were conducted to refine the questionnaire. Investigators received unified training on survey objectives and procedures. Completed questionnaires were checked for missing items. Data were double-entered independently for consistency verification.

Statistical Analysis Data were managed using Epidata 3.0 and analyzed with SPSS 14.0. Categorical data are presented as [n(%)]. Chi-square tests compared dyslipidemia prevalence across demographic characteristics. Factor analysis with varimax rotation extracted dietary patterns (eigenvalue >1). Factor scores were calculated for each participant and divided into quartiles (Q1-Q4). Logistic regression examined associations between dietary patterns and dyslipidemia risk. Two-sided tests with α=0.05 were used.

Results

Participant Characteristics and Dyslipidemia Prevalence Among 1,508 participants (484 men [32.10%], 1,024 women [67.90%]), mean age was 55.1$±$7.7 years. Most were married (1,443 [95.69%]), had junior high school education or below (1,079 [71.55%]), and engaged in physical labor (1,106 [73.34%]). Overall dyslipidemia prevalence was 36.07% (544/1,508), with a sex-standardized rate of 36.37% based on 2020 national census data. No significant differences in prevalence were observed by sex, marital status, education level, or occupation (P>0.05) .

Behavioral Habits and Dyslipidemia Prevalence Residents with adequate water intake had significantly higher dyslipidemia prevalence (P<0.05). No significant differences were found by smoking status, alcohol consumption,

taste preference, food portion size, physical activity frequency, or sleep duration (P>0.05) .

BMI, Disease History and Dyslipidemia Prevalence No significant differences were observed across BMI categories or heart disease history (P>0.05). However, residents without hypertension history and those with diabetes history showed higher dyslipidemia prevalence (P<0.05) .

Dietary Pattern Identification Factor analysis yielded a KMO value of 0.692 and Bartlett' s test P<0.001. Four dietary patterns were extracted with factor loadings >0.2, explaining 48.576% of total variance: (1) carbohydrate-vegetable-seafood, (2) coarse grain-fruit-dairy, (3) poultry meat-preserved products, and (4) egg-soy products .

Association Between Dietary Patterns and Dyslipidemia Logistic regression analysis used dyslipidemia status as the dependent variable (1=yes, 0=no) and dietary pattern quartiles as independent variables (Q1=1, Q2=2, Q3=3, Q4=4). After adjusting for sex, food portion size, water intake, smoking, BMI, diabetes history, and hypertension history, the egg-soy product pattern showed protective effects at Q2 and Q3 levels compared to Q1 (Q2: OR=0.648, 95%CI=0.478-0.879, P=0.005; Q3: OR=0.616, 95%CI=0.454-0.836, P=0.002) . Other patterns showed no significant associations.

Discussion

This study identified four distinct dietary patterns in Gannan: carbohydrate-vegetable-seafood, coarse grain-fruit-dairy, poultry meat-preserved products, and egg-soy products. These patterns differ from those reported in Harbin [20], Chongqing [21], and Guizhou [12], reflecting substantial regional dietary variations influenced by local food culture and research methodologies.

The overall dyslipidemia prevalence of 36.07% (standardized: 36.37%) exceeds national levels [3] and represents a significant increase from the 24.37% reported in Gannan in 2016 [22]. The finding that adequate water intake was associated with higher dyslipidemia prevalence contradicts some research [23], likely because our threshold (>1 L/day) was easily exceeded during the summer survey period, creating a confounded association. The unexpected result regarding hypertension history may reflect low awareness rates in this rural population [24] and potential use of β-blockers, which can elevate TG levels [25]. The association between diabetes history and dyslipidemia is well-established, as insulin resistance increases free fatty acids and hepatic very-low-density lipoprotein synthesis while reducing lipoprotein lipase activity [26].

After controlling for confounders, the egg-soy product pattern demonstrated protective effects against dyslipidemia, consistent with previous studies [29-30]. Egg components may enhance HDL function through lecithin binding [31-32],

while soy isoflavones upregulate genes involved in cholesterol homeostasis (HDL-C, LDLR, LXRα, ABCG1) [34]. Soy fiber also reduces cholesterol absorption and inhibits HMG-CoA reductase activity [35].

The lack of significant associations for other patterns warrants consideration. The carbohydrate-vegetable-seafood pattern' s potential benefits from vegetables and seafood may be offset by high carbohydrate intake, which elevates TG levels [36-37]. The coarse grain-fruit-dairy pattern' s neutral effect may relate to specific food choices (high-starch grains, high-fructose fruits, whole-fat dairy) and cooking methods adding fats. The poultry meat-preserved products pattern showed no association, possibly because preserved foods were consumed primarily during the Lunar New Year period, limiting their population-level impact [38-39].

Limitations This study has several limitations. First, dietary data relied on recall, introducing potential bias. Second, despite controlling for multiple confounders, unmeasured factors may influence results. Third, the cross-sectional design precludes causal inference. Fourth, the predominantly rural sample had lower meat intake than national recommendations.

Conclusion

Dyslipidemia prevalence is high among Gannan residents aged $ $35. Four dietary patterns were identified, with the egg-soy product pattern showing protective effects. Promoting balanced diets with moderate egg and soy product intake may reduce dyslipidemia risk in this population.

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