Postprint: A Study on the Comorbidity of "Three Highs" and Family Function Status and Influencing Factors among Older Adults in Guangzhou Urban Villages

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Abstract

Background: With the intensification of global population aging, the growth of China's elderly population has brought a series of health challenges, particularly in the management of chronic diseases such as hypertension, diabetes, and dyslipidemia ("the three highs"). Urban villages, as a special social unit in the urbanization process, exhibit a more prevalent phenomenon of comorbidity of "three highs" diseases among their residents, highlighting the urgent need for effective comprehensive management strategies. Family function plays an important role in patients with chronic diseases; for patients with "three highs", family support is not only crucial for improving treatment outcomes but also an important factor in enhancing quality of life. Objective: To understand the comorbidity and family function status of elderly patients with "three highs" in Guangzhou urban villages, analyze their main influencing factors, and provide a basis for formulating intervention strategies for these patients. Methods: A cross-sectional survey was conducted from January to June 2023 in a street of Panyu District, Guangzhou. Using stratified random sampling, permanent residents who had lived in the street for more than 6 months were surveyed. The survey was based on the annual health examination service for hypertensive patients and type 2 diabetic patients in the National Basic Public Health Service Standards (Third Edition). The Family Care Index (APGAR) questionnaire was used to evaluate patients' family function, and the comorbidity and family function status and their influencing factors among elderly "three highs" patients in Guangzhou urban villages were explored. Results: A total of 2,507 patients were surveyed, including 202 patients with "single high" (8.1%), 1,712 patients with "double highs" comorbidity (68.3%), and 593 patients with "triple highs" comorbidity (23.7%). There were statistically significant differences in

the distribution of disease types among patients with different genders, household registration types, number of "three highs" patients in the family, BMI, exercise status, fasting blood glucose status, lipid status, and family function grades (P<0.05). The mean total score of family function was (7.63$±$1.83) points, and there were statistically significant differences in the cooperation, emotion, intimacy scores and total scores of family function among patients with different disease types (P<0.05). Multiple linear regression analysis showed that gender (female: β=-0.148, t=-2.275, P=0.023), residence (community: β=-0.155, t=-2.402, P=0.016), and fasting blood glucose (abnormal glucose: β=-0.045, t=-2.465, P=0.014) were risk factors for lower total family function scores, while the number of "three highs" patients in the family (2 or more: β=0.174, t=2.356, P=0.026) and disease types (2 types: β=0.193, t=2.586, P=0.010; 3 types: β=0.342, t=3.248, P=0.001) were protective factors for higher total family function scores. Conclusion: Elderly "three highs" patients in Guangzhou urban villages are mainly characterized by the "double highs" comorbidity pattern, with overall good family function. Gender, residence, number of "three highs" patients in the family, disease types, and fasting blood glucose are influencing factors of family function.

Full Text

Multimorbidity of Hypertension, Diabetes, and Dyslipidemia and Influencing Factors of Family Function among the Elderly in Guangzhou's Urban Villages

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Abstract

Background: With accelerating global population aging, China's rapidly growing elderly population presents significant health challenges, particularly in managing chronic conditions such as hypertension, diabetes, and dyslipidemia (the "three highs"). Residents of urban villages—unique social units formed during

urbanization—experience higher prevalence of multimorbidity involving these conditions, underscoring the urgent need for effective comprehensive management strategies. Family function plays a critical role in chronic disease management, and for patients with the "three highs," family support is crucial not only for improving treatment outcomes but also for enhancing quality of life.

Objective: To investigate the prevalence of multimorbidity and family function status among elderly patients with hypertension, diabetes, and dyslipidemia in Guangzhou's urban villages, and to identify major influencing factors to inform intervention strategies.

Methods: A cross-sectional survey was conducted between January and June 2023 in a street community of Panyu District, Guangzhou. Using stratified random sampling, we surveyed permanent residents who had lived in the community for over six months. The survey was integrated with annual health examination services for patients with hypertension and type 2 diabetes under the National Basic Public Health Service Standards (Third Edition). Family function was assessed using the Family APGAR questionnaire. We explored multimorbidity patterns and family function status and their influencing factors among elderly patients with the "three highs" in Guangzhou's urban villages.

Results: Among 2,507 surveyed patients, 202 (8.1%) had a single condition, 1,712 (68.3%) had two coexisting conditions, and 593 (23.7%) had all three conditions. Statistically significant differences in disease patterns were observed across gender, household registration type, number of family members with "three highs" conditions, BMI, exercise habits, fasting blood glucose status, lipid profiles, and family function classification (P<0.05). The prevalence ratio for hypertension, dyslipidemia, and diabetes was 2.4:2.4:1. Among multimorbidity patterns, hypertension combined with dyslipidemia was most common (1,404 cases, 56.0%), followed by "three highs" co-occurrence (593 cases, 23.7%). No statistically significant differences were found in the distribution of comorbidity patterns by gender or age (P>0.05). The mean total family function score was (7.63$\pm$1.83). $Significantdifferenceswereobservedinpartnership, affection, andresolvesubscales, aswellasto$ 0.05). $Multiplelinearregressionanalysisidentifiedfemalegender(= -0.148, t = -2.275, P = 0.023), residenceinapartmentcomplexes(= -0.155, t = -2.402, P = 0.016), andabnormalfastingbloodglucose(= -0.045, t = -2.465, P = 0.014)asriskfactorsforlowerfamilyfunctionscores. Conversely, havingtwoormorefamilymemb$ t=2.356, P=0.026) and multimorbidity status (two conditions: β=0.193, t=2.586, P=0.010; three conditions: β=0.342, t=3.248, P=0.001) were protective factors associated with higher family function scores.

Conclusion: Elderly patients with the "three highs" in Guangzhou's urban villages predominantly exhibit a "two conditions co-occurring" pattern, with generally good overall family function. Gender, place of residence, number of family members with "three highs" conditions, disease pattern, and fasting blood glucose status are key influencing factors of family function.

Keywords: Multiple chronic conditions; Hypertension; Diabetes mellitus, type

2; Dyslipidemias; Aged; Family function; Root cause analysis

Introduction

Against the backdrop of global population aging in the 21st century, China is rapidly becoming an aging society. During the 14th Five-Year Plan period, China's elderly population is projected to exceed 300 million, making their health issues particularly concerning [1]. A 2022 research report by the National People's Congress indicates that Chinese elderly live with chronic diseases for an average of over eight years, with more than 190 million suffering from chronic conditions, among which hypertension, type 2 diabetes, and dyslipidemia (the "three highs") show particularly prominent prevalence rates [2-3]. Moreover, these "three highs" often appear as comorbidities or multiple chronic conditions, where two or more chronic diseases coexist in the same patient [4], which not only increases medical needs and treatment complexity but also places enormous pressure on the healthcare system [5].

Family function refers to the capacity of a family as a unit to meet various needs of its members, manifested through mutual care, support, emotional communication, and shared ability to cope with life events and stressors [6]. In China, the family serves as the primary setting for elderly care and daily living [7], playing a vital supportive role in seniors' health and quality of life. Effective family function is crucial for addressing health challenges brought by prolonged disease survival and high prevalence of "three highs." Urban villages, as products of rapid urbanization, constitute unique and complex social units within cities. These areas are typically densely populated, with residents' health literacy and access to health services varying considerably [8]. Elderly patients with the "three highs" living in urban villages face multiple challenges that affect family function. Therefore, this study selected a typical urban village in Guangzhou as the research site and used the Family APGAR Index [9] to investigate the status of multimorbidity and family function among elderly "three highs" patients and their influencing factors, providing reference for multimorbidity prevention and control efforts among Chinese elderly.

Methods

Study Design and Participants A cross-sectional survey was conducted between January and June 2023 in a street community of Panyu District, Guangzhou, integrating questionnaire surveys with "three highs" indicator measurements. The survey was based on annual health examination services for patients with hypertension and type 2 diabetes under the National Basic Public Health Service Standards (Third Edition). The target population comprised permanent residents who had lived in the community for over six months.

Inclusion criteria: (1) Resided in the surveyed street community within the past six months; (2) Aged 60 years or older; (3) Diagnosed with at least one of

hypertension or type 2 diabetes; (4) Clear consciousness; (5) Informed voluntary participation.

Exclusion criteria: (1) Severe cognitive or intellectual impairment; (2) Physical activity limitations or loss of self-care ability; (3) Unwillingness to participate.

Sample Size and Sampling Method This cross-sectional study used the following formula for sample size calculation: $n = pq/s^2 = t^2pq/d^2$, where n represents sample size, s is population standard deviation, d is allowable error, p is estimated population rate, q = 1-p, and t is the t-value corresponding to the defined significance level. Based on 2022 community chronic disease examination data from the area, p = 0.67 (the rate of elderly having at least one of hypertension or type 2 diabetes). With $\alpha = 0.05$ ($t_{0\cdot05} = 1.96$) and d = 0.05, the formula yielded n = 340. Accounting for a 10% non-response rate, the minimum required sample size was n = 374. The selected street community comprised 20 administrative areas, including 14 administrative villages and 6 residential communities. Using stratified random sampling, we randomly selected 5 administrative villages and 2 residential communities, resulting in a required sample size of $374 \times 7 = 2{,}618$. Through telephone, internet, and poster announcements, we ultimately recruited 2,760 patients, and after excluding invalid questionnaires, 2,507 valid participants were retained.

Survey Instruments and Definitions 1.3.1 General Personal Information: Basic personal information included gender, age, marital status, household registration type, residence location, education level, occupation, medical insurance type, number of family members with "three highs" conditions, and BMI. Lifestyle factors included smoking status, alcohol consumption, and exercise frequency. Clinical indicators included blood pressure, fasting blood glucose, and lipid profiles.

1.3.2 Relevant Standards and Definitions: - **Hypertension diagnosis:** Based on the Chinese Hypertension Prevention and Treatment Guidelines (2018 Revision) [10], systolic blood pressure $\geq$ 140 mmHg and/or diastolic blood pressure $\geq$ 90 mmHg was considered abnormal, or prior diagnosis by township-level or higher hospitals. - **Diabetes diagnosis:** Based on the Chinese Type 2 Diabetes Prevention and Treatment Guidelines (2020 Edition) [11], fasting blood glucose $\geq$ 7.0 mmol/L was considered abnormal, or prior diagnosis by township-level or higher hospitals. - **Dyslipidemia diagnosis:** Based on the Chinese Adult Dyslipidemia Prevention and Treatment Guidelines (2016 Revision) [12], meeting any of the following criteria was considered abnormal: triglycerides $\geq$ 2.26 mmol/L, total cholesterol $\geq$ 6.22 mmol/L, low-density lipoprotein cholesterol $\geq$ 4.14 mmol/L, or high-density lipoprotein cholesterol $<$ 1.04 mmol/L, or prior diagnosis by township-level or higher hospitals. - **BMI classification:** Based on recommendations by the Working Group on Obesity in China, BMI $<$ 18.5 kg/m^2 was underweight, 18.5-23.9 kg/m^2 normal weight, 24.0-27.9 kg/m^2

overweight, and $\geq$ 28.0 kg/m^2 obese. - **Smoking status:** Current smoker (at least one cigarette per week, continuously or cumulatively for over six months); former smoker (previously smoked but currently completely abstinent). - **Alcohol consumption:** Occasional (average drinking frequency $<$ 1 time/week); frequent (average drinking frequency $\geq$ 1 time/week). - **Exercise frequency:** Occasional (average exercise frequency $<$ 1 time/week); at least once weekly (average exercise frequency $\geq$ 1 time/week).

1.3.3 Assessment of "Three Highs" Conditions: Participants were first asked whether they had been diagnosed by a physician with hypertension, diabetes, or dyslipidemia. Second, we supplemented this information through health records from the Panyu District primary healthcare information system to verify diagnoses from other medical institutions in Guangzhou, reducing recall bias. Patients with only hypertension or only diabetes were classified as "single condition"; those with any two conditions including dyslipidemia were "two conditions co-occurring"; and those with all three conditions were "three conditions co-occurring."

1.3.4 Family Function Assessment: Family function was evaluated using the Family APGAR questionnaire [9], which includes five dimensions: Adaptation (A), Partnership (P), Growth (G), Affection (A), and Resolve (R). Each dimension uses a 3-point scoring system (0-2 points). Total scores were categorized as: severe family dysfunction (0-3 points), moderate family dysfunction (4-6 points), and good family function (7-10 points). The specific questions were: Adaptation—"When I have troubles or worries, can I get satisfactory help from my family?"; Partnership—"Am I satisfied with how my family discusses matters and shares problems with me?"; Growth—"When I want to do something new, does my family provide satisfactory acceptance and support?"; Affection—"Am I satisfied with how my family shows concern and care for my emotions?"; Resolve—"Can I spend pleasant time with my family?"

1.3.5 Pilot Survey: In January 2023, the research team conducted a pilot survey in two administrative villages and one community in Panyu District using the same inclusion and exclusion criteria. A total of 200 individuals were surveyed, yielding 189 valid questionnaires (94.5% response rate). Reliability and validity analysis showed a Cronbach's α coefficient of 0.849 and KMO (Kaiser-Meyer-Olkin) value of 0.852, indicating good questionnaire reliability and validity.

1.3.6 Questionnaire Administration and Clinical Measurements: The questionnaire consisted of two parts: (1) personal basic information from residents' health records, and (2) the APGAR questionnaire. Trained investigators conducted face-to-face interviews. Three levels of quality control were implemented: primary control during questionnaire collection, secondary control by a quality control team, and tertiary control by the project leader. Invalid questionnaires (incomplete, logically contradictory, duplicate submissions, perfunctory responses, improperly filled, or not meeting selection criteria) were returned or excluded. Clinical measurements included blood pressure, fasting blood glucose,

and lipid profiles. Blood pressure was measured on the left upper arm using a certified upper-arm electronic sphygmomanometer (validated by ESH, BHS, AAMI standards), including systolic and diastolic readings. Fasting blood glucose was measured using a fingerstick glucometer. Lipid profiles (triglycerides, total cholesterol, LDL-C, and HDL-C) were measured using a biochemical analyzer.

Statistical Analysis Data were analyzed using IBM SPSS 25.0. All measurement data underwent normality testing. For data showing significant normality test results ($P<0.05$) but with absolute kurtosis < 10 and absolute skewness < 3, normal distribution was considered acceptable [13]. Measurement data were expressed as ($\bar{x}\pm s$). Two-group comparisons used independent samples t-tests, while multi-group comparisons used one-way ANOVA. Post-hoc pairwise comparisons used LSD method (for homogeneous variance) or Tamhane's method (for heterogeneous variance). Count data were expressed as percentages and compared using ^{2} tests, with Bonferroni correction for multiple comparisons. Multiple linear regression analysis was used to explore factors influencing family function. Statistical significance was set at $P<0.05$.

Results

2.1 General Characteristics A total of 2,760 patients were surveyed, yielding 2,507 valid questionnaires (90.8% response rate). Among the 2,507 participants, 1,479 (59.0%) were female and 1,028 (41.0%) were male. The mean age was (70.7$±$7.1) years, with 454 (18.1%) aged 60-64, 774 (30.9%) aged 65-69, 624 (24.9%) aged 70-74, and 655 (26.1%) aged 75 or older. Most were married (2,315, 92.3%). Regarding household registration, 673 (26.8%) were non-local residents and 1,834 (73.2%) were local residents. Residence distribution showed 1,484 (59.2%) in urban villages and 1,023 (40.8%) in residential communities. Education levels were predominantly primary school (1,170, 46.7%) and junior high school (799, 31.9%). Pre-retirement occupations were mainly agricultural, forestry, animal husbandry, fishery, and water conservancy workers (1,373, 54.8%). The vast majority had social medical insurance (2,458, 98.0%). Detailed demographic information is presented in Table 1 .

2.2 Univariate Analysis of Multimorbidity Patterns Among the 2,507 patients, 202 (8.1%) had a single condition, 1,712 (68.3%) had two coexisting conditions, and 593 (23.7%) had all three conditions. Significant differences in disease patterns were found across gender, household registration type, number of family members with "three highs" conditions, BMI, exercise habits, fasting blood glucose status, lipid profiles, and family function classification ($P<0.05$). Post-hoc pairwise comparisons revealed that among females, the proportions of "two conditions co-occurring" and "three conditions co-occurring" were both higher than "single condition" ($P<0.05$). Among non-local residents, "single condition" showed the highest proportion, followed by "two conditions co-occurring," with "three conditions co-occurring" being lowest. In families

with two or more members having "three highs" conditions, "three conditions co-occurring" showed the highest proportion, followed by "two conditions co-occurring," with "single condition" being lowest. Underweight patients had higher proportions of "single condition" and "two conditions co-occurring" compared to "three conditions co-occurring" (P<0.05). Conversely, among obese patients, "three conditions co-occurring" showed the highest proportion, followed by "two conditions co-occurring," with "single condition" being lowest. Among non-exercising patients, "single condition" proportion was higher than both "two conditions co-occurring" and "three conditions co-occurring" (P<0.05), while daily exercisers showed the opposite trend. Patients with abnormal fasting blood glucose had higher proportions of "three conditions co-occurring" compared to other groups (P<0.05). Patients with dyslipidemia had higher proportions of "two conditions co-occurring" and "three conditions co-occurring" compared to "single condition" (P<0.05). Among patients with severe family dysfunction, "single condition" and "two conditions co-occurring" proportions were higher than "three conditions co-occurring" (P<0.05), while among those with good family function, "two conditions co-occurring" and "three conditions co-occurring" proportions were higher than "single condition" (P<0.05). No significant differences were found across age, marital status, residence location, education level, occupation, medical insurance type, smoking status, alcohol consumption, or blood pressure status (P>0.05). Details are shown in Table 1 .

2.3 Multimorbidity Patterns among Elderly Patients Among the 2,507 surveyed patients, 2,241 (89.4%) had hypertension, 925 (36.9%) had diabetes, and 2,239 (89.3%) had dyslipidemia. The specific patterns were: 178 (7.1%) with hypertension only, 24 (1.0%) with diabetes only, 66 (2.6%) with hypertension and diabetes, 1,404 (56.0%) with hypertension and dyslipidemia, 242 (9.7%) with diabetes and dyslipidemia, and 593 (23.7%) with all three conditions. [2] analysis revealed no statistically significant differences in the distribution of any comorbidity pattern (hypertension with diabetes, hypertension with dyslipidemia, diabetes with dyslipidemia, or all three) across gender or age groups (P>0.05). Details are presented in Table 2 .

2.4 Family Function Scores The mean total family function score was (7.63$±1.83).$Subscalescoreswere : Adaptation(1.19±0.48), Partnership(1.59±0.54), Growth(1.41±0.56), Aff$ Significant differences were found in Partnership, Affection, Resolve, and total scores across different disease patterns (P<0.05). Post-hoc comparisons showed that patients with "two conditions co-occurring" and "three conditions co-occurring" scored higher than "single condition" patients on Partnership and Affection subscales (P<0.05). For Resolve and total scores, "three conditions co-occurring" patients scored highest, followed by "two conditions co-occurring," with "single condition" patients scoring lowest. No significant differences were found in Adaptation or Growth scores across disease patterns (P>0.05). Details are shown in Table 3 .

2.5 Factors Associated with Family Function Using total family function score as the dependent variable, factors showing statistical significance in univariate analysis were included in multiple linear regression analysis. Results identified female gender (β=-0.148, t=-2.275, P=0.023), residence in apartment complexes (β=-0.155, t=-2.402, P=0.016), and abnormal fasting blood glucose (β=-0.045, t=-2.465, P=0.014) as risk factors for lower family function scores. Conversely, having two or more family members with "three highs" conditions (β=0.174, t=2.356, P=0.026) and multimorbidity status (two conditions: β=0.193, t=2.586, P=0.010; three conditions: β=0.342, t=3.248, P=0.001) were protective factors associated with higher family function scores. Details are presented in Table 4 .

Discussion

The Healthy China Action (2019-2030) first introduced the innovative concept of "integrated management of the three highs," emphasizing the importance of standardized management of hypertension, diabetes, and dyslipidemia [14]. Recent studies show that among individuals aged 60 and above, the comorbidity rate of hypertension and dyslipidemia reaches 26%, hypertension and diabetes 16.4%, and all three conditions 10%, highlighting the prevalence and severity of "three highs" multimorbidity [15]. Since its implementation, the National Basic Public Health Service Program has achieved remarkable success [16], but its coverage remains limited to hypertension and type 2 diabetes, proving insufficient for comprehensive "three highs" management. Therefore, this study, following the National Basic Public Health Service Standards (Third Edition) for hypertension and type 2 diabetes health management [17], investigated the prevalence of "three highs" and family function among elderly patients with either hypertension or diabetes in Guangzhou's urban villages, aiming to provide data support for prevention and control strategies and promote more comprehensive health management practices.

3.1 Multimorbidity Patterns among Elderly Patients in Urban Villages This study of 2,507 patients with "three highs" conditions found that "two conditions co-occurring" was most prevalent, followed by "three conditions co-occurring," with "single condition" being least common. This suggests comorbidity is common among patients with hypertension and diabetes, differing from studies by Xu et al. [18] and Chen et al. [19], possibly because our study population was limited to patients with at least one of hypertension or diabetes, excluding those with dyslipidemia only. Further analysis revealed that hypertension combined with diabetes was less common than hypertension with dyslipidemia, diabetes with dyslipidemia, or all three conditions combined, suggesting dyslipidemia may be underdiagnosed in hypertension and diabetes patients. Therefore, we recommend greater emphasis on dyslipidemia screening and management in comprehensive prevention and treatment of hypertension and diabetes to achieve more effective chronic disease management.

3.2 Factors Associated with Multimorbidity Our study found that females had higher proportions of "two conditions co-occurring" and "three conditions co-occurring" compared to "single condition," consistent with previous research [20]. This may be attributed to postmenopausal estrogen decline in elderly women, which can impair lipid metabolism and vascular endothelial function regulation, increasing risks of hypertension and hyperlipidemia [21] and thus multimorbidity likelihood. We also found that among non-local residents, "single condition" was most common, followed by "two conditions co-occurring," with "three conditions co-occurring" being least common, while local residents showed the opposite trend—consistent with Ni's findings [22]. Possible explanations include that non-local populations have lower healthcare utilization than local residents [23], while local residents, having greater confidence in local health services and tending to use them more frequently, have increased opportunities for multiple chronic disease diagnoses. Non-local residents may underutilize services due to distrust, language barriers, or cost concerns. Therefore, we believe enhanced promotion of primary healthcare accessibility and medical insurance is needed to address non-local patients' concerns, which is essential for achieving health equity and improving public health.

We found a significant trend where families with two or more members having "three highs" conditions most commonly exhibited "three conditions co-occurring," followed by "two conditions co-occurring," with "single condition" being rarest. This suggests clustering of "three highs" conditions within families, consistent with related research [24-26], likely due to shared living environments, similar lifestyles, and genetic factors. Thus, we argue that family-level considerations are important in "three highs" prevention and management.

Our study also found that patients with multimorbidity had higher proportions of daily physical exercise, differing from Zhang et al. [27], possibly because individuals with multiple chronic conditions recognize the positive correlation between exercise intensity and health status [28], leading them to increase exercise frequency. Additionally, abnormal blood glucose and dyslipidemia were more common in "two conditions co-occurring" and "three conditions co-occurring" patients, consistent with Zhang et al. [29], suggesting that patients with glycemic or lipid abnormalities are more likely to have multimorbidity. This may be because blood glucose and lipid levels are key diagnostic indicators for diabetes and dyslipidemia, and abnormal levels can increase hypertension risk [30]. Therefore, patients with abnormal glucose or lipid profiles should be actively screened and intervened to prevent multimorbidity development and progression.

Regarding obesity and "three highs" multimorbidity, we found that among obese patients, "three conditions co-occurring" was most prevalent, followed by "two conditions co-occurring," with "single condition" being least common. This suggests obese patients face higher risks of multiple chronic conditions, consistent with Delpino et al. [31], possibly because obesity not only increases risks of hypertension, diabetes, and dyslipidemia but is also closely linked to endocrine disorders that promote hypertension development [32-37]. Therefore,

clinicians should pay special attention to obese patients when diagnosing and treating "three highs" to provide more precise health education and interventions, thereby improving health outcomes and quality of life.

3.3 Multimorbidity Patterns in Different Demographic Groups Among elderly "three highs" patients aged 60 and above, no statistically significant differences were found in comorbidity pattern distribution across gender or age groups, indicating that both men and women across different advanced age groups may experience "three highs" concurrently. This finding differs from Han et al. [42] and Chen et al. [19], possibly because Han's study included subjects aged 35-75, involving non-retired adults with different education and economic status from our population, while Chen's study of Shenzhen elderly aged 65+ included subjects with zero diseases in multifactorial analysis, and this data heterogeneity may have led to inconsistent results.

3.4 Relationship Between Multimorbidity and Family Function Scores The mean total family function score among elderly "three highs" patients in Guangzhou's urban villages was (7.63$±$1.83), with total scores, Partnership, Affection, and Resolve being higher in multimorbidity patients than in single-condition patients. This suggests overall good family function, with multimorbidity patients perceiving better family emotional support, consistent with Sun et al. [43]. This phenomenon may be related to shared lifestyle intervention needs among "three highs" patients [44-45]. Research shows that hypertension, diabetes, and dyslipidemia have higher comorbidity rates than other chronic diseases [40,46], and these conditions require long-term lifestyle management and medication, necessitating family member participation in healthy lifestyle practices. This not only improves patient compliance but also strengthens family cohesion. Additionally, because these three conditions interact and can form vicious cycles [47], affecting both disease prognosis and family function, multimorbidity results showed that abnormal blood glucose was associated with lower total family function scores, indicating that disease abnormalities and family function influence each other. Therefore, family member participation is crucial for disease control and complication prevention. Third, good family function provides necessary emotional support, enhancing patients' psychological resilience. Family members' understanding and support help patients better follow medical advice and undergo regular examinations and monitoring. Moreover, "three highs" patients and their families face more comprehensive and in-depth needs for health education and lifestyle modification [40], requiring not only understanding of three disease management strategies but also joint efforts to improve lifestyle habits. Thus, good family function is particularly important for collective participation and lifestyle adjustment among "three highs" patients and their families.

3.5 Multifactorial Analysis of Family Function Our results show that female gender is a risk factor for lower family function scores among elderly ur-

ban village residents, suggesting women have lower total family function scores than men. This may be related to our urban village elderly population, as research shows [48] that urban village residents still maintain "village membership" systems forming clan-based structures with shareholding dividends. In these families, men are often shareholders in this "village corporate system," leading them to assume family leadership roles while women have less decision-making power, potentially reducing their satisfaction with family partnership. Therefore, when improving family function in urban villages, gender differences and clan culture influences should be considered.

Our study also found that residence in apartment complexes is a risk factor for family function, with elderly residents in complexes scoring lower than those in urban villages, consistent with Xu et al. [49]. This may be because the close-knit community structure of urban villages fosters stronger neighborhood and family partnerships, while apartment living creates isolation and lacks these emotional connections. Therefore, improving elderly family function should focus more on social and emotional aspects of living environments.

Abnormal blood glucose emerged as a risk factor for family function, with glucose-abnormal patients having lower scores, consistent with Niu et al. [50]. This may be because glucose management requires adjustments in treatment, monitoring, and health management that can create pressure and challenges for family relationships, support, and finances. Therefore, we argue that physicians should consider family-level needs when developing interventions for glucose-abnormal elderly to reduce family stress and enhance support systems, thereby improving family function and quality of life.

Our study found that having two or more family members with "three highs" conditions is a protective factor for family function, with these families scoring higher than those with only one affected member, consistent with Dai et al. [51]. This may be because families with multiple affected members become more accustomed to jointly addressing health challenges, more easily forming strong social support networks with tighter partnerships, enhanced emotional connections, and mutual support capabilities, while also sharing health resources more effectively. Therefore, we believe that within-family cooperation has potential value for enhancing family function and addressing health challenges among urban village elderly.

Disease pattern also emerged as a protective factor, with "two conditions co-occurring" and "three conditions co-occurring" patients having higher total family function scores than "single condition" patients, differing from Zheng et al. [38]. This may be because our population specifically comprised patients with hypertension, diabetes, and dyslipidemia, whose health management strategies are similar to general population health management, potentially fostering closer cooperation and communication among family members. The APGAR scale focuses on assessing patients' subjective satisfaction with family emotion, support, and care [52] rather than family burden and stress, so multimorbidity patients may have more positive perceptions of family function. Therefore, we

argue that family support interventions should consider internal family dynamics and specific needs of multimorbidity patients to more effectively improve family function and quality of life.

Conclusion

Among elderly patients with the "three highs" in Guangzhou's urban villages, the "two conditions co-occurring" pattern is most prevalent, followed by "three conditions co-occurring," with hypertension-dyslipidemia combination being most common, followed by diabetes-dyslipidemia. Therefore, physicians should consider dyslipidemia history or conduct lipid screening when treating elderly hypertension and diabetes patients to detect dyslipidemia early and provide targeted health education to enhance chronic disease management effectiveness. Community health institutions should emphasize not only "two conditions co-management" but also "three conditions co-management," actively providing health education guidance such as peer education and family education, encouraging patients to communicate with family members, express their emotions and needs, create positive family atmospheres, maintain good family relationships, and improve family function and health management outcomes for multimorbidity patients.

This study simultaneously examined the prevalence of "three highs" and family function status among urban village elderly in Guangzhou, further analyzing influencing factors of both, providing data support for hypertension, diabetes, and dyslipidemia comorbidity and potential family-related interventions. However, limitations exist: this descriptive study cannot establish causality and requires further verification; despite using scientific sampling, the cross-sectional survey was limited to one street community in Guangdong with a relatively small sample; the screening focused on hypertension and diabetes patients without including dyslipidemia-only patients, which may not fully reflect relationships between "three highs" and family function or provide true "three highs" multimorbidity prevalence. Future research should expand the study population and scope for more comprehensive exploration of "three highs" multimorbidity and its influencing factors.

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