



Multimorbidity of hypertension, diabetes, and dyslipidemia and influencing factors of family function among the elderly of original residential communities of Guangzhou city



Huang Zhijie^{a,b}, Mai Zhihua^b, Wang Haoxiang^c, He Yuming^b, Deng Qiaoyan^b, Dai Ranran^b, Zhou Zhiheng^{d,*}

^a Faculty of Medicine, Macau University of Science and Technology, Macao 999078, China

^b Dashi Community Health Service Center, Panyu District, Guangzhou 511430, China

^c School of Public Health, Sun Yat-Sen University, Guangzhou 510080, China

^d Shenzhen Pingshan General Hospital of Southern Medical University, Shenzhen 518118, China

ARTICLE INFO

Keywords:

The elderly; Hypertension; type 2 diabetes; Dyslipidemia; Multimorbidity; Family function; Influence factors

ABSTRACT

Background: With the global population aging at an accelerating rate, the rapid growth of the elderly population in China presents a series of health challenges, particularly in the management of chronic conditions such as hypertension, diabetes, and dyslipidemia. Residents of original residential communities, a unique social unit within the urbanization process, experience a higher prevalence of comorbidities related to these conditions. This underscores the urgent need for effective and comprehensive management strategies. Family function plays a critical role in the management of chronic diseases. For patients with the hypertension, diabetes, and dyslipidemia, family support is not only crucial for improving treatment outcomes but also a key factor in enhancing overall quality of life.

Objective: This study aims to investigate the prevalence of comorbidities and family function among older people of original residential communities of Guangzhou city with hypertension, diabetes, and dyslipidemia.

Methods: A stratified random sampling method was employed to conduct a survey using the Family APGAR Questionnaire. The survey targeted patients aged 60 and above with hypertension, diabetes, and dyslipidemia in the Panyu District of Guangzhou, to explore the comorbidities, family function and its influencing factors.

Results: A total of 2,507 patients were surveyed. Among them, 202 (8.1%) had only one condition, 1,712 (68.3%) had two conditions, and 593 patients (23.7%) had all three conditions. Statistically significant differences ($P < 0.05$) were observed in the types of conditions present based on variables such as gender, place of residence, number of household members with hypertension, diabetes, and dyslipidemia, BMI, exercise habits, fasting blood glucose levels, lipid profiles, and family function score. The prevalence ratio for hypertension, dyslipidemia, and diabetes was 2.4: 2.4: 1. Among the comorbidity patterns, hypertension combined with dyslipidemia was the most common (1,404 cases, 56.0%), followed by patients with all three conditions (593 cases, 23.7%). No statistically significant differences ($P > 0.05$) were found in the distribution of different comorbidity patterns between genders or across age groups. The mean total family function score was 7.63 ± 1.83 . Significant differences ($P < 0.05$) were found in the partnership, affection, and resolve sub-scores, as well as in the total family function scores, among patients with different disease patterns. Multivariate linear regression analysis identified gender (female: $\beta = -0.148$, $t = -2.275$, $P = 0.023$), place of residence (Apartment complex: $\beta = -0.155$, $t = -2.402$, $P = 0.016$), and fasting blood glucose levels (abnormal glucose: $\beta = -0.045$, $t = -2.465$, $P = 0.014$) as risk factors for lower total family function scores. On the other hand, the number of family members with hypertension, diabetes, and dyslipidemia (two or more: $\beta = 0.174$, $t = 2.356$, $P = 0.026$) and the type of disease patterns (comorbidity of two conditions: $\beta = 0.193$, $t = 2.586$, $P = 0.010$; comorbidity of all three conditions: $\beta = 0.342$, $t = 3.248$, $P = 0.001$) were identified as protective factors for higher total family function scores.

Conclusion: Elderly patients with the hypertension, diabetes, and dyslipidemia in original residential community of Guangzhou city predominantly exhibit a "comorbidity of two conditions" pattern with generally good

* Corresponding author.

E-mail address: zhihengz@163.com (Z. Zhiheng).

<https://doi.org/10.1016/j.cgpj.2024.09.001>

Received 10 June 2024; Received in revised form 3 August 2024; Accepted 18 August 2024

Available online 14 October 2024

2950-5593/© 2024 Chinese General Practice Publishing House Co., Ltd. Publishing services by Elsevier B.V. on behalf of KeAi Communications Co. Ltd. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>)

family function. Gender, place of residence, the number of family members with hypertension, diabetes, and dyslipidemia, type of disease, and fasting blood glucose levels are key influencing factors of family function.

In the 21st century, with the global trend of population aging, China is rapidly becoming an aging society. It is projected that during the "14th Five-Year Plan" period, the elderly population in China will exceed 300 million, making elderly health issues increasingly urgent¹. A 2022 research report by representatives of the National People's Congress highlighted that, on average, elderly individuals in China live more than eight years with illness. Over 190 million elderly individuals suffer from chronic diseases, with particularly high rates of comorbid hypertension, diabetes, and dyslipidemia^{2,3}.

The comorbidity of hypertension, diabetes, and dyslipidemia often manifests as comorbidities or multimorbidity, where two or more chronic diseases affect the same patient⁴.

This not only escalates medical needs and complicates treatment but also places a significant burden on health care system⁵. Family function refers to the ability of the family unit to meet the various needs of its members, which is reflected in mutual care, support, emotional communication, and the shared management of life events and stressors among family members⁶. In China, the family remains the primary setting for elderly care and daily living⁷, crucially supporting the health and quality of life of older adults. Effective family functioning is particularly important in addressing the challenges posed by prolonged illness and the high prevalence of hypertension, diabetes, and dyslipidemia among the elderly. Original residential community of metropolitan, formed through rapid urbanization, represent unique and complex social units within cities. These areas are often densely populated, with varying levels of health literacy and access to healthcare services⁸. Elderly patients with hypertension, diabetes, and dyslipidemia living in these original residential communities of Guangzhou city face multiple challenges that impact their family function. Therefore, this study focuses on original residential communities of Guangzhou city, using the Family APGAR Questionnaire⁹ to investigate the prevalence of comorbidities and family function among elderly patients with hypertension, diabetes, and dyslipidemia. The study aims to provide suggestions for improving the prevention and management of multimorbidity among the elderly in China.

Materials and methods

Respondents and methods

A cross-sectional study was conducted from January to June 2023 in a selected neighborhood of Panyu District, Guangzhou. The study involved a questionnaire survey and measurements of hypertension, diabetes, and dyslipidemia indexes. The target population consisted of residents live in the street for more than six months. The survey used data from annual health examination outlined in the National Basic Public Health Service Standards (Third Edition) for patients with hypertension and type 2 diabetes. The inclusion criteria were as follows: residents who live in the street for more than six months; age ≥ 60 years old; with diagnosis of at least one of the following conditions: with hypertension or type 2 diabetes; with clear consciousness; voluntary participation in the survey. The exclusion criteria encompassed individuals with cognitive impairments; limited physical mobility, those unable to care for themselves, or those unwilling to participate in the study.

Sample size and sampling method

This cross-sectional study determined the sample size using the following formula:

$$n = \frac{pq}{d^2} = \frac{t^2 pq}{d^2}$$

where n is the sample size, s is the overall standard deviation, d is the allowable error, P is the estimated prevalence rate, $q = 1 - P$, and t is the

t -value corresponding to the defined confidence level. The estimated prevalence rate P for having either hypertension or type 2 diabetes among the elderly was based on community chronic disease screening data from 2022 in the area, with $P = 0.67$. Setting $\alpha = 0.05$ gives $t = 1.96$ and $d = 0.05$, resulting in a required sample size of $n = 340$. Considering a design efficiency factor of 10%, the minimum required sample size was calculated to be $n = 374$. The selected street in this study was divided into 20 administrative areas, including 14 villages and 6 communities. A stratified random sampling method was employed. First, based on the population structure as of December 2022, the street was divided into 20 groups according to the proportion of each administrative area in the total population. By employing random sampling, five administrative villages and two communities were selected. The required sample size was expanded to at least 2,618 participants (374 per unit $\times 7$ units). Next, to ensure representativeness and coverage of the survey, the number of elderly individuals aged 60 and above who participated in hypertension or type 2 diabetes health screenings in 2022 was used to determine the required number of participants from each age group (60-64 years, 65-69 years, 70-74 years, 75 years and above) based on a 3:1 ratio. The total number of patients was calculated to be 2,760. Finally, patients were recruited according to the total required sample size, stratified by age and administrative area.

Survey content

General information

The survey collected general information, including personal information such as gender, age, marital status, household registration, place of residence, educational level, occupation, type of medical insurance, the number of household members with hypertension, diabetes, and dyslipidemia in the household, and Body Mass Index (BMI). It also covered lifestyle factors such as smoking status, alcohol consumption, and exercise frequency. Additionally, clinical indicators for hypertension, diabetes, and dyslipidemia were recorded, including measurements of blood pressure, fasting blood glucose, and blood lipid levels.

Relevant standards and definitions

Diagnosis of hypertension is based on the "Chinese Guidelines for the Prevention and Treatment of Hypertension (2018 Revision)"¹⁰. Abnormal blood pressure is defined as systolic blood pressure (SBP) ≥ 140 mmHg and/or diastolic blood pressure (DBP) ≥ 90 mmHg, or a prior hypertension diagnosis from a hospital at the township level or higher. Diabetes diagnosis follow the Chinese Guidelines for the Prevention and Treatment of Type 2 Diabetes (2020 Edition)¹¹. Abnormal fasting blood glucose (FBG) was defined as FBG ≥ 7.0 mmol/L, or a prior diabetes diagnosis from a hospital at the township level or higher. Dyslipidemia diagnosis adhered to the Guidelines for the Prevention and Treatment of Dyslipidemia in Chinese Adults (2016 Revision)¹². Abnormal lipid levels are defined as triglycerides (TG) ≥ 2.26 mmol/L, total cholesterol (TC) ≥ 6.22 mmol/L, low-density lipoprotein cholesterol (LDL-C) ≥ 4.14 mmol/L, or high-density lipoprotein cholesterol (HDL-C) < 1.04 mmol/L. Dyslipidemia is identified if one or more of these criteria were met, or if the individual had a prior diagnosis of dyslipidemia from a hospital at the township level or higher. BMI is categorized according to the recommendations of the Working Group on Obesity in China: underweight (BMI < 18.5 kg/m²), normal weight (18.5-23.9 kg/m²), overweight (24.0-27.9 kg/m²), and obese (≥ 28.0 kg/m²). Smoking is defined as the consumption of at least one cigarette per week, either continuously or cumulatively, for more than six

months. Former smokers are those who had quit smoking. Alcohol consumption is categorized as occasional (average drinking frequency <1 time per week) or frequent (average drinking frequency ≥ 1 time per week). Exercise frequency is classified as occasional (average exercise frequency <1 time per week) or regular (average exercise frequency ≥ 1 time per week).

Investigation of the prevalence of comorbid hypertension, diabetes, and dyslipidemia

The prevalence of comorbid hypertension, diabetes, and dyslipidemia was assessed through a two-step process. First, participants were asked if they had been diagnosed by a doctor with hypertension, diabetes, or dyslipidemia. This self-reported information was then supplemented and verified by reviewing health records from the primary healthcare information system of Panyu District. This system allowed for cross-referencing participants' diagnoses with records from other medical institutions in Guangzhou, helping to reduce recall bias.

Family function assessment

Family function was evaluated using the Family APGAR questionnaire⁹, including five dimensions: Adaptation (A), Partnership (P), Growth (G), Affection (A), and Resolve (R). Each dimension is rated on a 3-point scale, with scores ranging from 0 to 2. Based on the total score, family function is categorized as severe dysfunction (0–3 points), moderate dysfunction (4–6 points), and good family function (7–10 points).

Pilot Study

In January 2023, a pilot study was conducted in two administrative villages and one community within a selected street in Panyu District. The pilot adhered to the same inclusion and exclusion criteria as the main study. A total of 200 participants were surveyed, with a 100% response rate. Of these, 189 questionnaires were valid, yielding a validity rate of 94.5%. Reliability and validity analyses indicated a Cronbach's α of 0.849 and a Kaiser-Meyer-Olkin (KMO) measure of 0.852, demonstrating good reliability and validity. Consequently, the questionnaire was deemed for use in the main study population.

Questionnaire survey and assessment indicators of hypertension, diabetes, and dyslipidemia

The survey questionnaire encompassed two parts. The first part included personal information from the residents' health records, while the second part comprised the Family APGAR questionnaire. Trained researchers conducted face-to-face interviews with the sampled participants to complete the questionnaire. Quality control was implemented at three levels: primary quality control during questionnaire collection, secondary review by a quality control team, and final validation by the project leader. Invalid questionnaires—those incomplete, containing logical inconsistencies, duplicates, perfunctory responses, or failing to meet inclusion criteria—were either returned for correction or discarded. The indicators assessment of hypertension, diabetes, and dyslipidemia included measurements of blood pressure, fasting blood glucose, and blood lipid levels. Blood pressure was measured on the left upper arm using a medical-grade electronic blood pressure monitor certified by international standard protocols (ESH, BHS, AAMI), recording both systolic and diastolic blood pressure. Fasting blood glucose was measured using a fingertip rapid glucose meter. Lipid levels, including triglycerides, total cholesterol, LDL-C, and HDL-C, were analyzed from venous blood samples using a biochemical analyzer.

Statistical methods

IBM SPSS Version 25 was used to establish the database and perform all the statistical analyses. All continuous data were tested for nor-

mality. For data with significant normality test results ($P < 0.05$), if the absolute value of kurtosis was less than 10 and the absolute value of skewness was less than 3, the data were considered to approximately follow a normal distribution¹³. Measurement data were expressed as mean \pm standard deviation. Group comparisons were conducted using t-tests and one-way analysis of variance (ANOVA). Pairwise comparisons of means in the ANOVA were performed using the LSD method for homogeneity of variance and the Tamhane method for heterogeneity. Categorical variables were expressed as rates or percentages, and comparisons between groups made using the chi-square test. The Bonferroni correction was applied for multiple comparisons among rates.

A multiple linear regression model was used to analyze factors influencing family function. Statistical significance was set at $\alpha = 0.05$, with $P < 0.05$ considered statistically significant.

Results

General characteristics

A total of 2,760 patients were surveyed, with 2,507 valid questionnaires, yielding a validity rate of 90.8%. Among the 2,507 respondents, 1,479 were female (59.0%) and 1,028 were male (41.0%).

The average age was 70.7 ± 7.1 years, with 454 individuals aged 60–64 years (18.1%), 774 aged 65–69 years (30.9%), 624 aged 70–74 years (24.9%), and 655 aged 75 years or older (26.1%). Most respondents were married (92.3%, $n = 2,315$). Additionally, 26.8% ($n = 673$) were non-local residents, while 73.2% ($n = 1,834$) were local residents. Regarding place of residence, a total of 1,484 participants (59.2%) resided in urban villages, while 1,023 participants (40.8%) lived in residential communities. The majority of respondents had primary school (46.7%, $n = 1,170$) or junior high school education (31.9%, $n = 799$). Before retirement, 54.8% ($n = 1,373$) were employed in agriculture, forestry, animal husbandry, fishery, or water conservancy. The vast majority of respondents (98.0%, $n = 2,458$) had social medical insurance. Detailed information is presented in [Table 1](#).

Univariate Analysis of Elderly Patients with hypertension, diabetes, and dyslipidemia in original residential communities of Guangzhou city

Among the 2,507 respondents, 202 (8.1%) had "single condition", 1,712 (68.3%) had "comorbidity of two conditions," and 593 (23.7%) had "comorbidity of three conditions".

Significant differences in the prevalence of comorbid hypertension, diabetes, and dyslipidemia were found across groups based on gender, household registration, exercise frequency, fasting blood glucose levels, blood lipid levels, the number of household members with hypertension, diabetes, and dyslipidemia in the household, BMI and family function classification ($P < 0.05$). However, no statistically significant differences were found in relation to age, marital status, place of residence, education level, occupation, type of medical insurance, smoking status, or alcohol consumption, blood pressure levels ($P > 0.05$). Detailed results are provided in [Table 1](#).

Comorbidity Status of Elderly Patients with hypertension, diabetes, and dyslipidemia in original residential communities of Guangzhou city

Among the 2,507 respondents, 2,241 (89.4%) had hypertension, 925 (36.9%) had diabetes, and 2,239 (89.3%) had dyslipidemia. A total of 178 individuals (7.1%) had only hypertension, and 24 individuals (1.0%) had only diabetes. The comorbidity patterns included 66 individuals (2.6%) with both hypertension and diabetes, 1,404 individuals (56.0%) with both hypertension and dyslipidemia, 242 individuals (9.7%) with both diabetes and dyslipidemia, and 593 individuals (23.7%) with all three conditions—hypertension, diabetes, and dyslipidemia. Chi-square tests indicated no statistically significant differences in age and gender among the four comorbidity patterns ($P > 0.05$). Detailed results are provided in [Table 2](#).

Family Function Scores Among Elderly Patients with hypertension, diabetes, and dyslipidemia in original residential communities of Guangzhou city

Table 1
Prevalence of comorbid hypertension, diabetes, and dyslipidemia among the elderly in original residential communities of Guangzhou city and univariate analysis[n(%)].

Item	Cases	Type of disease			cX2 value	P value
		1	2	3		
Gender						
Female	1479(59.0)	87(43.1) ^a	1031(60.2) ^a	361(60.9) ^a	23.112	<0.001*
Male	1028(41.0)	115(56.9)	681(39.8) ^a	232(39.1) ^a		
Age						
60-64	454(18.1)	38(18.8)	315(18.4)	101(17.0)	7.268	0.297
65-69	774(30.9)	55(27.2)	547(32.0)	172(29.0)		
70-74	624(24.9)	49(24.3)	428(25.0)	147(24.8)		
75 and above	655(26.1)	60(29.7)	422(24.6)	173(29.2)		
Marital status						
Married	2315(92.3)	188(93.1)	1591(92.9)	536(90.4)	4.196	0.123
Not married	192(7.7)	14(6.9)	121(7.1)	57(9.6)		
Household registration						
Non-household	673(26.8)	83(41.1)	461(26.9) ^a	129(21.8) ^{ab}	28.703	<0.001*
Domicile	1834(73.2)	119(58.9)	1251(73.1) ^a	464(78.2) ^{ab}		
Residence						
Original residential community of metropolitan	1484(59.2)	108(53.5)	1012(59.1)	364(61.4)	3.925	0.140
Apartment complex	1023(40.8)	94(46.5)	700(40.9)	229(38.6)		
Educational level						
Illiterate or semi-literate	171(6.8)	14(6.9)	111(6.5)	46(7.8)	12.801	0.119
Elementary school	1170(46.7)	83(41.1)	793(46.3)	294(49.6)		
Middle school	799(31.9)	70(34.7)	551(32.2)	178(30.0)		
High school/vocational school	279(11.1)	31(15.3)	188(11.0)	60(10.1)		
College and above	88(3.5)	4(2.0)	69(4.0)	15(2.5)		
Occupation						
Agriculture, forestry, animal husbandry, fishery, water conservancy production personnel	1373(54.8)	120(59.4)	911(53.2)	342(57.7)	15.673	0.207
Professional and technical personnel	40(1.6)	4(2.0)	26(1.5)	10(1.7)		
Clerical and related personnel	48(1.9)	3(1.5)	37(2.2)	8(1.3)		
Commercial and service workers	193(7.7)	11(5.4)	142(8.3)	40(6.7)		
Production and transportation equipment operators and related personnel	52(2.1)	6(3.0)	34(2.0)	12(2.0)		
Other workers who are not conveniently classified	127(5.1)	16(7.9)	82(4.8)	29(4.9)		
No occupation	674(26.9)	42(20.8)	480(28.0)	152(25.6)		
Types of medical payments						
Social health insurance	2458(98.0)	197(97.5)	1679(98.1)	582(98.1)	2.527	0.640
Publicly funded medical care	8(0.3)	0(0)	7(0.4)	1(0.2)		
Fully self-funded	41(1.6)	5(2.5)	26(1.5)	10(1.7)		
Number of members with hypertension, diabetes, and dyslipidemia in household						
1	785(31.3)	178(88.1)	520(30.4) ^a	87(14.7) ^{ab}	380.131	<0.001*
2 or more	1722(68.7)	24(11.9)	1192(69.6) ^a	506(85.3) ^{ab}		
BMI						
Low weight	68(2.7)	10(5.0)	51(3.0)	7(1.2) ^{ab}	28.619	<0.001*
Normal weight	1394(55.6)	117(57.9)	969(56.6)	308(51.9)		
Overweight	891(35.5)	72(35.6)	595(34.8)	224(37.8)		
Obese	154(6.1)	3(1.5)	97(5.7) ^a	54(9.1) ^{ab}		
Smoking status						
Never smoked	2247(89.6)	179(88.6)	1543(90.1)	525(88.5)	3.177	0.529
Smoker	238(9.5)	22(10.9)	152(8.9)	64(10.8)		
Quit smoking	22(0.9)	1(0.5)	17(1.0)	4(0.7)		
Alcohol consumption						
Never	2305(91.9)	182(90.1)	1574(91.9)	549(92.6)	3.289	0.772
Occasionally	117(4.7)	9(4.5)	81(4.7)	27(4.6)		
Often	8(0.3)	1(0.5)	5(0.3)	2(0.3)		
Daily	77(3.1)	10(5.0)	52(3.0)	15(2.5)		
Exercise frequency						
Not Exercise	368(14.7)	48(23.8)	232(13.6) ^a	88(14.8) ^a	15.646	0.014*
Occasionally	79(3.2)	7(3.5)	52(3.0)	20(3.4)		
More than once a week	48(1.9)	5(2.5)	34(2.0)	9(1.5)		
Daily	2012(80.3)	142(70.3)	1394(81.4) ^a	476(80.3) ^a		
Blood pressure						
Normal blood pressure	853(34.0)	75(37.1)	590(34.5)	188(31.7)	2.437	0.296
Abnormal blood pressure	1654(66.0)	127(62.9)	1122(65.5)	405(68.3)		
Fasting blood glucose						
Normal blood glucose	1656(66.1)	161(79.7)	1292(75.5)	203(34.2) ^{ab}	352.238	<0.001*
Diabetes	851(33.9)	41(20.3)	420(24.5)	390(65.8) ^{ab}		
Lipid						
Normal lipid level	694(27.7)	186(92.1)	361(21.1) ^a	147(24.8) ^a	458.124	<0.001*
Dyslipidemia	1813(72.3)	16(7.9)	1351(78.9) ^a	446(75.2) ^a		
Family function classification						
Severely impaired family function	145(5.8)	18(8.9)	101(5.9) ^a	26(4.4) ^{ab}	10.336	0.035*
Moderately impaired family function	127(5.1)	15(7.4)	77(4.5)	35(5.9)		
Good Family Function	2235(89.2)	169(83.7)	1534(89.6) ^a	532(89.7) ^{ab}		

Note: Comparison with disease type of 1 ^aP < 0.05; comparison with disease type of 2 ^bP < 0.05.

Table 2
Prevalence of comorbid hypertension, diabetes, and dyslipidemia among elderly patients in original residential communities of Guangzhou city[n(%)].

Age	Comorbidity of hypertension and diabetes			Comorbidity of hypertension and dyslipidemia			Comorbidity of diabetes and dyslipidemia			Comorbidity of hypertension, diabetes and dyslipidemia		
	Female	Male	Total	Female	Male	Total	Female	Male	Total	Female	Male	Total
60-64	3(27.3)	8(20.0)	11(16.7)	115(18.1)	81(14.8)	236(16.8)	44(29.9)	24(25.3)	68(28.1)	65(18.0)	36(15.5)	101(17.0)
65-69	5(38.5)	8(20.0)	13(19.7)	268(31.2)	175(32.1)	443(31.6)	54(36.7)	37(38.9)	91(37.6)	104(28.8)	68(29.3)	172(29.0)
70-74	6(23.1)	9(22.5)	15(22.7)	224(26.1)	143(26.2)	367(26.1)	33(22.4)	13(13.7)	46(19.0)	82(22.7)	65(28.0)	147(24.8)
≥75	12(46.2)	15(37.5)	27(40.9)	211(24.6)	147(26.9)	358(25.5)	16(10.9)	21(22.1)	37(15.3)	110(30.5)	63(27.2)	173(29.2)
cZ value	0.996			2.853			7.607			2.660		
P value	0.838			0.415			0.055			0.447		

Table 3
Family functioning score among the elderly patients with hypertension, diabetes, and dyslipidemia in original residential communities of Guangzhou city.

Item	Type of disease			F value	P value
	1	2	3		
Adaptation	1.13±0.50	1.19±0.49	1.19±0.47	1.288	0.276
Partnership	1.55±0.58	1.59±0.54 ^a	1.59±0.54 ^a	3.649	0.023 [*]
Growth	1.35±0.59	1.41±0.56	1.43±0.54	1.634	0.195
Affection	1.60±0.59	1.70±0.54 ^a	1.72±0.49 ^a	3.710	0.025 [*]
Resolve	1.72±0.54	1.75±0.52 ^a	1.79±0.46 ^{ab}	3.943	0.033 [*]
Total score	7.35±2.09	7.64±1.85 ^a	7.71±1.68 ^{ab}	4.968	0.042 [*]

Note: Comparison with disease type of 1 ^aP < 0.05; comparison with disease type of 2 ^bP < 0.05.

The average total family function score among the respondents was 7.63±1.83, indicating generally good overall family function. The average scores for each dimension were as follows: Adaptation (1.19± 0.48), Partnership (1.59±0.54), Growth (1.41±0.56), Affection (1.70±0.54), and Resolve (1.75±0.51). Significant differences in family function scores were observed across different types of disease comorbidities (P<0.05). Specifically, the dimensions of Partnership, Affection, and Resolve showed significant differences among the various comorbidity types (P<0.05). Detailed results are provided in Table 3.

Analysis of Factors Associated with Family Function Among Elderly Patients with hypertension, diabetes, and dyslipidemia in original residential communities of Guangzhou city

A multiple linear regression analysis was conducted using the total family function score as the dependent variable. Independent variables included factors that showed statistically significant differences in the univariate analysis. The results indicated several significant factors influencing family function: gender (Female: β=-0.148, t=-2.275, P=0.023), place of residence (Apartment complex: β=-0.155, t=-2.402, P=0.016), number of household members with hypertension, diabetes, and dyslipidemia in the household (two or more: β=0.174, t=2.356, P=0.026), type of comorbidity (comorbidity of two conditions: β=0.193, t=2.586, P=0.010; comorbidity of three conditions: β=0.342, t=3.248, P=0.001), and fasting blood glucose levels (Abnormal blood glucose: β=-0.045, t=-2.465, P=0.014). Detailed results are provided in Table 4.

Discussion

The Healthy China Initiative (2019-2030) introduced the concept of "integrated management for hypertension, diabetes, and dyslipidemia," emphasizing the importance of standardized care for these conditions¹⁴. Recent research findings indicate that among the elderly population aged 60 and above, the comorbidity rate of hypertension and dyslipidemia reaches 26%, while the comorbidity rate of hypertension and diabetes is 16.4%. Additionally, the prevalence of all three conditions (hypertension, diabetes, and dyslipidemia) is as high as 10%, highlighting the widespread and serious nature of these comorbidities¹⁵. Since the implementation of the National Basic Public Health Service Program, significant progress has been made¹⁶. However, the chronic diseases

covered under the program remain limited to hypertension and diabetes, reflecting a gap in the comprehensive management of hypertension, diabetes, and dyslipidemia". Thus, this study investigates the multimorbidity of hypertension, diabetes, and dyslipidemia and family function among elderly patients living in urban villages in Guangzhou, who suffer from either hypertension or diabetes. Building on the health management services for hypertension and diabetes outlined in the third edition of the National Basic Public Health Service Program guidelines¹⁷, this study aims to provide data to support the prevention and control strategies for comorbidity of all three conditions in China, with the goal of advancing more comprehensive health management practices.

This study surveyed 2,507 patients with hypertension, diabetes, and dyslipidemia and found that the proportion of patients with two comorbid conditions was the highest, followed by those with all three conditions, while the proportion of patients with only one condition was the lowest. This suggests that comorbidities are quite common among patients with hypertension and diabetes. These findings differ from those of XU et al.¹⁸ and CHEN et al.¹⁹, possibly due to the fact that this study specifically included patients with either hypertension or diabetes, excluding those with only dyslipidemia. Further analysis revealed that the proportion of patients with both hypertension and diabetes was lower compared to those hypertension combined with dyslipidemia, diabetes combined with dyslipidemia, or hypertension combined with diabetes and dyslipidemia. This suggests that the prevalence of dyslipidemia may be underestimated among patients with hypertension and diabetes. Therefore, this study recommends placing greater emphasis on the screening and management of dyslipidemia in the comprehensive prevention and treatment of hypertension and diabetes, in order to achieve more effective chronic disease health management.

This study found that the proportion of women suffering from "two highs" and "three highs" is higher than that of "one high only". This result is consistent with previous studies²⁰ and may be due to postmenopausal women experiencing a decline in estrogen levels, potentially leading to impaired lipid metabolism and endothelial function, which increases the risk of conditions such as hypertension and dyslipidemia²¹, thereby raising the likelihood of comorbidities in women.

This study also found that non-resident patients had the highest proportion of "single condition presence," followed by "comorbidity of two conditions," with "comorbidity of all three conditions" being the lowest.

Table 4

Multivariate linear regression analysis of family functioning among elderly patients with hypertension, diabetes, and dyslipidemia in original residential communities of Guangzhou city.

Variable	B value	95%CI	Standard error	t value	P value
Constant	7.499	7.314,7.684	0.094	79.403	<0.001*
Gender					
Male	Ref				
Female	-0.148	-0.275,-0.020	0.065	-2.275	0.023
Residence					
Original residential community of metropolitan	Ref				
Apartment complex	-0.155	-0.281,-0.028	0.064	-2.402	0.016
Number of members with comorbid hypertension, diabetes, and dyslipidemia in household					
1	Ref				
2 and more	0.174	0.047,0.328	0.065	2.356	0.026
Type of disease					
1 type	Ref				
2 types	0.193	0.047,0.339	0.075	2.586	0.010
3 types	0.342	0.136,0.549	0.105	3.248	0.001
Fasting blood glucose					
Normal blood glucose	Ref				
hyperglycemia	-0.045	-0.081,-0.009	0.018	-2.465	0.014

In contrast, among local resident patients, the opposite trend was observed, with "comorbidity of all three conditions" being the most prevalent, consistent with Ni's findings²². A possible reason for this disparity could be the lower utilization of healthcare services by non-resident populations compared to local residents²³. Local residents, having more confidence in the local healthcare system and utilizing services more frequently, are more likely to be diagnosed with multiple chronic conditions. In contrast, non-residents may use healthcare services less often due to mistrust, language barriers, or concerns about costs. Therefore, this study suggests enhancing the accessibility of primary care services and medical insurance and addressing the concerns of non-resident patients, which is crucial for achieving health equity and improving public health.

A significant trend found in this study is that households with two or more members with hypertension, diabetes, and dyslipidemia had the highest proportion of "comorbidity of all three conditions," followed by "comorbidity of two conditions," while "single condition presence" was the least common. This suggests that the "comorbidity of two or three conditions" tend to cluster among family members, consistent with previous studies^{24–26}. This clustering may be attributed to shared living environments, similar lifestyles, and genetic factors among family members. Therefore, we believe that the family context should be considered when preventing and managing "comorbidity of two or three conditions."

This study also found that a higher proportion of comorbid patients engaged in daily physical exercise, while the proportion of those who did not exercise regularly (none, occasionally, or more than once per week) was lower. This finding contrasts with ZHANG's study²⁷, and the reason may be that patients with multiple chronic conditions recognize the positive correlation between exercise frequency and their health status²⁸. As a result, elderly patients with comorbidities may be more inclined to increase their exercise frequency to promote better health.

Additionally, the study found that abnormal blood glucose and lipid levels were more common among patients with "comorbidity of two conditions" and "comorbidity of all three conditions", which is consistent with ZHANG's findings²⁹. This suggests that patients with abnormal glucose and lipid levels are more likely to develop "comorbidity of two or three conditions". The possible reason is that blood glucose and lipid levels are key diagnostic indicators for diabetes and dyslipidemia, and studies have shown that abnormalities in these levels can predict the risk of hypertension³⁰. Therefore, active screening and intervention for patients with hyperglycemia or dyslipidemia should be prioritized to prevent the development and progression of comorbid conditions.

Regarding the relationship between obesity and "different comorbidity patterns of hypertension, diabetes, and dyslipidemia", this study identified a trend in which the proportion of "comorbidity of all three con-

ditions" was the highest among obese patients, followed by "comorbidity of two conditions," while "single condition presence" was the lowest. This suggests that obese patients are more likely to face multiple chronic conditions, consistent with the findings of Delpino et al.³¹. The possible reason is that obesity not only increases the risk of hypertension, diabetes, and dyslipidemia but also closely correlates with endocrine dysfunction, which promotes the development of hypertension through endocrine pathways^{32–38}. Therefore, clinicians should pay special attention to patients with obesity when diagnosing and treating "hypertension, or diabetes, or dyslipidemia" providing more targeted health education and interventions to improve their health outcomes and quality of life.

Finally, this study found a relationship between family function and "different comorbidity patterns of hypertension, diabetes, and dyslipidemia". The overall family function of elderly patients with "hypertension, diabetes, and dyslipidemia" in original residential communities of Guangzhou city was generally good, and the proportion of patients with good family function was higher among those with "comorbidity of two conditions" and "comorbidity of all three conditions" compared to those with "single condition presence." This suggests that comorbid patients experience better family function than those with a single condition, a finding that contrasts with ZHENG's study³⁸. The possible reason is that patients with comorbidities facing multiple health challenges may receive more support and care from their families. This support could enhance patients' confidence in managing their diseases³⁹, leading to a more favorable subjective perception of family function.

Among the patients surveyed in this study, the proportion of hypertension was the highest (89.4%), followed by dyslipidemia (89.3%), while the proportion of diabetes was the lowest (36.9%). The prevalence ratio of "hypertension, dyslipidemia, and diabetes, which means that the ratio of hypertension, dyslipidemia, and diabetes is 2.4: 2.4: 1", indicating that the proportions of hypertension and dyslipidemia are higher than that of diabetes among the elderly population living in urban villages in Guangzhou. This finding aligns with current research on the prevalence trends of "hypertension, diabetes, and dyslipidemia" in China^{19,40,41}, suggesting that these conditions are common, especially among the elderly. The study also found no statistically significant differences in the distribution of different comorbidity patterns by gender or age among elderly patients aged 60 and above with "hypertension, diabetes, and dyslipidemia". This suggests that both men and women, across different older age groups, are equally likely to experience "comorbidity of two or three conditions". This finding contrasts with the studies by HAN⁴² and CHEN¹⁹. A possible reason for the discrepancy could be that Han's study included participants aged 35 to 75, involving non-retired adults who differ from the participants in this study in terms of education and economic status. Meanwhile, Chen's study focused on elderly

individuals aged 65 and above in Shenzhen, and their multivariate analysis included individuals with no chronic conditions, which may have introduced heterogeneity into the data, leading to different results.

The overall family function of elderly patients with hypertension, diabetes, and dyslipidemia in original residential communities of Guangzhou city is generally good. Patients with comorbidities tend to exhibit better scores in family emotional perception, such as partnership, affection, and intimacy. This finding is consistent with the results of SUN et al.⁴³. Additionally, households with two or more individuals suffering from these comorbidities demonstrate better family function, which may be related to the shared need for lifestyle interventions among patients with hypertension, diabetes, and dyslipidemia^{44,45}. Research indicates that the comorbidity rate of hypertension, diabetes, and dyslipidemia is particularly high^{40,46}. Given that managing hypertension, diabetes, and dyslipidemia requires long-term lifestyle adjustments and medication, active involvement of family members in these healthy lifestyle practices not only improves patient adherence but also strengthens family cohesion. Moreover, comorbidity of hypertension, diabetes, and dyslipidemia can interact and exacerbate one another, potentially creating a vicious cycle⁴⁷, poor disease prognosis can negatively impact family function. The multivariate analysis reveals that diabetes is associated with a decrease in overall family function, suggesting that poor health outcomes and family function influence each other in patients with these conditions. Therefore, active participation by family members is crucial for disease control and complications prevention. Good family function also provides essential emotional support, enhancing patients' psychological resilience in coping with their illnesses. Understanding and support from family members can help patients adhere better to medical advice, attend regular check-ups, and monitor their conditions effectively. Additionally, in terms of the scope and depth of health education and lifestyle changes, patients and their families face more comprehensive and in-depth needs⁴⁰. They must not only understand and manage the necessary knowledge for these three conditions but also work together to improve lifestyle habits. Therefore, compared to other diseases, good family function is especially important for the collective participation and lifestyle adjustments necessary for patients with hypertension, diabetes and dyslipidemia and their families.

The multivariate linear regression analysis showed that being female is a risk factor for family function among the elderly in urban villages in Guangzhou. This suggests that women have lower family function scores compared to men, possibly due to the unique characteristics of the original residential communities population. Studies have shown⁴⁸ that original residential communities residents often maintain a "village-based" organizational structure characterized by clan-based companies that distribute dividends based on shares. In such families, men are typically shareholders in these "village companies" and assume leadership or representative roles within the clan structure, while women have less decision-making power within the family. This disparity may lead to lower satisfaction among women with the cooperative dynamics in the family. Therefore, improving family function in this specific social structure must take gender differences and the influence of clan culture into account.

The study also identified living in residential communities as a risk factor for family function in this population. This suggests that elderly individuals residing in residential communities have lower family function scores compared to those living in original residential communities, consistent with the findings of XU et al.⁴⁹. A possible reason for this is that the close-knit community structure of urban villages fosters stronger neighborhood and family cooperation, while residential communities may create a sense of isolation, lacking such emotional connections. Therefore, when aiming to improve family function among the elderly, it is important to focus on the social and emotional aspects of their living environment. Furthermore, the study found that abnormal blood glucose levels are a risk factor for family function among the elderly in original residential communities in Guangzhou, consistent with the findings of NIU et al.⁵⁰. Patients with abnormal blood glucose

may require adjustments in treatment, monitoring, and health management, which could place additional stress and challenges on family relationships, support systems, and finances. Therefore, when designing interventions for elderly patients with diabetes, physicians should consider the needs of the family to alleviate familial stress, enhance family support systems, and ultimately improve patients' family function and quality of life. The study also revealed that the number of family members with "hypertension, diabetes, and dyslipidemia, corresponding to the table description" is a protective factor for family function. Elderly patients from urban villages with two or more family members suffering from "hypertension, diabetes, and dyslipidemia" had higher family function scores than those with only one affected family member, consistent with the findings of DAI et al.⁵¹. This may be because when multiple family members are dealing with "multimorbidity", they are more accustomed to collectively addressing health challenges, which can foster a strong social support network, tighter cooperation, and strengthened emotional bonds and mutual support within the family.

Additionally, health resources may be more effectively shared and utilized among family members. Therefore, this study suggests that family cooperation plays a valuable role in improving family function and addressing health challenges among the elderly in original residential communities. Lastly, the study found that the type of illness is a protective factor for family function. Patients with "comorbidity of two conditions" and "comorbidity of all three conditions" had higher family function scores than those with "single condition," a finding inconsistent with ZHENG's study³⁸. The discrepancy may be due to the fact that this study focused specifically on patients with comorbid hypertension, diabetes, and dyslipidemia, whose health management strategies are similar to those for the general population. This similarity may promote closer cooperation and communication among family members. The APGAR scale used in this study primarily assesses patients' subjective satisfaction with their family's emotional support and care⁵², rather than the burdens or stress experienced by the family. Therefore, patients with "comorbidity of two or three conditions" may have a more positive perception of their family function. In conclusion, this study suggests that when designing family support interventions, it is essential to consider the family dynamics and specific needs of patients with comorbid conditions. This approach can more effectively enhance family function and improve patients' quality of life.

This study simultaneously examined the prevalence of comorbid hypertension, diabetes, and dyslipidemia among elderly residents in original residential communities of Guangzhou city, as well as their family function status. Furthermore, it analyzed the influencing factors of both, providing data support for the comorbidity of hypertension, diabetes, and dyslipidemia, while also exploring the potential for family-related interventions in managing these conditions. However, this study has some limitations: it is a descriptive study, so causal inferences remain unclear and require further validation. Although a scientific sampling method was employed, the study was conducted as a cross-sectional survey in only one neighborhood in Guangdong, with a relatively small sample size, which may limit the generalizability of the results. The selection criteria for the population surveyed focused primarily on patients with hypertension and diabetes, without considering those with dyslipidemia. This may prevent a comprehensive understanding of the relationship between "comorbidity of three conditions" and family function, as well as an accurate determination of the prevalence of these comorbidities. Therefore, future research should expand the scope of the survey population and broaden the investigation to achieve a more comprehensive and in-depth exploration of "comorbidity of three conditions" and its influencing factors.

In conclusion, among elderly patients in original residential communities of Guangzhou city, the highest proportion of individuals had comorbidity of two conditions, followed by those with three conditions. The most common comorbidity pattern is the comorbidity of hypertension and dyslipidemia, followed by the comorbidity of diabetes and dyslipidemia. Therefore, when treating elderly patients with hypertension

and diabetes, physicians should consider whether the patient has a history of dyslipidemia or conduct lipid screening to facilitate early detection. This approach enables timely, targeted health education and enhances chronic disease management for patients with comorbidities. Community health centers should focus not only on managing comorbidity of two conditions, but also on comorbidity of three conditions management. During the process, they should actively provide health education guidance, such as peer education and family education, to encourage patients to communicate openly with their families, express their emotions and needs, and create a positive family atmosphere. Maintaining good family relationships and improving family function can enhance the effectiveness of health management for patients with comorbidities.

Declarations

Not applicable.

Authors' contributions

Conceptualization, H.Z. and M.Z.; Methodology, W.H. and Z.Z.; Data curation, H.Z., H.Y. and M.Z.; Formal analysis, H.Z., D.Q. and D.R.; Funding acquisition, not applicable; Project administration, not applicable; Resources, not applicable; Supervision, Z.Z.; Validation, Z.Z.; Writing—original draft, H.Z. and M.Z.; Writing—review and editing, W.H. and Z.Z. All authors have read and agreed to the published version of the manuscript.

Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Availability of data and materials: Not applicable.

Competing interests

Not applicable.

Funding

This research was supported by grants from [National Natural Science Foundation of China \(72061137002\)](#), [Monitoring and Statistical Research Center \(YGZXKT2024327\)](#), [Guangzhou Municipal Health Commission \(20241A041006\)](#), [Shenzhen Science and Technology Innovation Committee \(JCYJ20210324135411031\)](#), [Shenzhen Pingshan District Health Bureau \(202289\)](#).

Acknowledgements

Not applicable.

Authors' other information

Not applicable.

Reference

- Liang Y, Wang GZ, Ma LT. Thoughts on Population Changes and Educational Planning in the 14th Five-Year Plan Period. *J Natl Acad Educ Adm*. 2020(9):86–95. doi:10.3969/j.issn.1672-4038.2020.09.011.
- Research Report by the Special Research Group of the Standing Committee of the National People's Congress on the Implementation of the National Strategy for Actively Responding to Population Aging and Promoting High-Quality Development of Aging Services [Internet]. 2022 Sep 2 [cited 2024 Aug 2]. Available from: http://www.npc.gov.cn/c2/c30834/202209/t20220902_319168.html.
- Liao XM, Wang XJ. The Current Situation and Coping Strategies for Comorbid Chronic Diseases among the Elderly in. *China. J Appl Prev Med*. 2022;28(2):191–194 197. doi:10.3969/j.issn.1673-758X.2022.02.028.
- Morici N, De Servi S, De Luca L, et al. Management of acute coronary syndromes in older adults. *Eur Heart J*. 2022;43(16):1542–1553. doi:10.1093/eurheartj/ehab391.
- Fan J, Sun Z, Yu C, et al. Multimorbidity patterns and association with mortality in 0.5 million Chinese adults. *Chin Med J (Engl)*. 2022;135(6):648–657. doi:10.1097/CM9.0000000000001985.
- Gu Y, Lv F. *Theory and Practice of General Medicine*. Beijing: World Book Publishing Company Beijing Branch. 1995:14–15.
- Wu YS, Li J. Problems and Countermeasures of Home-Based Elderly Care Services in China. *Adm Reform*. 2024;3(3):44–51. doi:10.3969/j.issn.1674-7453.2024.03.005.
- Wang N, Zhang SP. Investigation of Health Information Literacy of Chronic Patients in a Village Inside Fenyang City. *Health Educ Health Promot*. 2018;13(2):125–127. doi:10.16117/j.cnki.31-1974/r.201802011.
- Souza Júnior EV, Viana ER, Cruz DP, et al. Relationship between family functionality and the quality of life of the elderly. *Rev Bras Enferm*. 2021;75(2). doi:10.1590/0034-7167-2021-0106.
- The Revision Committee of the Chinese Guidelines for the Prevention and Treatment of Hypertension. Chinese Guidelines for the Prevention and Treatment of Hypertension: 2018 Revised Edition. *Cardiovasc Dis Prev Treat*. 2019;19(1):1–44. doi:10.3969/j.issn.1009-816X.2019.01.001.
- Chinese Diabetes Society of the Chinese Medical Association. China's Guidelines for the Prevention and Treatment of Type 2 Diabetes (Version 2020). *Chin J Diabetes*. 2021;13(4):315–409. doi:10.3760/cma.j.cn115791-20210221-00095.
- Chinese Joint Committee for the Revision of Guidelines on the Prevention and Treatment of Dyslipidemia in Adults (Version 2016). *Chin Circ J*. 2016;31(10):937–950. doi:10.3969/j.issn.1000-3614.2016.10.001.
- Kline RB. *Principles and Practice of Structural Equation Modelling*. New York: The Guilford Press; 2015:74–77.
- The State Council. Healthy China Initiative (2019-2030) [Internet]. 2019 Jul 15 [cited 2023 Oct 11]. Available from: https://www.gov.cn/xinwen/2019-07/15/content_5409694.htm.
- Li GY. *A study on health-related quality of life and medical service utilization among elderly patients with comorbid chronic diseases in China*. Lanzhou University; 2023.
- You L, Zhao JH, Chen XY, et al. Evaluation of the national basic public health service project over ten years (2009–2019) series report (II): Progress and achievements of the national basic public health service project implementation over ten years. *Chin Gen Pract*. 2022;25(26):3209–3220.
- National Health and Family Planning Commission. Notice on the issuance of the "National Basic Public Health Service Specifications [Third Edition]". Available from: <http://www.nhc.gov.cn/jws/s3578/201703/d20c37e23e1f4c7db7b8e25f34473e1b.shtml>. 2017.
- Xu H, Chen YJ, Wu J, et al. Analysis of the Current Status and Influencing Factors of Comorbid Hypertension, Diabetes, and Dyslipidemia among Adults in Nanjing City. *Chin J Prev Control Chron Dis*. 2023;31(7):539–544. doi:10.16386/j.cjpcd.issn.1004-6194.2023.07.014.
- Chen WB, Zhang Y, Yuan XL, et al. Analysis of the current status and related factors of the "Three Highs" comorbidity among the elderly in Shenzhen. *Chin. J Prev Control Chron Dis*. 2023;31(1):51–55. doi:10.16386/j.cjpcd.issn.1004-6194.2023.01.012.
- Nguyen H, Manolova G, Daskalopoulou C, et al. Prevalence of multimorbidity in community settings: A systematic review and meta-analysis of observational studies. *J. comorb.*, 2019 92235042X19870934. doi:10.1177/2235042X19870934.
- Won JR, et al. Multimorbidity of cardiovascular disease subtypes in a prospective cohort of 1.2 million UK women. *Open Heart*. 2023;10(2). doi:10.1136/openhrt-2023-002552.
- Wenqing N, Xueli Y, Yan Z, et al. Sociodemographic and lifestyle determinants of multimorbidity among community-dwelling older adults: findings from 346,760 SHARE participants. *BMC Geriatrics*. 2023;23(1):419. doi:10.1186/s12877-023-04128-1.
- Yu HY, Jiang LY, Fei CC, et al. The logical mechanism and measurement path of collaborative supply of health services for floating populations: a mixed study based on grounded exploration and complex systems. *Zhejiang Social Sciences*. 2023(08):90–100 114, 159. doi:10.14167/j.zjss.2023.08.018.
- Du J. Study on the prevalence of hypertension among urban citizens, farmers, and herdsmen of the Kazakh ethnic group in Xinjiang and family clustering. *Beijing Union Medical College*. 2022. doi:10.27648/d.cnki.gzxhu.2022.000546.
- Aasbjerg K, Nørgaard CH, Vestergaard N, et al. Risk of diabetes among related and unrelated family members. *Diabetes Res Clin Pract*. 2020;160:107997. doi:10.1016/j.diabres.2019.107997.
- Suraj MY, Gavin RN, Vernice P, et al. Marked intrafamilial aggregation and heritability of aortic flow in a community with prevalent volume-dependent hypertension in Africa. *J Hypertens*. 2021;40(3):615–623. doi:10.1097/HJH.0000000000003057.
- Zhang MJ, Zheng X, Liao YM, et al. Path analysis of the effect of social networks on multimorbidity in older adults: a study on the mediating effects of physical activity and sleep quality. *Chin Gen Pract*. 2024;27(17):2130–2137. doi:10.12114/j.issn.1007-9572.2023.0669.
- Linjin L, Fengfeiyue D, Dan Z. The effect of exercise intensity types on the self-rated health status of young-old comorbidities patients: a cross-sectional study in Guangdong, China. *Front Public Health*. 2023;11:1292712. doi:10.3389/fpubh.2023.1292712.
- Zhang R, Lu Y, Zhang SS, et al. Analysis of chronic disease comorbidity patterns and disease correlations among elderly people in China. *Chin Public Health*. 2019;35(08):1003–1005. doi:10.11847/zgggws1120351.
- Tian FS. *Research on the prediction model of common chronic disease incidence risk and management control strategies in a comprehensive hospital in Liaoning Province*. Liaoning: China Medical University; 2023.

31. Delpino FM, Dos Santos Rodrigues AP, Petarli GB, et al. Overweight, obesity and risk of multimorbidity: A systematic review and meta-analysis of longitudinal studies. *Obes Rev.* 2023;24(6):e13562. doi:10.1111/obr.13562.
32. Klop B, Elte JW, Cabezas MC. Dyslipidemia in obesity: mechanisms and potential targets [J]. *Nutrients.* 2013;5(4):1218–1240. doi:10.3390/nu5041218.
33. Ruze R, Liu T, Zou X, et al. Obesity and type 2 diabetes mellitus: connections in epidemiology, pathogenesis, and treatments [J]. *Front Endocrinol (Lausanne).* 2023;14:1161521. doi:10.3389/fendo.2023.1161521.
34. Luo X. *Study on comorbidity-related factors and mortality risk in chronic disease patients aged 45 and above in Huangdao District.* Shandong: Shandong University; 2023.
35. Liu SQ, Zhou Y. Progress in neuroendocrine mechanisms of obesity-related hypertension. *Zhejiang Med J.* 2021;43(16):1805–1809. doi:10.12056/j.issn.1006-2785.2021.43.16.2020-3397.
36. Piché ME, Tchernof A, Després JP. Obesity phenotypes, diabetes, and cardiovascular Diseases. *Circ Res.* 2020;126(11):1477–1500. doi:10.1161/CIRCRESAHA.120.316101.
37. Nussbaumerova B, Rosolova H. Obesity and dyslipidemia. *Curr Atheroscler Rep.* 2023;25(12):947–955. doi:10.1007/s11883-023-01167-2.
38. Zheng JH. Effect of family function on the quality of life in elderly patients with multimorbidity. *Nanjing University of Chinese Medicine.* 2024. doi:10.27253/d.cnki.gnjzu.2024.000006.
39. Wang ZY, Lu XY, Xing FM. Effect of disease acceptance and family care on the sense of coherence in elderly patients with comorbidities. *J PLA Nurs.* 2022;39(02):25–28.
40. Beijing Hypertension Prevention and Control Association, Chinese Society of Geriatrics, Beijing Community Health Association. Chinese expert consensus on primary care for adults with hypertension, type 2 diabetes, and dyslipidemia (2024 edition). *Chin Gen Pract.* 2024;27(28):3453–3475 3482. doi:10.12114/j.issn.1007-9572.2024.0116.
41. Wu L, Fan GS, Lu J, et al. Analysis of chronic disease prevalence and comorbidity patterns among residents in Quanzhou. *Appl Prev Med.* 2024;30(04):265–270.
42. Han SH, Zhang PJ, Li JL, et al. Analysis of the prevalence and comorbidity of hypertension, diabetes, and dyslipidemia among residents aged 35-75 in Hubei Province. *Appl Prev Med.* 2019;25(05):356–360.
43. Sun LM, Liu HT, Luo FB, et al. Effect of family care and social support on active aging among community-dwelling elderly. *Chin Health Serv Manage.* 2024;41(05):565–569.
44. Lai JJ, Huang YQ, Huang YM, et al. Analysis of the association between comorbidity of chronic diseases and health-related behaviors among middle-aged and elderly people in China. *Mod Prev Med.* 2023;50(15):2804–2810. doi:10.20043/j.cnki.MPM.202302228.
45. Boutari C, DeMarsilis A, Mantzoros CS. Obesity and diabetes. *Diabetes Res Clin Pract.* 2023;202:110773. doi:10.1016/j.diabres.2023.110773.
46. Yu N, Zhang M, Zhang X, et al. Study on the status and influencing factors of comorbidity of hypertension, diabetes, and dyslipidemia among middle-aged and elderly residents in China. *Chin J Epidemiol.* 2023;44(2):196–204. doi:10.3760/cma.j.cn112338-20220523-00451.
47. Xu CX, Guo XL, Lu ZL, et al. Analysis of “three highs” control and secondary prevention medication status in patients with ischemic cardiovascular disease aged 35-75 in Shandong Province, 2016-2020. *Chin J Prev Control Chron Dis.* 2023;31(5):343–348. doi:10.16386/j.cjpcd.issn.1004-6194.2023.05.005.
48. Zhou L, Zhao YZ, He ZT, et al. “Discovering China in the countryside”: Interdisciplinary research records (2023). *J Shanxi Agric Univ (Soc Sci Ed).* 2024;23(3):1–31. doi:10.13842/j.cnki.issn1671-816X.2024.03.001.
49. Xu LX. Survey on care needs and influencing factors of elderly people in urban villages. *J Shijiazhuang Vocat Techn Coll.* 2020;32(03):50–54.
50. Niu R. Study on the relationship between fear of disease progression, coping style, and family function in patients with type 2 diabetes. *Guangxi Univ Chin Med.* 2021. doi:10.27879/d.cnki.ggxy.2021.000322.
51. Dai MH, Xue MX, Liu M, et al. Mediating role of family care in the relationship between health literacy and self-care ability among elderly residents with hypertension. *Jiangsu Health Serv Manage.* 2023;34(01):138–142.
52. Niu GF, Sun JP, Yang ZL, et al. Correlation between family care and life satisfaction among elderly residents in nursing homes. *Chin J Gerontol.* 2018;38(24):6096–6098.