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ORIGINAL RESEARCH

Analysis of the Current Status of Self-Management Behaviors and Factors Affecting Self-Management in Elderly Empty Nesters with Comorbid Hypertension and Type 2 Diabetes Mellitus, a Cross-Sectional Study From the Community

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Purpose: This study aimed to investigate disease self-management and its influencing factors among empty nesters with comorbid hypertension and type 2 diabetes mellitus in the Chinese community.

Patients and Methods: A questionnaire was administered to 385 empty nesters in the community with comorbid hypertension and type 2 diabetes mellitus, including general information about the patients, the conditions of hypertension and type 2 diabetes mellitus, and self-management scores. The results were analysed using independent samples *t*-test, one-way ANOVA and multiple linear regression.

Results: Disease self-management ability among 360 empty nesters in the community with comorbid hypertension and type 2 diabetes mellitus was low to moderate level. The results of the multiple linear regression analysis showed that age, education, healthcare payment method, and systolic blood pressure were common influences on self-management of the two diseases; hypertension classification, body mass index, and 2-hour postprandial blood glucose were influences on self-management of hypertension; and diabetes treatment method and residence mode were influences on self-management of type 2 diabetes mellitus.

Conclusion: Primary healthcare providers need to pay close attention to the self-management skills of empty nesters with comorbid hypertension and type 2 diabetes mellitus in the community, especially in terms of disease monitoring and dietary management. Effective self-management health education, including sustained and effective lifestyle interventions, should be provided as early as possible for those living alone, newly diagnosed, less educated, and with limited healthcare resources, and the addition of elements of Chinese medicine health management, can also be considered to play a role in integrating prevention and treatment.

Keywords: comorbid, type 2 diabetes mellitus, hypertension, self-management, empty-nest, elderly

Introduction

Worldwide, populations are aging more rapidly than in the past, and many countries are facing social problems caused by population aging. China has one-fifth of the world's older adult population, the largest in the world.[1] In 2019, there were 164.5 million people over the age of 65 years in China. By 2050, this number is expected to increase to 365 million, or about 26.1% of the population.[2] With the increased development of aging, implementation of the former one-child policy, and changes in traditional concepts of old-age care, becoming empty-nesters has become the main family pattern among the elderly in China. According to the seventh national census data, as of 2020, there are at least 145 million empty-nest

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older adults in China, accounting for 55.68% of the total older population.[3] Studies have shown that empty-nesters have lower physical and mental health levels than non-empty-nesters.[4] The number of empty-nesters will be further increased, so health problems in this older population require greater attention.

As the population ages, life expectancy is increasing, and the risk of various age-related diseases, such as cardiovascular and metabolic diseases, is also rising.[5] As common diseases of the cardiovascular system and metabolic diseases, hypertension and type 2 diabetes mellitus cause problems for an increasing number of elderly. Studies have shown that hypertensive and diabetic patients are more likely to develop osteoporosis than the normal population. Blood uric acid levels and plasma aldosterone concentrations in hypertensive patients are associated with the development of osteoporosis,[6,7] and it is encouraging to note that researchers have found that spironolactone reduces the risk of osteoporosis in middle-aged and elderly patients while lowering blood pressure.[8] A systematic review indicated that age, gender, pharmacological agents, comorbid diabetic nephropathy, comorbid hypertension, and the severity of the disease are among the risk factors for the development of osteoporosis in elderly type 2 diabetic patients, moreover, metformin and dipeptidyl peptidase-4 inhibitors have a positive effect on preventing the development of osteoporosis in elderly type 2 diabetic patients.[9] Hypertension and type 2 diabetes mellitus are often causative of each other owing to the presence of many of the same pathophysiologic mechanisms.[10] Moreover, the probability of cardiovascular events is increased in patients with two co-morbidities compared with a single disease.[11] It has been reported that in Hong Kong, China, only 42% of patients with type 2 diabetes mellitus have normal blood pressure, and 50%–80% of patients with type 2 diabetes mellitus in the United States have hypertension.[12] This makes the management of patients with comorbid hypertension and type 2 diabetes mellitus particularly important.

Self-management skills in patients with chronic disease can substantially improve their quality of life. Existing studies have only focused on the impact of a single disease on empty-nested older patients. However, empty-nested patients with diabetes also have poor awareness regarding the prevention of complications and poor glucose monitoring skills.[13]

To the best of our knowledge, this is the first to examine the self-management of elderly patients with comorbid hypertension and type 2 diabetes mellitus in the Chinese community with empty nest status to understand the factors that influence the self-management of both diseases.

Materials and Methods

Setting

A cross-sectional study of empty-nester elderly patients with comorbid hypertension and type 2 diabetes mellitus was conducted in the Lanzhou City community between October 2022 and June 2023. A multi-stage random sampling method was used, which was implemented according to the following steps. First, two of the five jurisdictions in Lanzhou City were randomly selected, and then six streets were randomly selected at a 5:1 ratio of the total number of communities in each of the two jurisdictions. Then, seven communities were randomly selected from among all communities within the selected streets. In each community, 55 people were randomly selected, for a total of 385 people. After collating the data, we excluded 25 questionnaires with incomplete data, thus a total of 360 questionnaires were included in the analysis. The overall validity of the questionnaires was 93.5%. The number of research subjects in each phase is shown in Figure 1.

Participants

The inclusion criteria for enrollment were diagnosis of hypertension and type 2 diabetes mellitus, age 60 years or older, residing in the area for at least 1 year, native speaker of Chinese, living alone or with a spouse, and no cognitive disorders or blindness according to the medical records. The degree of cognitive impairment was evaluated using the Montreal Cognitive Assessment Scale, (MoCA). Participants were eligible for inclusion if they demonstrated a score of at least 26 on the MoCA questionnaire. Exclusion criteria included recent participation or ongoing involvement in related studies, the presence of serious complications, and the inability to tolerate the research process. Patient tolerance of the survey

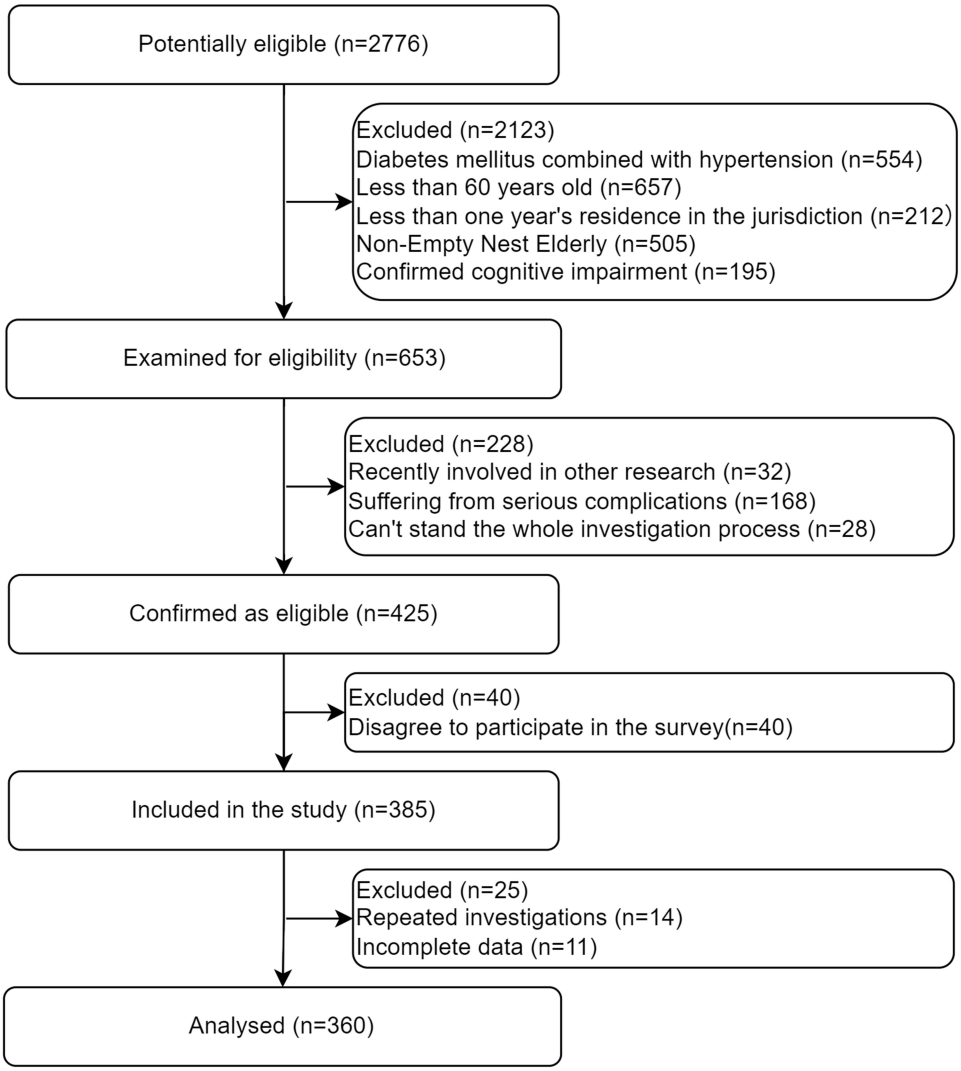

Figure 1 Number of participants in each phase.

was assessed using the Hamilton Anxiety Scale (HAM-A), with patients exhibiting scores≥14 being excluded from the study.

Variables of Study

Dependent Variable

The primary outcome was self-management of hypertension and type 2 diabetes, followed by simultaneous measurement of blood pressure and blood glucose profiles, ie, systolic blood pressure (SBP) and diastolic blood pressure (DBP), fasting blood glucose (FBG), and 2-hour postprandial blood glucose (2h-PBG).

Independent Variable

The variables of interest in this study included empty-nest status and information related to hypertension and diabetes (Course, family history, grading and complications of hypertension; The course of diabetes, family history, treatment modalities and complications). We also collected general information about participants, sex, age, waist circumference (WC), body mass index (BMI), education, health insurance, smoking and alcohol consumption.

The main types of health insurance chosen by the participants in our study were as follows: Urban Employee Basic Medical Insurance (UEBMI) was launched in 1998 for urban workers and retirees and is financed by a fixed proportion

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of the employee's salary. Urban Resident Basic Medical Insurance (URBMI) covers the urban population that is ineligible for the UEBMI scheme including children, students, the elderly, the disabled and other unemployed urban residents and is financed by government subsidies and household-level contributions. New Rural Cooperative Medical Scheme (NRCMS), which covers the rural population, was launched in 2003 and is funded by government subsidies and premiums.

Data Collection and Tools

The research team obtained permission to screen the medical records from community health centres to identify potential participants who met the inclusion criteria. Researchers then conducted telephone or face-to-face interviews with potential participants to determine eligibility. All participants signed informed consent forms in the Community Health Service Centre Education Room and then underwent a physical examination to measure height, weight, blood pressure, and fingertip FBG. We recorded 2h-PBG as the patient's most recent measurement. Then, trained researchers explained the content of the study and precautions for completing the questionnaire to participants and distributed the questionnaires. The questionnaires were completed independently by participants as much as possible. If this was not possible, a researcher asked the respondent questions in a non-suggestive manner and assisted them in completing the questionnaire. Questionnaires that were missing or incorrectly completed were checked and completed accurately together with the participants and were then collected on the spot.

Hypertension Patients Self-Management Behavior Rating Scale (HPSMBRS)

This scale, compiled by Chinese scholars Zhao et al,[14] comprised six dimensions including medication administration, disease monitoring, diet management, exercise management, rest and activity management, and emotion management, with a total of 33 items. Responses were given utilizing a 5-point Likert rating scale, with "Never" to "Always" scored from 1 to 5 points, respectively. The range of scores was 33–165 points; the higher the score, the better the self-management behavior. To make the scores for each dimension comparable, the original scores were converted into standardized scores. The standardized score = (full actual score of each entry/full score of each entry)×100. The standardized score for the self-management level was graded, that is, low level (<60 points), moderate level (60–80 points), and high level (>80 points).[15] With Cronbach's alpha coefficient of 0.914 and content validity of 0.910, the scale is widely applicable in the evaluation of self-management behaviors in hypertension.

Diabetes Self-Care Scale (DSCS)

This scale was developed by American scholars Hurley et al. In 1998, Wang et a[16] translated and revised the scale into a Chinese version with six dimensions and 26 items. The scale includes exercise management, dietary management, medication management, blood glucose monitoring, foot care, and high or low blood glucose management. Scoring utilizes a 5-point Likert rating scale with 1–5 points from "not at all" to "completely", respectively, and a score range of 26–130 points; the higher the score, the better the self-management behavior. To make the scores of each dimension comparable, the original scores were converted into standardized scores. The standardized score = (actual score of each entry/full score of each entry)×100. A standardized score of <60 was defined as poor, 60–80 as moderate, and >80 as good.[17] The scale has Cronbach's alpha coefficient of 0.764 and retest reliability of 0.96, which indicates good reliability and comprehensiveness and that the scale is suitable for the evaluation of self-management behavior in type 2 diabetes mellitus.

Sample Size Calculation

According to the results of the pre-test and review of the relevant literature,[18] the standard deviation of the score for ability in self-management of hypertension was larger than self-management of type 2 diabetes mellitus, and the standard deviation of Hypertension Self-Management Score σ was expected to be 5.7. A two-sided test was required with α=0.05, and the permissible error δ was 0.6 points. The sample size was calculated according to the following formula $n= (z^2_{\alpha/2}\times\sigma^2)/\delta^2$. A sample size of N=347 was obtained, and considering 10% invalid questionnaires, a minimum of 382 individuals needed to be included.

Data Analysis

Data were entered independently by two individuals using EpiData 3.1 software to ensure data reliability. Statistical descriptions and analyses were performed using IBM SPSS 26.0 software. Data that conformed to a normal distribution are expressed as mean±standard deviation; data that did not conform to normal distribution are expressed as median and interquartile range M (P_{25}, P_{75}). Count and rank data are expressed as frequency and percentage. In univariate analysis, all independent variables were transformed into hierarchical data; self-management scores were analyzed using analysis of variance (ANOVA). An independent samples *t*-test was used for dichotomous variables. ANOVA was used for three or more independent variables and self-management scores in each group that conformed to a normal distribution or approximate normal-tai distribution. In multiple linear regression analysis, hypertension and diabetes self-management scale scores were analyzed as dependent variables, and factors that were significant in univariate analysis were analyzed as independent variables. Grading variables were virtualized. Two-sided tests were used, with $P<0.05$ indicating a statistically significant difference.

Ethical Approval

The Ethics Committee of the Affiliated Hospital of Gansu University of Chinese Medicine approved the study in December 2021: (Ethics Committee of the Affiliated Hospital of Gansu University of Chinese Medicine Issued [2021] No. 131). The researcher elucidated the objective of the study to empty-nester elderly patients with comorbid hypertension and type 2 diabetes mellitus. Participants were included in the study if they voluntarily chose to participate. Following the provision of comprehensive information to all participants, a written informed consent form was signed by all participants. Participants were informed of their right to withdraw from the study at any time. The anonymity of the survey was ensured and any personally identifiable information was kept confidential.

Results

Characteristics of the Study Population

We analyzed data from 360 participants. The median age of participants was 71.07 years (66.00–76.00) in this survey. There was a slightly higher percentage of men (54.8%) than women participants. Most participants lived with their spouses (83.1%), and most had Urban Employee Basic Medical Insurance (UEBMI, 53.6%). Only 10.3% of participants had attained an education level higher than college. More than half of the participants had never smoked (57.5) or drank alcohol (62.5). More than half of patients with comorbid hypertension (55.7%) and type 2 diabetes (52.4%) had one or more co-morbidities. Most participants had a longer duration of hypertension than type 2 diabetes mellitus (Table 1).

Table 1 Characteristics of the Study Population (n=360)

Variable	n	%	$\bar{x} \pm s$/M(P_{25},P_{75})
Sex			
Male	165	45.8	
Age (year)			71.07 (66, 76)
60–69	156	43.3	
70–79	156	43.3	
≥80	48	13.3	
Residential status			
Living alone	61	16.9	
Living with spouse	299	83.1	
Education			
Junior high school and below	144	40.0	
High school/junior college	179	49.7	
College and above	37	10.3	

(*Continued*)

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Table 1 (Continued).

Variable	n	%	$\bar{x} \pm s$/M(P_{25},P_{75})
Health insurance			
UEBMI	211	58.6	
URBMI	108	30.0	
NRCMS	30	8.30	
Other	11	3.0	
Smoking status			
Never smoked	207	57.5	
Quit smoking	101	28.1	
Current smoking	52	14.4	
Drinking status			
Never drank alcohol	225	62.5	
Quit drinking	70	19.4	
Current drinking	65	18.1	
Hypertension duration (year)			
1–5	60	16.7	
6–10	120	33.3	
11–15	95	26.4	
≥16	85	23.6	
Family history of hypertension			
Yes	137	38.1	
Hypertension classification			
Grade 1	266	73.9	
Grade 2	94	26.1	
Complications of hypertension			
None	156	43.3	
One	113	31.4	
Two or more	91	25.3	
T2DM duration (year)			
<1	15	4.2	
1–5	131	36.4	
6–10	137	38.1	
11–15	29	8.0	
≥16	48	13.3	
Family history of T2DM			
Yes	70	19.4	
Diabetes treatment modalities			
Oral hypoglycemic agent	188	52.2	
Insulin injection	23	6.4	
Combination therapy	104	28.9	
None	45	12.5	
Complications of T2DM			
None	171	47.5	
One	105	29.1	
Two or more	84	23.3	
BP (mmHg)			
SBP <140(and)BP <90	321	89.2	
SBP ≥140 and (or) DBP ≥90	39	10.8	
FBG (mmol/L)			7.80 (6.80,9.30)
<7.0	113	31.4	
≥7.0	247	68.6	

(*Continued*)

Table 1 (Continued).

Variable	n	%	$\bar{x} \pm s$/M(P_{25},P_{75})
2h-PBG (mmol/L)			10.30 (9.00,12.00)
<10.0	127	35.3	
≥10.0	233	64.7	
BMI (Kg/m^2)			25.77±3.21
18.5–23.9	104	28.9	
24–27.9	182	50.5	
≥28	74	20.6	
WC (cm)			86 (82,94)
WCM <90	70	19.4	
≥90	95	26.4	
WCF <85	104	28.9	
≥85	91	25.3	

Abbreviations: UEBMI, Urban Employee Basic Medical Insurance; URBMI, Urban Resident Basic Medical Insurance; NRCMS, New Rural Cooperative Medical Scheme; BP, Blood Pressure; SBP, Systolic Blood Pressure; DBP, Diastolic Blood Pressure; FBS, Fasting Blood Glucose; 2h-PBG, 2-hour Postprandial Blood Glucose; BMI, Body Mass Index; WC, Waist Circumference; WCM, Waist Circumference of Males; WCF, Waist Circumference of Females.

Participants who had a family history of hypertension were nearly twice as frequent as those with type 2 diabetes mellitus. In this study, 73.9% of participants were diagnosed with grade 1 hypertension, with more than half having received glucose-lowering medication for type 2 diabetes mellitus.

Current Status of Self-Management Skills in the Dimensions of the Two Diseases

Figure 2 presented the maximum and minimum values of actual scores for each dimension of self-management for hypertension and type 2 diabetes mellitus, as well as the total scores after standardization. Participants' hypertension and type 2 diabetes mellitus self-management were both at low to moderate levels, with less variation between the dimensions of hypertension self-management and the worst dimension being disease monitoring. The three dimensions of exercise management, medication management, and foot care were better for diabetes; the worst dimension was also disease monitoring.

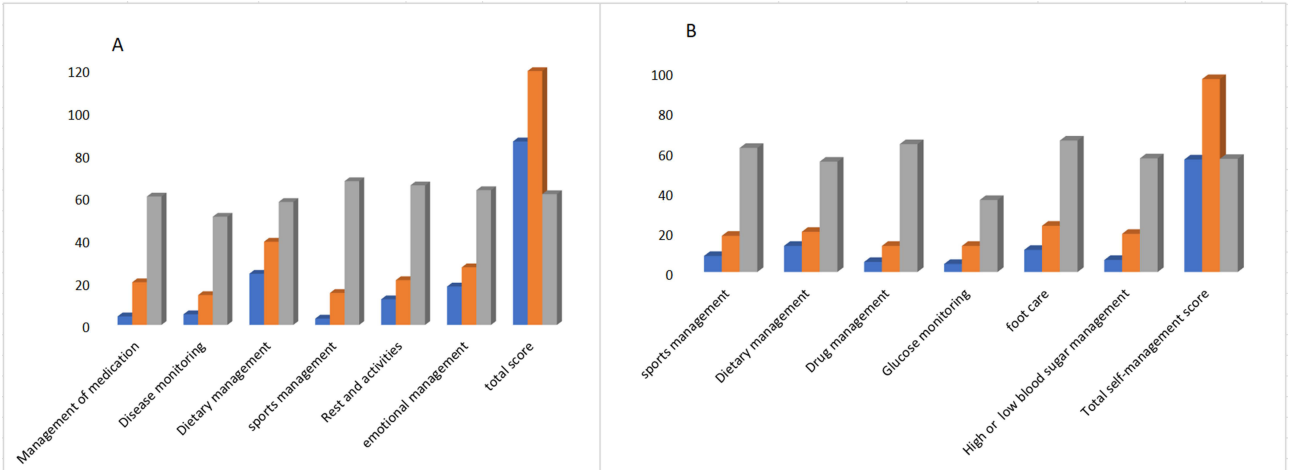

Figure 2 Current status of self-management in the dimensions of the two diseases. (**A**) The current status of self-management of hypertension. (**B**) The current status of self-management of type 2 diabetes mellitus. Actual Minimum Score Actual Maximum Score Standardied Score.

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Self-Management of the Disease and Associated Factors

We observed a sex difference in the self-management capability of hypertension (t=6.327, P=0.012) (Table 2). Age, residential situation, literacy, education level, and the type of health insurance were correlated with self-management of hypertension. Age was negatively associated with the ability to self-manage hypertension, education level was positively associated with the ability to self-manage hypertension, and participants with UEBMI insurance were more likely than those with URBMI and NRCMS to be able to self-manage their hypertension. Participants in all age ranges showed variability in self-management of type 2 diabetes mellitus (F=4.930, P =0.008). Participants aged≥80 years had poorer self-management of type 2 diabetes mellitus than those in the other two age groups, with no variability in the other age groups (Table 2). Mode of residence, education, and the type of health insurance showed variability in self-management of type 2 diabetes mellitus. Educational attainment was positively associated with self-management of type 2 diabetes mellitus; in terms of health insurance, participants with UEBMI insurance were better able to manage their diabetes than participants with URBMI or NRCMS.

We found differences according to BMI in self-management of hypertension (F=4.225, P=0.015) and type 2 diabetes mellitus (F=6.342, P=0.002) (Table 3). Patients with a normal BMI had better self-management of diabetes mellitus than those who were overweight and obese, whereas self-management of hypertension was only better than those of obese individuals. Duration of hypertension and hypertension grading were positively associated with the ability to self-manage hypertension, and patients with more than two hypertensive complications had better hypertension self-management. The duration of diabetes and diabetes treatment showed variability in self-management of type 2 diabetes mellitus. Patients

Table 2 Univariate Analysis of Demographic Characteristics and Disease Self-Management in Patients with Comorbid Hypertension and Type 2 Diabetes Mellitus (n=360)

Variable	Type 2 Diabetes Mellitus				Hypertension			
	Score of $\bar{x} \pm s$	*t/F*	*P*	Multiple Comparisons	Score of $\bar{x} \pm s$	*t/F*	*P*	Multiple Comparisons
Sex		3.226	0.073			6.327	0.012	
Male	73.81±6.16				102.27±7.78			
Female	72.64±6.17				100.25±7.40			
Age, (year)		4.93	0.008	A>C**, B>C*		13.735	<0.001	A>B*, A>C**, B>C**
60–69 (A)	73.85±6.41				102.93±7.38			
70–79 (B)	73.28±5.71				100.82±7.21			
≥80 (C)	70.69±6.39				96.63±7.85			
Residence status		24.451	<0.001			13.428	<0.001	
LA	69.72±6.43				97.97±7.08			
LS	73.88±5.90				101.83±7.5			
Education		30.89	<0.001	A<B**, A<C**, B<C**		16.839	<0.001	A <B**, A <C**, B <C**
JHSB (A)	71.39±5.55				99.11±7.08			
HS/JC (B)	73.27±5.50				101.69±7.38			
CA (C)	79.68±7.30				106.73±7.90			
Health insurance		6.117	<0.001	A>B**, A>C*		2.867	0.037	A>B*, A>C*
UEBMI (A)	74.32±5.78				102.01±7.36			
URBMI (B)	71.61±6.08				100.20±8.04			
NRCMS (C)	71.60±7.84				98.4±7.82			
Other (D)	70.91±5.41				102.27±5.90			
Smoking status		1.288	0.257			2.742	0.099	
Never smoking	72.86±6.08				100.60±7.39			
Quit/Current smoker	73.61±6.31				101.95±7.90			
Drinking status		2.466	0.117			0.027	0.869	
Never drinking	72.78±6.22				101.23±7.63			
Quit/currently drinking	73.84±6.09				101.09±7.66			

Notes: *p<0.05; **p<0.01.

Abbreviations: LA, Living Alone; LS, Living with Spouse; JHSB, Junior High School and Below; HS/JC, High School/Junior College; CA, College and Above; UEBMI, Urban Employee Basic Medical Insurance; URBMI, Urban Resident Basic Medical Insurance; NRCMS, New Rural Cooperative Medical Scheme.

Table 3 Univariate Analysis of Disease-Related Information and Disease Self-Management in Patients with Comorbid Hypertension and Type 2 Diabetes Mellitus (n=360)

Variable	Type 2 Diabetes Mellitus				Hypertension			
	Score of $\bar{x} \pm s$	*t/F*	*P*	Multiple Comparisons	Score of $\bar{x} \pm s$	*t/F*	*P*	Multiple Comparisons
BP (mmHg)		−0.057	0.995			−0.804	0.422	
SBP<140(AND)DBP<90	73.23±6.41				102.10±7.14			
SBP≥140AND(OR) DBP≥90	73.17±6.17				101.06±7.69			
FBG (mmol/L)		−0.167	0.868			1.464	0.144	
<7.0	73.10±5.91				102.04±7.71			
≥7.0	73.21±6.32				100.78±7.58			
2h-PBG (mmol/L)		−2.47	0.014			0.69	0.491	
<10.0	72.09±6.09				101.55±7.21			
≥10.0	73.77±6.17				100.97±7.86			
BMI (Kg/m^2)		6.342	0.002	A>C**, B>C**		4.225	0.015	A>C*
18.5–23.9 (A)	73.96±6.22				102.63±7.74			
24–27.9 (B)	73.64±6.13				101.10±7.92			
≥28 (C)	70.95±5.81				99.93±6.31			
WC (cm)						0.007	0.995	
WCM<90	73.86±5.30	0.08	0.936		102.27±7.76			
≥90	73.78±6.74				102.26±7.83			
WCF<85	72.64±5.75	0.008	0.994		99.38±7.53	−1.777	0.077	
≥85	72.64±6.65				101.25±7.16			
Duration (year)		4.519	0.001	B<E**, C<E**		3.546	0.015	B<E*,C<D*,C <E**
<1 (A)	74.4±9.78				/			
1–5 (B)	72.52±6.58				99.72±8.01			
6–10 (C)	72.34±5.55				100.00±6.62			
11–15 (D)	74.45±4.84				102.11±8.89			
≥16 (E)	76.26±4.98				102.82±6.79			
Family history		2.878	0.091			0.992	0.32	
Yes	74.3±6.37				101.69±7.13			
None	72.91±6.12				100.86±7.92			
Complications		0.583	0.559			4.073	0.018	A<C*
None	72.82±6.40				99.98±7.17			
One	73.63±6.46				101.55±8.15			
Two or more	73.33±5.36				102.76±7.47			
Type of treatment		8.347	<0.001	A<C**, C>D**				
Oral hypoglycemic agent (A)	72.46±6.00							
Insulin injection (B)	72.83±4.29							
Combination therapy(C)	75.75±5.63							
None (D)	70.93±7.41							
Hypertension classification						9.084	0.003	
Grade 1					100.46±7.38			
Grade 2					103.19±8.01			

Notes: *p<0.05; **p<0.01.

Abbreviations: BP, Blood Pressure; SBP, Systolic Blood Pressure; DBP, Diastolic Blood Pressure; FBG, Fasting Blood Glucose; 2h-PBG, 2-hour Postprandial Blood Glucose; BMI, Body Mass Index; WC, Waist Circumference; WCM, Waist Circumference of Males; WCF, Waist Circumference of Females.

treated with oral hypoglycemic agents in combination with insulin injections and those with a disease duration of 16 years or more had better diabetes self-management.

Table 4 shows the results of multivariate linear regression for hypertension self-management capacity in patients with comorbid hypertension and type 2 diabetes mellitus who had empty-nest status. The model results showed F=7.915, R^2=0.282, and adjusted R^2=0.247, indicating that the model explains 24.7% of the variance in diabetes self-management ability among elderly patients with comorbid hypertension and type 2 diabetes mellitus in the patient's empty nest state. Age, SBP, BMI, and 2h-PBG were negatively associated with self-management capability

Table 4 Multiple Linear Regression Analysis of Factors Influencing Hypertension Self-Management in Elderly with Comorbid Hypertension and Type 2 Diabetes Mellitus in the Empty-Nest State (n=360)

Variable	B	Standardized Error	Standardized B	t	P	VIF
Age (year) (ref: 60–69)						
70–79	−2.024	0.773	−0.132	−2.620	0.009	1.203
≥80	−6.364	1.164	−0.284	−5.468	<0.001	1.285
Education (ref: JHSB)						
HS/JC	1.712	0.780	0.112	2.193	0.029	1.250
CA	4.686	1.324	0.187	3.540	<0.001	1.326
Residence status (ref: LA)						
LS	1.018	1.011	0.050	1.007	0.315	1.179
Health insurance (ref: UEBMI)						
URBMI	−0.479	0.828	−0.029	−0.578	0.564	1.183
NRCMS	−3.865	1.381	−0.140	−2.799	0.005	1.196
Other	0.198	2.085	0.004	0.095	0.924	1.057
SBP	−0.104	0.034	−0.162	−3.34	0.003	1.354
BMI	−0.267	0.113	−0.112	−2.369	0.018	1.069
2h-PBG	−0.361	0.130	−0.134	−2.784	0.006	1.098
Duration(year) (ref: 1–5)						
6–10	1.363	1.082	0.084	1.259	0.209	2.136
11–15	3.920	1.264	0.227	3.100	0.002	2.549
≥15	3.659	1.280	0.204	2.858	0.005	2.426
Hypertension classification (ref: Grade 2)						
Grade 1	−3.317	0.901	−0.191	−3.681	<0.001	1.286

Abbreviations: JHSB, Junior High School and Below; HS/JC, High School/Junior College; CA, College and Above; LA, Live Alone; LS, Living with Spouse UEBMI, Urban Employee Basic Medical Insurance; URBMI, Urban Resident Basic Medical Insurance; NRCMS, New Rural Cooperative Medical Scheme.

and hypertension duration and grading were positively associated with hypertension self-management capability, with the absolute value of standardized coefficient B being highest in the age group ≥80 years, followed by subgroups with a duration of 11–15 years. The covariate tolerances for the covariate diagnostic results ranged from 0.392 to 0.946, and the variance inflation factor (VIF) ranged from 1.057 to 2.549, with no covariance among the independent variables.

Table 5 demonstrates the results of multiple linear regression for type 2 diabetes mellitus self-management capacity in patients with comorbid hypertension and type 2 diabetes mellitus in the empty-nest state. The model results showed F=7.650, R^2=0.300, and adjusted R^2=0.261, meaning that the model could explain 26.1% of the variance in type 2 diabetes mellitus self-management capability. Age and SBP were negatively correlated with type 2 diabetes mellitus self-management capability. Oral hypoglycemic drugs, combined treatment with oral

Table 5 Multiple Linear Regression Analysis of Factors Influencing Type 2 Diabetes Mellitus Self-Management in Elderly with Comorbid Hypertension and Type 2 Diabetes Mellitus in the Empty-Nest State (n=360)

Variables	B	Standardized Error	StandardizedB	t	P	VIF
Age (year) (ref: 60–69)						
70–79	−0.090	0.636	−0.007	−0.141	0.888	1.26
≥80	−2.683	0.967	−0.148	−2.775	0.006	1.373
Education (ref: JHSB)						
HS/JC	1.118	0.643	0.090	1.740	0.083	1.310
CA	6.624	1.068	0.326	6.203	<0.001	1.337
Residence status (ref: LA)						
LS	2.119	0.803	0.129	2.640	0.009	1.153

(*Continued*)

Table 5 (Continued).

Variables	B	Standardized Error	StandardizedB	t	*P*	*VIF*
Health insurance (ref: UEBMI)						
URBMI	−1.325	0.672	−0.098	−1.973	0.049	1.204
NRCMS	−0.729	1.094	−0.033	−0.667	0.505	1.163
Other	−2.091	1.681	−0.058	−1.244	0.214	1.064
SBP	−0.059	0.026	−0.113	−2.284	0.023	1.192
Duration (year) (ref: <1)						
1–5	−1.463	1.496	−0.115	−0.978	0.329	6.718
6–10	−1.488	1.556	−0.116	−0.956	0.340	7.090
11–15	1.399	1.830	0.062	0.764	0.445	3.153
≥15	1.589	1.743	0.087	0.912	0.362	4.382
Type of treatment (ref: None)						
Oral hypoglycemic agent	1.854	0.930	0.150	1.994	0.047	2.738
Insulin injection	1.964	1.417	0.078	1.368	0.167	1.526
Combination therapy	3.013	1.122	0.221	2.686	0.008	3.283

Abbreviations: JHSB, Junior High School and Below; HS/JC, High School/Junior College; CA, College and Above; LA, Live Alone; LS, Living with Spouse UEBMI, Urban Employee Basic Medical Insurance; URBMI, Urban Resident Basic Medical Insurance; NRCMS, New Rural Cooperative Medical Scheme.

hypoglycemic drugs and insulin injections, living with spouse, and UEBMI were associated with good diabetes self-management capability. The absolute value of standardized coefficient *B* was the highest for participants with an education level of college and above, followed by those who took oral hypoglycemic drugs. The covariate tolerance of the covariate diagnostic results ranged from 0.141 to 0.940, and the VIF ranged from 1.064 to 7.090.

Discussion

For older patients with chronic disease co-morbidities, self-management is complex, and the focus of self-management changes with changing conditions and needs. Therefore, self-management of patients with chronic disease co-morbidities should be dynamic, depending on the patient's disease and living status. To the best of our knowledge, this is the first survey of disease self-management ability among older empty-nesters with comorbid hypertension (61.31 points) and type 2 diabetes mellitus (56.29 points) conducted in community health centres in China. We found that the disease self-management capability of older hypertensive and diabetic empty-nesters was at a low to moderate level. The self-management capability for hypertension demonstrated in this study was consistent with the findings of a preceding investigation.[19] However, the level of diabetes self-management (61.64 points) was slightly lower than the results of a study in Nanning City.[20] This may be related to the fact that co-morbidities increase the burden of self-management in the elderly. On the one hand, the interplay between the pathophysiological mechanisms of hypertension and diabetes is a multifaceted phenomenon. Activation of the renin-angiotensin system, oxidative stress, inflammation and the immune system have been demonstrated as factors that play a role in the association between diabetes mellitus and hypertension.[21,22] It can therefore be hypothesised that a vicious circle is created when patients suffer from both diseases, thereby increasing their burden of self-management. On the other hand, Hypertensive comorbid diabetes can pose significant challenges to the long-term self-management of patients, characterised by chronic and sudden stress.[23] The management of these conditions is often complicated by the coexistence of multiple diseases, which adds to the psychological burden of the patient.[23] The study established that patients afflicted with two somatic diseases exhibited a 45% elevated risk of depression in comparison with patients suffering from a single somatic disease.[24] This finding suggests that patients with comorbid hypertension and type 2 diabetes mellitus encounter more complex self-management challenges. Consequently, future research endeavours should seek to comprehensively assess these self-management challenges and provide targeted interventions.

It is noteworthy that the two dimensions in which participants performed worst in self-management of hypertension and type 2 diabetes mellitus were the same. The first was disease monitoring, The reasons underlying patients' inadequate monitoring of their condition are manifold. Research findings demonstrate an established link between inadequate self-monitoring by diabetic patients and factors such as literacy, household financial income, healthcare knowledge and the type of healthcare insurance.[25,26] This is similar to our results. Although self-monitoring of co-morbidities imposes a more severe burden on patients,[27] However, a recent systematic review of self-monitoring in patients with hypertension co-morbidity noted a protective effect of self-monitoring against stroke when hypertension was combined with obesity. in addition, self-monitoring combined with other interventions for hypertension combined with diabetes resulted in better control of blood pressure and economic benefits.[28] The second dimension with poor performance was dietary management, which is known to be extremely important for the prognosis of both diseases. The reasons for poor dietary management might be as follows. Firstly, clinicians, especially primary healthcare workers, are not professionally trained in nutritional interventions, which leads to barriers to dietary counselling for patients.[29] Secondly, in clinical practice, physicians often focus only on the effects of medication without following up regarding healthy lifestyle changes in patients over time.[30] From the patient's point of view, older patients have been taking prescription and over-the-counter medications for a long time. These factors can easily lead to the development of geriatric anorexia nervosa,[31] resulting in deficiencies in patients' dietary management. Therefore, the self-management capability of empty-nester patients with comorbid hypertension and type 2 diabetes mellitus needs to be improved, especially concerning disease monitoring and dietary management. Community health workers should improve their nutritional knowledge as well as strengthen the health guidance for those patients with low literacy levels.

The patient's residential situation was only associated with diabetes self-management in our final multivariate linear regression model, where participants living with a spouse were better at diabetes self-management than those living alone. We believe this is related to the fact that type 2 diabetes mellitus is more complex to treat than hypertension, especially in patients treated with insulin, and that couples living together can help each other with insulin injections and with their health management such as through diet, exercise, and taking medications. In addition, compared with those who live alone, individuals who live together as a couple have a trusted source for daily communication and an emotional outlet, which reduces feelings of loneliness and lowers the impact of negative mood on illness.[32] A spouse also plays a social role by providing social support and life care for the patient, thereby increasing their access to health resources.[33] This suggests that patients with comorbid hypertension and type 2 diabetes mellitus who live alone are more in need of health management as well as emotional and social support. It is evident that the provision of medical services by community health centres for empty nesters, particularly those residing alone, is not only conducive to the self-management of their diseases but also constitutes a form of social support.[13] Thus, primary healthcare workers play an important role in improving the self-management of disease and the quality of life of these patients.

We found that some conditions associated with comorbid hypertension and type 2 diabetes mellitus were correlated with their respective disease management abilities in a multiple linear regression model. When the health crisis caused by the disease was greater, the self-management capability of participants was better, eg, participants with hypertension of more than 10 years' duration and requiring a combination of oral hypoglycemic drugs and insulin injections showed better self-management of the disease. On the one hand, when a patient has lived with a disease for a sufficiently long period and has acquired the knowledge related to the disease, they can calmly deal with common disease conditions, rather than being nervous and overwhelmed. On the other hand, as the disease progresses, patients become more aware of its irreversibility and pay greater attention to disease management.[23,27] Therefore, community health workers should provide comprehensive self-management health education to newly diagnosed patients to reduce feelings of being overwhelmed by a new disease diagnosis and increase their confidence in coping with future changes in the disease. Patients should be empowered to adapt as quickly as possible to the health threats posed by the disease and to better coexist with chronic conditions. Inadequate management of one disease has the potential to hinder the effective management of another. In our study, participants with worse SBP had worse self-management of both hypertension and type 2 diabetes mellitus and those with worse postprandial 2h-PBG had worse self-management of hypertension. As stated earlier, hypertension and diabetes share multiple pathophysiologic mechanisms and track each other over time, overlapping concerning the development of cardiovascular complications.[10,11] Patients with comorbid hypertension and

type 2 diabetes mellitus therefore face more challenges in disease self-management, including the health impacts of the disease itself and the psychological burden triggered by the interaction of multiple diseases. Encouragingly a systematic review indicated that lifestyle interventions and antihypertensive medications are effective in reducing cardiovascular risk in hypertension and diabetes.[10] Thus, effective lifestyle and rational pharmacologic interventions are powerful measures to promote self-management in patients with comorbid hypertension and type 2 diabetes mellitus.

In our model, the self-management capacity of comorbid hypertension and type 2 diabetes mellitus in empty-nesters was affected by age, education level, and type of health insurance. Self-management capacity declines with age for both conditions, especially among those over 70 years of age who have begun to decline in their self-management of hypertension. Older people's physical functioning declines progressively with age,[34] which can result in elevated health risks for the elderly, including an increased probability of falls.[35] As mentioned above, social support is reduced for empty-nesters, making them prone to negative emotions[13] and reducing their ability to manage their disease. As expected, lower education level was related to worse self-management of comorbid hypertension and type 2 diabetes mellitus among empty-nesters, which is consistent with the results of previous studies.[20] It is worth noting that we found that participants with employee health insurance had better disease self-management, and their diabetes self-management ability was different from that of participants with NRCMS and hypertension self-management was different from that of participants with resident medical insurance in the model. This is similar to the results of previous studies[36,37] and may be related to the fact that the UEBMI as a higher level of compensation and cost-sharing than the NRCMS. Therefore, when such patients are faced with a number influences, rational health insurance allocation is important to reduce patients' medical burden as their need for health care services increases. We have noticed that Traditional Chinese Medicine may present an advantage in self-management among such patients, being characterised as simple, convenient, effective, and inexpensive, as confirmed in past studies. The Baduanjin exercise is effective in improving the physical and mental health of older patients with hypertension and type 2 diabetes mellitus,[38–40] and acupressure is safe and effective in the control of both diseases.[41–43] Therefore, Primary healthcare providers should assist patients with comorbidities in learning traditional Chinese medicine methods, tailored to their treatment plans, to enhance their quality of life while managing these chronic conditions.

Limitations

It is imperative to acknowledge the limitations of this study. Firstly, the study employed a cross-sectional research design; therefore, it was not possible to assess causal relationships between observations. Secondly, the analysis was conducted without considering missing values, which may have introduced bias in the results due to the missing data. In light of the limitations of this study, it is recommended that a longitudinal study be conducted to investigate the causal relationship between self-management and predictor variables in patients with comorbid hypertension and type 2 diabetes.

Conclusion

Disease self-management among empty-nested elderly with comorbid hypertension and type 2 diabetes mellitus needs to be improved, particularly concerning disease monitoring and dietary management. Primary healthcare providers need to comprehensively assess self-management issues among people with comorbid hypertension and type 2 diabetes mellitus to provide targeted self-management interventions. The earlier Primary healthcare providers can intervene with newly diagnosed patients with comorbid hypertension and type 2 diabetes mellitus, the greater the benefit is likely to be. People with comorbid hypertension and type 2 diabetes mellitus who live alone have a greater need for emotional and social support. For patients who are older, less educated and with relatively fewer healthcare resources, consideration may also be given to incorporating elements of Chinese medicine healthcare, such as the eight-duan brocade and acupressure, to combine prevention and treatment mellitus.

Ethics Approval and Consent to Participants

This study was approved by the Ethics Committee of the Affiliated Hospital of Gansu University of Traditional Chinese Medicine, No.732 Jiayuguan West Road, Chengguan District, Lanzhou City, Gansu Province, China (NO.[2021] 131).

All methods were carried out in accordance with the Declaration of Helsinki. Written informed consent was obtained from all participants.

Consent for Publication

Consent for publication was obtained from all authors.

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Disclosure

The authors declare that there is no conflict of interest in this work.

References

1. Chen X, Giles J, Yao Y, et al. The path to healthy ageing in China: a Peking University-Lancet Commission. *Lancet*. 2022;400(10367):1967–2006. doi:10.1016/s0140-6736(22)01546-x
2. Fang EF, Xie C, Schenkel JA, et al. A research agenda for ageing in China in the 21st century (2nd edition): focusing on basic and translational research, long-term care, policy and social networks. *Ageing Res Rev*. 2020;64:101174. doi:10.1016/j.arr.2020.101174
3. Guo W, Meng L, Han J, et al. Intrinsic capacity and its association with predictors among Chinese empty nest older adults in communities: a latent class analysis. *BMC Geriatr*. 2024;24(1):1008. doi:10.1186/s12877-024-05583-0
4. Su D, Chen Z, Chang J, et al. Effect of social participation on the physical functioning and depression of empty-nest elderly in China: evidence from the China health and retirement longitudinal survey (CHARLS). *Int J Environ Res Public Health*. 2020;17(24):9438. doi:10.3390/ijerph17249438
5. Guo J, Huang X, Dou L, et al. Aging and aging-related diseases: from molecular mechanisms to interventions and treatments. *Signal Transduct Target Ther*. 2022;7(1):391. doi:10.1038/s41392-022-01251-0
6. Song S, Cai X, Hu J, et al. Serum uric acid and bone health in middle-aged and elderly hypertensive patients: a potential u-shaped association and implications for future fracture risk. *Metabolites*. 2025;15(1):1. doi:10.3390/metabo15010015
7. Song S, Cai X, Hu J, et al. Correlation between plasma aldosterone concentration and bone mineral density in middle-aged and elderly hypertensive patients: potential impact on osteoporosis and future fracture risk. *Front Endocrinol*. 2024;15:1373862. doi:10.3389/fendo.2024.1373862
8. Song S, Cai X, Hu J, et al. Effectiveness of spironolactone in reducing osteoporosis and future fracture risk in middle-aged and elderly hypertensive patients. *Drug Des Devel Ther*. 2024;18:2215–2225. doi:10.2147/dddt.S466904
9. Su W, Jia H, Yang L, et al. Risk factors for osteoporosis in elderly patients with type 2 diabetes: a protocol for systematic review and meta-analysis. *PLoS One*. 2025;20(2):e0319602. doi:10.1371/journal.pone.0319602
10. Yildiz M, Esenboğa K, Oktay AA. Hypertension and diabetes mellitus: highlights of a complex relationship. *Curr Opin Cardiol*. 2020;35(4):397–404. doi:10.1097/hco.0000000000000748
11. Strain WD, Paldánius PM. Diabetes, cardiovascular disease and the microcirculation. *Cardiovasc Diabetol*. 2018;17(1):57. doi:10.1186/s12933-018-0703-2
12. Cheung BM, Li C. Diabetes and hypertension: is there a common metabolic pathway? *Curr Atheroscler Rep*. 2012;14(2):160–166. doi:10.1007/s11883-012-0227-2
13. Lv X, Yu DSF, Cao Y, Xia J. Self-care experiences of empty-nest elderly living with type 2 diabetes mellitus: a qualitative study from China. *Front Endocrinol*. 2021;12:745145. doi:10.3389/fendo.2021.745145
14. Zhao Qiuli LX. Development and reliability and validity tests of a self-management behavioral assessment scale for hypertensive patients. *China Nurs Manage*. 2012;12(11):26–31.
15. Huanhuan Q, Wang Y, Yuqiu Z, et al.A study on the correlation between self-management behaviors and coping styles of elderly patients at high risk of hypertensive emergencies in the community. *Nurs Res*. 2018;32(24):3896–3899.
16. Pingping Y, Xiangcheng X, Tao T, Gaohui Q.An investigation and analysis of self-management behaviours of community-based type 2 diabetes mellitus patients and their associated factors. *Chin J Modern Med*. 2012;22(32):96–99.
17. Fang W, Li Y, Rao L, Zhenzhen X.Analysis of the current status of self-management behaviors of hospitalized patients with type 2 diabetes mellitus and the factors influencing them. *J Nurs*. 2015;30(17):29–31.
18. Ying-ying P, CAI X, Xue-dong W.Status and influencing factors of self-management behavior in elderly with hypertension. *South China J Prev Med*. 2020;46(05):486–489.
19. Li P.A survey on the level of blood pressure self-management in elderly hypertensive patients with empty nests in the community. *Chinese J Geria*. 2016;14(06):73–74.
20. Guifen F, Yanping Z, Huihua X, Di W, Jiaxia H, Xiaoxue L.Self-management ability of empty-nested elderly diabetic patients in Nanning community and its influencing factors. *Nurs Res*. 2018;32(18):2913–2915.

21. Jia G, Sowers JR. Hypertension in diabetes: an update of basic mechanisms and clinical disease. *Hypertension*. 2021;78(5):1197–1205. doi:10.1161/hypertensionaha.121.17981
22. Sinha S, Haque M. Insulin resistance is cheerfully hitched with hypertension. *Life*. 2022;12(4). doi:10.3390/life12040564
23. Liu S, Yanling W, Shaohua C, Jiagui L, Ying W, Jun'e L.A qualitative study of perceived stress and coping experiences of elderly empty-nesting spouses with chronic disease co-morbidities. *Military Nursing*. 2022;39(07):33–36.
24. Yao SS, Cao GY, Han L, et al. Associations between somatic multimorbidity patterns and depression in a longitudinal cohort of middle-aged and older Chinese. *J Am Med Dir Assoc*. 2020;21(9):1282–1287.e1282. doi:10.1016/j.jamda.2019.11.028
25. Hongchao L, Haijing G, Guoen L.A study of factors influencing adherence to blood glucose monitoring in Chinese community-based type 2 diabetes mellitus patients. *Chin Gene Prac*. 2020;23(S1):30–34.
26. Ying GH, Xiuying L, Li KL, Qingqing W, Liping K.A study on the adherence to self-monitoring of blood glucose in elderly patients with type 2 diabetes mellitus and the factors affecting it. *China Health Statist*. 2022;39(05):717–720.
27. Zhi Y, Jing G, Dingxi B, Rui LR.A qualitative study of the experience of treatment burden among older patients with chronic co-morbidities. *Chin Gene Med*. 2022;25(19):2336–2341.
28. Sheppard JP, Tucker KL, Davison WJ, et al. Self-monitoring of blood pressure in patients with hypertension-related multi-morbidity: systematic review and individual patient data meta-analysis. *Am J Hypertens*. 2020;33(3):243–251. doi:10.1093/ajh/hpz182
29. Kahan S, Manson JE. Nutrition counseling in clinical practice: how clinicians can do better. *JAMA*. 2017;318(12):1101–1102. doi:10.1001/jama.2017.10434
30. Lianov L, Johnson M. Physician competencies for prescribing lifestyle medicine. *JAMA*. 2010;304(2):202–203. doi:10.1001/jama.2010.903
31. Landi F, Calvani R, Tosato M, et al. Anorexia of aging: risk factors, consequences, and potential treatments. *Nutrients*. 2016;8(2):69. doi:10.3390/nu8020069
32. Yu-Ting Y, Miao Y, Yong-Wei Y, Qiong Y, Ting L. Relationships between children-related factors, basic psychological need satisfaction, and multiple happiness among urban empty-nesters in China: a structural equation modeling. *BMC Geriatr*. 2022;22(1):925. doi:10.1186/s12877-022-03640-0
33. Zhu H, He L, Peng J, et al. Community social capital and the health-related quality of life among empty-nest elderly in western China: moderating effect of living arrangements. *BMC Psychiatry*. 2022;22(1):685. doi:10.1186/s12888-022-04310-6
34. Marengoni A, Angleman S, Melis R, et al. Aging with multimorbidity: a systematic review of the literature. *Ageing Res Rev*. 2011;10(4):430–439. doi:10.1016/j.arr.2011.03.003
35. Feng C, Shi J, Lu W, Kun H, Xiao W, Xiangying Z. Analysis of fall risk indices in the elderly population with different exercise modes and chronic diseases. *Chin J Sports Med*. 2019;38(06):441–448. doi:10.16038/j.1000-6710.2019.06.001
36. Yu F, Mingsheng C. The impact of multimorbidities on catastrophic health expenditures among patients suffering from hypertension in china: an analysis of nationwide representative data. *Sustainability*. 2022;14(13).
37. Fu Y, Chen M, Si L. Multimorbidity and catastrophic health expenditure among patients with diabetes in China: a nationwide population-based study. *BMJ Glob Health*. 2022;7(2):e007714. doi:10.1136/bmjgh-2021-007714
38. Han Y, Peng L, Zhaohui F, Yunchuan W.The effects of community-managed Gongfu Ba Duan Jin on the clinical efficacy, psychological status, and glycemic indexes of elderly patients with type 2 diabetes mellitus. *Chin J Gerontol*. 2019;39(14):3433–3435.
39. Kong L, Ren J, Fang S, He T, Zhou X, Fang M. Effects of traditional Chinese mind-body exercise-Baduanjin for type 2 diabetes on psychological well-being: a systematic review and meta-analysis. *Front Public Health*. 2022;10:923411. doi:10.3389/fpubh.2022.923411
40. Ma Z, Lei H, Tian K, et al. Baduanjin exercise in the treatment of hypertension: a systematic review and meta-analysis. *Front Cardiovasc Med*. 2022;9:936018. doi:10.3389/fcvm.2022.936018
41. Ying X, MengTing H, JiaJia S, et al. Clinical effect of abdominal massage therapy on blood glucose and intestinal microbiota in patients with type 2 diabetes. *Oxida Med Cellular Long*. 2022;2022.
42. Qi Z, Haisong L, Meiqi J, et al. A systematic review and meta-analysis of the efficacy and safety of tui na in the treatment of essential hypertension. *J Chin Med*. 2018;59(18):1568–1573. doi:10.13288/j.11-2166/r.2018.18.009
43. Yang X, Zhao H, Wang J. Chinese massage (Tuina) for the treatment of essential hypertension: a systematic review and meta-analysis. *Compl Therap Med*. 2014,Jun;22(3):541–548. doi:10.1016/j.ctim.2014.03.008