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ORIGINAL RESEARCH

Exploring Self-Management Behavior Profiles in Patients with Multimorbidity: A Sequential, Explanatory Mixed-Methods Study

Yujia Fu[1,2,*], Jingjie Wu[3,*], Zhiting Guo[4], Yajun Shi[1], Binyu Zhao[1,2], Jianing Yu[1,2], Dandan Chen[3], Qiwei Wu[1,2], Erxu Xue[3], Haoyang Du[3], Huafang Zhang[1], Jing Shao[1,2]

[1]Department of Nursing, the Fourth Affiliated Hospital of School of Medicine, and International School of Medicine, International Institutes of Medicine, Zhejiang University, Yiwu, People's Republic of China; [2]School of Nursing and Institute of Nursing Research, School of Medicine, Zhejiang University, Hangzhou, Zhejiang, People's Republic of China; [3]Department of Nursing, Sir Run Run Shaw Hospital, Zhejiang University School of Medicine, Hangzhou, Zhejiang, People's Republic of China; [4]Department of Nursing, The Second Affiliated Hospital of Zhejiang University School of Medicine (SAHZU), Hangzhou, Zhejiang, People's Republic of China

*These authors contributed equally to this work

Correspondence: Jing Shao, Zhejiang University School of Medicine, 866 Yuhangtang Road, Hangzhou, 310058, People's Republic of China, Email 11318202@zju.edu.cn

Purpose: This study aims to identify self-management behavior profiles in multimorbid patients, and explore how workload, capacity, and their interactions influence these profiles.

Patients and Methods: A sequential explanatory mixed-methods design was employed. In the quantitative phase (August 2022 to May 2023), data were collected from 1,920 multimorbid patients across nine healthcare facilities in Zhejiang Province. Latent Profile Analysis (LPA) was used to identify distinct self-management behavior profiles. Multinomial logistic regression was then used to assess the influence of workload and capacity dimensions (independent variables in Model 1), as well as their interaction (independent variables in Model 2), on these profiles (dependent variables in two models). The qualitative phase (May to August 2023) included semi-structured interviews with 16 participants, and the Giorgi analysis method was used for data categorization and coding.

Results: Quantitative analysis revealed three self-management behavior profiles: Symptom-driven Profile (8.0%), Passive-engagement Profile (29.5%), and Active-cooperation Profile (62.5%). Compared to the Active-cooperation Profile, both the Symptom-driven and Passive-engagement Profiles were associated with a higher workload ($OR > 1$, $P < 0.05$) and lower capacity ($OR < 1$, $P < 0.05$). An interaction of the overall workload and capacity showed a synergistic effect in the Passive-engagement Profile ($OR = 1.08$, 95% $CI = 1.03$–1.13, $P < 0.05$). Qualitative analysis identified six workload themes, and related coping strategies of three self-management behavior profiles. The integrated results highlighted distinct characteristics: Symptom-driven Profile patients exhibited reactive behaviors with limited health awareness, Passive-engagement Profile patients reduced engagement once symptoms stabilized, while Active-cooperation Profile patients proactively managed their conditions.

Conclusion: Identifying three distinct self-management behavior profiles and their relationship with workload and capacity provides valuable insights into multimorbid patients' experiences, emphasizing the need for tailored interventions targeting workload and capacity to improve health outcomes.

Keywords: multimorbidity, self-management, workload, capacity, interaction, mixed-methods study

Introduction

Multimorbidity, defined as the coexistence of two or more chronic conditions,[1] affects approximately one-third of adults globally[2] and over half of all patients with chronic illnesses.[3,4] Over the past two decades, the prevalence of chronic diseases has doubled, with the proportion of patients suffering from four or more chronic conditions increasing by approximately 300%.[5] Multimorbidity is associated with considerable declines in physical and/or cognitive functioning,[6] reduced quality of life,[7] and increased healthcare costs,[8,9] posing substantial challenges to individuals, families, and society at large.[1]

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The effective management of multimorbidity requires a long-term, continuous approach to treatment and self-care, with patients positioned at the center of the care process. The successful management of multiple chronic conditions requires patients to develop a comprehensive understanding of their illnesses and actively engage in self-management behaviors. These behaviors involve prioritizing and making decisions across various tasks, managing complex medication regimens, monitoring symptoms, and processing extensive health-related information.[10] By maintaining effective self-management behaviors, patients can improve or sustain physical and mental health, ultimately achieving a better quality of life despite living with chronic diseases.[11]

However, the onset and progression of chronic conditions often disrupt daily routines. Patients are situated at the intersection of personal, healthcare system, and social factors, which exert a significant influence on their self-management behaviors, leading to notable individual variability. Living with multimorbidity has been described as navigating a constellation of interconnected medical, emotional, and social challenges.[12] Furthermore, the heterogeneity of diseases greatly impacts patients' workload of demands (hereafter referred to as "patient workload"),[13] while variations in capacities—such as illness knowledge and beliefs—affect their ability to cope effectively.[14] Boehmer et al identified the following key components of patient capacity: chronic disease experiences, available resources, social environment, and medical treatment.[14] This complexity highlights the necessity for a comprehensive understanding of patients' specific workload, their available resources and capacities, and strategies to maximize the effective utilization of these capacities to manage their workload.[15] Such an approach is fundamental to enabling long-term, effective self-management and improving patients' adaptation to living with chronic conditions.[16]

The Cumulative Complex Model (CuCoM)[17] proposed by Shippee et al offers a patient-centered framework to conceptualize these dynamics. CuCoM classifies the myriad of complex influences into two categories: patient capacity and patient workload of demands. According to the CuCoM, the balance or imbalance between workload and capacity is a key determinant of variations in self-management behaviors. When patients struggle to meet workload effectively, they may resort to coping strategies such as "structural non-adherence"[18] or "rational non-adherence"[19] to reduce their engagement in self-management. Previous researches have largely overlooked the heterogeneity of self-management behavior profiles and their influencing factors among patients with multimorbidity.[20] The majority of studies have examined the relationship between workload and capacity, and self-management in isolation among patients with specific chronic diseases. These studies have employed either qualitative analysis to identify the constituent dimensions of these variables or quantitative methods to quantify specific levels.[21–24] While these studies have contributed to our understanding of the individual components of the CuCoM framework, they have not sufficiently addressed the complex interactions between workload and capacity. In addition, they have not provided a comprehensive understanding of the impact of these interactions on self-management behavior profiles. Consequently, a comprehensive, system-level understanding remains to be elucidated.

Thus, this study seeks to fill these gaps by exploring the complex relationships between workload, capacity, and self-management behaviors in multimorbid populations. Specifically, the study has the following objectives: (i). To identify distinct self-management behavior profiles among patients with multimorbidity and determine the workload and capacity dimensions that influence these profiles. (ii). To investigate whether the interaction between overall workload and capacity affects self-management behavior profiles and explore how patients within each profile utilize their capacities to manage workload.

By integrating quantitative and qualitative methods, this study aims to provide a comprehensive understanding of the dynamics between workload and capacity. The findings aim to refine the theoretical framework of CuCoM and inform the development of tailored interventions for patients with multimorbidity.

Materials and Methods

This study adopted a sequential explanatory mixed-method design,[25] adhering to the Good Reporting of a Mixed-Methods Study (GRAMMS) standards.[26] The quantitative phase (Phase One) identified self-management behavior profiles among patients with multimorbidity and examined the influence of capacity, workload, and their interaction on these profiles. The subsequent qualitative phase (Phase Two) involved in-depth interviews to complement the quantitative findings, providing a deeper understanding of how patients across different profiles leverage their capacity to manage workload. The theoretical framework and flowchart of the mixed-methods study are presented in Figure 1.

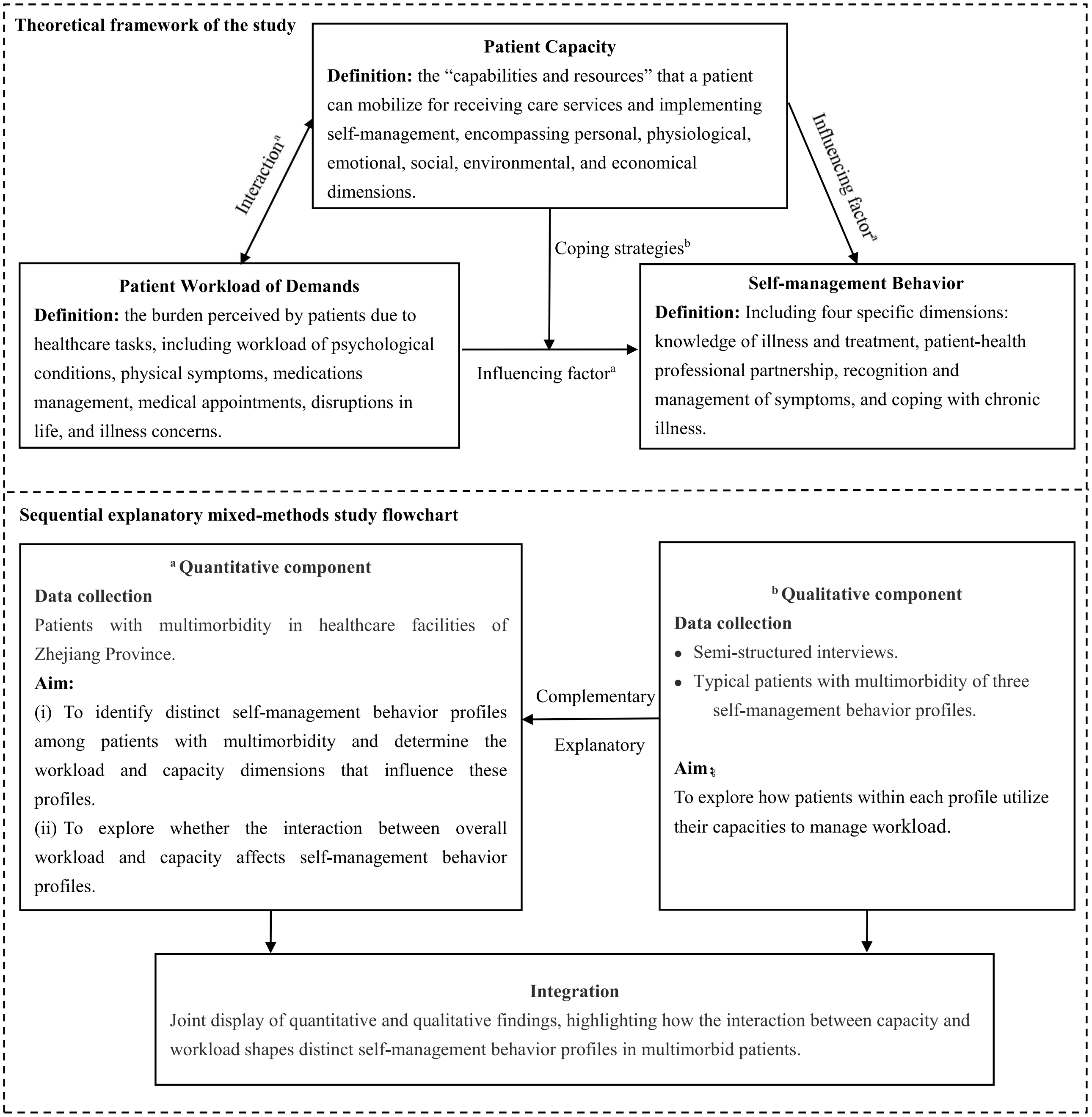

Figure 1 Theoretical framework and flowchart of the mixed-methods study.
Note: [a]means components of quantitative study, and [b]means components of qualitative study.

Quantitative Research

Participants

The research team employed convenience sampling to recruit participants from nine healthcare facilities situated in three cities within the Zhejiang Province of China, representing mountainous, plain, and island regions. The facilities included one provincial tertiary hospital, three county-level tertiary hospitals, three urban community healthcare centers, and two rural community healthcare centers. Inclusion criteria: (i) age 18 years or older; (2) diagnosed with two or more chronic diseases[27] (confirmed by community healthcare centers or higher-level institutions with medical records accessible in the healthcare system) (see disease list in eAppendix 1); (3) provided informed consent. Exclusion criteria: (1) severe visual or auditory impairments; (2) severe cognitive disorders.

Data Collection

Eligible patients were recruited with the assistance of nurse managers or doctors from healthcare centers and hospitals. Patients' disease-related data were first obtained from medical records and coded for disease severity using the Charlson Comorbidity Index (CCI).[28] This approach ensured a balanced distribution of disease severity in the sample, encompassing mild (score = 0), moderate (scores = 1–2), and severe (scores ≥ 3) conditions. The collaboration with healthcare staff and the distribution of small incentives (eg, tissues or towels valued at approximately 20 RMB) enhanced trust and engagement, ensuring high response rates. The data were collected face to face via two methods: online (www.WJX.com) or paper questionnaires, allowing respondents to choose their preferred method. A team of trained nursing students served as investigators, assisting elderly or electronically inaccessible participants.

Measurements

This study utilized ten validated and two self-developed scales to assess workload, capacity, and self-management behavior in multimorbid patients across 14 dimensions. The scales were selected based on their strong reliability and validity, alignment with the study framework, and their widespread application in both Chinese and international contexts. Despite the selection of concise scales with comprehensive measurement content, the complexity of assessing multiple dimensions presented a challenge to survey response rates. To address this, a preliminary survey with 323 participants was conducted, leading to the revision of three scales through factor analysis to enhance the feasibility of the investigation while maintaining their validity. The revised scales included the Brief Resilience Scale (BRS),[29] Mental Health dimension of Short Forms-36,[30] and the Patient-Reported Outcomes Measurement Information System® (PROMIS®) Social Support scale.[31] The specifics of the revised items were outlined in eAppendix 2. All scales demonstrated good reliability for both the original research[29–36] and this study. The detailed information about each scale was summarized in eAppendix 3.

Dependent Variables: Self-Management Behavior

The Partners in Health (PIH) scale[32] was used to evaluate self-management behavior in multimorbid patients, encompassing four key domains: knowledge of illness and treatment, patient-health professional partnership, recognition and management of symptoms, and coping with chronic illness. Widely applied in assessing self-management among patients with chronic diseases, the PIH scale consists of 12 items rated on a 9-point Likert scale, ranging from 0 (very dissatisfied) to 8 (very satisfied). Higher scores indicate better self-management in chronic disease patients. In this study, the scale demonstrated excellent reliability, with a Cronbach's alpha coefficient of 0.90.

Independent Variables: Patient Workload of Demands

Patient workload of demands was assessed across six dimensions. Workload of psychological conditions was measured using the PROMIS® Anxiety Scale[31] and the PHQ-9.[33] The PROMIS Anxiety Scale, a widely used tool for evaluating negative emotions, consists of four items selected through rigorous testing from the PROMIS item bank. Each item is rated on a 5-point Likert scale (1 = never to 5 = always), with higher scores indicating greater anxiety severity. Depression was assessed with the PHQ-9, a 9-item scale commonly used for screening and evaluating depressive symptoms, with responses scored from 0 (not at all) to 3 (nearly every day). In this study, the Cronbach's alpha coefficients for the PROMIS Anxiety Scale and PHQ-9 were 0.94 and 0.87, respectively.

Workload of physical symptoms was evaluated using the PHQ-15,[34] which measures the severity of 15 common physical symptoms experienced over the past four weeks. Each symptom is rated on a scale from 0 (not bothered) to 2 (bothered a lot), with a Cronbach's alpha coefficient of 0.77 in this study.

The remaining four workload dimensions—medications management, medical appointments, disruptions in life, and illness concerns—were assessed using the Treatment Burden Questionnaire (TBQ).[35] The TBQ, which has been widely applied in China, includes 15 items scored from 0 (no burden) to 10 (extreme burden). In this study, the Cronbach's alpha coefficient was 0.87.

Independent Variables: Patient Capacity

Patient capacity involves six aspects: personal, physical, emotional, social, economic, and environmental.[37] Personal capacity was measured using the Self-efficacy for Chronic Disease 6-Item Scale (SECD-6)[36] and the Brief Resilience

Scale (BRS).[29] The SECD-6 consists of six items scored on a 10-point Likert scale (1 = "not confident at all" to 10 = "very confident"), with a Cronbach's alpha of 0.88 in this study. The BRS, used to assess adaptability and resilience under stress, originally includes six items (three positively and three negatively worded). After factor analysis, leaving five items rated on a 5-point Likert scale, with higher scores indicating greater resilience (Cronbach's alpha = 0.87).

Physical and emotional capacities were assessed using the Physical Functioning (PF) and Mental Health (MH) subscales of the SF-36,[30] respectively. The PF subscale, comprising 10 items scored on a 3-point scale (0 = "severely limited" to 2 = "not limited at all"), had a Cronbach's alpha of 0.92. The MH subscale, reduced from nine to four items via factor analysis, measured emotional states over the past month on a 6-point scale (1 = "all of the time" to 6 = "none of the time") and achieved a Cronbach's alpha of 0.76.

Social capacity was evaluated using a modified PROMIS® Social Support scale,[31] reduced from 16 items to four items that best represented and sensitively captured social support over the past 30 days. Items were rated on a 5-point Likert scale (1 = "never" to 5 = "always"), with a Cronbach's alpha of 0.83 in this study.

Environmental capacity was measured using a self-developed scale assessing living facilities and medical resource accessibility, consisting of five items rated on a 5-point Likert scale (1 = "strongly disagree" to 5 = "strongly agree"), with a Cronbach's alpha of 0.91.

Economic capacity was evaluated by a single-item measure of current economic situation, rated on a scale of 0 to 10, where higher scores indicated better financial conditions.

Covariates

The covariates included demographic characteristics and disease-related information. Demographic characteristics comprised gender (male, female), age (<60 years, ≥60 years), marital status (married, others), educational level (junior school or below, middle/high school/specialty degree, college education or above), place of investigation (provincial tertiary hospitals, county-level tertiary hospitals, urban community healthcare centers, rural community healthcare centers), residential type (urban, town, rural), occupational status (retired/unemployed, employed), medical insurance (urban resident basic medical insurance, urban employee basic medical insurance, new rural cooperative medical scheme), and monthly household income (<5,000 RMB, ≥5,000 RMB). Disease-related information included the number of diseases (2, 3, ≥4), the number of medications (0–2, 3–4, ≥5), categorized into tertiles,[38] and the CCI.

Quantitative Data Analysis

The four dimensions of the PIH scale were utilized as indicators to identify profiles of self-management behaviors among patients with multimorbidity through Latent Profile Analysis (LPA),[39] a person-centered methodology for detecting significantly distinct profiles. LPA was executed using Mplus v8.3, with descriptive and analytical statistics were performed using IBM SPSS v26.0. Scores representing different aspects of patient workload and capacity were normalized on a 0–10 point scale to mitigate discrepancies between dimensions.[40]

Continuous variables were reported as means and standard deviations (SD), while categorical variables were presented as frequencies and percentages. Differences between categorical variables were assessed using the Chi-square test, and comparisons of ordinal data were performed with the Kruskal–Wallis *H*-test.

Multinomial logistic regression was employed to calculate the Odds Ratios (ORs) and 95% Confidence Intervals (CIs) for the associations between sociodemographic factors, workload, and capacity variables, and the different self-management behavior profiles. Each dimension of capacity and workload was sequentially added to the regression model, controlling for covariates. Subsequently, the standardized scores for each dimension of patient workload and patient capacity were summed to calculate the overall patient workload and overall patient capacity. These total scores were then further standardized (range: 0–10). An interaction term (Patient Workload of Demands × Patient Capacity) was included in Model 2 of the multinomial logistic regression. The interactions between each dimension of workload and capacity were then analyzed using the regression model.[41] All tests were two-sided, and results were considered statistically significant at $P < 0.05$.

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Qualitative Research

Participants

Purposeful sampling and maximum variation sampling were used to select representative multimorbid patients from the various self-management behavior profiles identified by LPA. The criteria for patient recruitment were consistent with those used in the quantitative study. Representative patients were selected from each profile based on the scores in workload, capacity, and self-management behavior to ensure a diverse range of perspectives.

Data Collection

Semi-structured interviews were conducted following a guide developed based on quantitative findings and the CuCoM framework (eAppendix 4). The sample size was determined based on data saturation. All interviews were recorded with the participants' permission.

Data Analysis

The Giorgi analysis method[42] was used in the qualitative research, with NVivo v12.0 employed as an auxiliary tool for data categorization and coding. Two researchers independently generated codes, which were refined through iterative adjustments and discussions. Similar codes were organized into themes, reviewed by the research team, and verified by participants for relevance.

Integration of Quantitative and Qualitative Results

Meta-themes were derived from both quantitative and qualitative studies. Firstly, the statistically significant interactions between workload and capacity that affect the self-management behavior profiles of patients with multimorbidity were explored. Subsequently, qualitative themes were employed to investigate how patients manage their capacity and workload in their daily lives. The qualitative themes were used to further elucidate and complement the quantitative results.[43]

Ethics Consideration

The study protocol adheres to the Declaration of Helsinki and has been approved by the Ethics Committee of Zhejiang University School of Medicine [ID: 2022–006]. Before the formal surveys and interviews, participants were fully informed about the study's purpose, anonymity, and confidentiality. All participants signed a consent form approved by the ethics committee, including permission for interviews to be recorded and publication of anonymized responses/direct quotes. Participants' names were anonymized and replaced with numerical identifiers. All data are securely stored in a confidential room, accessible only with approval.

Results

Quantitative Research

Participants' Characteristics

Quantitative data collection occurred from August 2022 to May 2023, involving 1,920 eligible multimorbid patients. In this study, patients with multimorbidity aged between 18 and 95 years (M±SD: 66.44 ± 11.71), with 47.2% being female. The number of chronic diseases ranged from 2 to 17 (M±SD: 3.22 ± 1.50), and the number of medications ranged from 0 to 25 (M±SD: 3.38 ± 2.52). Main demographic characteristics are summarized in Table 1.

Latent Profile Analysis

As shown in eTable 2, fit indices for latent profile models 1–5 demonstrate progressively decreasing *AIC, BIC*, and *aBIC* values as more profiles are included. The three-profile model demonstrated both theoretical and practical significance, with an *entropy* of 0.852 and P-values < 0.001 for both the *LMR* and *BLRT* tests. Consequently, this model was selected to represent self-management behavior profiles. The discriminant analysis confirmed its accuracy, with posterior probability means exceeding 90%.

As illustrated in Figure 2, Profile 1 consisted of 154 patients (8.0%), with a mean PIH scale score of 31.48 ± 11.73. Based on the integrated scores across four dimensions, Profile 1 had the highest score in the "Recognition and management of symptoms" dimension, thus labeled as the "Symptom-driven Profile".

Profile 2 included 566 patients (29.5%), with a mean PIH scale score of 59.08 ± 7.98. The scores across all dimensions were relatively balanced, and overall, it was at a mid-level, so it was referred to as the "Passive-engagement Profile".

Table 1 Characteristics in Relation to Different Self-Management Behavior Profiles (*n*=1,920)

Characteristics	**M±SD/ No. (%)**				**χ^2/*H***	***P*-value**
	Symptom-driven Profile (*n*=154)	**Passive-engagement Profile (*n*=566)**	**Active-cooperation Profile (*n*=1,200)**	**Total (*n*=1,920)**		
Gender					1.082[a]	0.582
Male	74 (48.1)	257 (45.4)	576 (48.0)	907 (47.2)		
Female	80 (51.9)	309 (54.6)	624 (52.0)	1,013 (52.8)		
Age					3.864[a]	0.145
<60	26 (16.9)	138 (24.4)	275 (22.9)	439 (22.9)		
≥60	128 (83.1)	428 (75.6)	925 (77.1)	1,481 (77.1)		
Place of investigation					164.125[a]	<0.001
Provincial tertiary hospitals	80 (51.9)	325 (57.4)	420 (35.0)	825 (43.0)		
County-level tertiary hospitals	53 (34.4)	110 (19.4)	216 (18.0)	379 (19.7)		
Urban community healthcare centers	7 (4.5)	73 (12.9)	400 (33.3)	480 (25.0)		
Rural community healthcare centers	14 (9.1)	58 (10.2)	164 (13.7)	236 (12.3)		
Educational Level					75.467[a]	<0.001
Junior school or below	111 (72.1)	283 (50.0)	471 (39.3)	865 (45.1)		
Middle/high school/ specialty degree	38 (24.7)	256 (45.2)	608 (50.7)	902 (47.0)		
College education or above	5 (3.2)	27 (4.8)	121 (10.1)	153 (8.0)		
Marital status					0.263[a]	0.877
Married	137 (89.0)	511 (90.3)	1,077 (89.8)	1,725 (89.8)		
Others	17 (11.0)	55 (9.7)	123 (10.3)	195 (10.2)		
Ethnic group					3.987[a]	0.136
Han Chinese	151 (98.1)	564 (99.6)	1,188 (99.0)	1,903 (99.1)		
Minority	3 (1.9)	2 (0.4)	12 (1.0)	17 (0.9)		
Religion					12.237[a]	0.002
No	136 (88.3)	522 (92.2)	1,038 (86.5)	1,696 (88.3)		
Yes	18 (11.7)	44 (7.8)	162 (13.5)	224 (11.7)		
Residential type					79.108[a]	<0.001
Urban	33 (21.4)	211 (37.3)	618 (51.5)	862 (44.9)		
Town	35 (22.7)	127 (22.4)	244 (20.3)	406 (21.1)		
Rural	86 (55.8)	228 (40.3)	338 (28.2)	652 (34.0)		
Occupational status					56.361[a]	<0.001
Retired/ Unemployed	63 (40.9)	244 (43.1)	723 (60.3)	1,030 (53.6)		
Employed	91 (59.1)	322 (56.9)	477 (39.8)	890 (46.4)		
Medical insurance					55.556[a]	<0.001
Urban resident basic medical insurance	59 (38.3)	226 (39.9)	463 (38.6)	748 (39.0)		
Urban employee basic medical insurance	34 (22.1)	177 (31.3)	506 (42.2)	717 (37.3)		
New rural cooperative medical scheme	61 (39.6)	163 (28.8)	231 (19.3)	455 (23.7)		
Monthly household income					22.945[a]	<0.001
<5,000 RMB	127 (82.5)	451 (79.7)	846 (70.5)	1,424 (74.2)		
≥5,000 RMB	27 (17.5)	115 (20.3)	354 (29.5)	496 (25.8)		
Number of diseases					6.753[a]	0.150
2	56 (36.4)	247 (43.6)	479 (39.9)	782 (40.7)		
3	45 (29.2)	166 (29.3)	332 (27.7)	543 (28.3)		
≥4	53 (34.4)	153 (27.0)	389 (32.4)	595 (31.0)		
Number of medicines					13.799[a]	0.008
0–2	57 (37.0)	207 (36.6)	526 (43.8)	790 (41.1)		
3–4	49 (31.8)	192 (33.9)	396 (33.0)	637 (33.2)		
≥5	48 (31.2)	167 (29.5)	278 (23.2)	493 (25.7)		

(*Continued*)

Table 1 (Continued).

Characteristics	**M±SD/ No. (%)**				**χ^2/H**	***P*-value**
	Symptom-driven Profile (*n*=154)	**Passive-engagement Profile (*n*=566)**	**Active-cooperation Profile (*n*=1,200)**	**Total (*n*=1,920)**		
CCI	2.38 ± 1.98	2.43 ± 1.93	1.52 ± 1.46	1.86 ± 1.71	65.195^{b}	<0.001
Patient workload of demands	4.15 ± 2.17	3.61 ± 1.77	2.63 ± 1.57	3.04 ± 1.77	176.927^{b}	<0.001
Workload of psychological conditions	2.40 ± 2.22	1.90 ± 1.78	1.50 ± 1.50	1.69 ± 1.68	34.608^{b}	<0.001
Workload of physical symptoms	3.15 ± 2.50	2.57 ± 1.79	2.37 ± 1.80	2.49 ± 1.88	13.286^{b}	0.001
Workload of medications management	2.74 ± 2.33	2.09 ± 2.04	1.27 ± 1.68	1.63 ± 1.92	116.467^{b}	<0.001
Workload of medical appointments	2.86 ± 1.98	2.50 ± 1.91	1.34 ± 1.60	1.81 ± 1.83	229.313^{b}	<0.001
Workload of disruptions in life	3.09 ± 2.01	2.90 ± 1.92	1.78 ± 1.71	2.21 ± 1.88	191.170^{b}	<0.001
Workload of illness concerns	3.81 ± 2.51	3.81 ± 2.69	4.19 ± 2.99	4.04 ± 2.87	4.984^{b}	0.083
Patient capacity	4.35 ± 1.72	5.86 ± 1.30	6.79 ± 1.33	6.32 ± 1.53	235.285^{b}	<0.001
Self-efficacy capacity	5.32 ± 1.75	6.72 ± 1.40	7.31 ± 1.29	6.98 ± 1.47	59.817^{b}	<0.001
Resilience capacity	4.95 ± 1.98	5.98 ± 1.61	6.27 ± 1.70	6.08 ± 1.74	105.232^{b}	<0.001
Physical capacity	5.08 ± 3.49	6.74 ± 2.73	7.59 ± 2.39	7.14 ± 2.69	69.374^{b}	<0.001
Psychological capacity	6.11 ± 2.15	6.99 ± 1.91	7.47 ± 1.89	7.22 ± 1.96	253.141^{b}	<0.001
Social capacity	6.53 ± 1.65	7.11 ± 1.53	8.10 ± 1.65	7.68 ± 1.71	155.208^{b}	<0.001
Environmental capacity	5.24 ± 3.30	6.83 ± 2.56	7.93 ± 2.35	7.39 ± 2.63	237.288^{b}	<0.001
Economic capacity	4.92 ± 1.98	5.39 ± 2.13	6.91 ± 2.23	6.30 ± 2.32	235.285^{b}	<0.001

Note: ^{a}*chi-square* test. ^{b}Kruskal-Wallis *H*-Test. The scores of the dimensions of patient workload and patient capacity have been normalized and range from 0 to 10.
Abbreviation: CCI, Charlson Comorbidity Index.

Profile 3 had the largest group, with 1,200 patients (62.5%), and the highest PIH scale score (78.97 ± 9.87). This profile showed relatively high scores in the "Knowledge of illness and treatment" and "Patient-health professional partnership" dimensions, thus named the "Active-cooperation Profile".

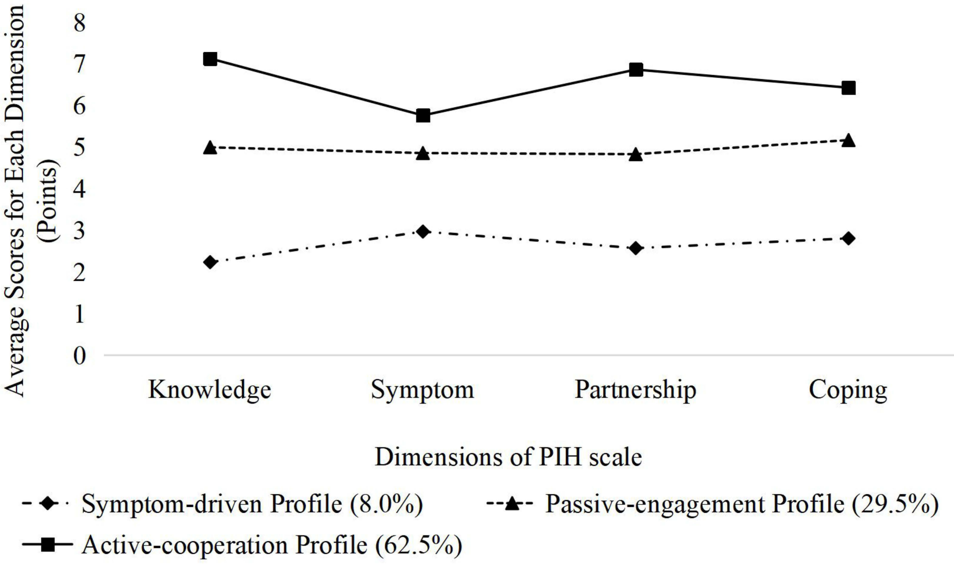

Figure 2 Distribution of three potential profiles of self-management behavior.
Note: Knowledge = Knowledge of illness and treatment, Symptom = Recognition and management of symptoms, Partnership = patient-health professional partnership, Coping = Coping with chronic illness.
Abbreviation: PIH, the Partners in Health scale.

Differential analysis (Table 1) revealed significant differences between the three profiles in terms of Place of Investigation, Educational Level, Religion, Residential Type, Occupational Status, Medical Insurance, Monthly Household Income, Number of Medications, and CCI ($P < 0.05$). The scores for "Patient workload of demands" (excluding the "Workload of illness concerns" dimension) decreased sequentially across the three profiles, while the scores for "Patient capacity" increased sequentially, all showing statistical significance ($P < 0.05$).

Multinomial Logistic Regressions

The results of the multinomial logistic regression on self-management profiles of workload and capacity dimensions are presented in Model 1 of Table 2. Compared to the Symptom-driven Profile, participants with a middle/high school/specialty degree (OR = 0.39, 95% CI = 0.25–0.59), living in urban areas (OR = 0.55, 95% CI = 0.31–0.98), and those surveyed at community health service centers (OR = 0.14, 95% CI = 0.06–0.33; OR = 0.43, 95% CI = 0.22–0.83) were more likely to belong to the Active-cooperation Profile. Similarly, compared to the Passive-engagement Profile, participants with a college education or higher (OR = 0.53, 95% CI = 0.32–0.88), retirees (OR = 0.73, 95% CI = 0.55–0.97), and those surveyed in urban or rural community healthcare centers (OR = 0.37, 95% CI =0.25–0.53; OR = 0.56, 95% CI = 0.38–0.81) or county-level tertiary hospitals (OR = 0.65, 95% CI = 0.48–0.88) were more likely to belong to the Active-cooperation Profile.

As for specific dimensions of workload and capacity, all except for the Workload of illness concerns and Workload of physical symptoms showed significant associations ($P < 0.05$). Specifically, lower CCI ($OR > 1$, $P < 0.05$), lower workload ($OR > 1$, $P < 0.05$), and higher capacity ($OR < 1$, $P < 0.05$) were associated with a higher likelihood of belonging to the Active-cooperation Profile compared with the other two profiles.

The results of Model 2 in Table 2 reveal that the interaction between overall workload of demands and capacity had a synergistic effect in the Passive-engagement Profile (OR = 1.08, 95% CI = 1.03–1.13), indicating that higher workload diminishes the positive effect of capacity, increasing the likelihood of being in the Passive-engagement Profile. No statistically significant interaction effect was found for the Symptom-driven Profile.

Qualitative Research

Participants' Characteristics

16 multimorbid patients participated in qualitative interviews, with an average age of 72.41 years (SD = 6.83) and the majority were male (64.7%). Five participants were from Symptom-driven Profile, four from Passive-engagement Profile, and seven from Active-cooperation Profile. Detailed participant characteristics are shown in eTable 3.

Results of Qualitative Interviews

In the qualitative interview segment, we identified six workload themes experienced by patients with multimorbidity: (i) healthcare services acquisition and utilization; (ii) psychological strain; (iii) multiple medical knowledge acquisition and communication; (iv) adverse symptoms; (v) polypharmacy decision-making and management; (vi) multiple social roles conflict. For each dimension of workload, we detailed the actual practices of patients across three profiles in their self-management processes (ie, how they utilized their capacities to cope with these workloads). Quotes of participants are summarized in eTable 4.

(i) **Workload of healthcare services acquisition and utilization** Patients in Symptom-driven Profile faced inadequate economic support, potentially leading to forgone treatment due to high costs or opting for lower-priced alternatives. They had limited health awareness and access to higher-level medical resources. Passive-engagement Profile patients sought higher-level care when necessary but could barely cover basic medical expenses. In contrast, Active-cooperation Profile patients had better economic conditions, preferring quality medical resources despite higher costs. They showed stronger health awareness and actively sought necessary medical care.

(ii) **Workload of psychological strain** Due to the diversity and severity of chronic conditions, some patients experienced illness stigma or anxiety about disease recurrence. Symptom-driven Profile patients tended to adopt an avoidant approach, such as avoiding public places due to embarrassing symptoms. In contrast, some Passive-

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Table 2 Multinomial Logistic Regression on Self-Management Profiles of Workload and Capacity

Model 1			**Model 2**		
Variables	**Symptom-driven Profile (n = 154)**	**Passive-engagement Profile (n = 566)**	**Variables**	**Symptom-driven Profile (*n* = 154)**	**Passive-engagement Profile (*n* = 566)**
	OR (95% CI)	**OR (95% CI)**		***OR* (95% CI)**	***OR* (95% CI)**
Gender (Ref. Male)			**Gender (Ref. Male)**		
Female	1.19 (0.82–1.71)	1.11 (0.89–1.39)	Female	1.17 (0.78–1.75)	1.04 (0.82–1.31)
Age (Ref. ≥60)			**Age (Ref. ≥60)**		
<60	0.92 (0.56–1.52)	1.10 (0.83–1.46)	<60	0.95 (0.55–1.66)	1.06 (0.80–1.42)
Marriage Status (Ref. Others)			**Marriage Status (Ref. Others)**		
Married	0.84 (0.46–1.51)	0.78 (0.54–1.13)	Married	1.12 (0.59–2.16)	0.91 (0.63–1.33)
Educational level (Ref. Junior school or below)			**Educational level (Ref. Junior school or below)**		
College education or above	0.38 (0.14–1.03)	0.53 (0.32–0.88)*	College education or above	0.35 (0.12–1.06)	0.49 (0.29–0.83)**
Middle/high school/ specialty degree	0.39 (0.25–0.59)***	0.87 (0.69–1.11)	Middle/high school/ specialty degree	0.52 (0.33–0.82)**	0.89 (0.69–1.13)
Residential type (Ref. Rural)			**Residential type (Ref. Rural)**		
Urban	0.55 (0.31–0.98)*	1.02 (0.73–1.43)	Urban	0.57 (0.31–1.05)	0.98 (0.70–1.39)
Town	0.67 (0.41–1.09)	0.91 (0.66–1.26)	Town	0.63 (0.36–1.09)	0.89 (0.64–1.23)
Occupational status (Ref. Employed)			**Occupational status (Ref. Employed)**		
Retired	1.02 (0.65–1.62)	0.73 (0.55–0.97)*	Retired	0.98 (0.58–1.64)	0.78 (0.58–1.05)
Medical insurance (Ref. New rural cooperative medical scheme)			**Medical insurance (Ref. New rural cooperative medical scheme)**		
Urban residents basic medical insurance	1.03 (0.64–1.65)	1.05 (0.77–1.43)	Urban residents basic medical insurance	1.38 (0.81–2.34)	1.17 (0.85–1.61)
Urban employee basic medical insurance	0.67 (0.36–1.25)	0.73 (0.51–1.06)	Urban employee basic medical insurance	0.93 (0.46–1.88)	0.86 (0.59–1.26)
Monthly household income (Ref.<5,000 RMB)			**Monthly household income (Ref.<5,000 RMB)**		
≥5,000 RMB	0.97 (0.59–1.60)	0.97 (0.73–1.28)	≥5,000 RMB	1.39 (0.81–2.40)	1.13 (0.85–1.51)
Number of diseases (Ref. ≥4)			**Number of diseases (Ref. ≥4)**		
2	0.65 (0.41–1.04)	1.08 (0.81–1.44)	2	0.61 (0.36–1.04)	1.10 (0.82–1.49)
3	0.78 (0.49–1.24)	1.11 (0.83–1.48)	3	0.68 (0.41–1.15)	1.09 (0.81–1.48)
Number of medications (Ref. ≥5)			**Number of medicines (Ref. ≥5)**		
0–2	1.03 (0.65–1.64)	0.90 (0.68–1.20)	0–2	1.80 (1.05–3.08)*	1.13 (0.84–1.53)
3–4	0.94 (0.60–1.49)	0.93 (0.71–1.23)	3–4	1.32 (0.78–2.23)	1.03 (0.77–1.37)
Place of investigation (Ref. Provincial tertiary hospitals)			**Place of investigation (Ref. Provincial tertiary hospitals)**		
Urban community healthcare centers	0.14 (0.06–0.33)***	0.37 (0.25–0.53)***	Urban community healthcare centers	0.27 (0.10–0.69)**	0.47 (0.32–0.70)***
Rural community healthcare centers	0.43 (0.22–0.83)*	0.56 (0.38–0.81)**	Rural community healthcare centers	0.76 (0.37–1.57)	0.65 (0.44–0.95)*
County-level tertiary hospitals	1.03 (0.66–1.62)	0.65 (0.48–0.88)**	County-level tertiary hospitals	1.65 (0.98–2.78)	0.73 (0.53–1.00)

CCI	1.19 (1.07–1.32)**	1.29 (1.20–1.38)***	**CCI**	1.07 (0.95–1.20)	1.21 (1.13–1.30)***
Patient workload of demands			**Patient capacity**	0.44 (0.34–0.58)***	0.57 (0.48–0.68)***
Workload of psychological conditions	1.30 (1.18–1.43)***	1.09 (1.02–1.16)*	**Patient workload of demands**	1.05 (0.78–1.42)	0.77 (0.60–0.99)*
Workload of physical symptoms	1.22 (1.11–1.34)***	1.02 (0.96–1.08)	**Patient capacity × Patient workload of demands**	0.98 (0.92–1.04)	1.07 (1.03–1.12)**
Workload of medications management	1.45 (1.32–1.58)***	1.23 (1.16–1.31)***			
Workload of medical appointments	1.55 (1.41–1.70)***	1.41 (1.32–1.50)***			
Workload of disruptions in life	1.36 (1.24–1.49)	1.30 (1.23–1.39)***			
Workload of illness concerns	0.96 (0.90–1.03)	0.97 (0.94–1.01)			
Patient capacity					
Self-efficacy capacity	0.41 (0.36–0.47)***	0.75 (0.69–0.81)***			
Resilience capacity	0.64 (0.57–0.71)***	0.88 (0.82–0.94)***			
Physical capacity	0.78 (0.74–0.84)***	0.95 (0.91–0.99)*			
Emotional capacity	0.70 (0.64–0.77)***	0.86 (0.82–0.92)***			
Social capacity	0.50 (0.45–0.57)***	0.68 (0.63–0.73)***			
Environmental capacity	0.78 (0.73–0.83)***	0.93 (0.89–0.98)**			
Economic capacity	0.69 (0.63–0.76)***	0.80 (0.76–0.85)***			

Notes: The reference class was Active-cooperation Profile. Model 1 was the multinomial logistic regression on self-management profiles of workload and capacity dimensions; Model 2 was the multinomial logistic regression on self-management profiles of overall workload and overall capacity interactions. Covariates (gender, age, marriage status, educational level, residential type, occupational status, medical insurance, monthly household income, number of diseases, number of medications, place of investigation, CCI) were controlled in both regression models.*<0.05, **<0.01,***<0.001.

Abbreviation: CCI, Charlson Comorbidity Index.

engagement Profile patients showed heightened self-management awareness due to concerns about disease recurrence, leading to regular self-monitoring and follow-ups. Active-cooperation Profile patients positively adapted to their long-term chronic conditions and engaged in effective self-management strategies for better health outcomes.

(iii) **Workload of multiple medical knowledge acquisition and communication** Differences in knowledge and health literacy led to significant variations in doctor-patient communication among multimorbid patients. Active-cooperation Profile participants were more inclined to actively communicate with physicians and engage in shared decision-making, believing it "helps tailor treatment plans". In contrast, those in other profiles tended to passively adhere to medical instructions. Symptom-driven Profile patients had limited medical knowledge, mainly relying on family members for communication with physicians. Passive-engagement Profile patients understood medical knowledge but lacked accuracy in discernment, potentially leading to incorrect self-management behaviors.

(iv) **Workload of adverse symptoms** Individuals in Symptom-driven Profile might have ignored adverse symptoms or discontinued management if the effects were not satisfactory, while patients in Passive-engagement Profile typically endured symptoms until they significantly impacted their lives. Active-cooperation Profile individuals were proactive in addressing and preventing symptoms to control them early and prevent deterioration. Age-related functional decline, unavoidable for all patients, was typically relieved through rest.

(v) **Workload of polypharmacy decision-making and management** Patients with multimorbidity often face managing medication side effects, timing, and dosage, along with maintaining a healthy lifestyle for disease management. Some Symptom-driven Profile patients may have misunderstood the side effects of long-term medication, leading to refusal or sporadic intake. Passive-engagement Profile patients may have shown laxity in managing their condition, resulting in low treatment adherence. In contrast, Active-cooperation Profile patients adhered to medication schedules, engaged in self-monitoring, and maintained healthy lifestyles persistently.

(vi) **Workload of multiple social roles conflict** Social role balance involves coordinating personal daily life, family responsibilities, and disease management. Patients in Symptom-driven Profile and Passive-engagement Profile typically did not prioritize disease management due to overlapping role conflicts. Symptom-driven Profile patients may have focused more on family roles, while Passive-engagement Profile patients adjusted accordingly. Most Active-cooperation Profile patients successfully integrated disease management into their daily routines, minimizing conflicts and prioritizing health management even amid challenges.

Integration

Table 3 presents an integration of the quantitative and qualitative findings. For the three self-management behavior profiles, we summarize the dimensions of workload and capacity that were statistically significant in the multinomial logistic regression analysis. Additionally, the table includes the themes of patient workload identified from the qualitative interviews, along with the corresponding coping strategies employed by patients. Finally, the overall characteristics of each profile are depicted, providing a comprehensive view of the self-management behavior patterns across the profiles.

Discussion

This study is the inaugural investigation to meticulously identify three self-management behavior profiles of patients with multimorbidity through the utilization of latent profile analysis: the Symptom-driven Profile, Passive-engagement Profile, and Active-cooperation Profile. Moreover, we investigated the correlation between the specific dimensions of workload and capacity, as well as their interaction, and self-management behavior in patients with multiple chronic conditions. The findings contribute to a more profound comprehension of self-management behaviors in this patient population and provide a foundation for the development of personalized interventions.

Our findings indicated that higher educational levels, urban residence, retirement status, and lower disease severity are significantly associated with Active-cooperation Profile. Further analysis revealed that capacity positively influences self-management behavior profiles,[44] while workload has a negative impact,[22] consistent with the findings of previous studies. However, within specific dimensions, "Workload of illness concerns" emerged as a protective factor, though it was statistically insignificant. We speculate that this result may be related to patients' health awareness. "Frequently thinking about health issues" is more likely to be perceived as an indication of heightened attention to health matters

Table 3 Joint Display of Quantitative and Qualitative Findings by CuCoM Domains

Self-management Behavior Profiles	**Integrated Characteristics**	**Quantitative Study**		**Qualitative Study**	
		Patient Workload of Demands	**Patient Capacity**	**Patient Workload of Demands**	**Coping Strategies**
Symptom-Driven Profile	i. Low education level; ii. Poor economic condition; iii. Weak health awareness; iv. Limited access to medical resources; v. Taking actions only when symptoms worsened.	Lower workload of demands (*OR* > 1, *P* < 0.05) were significantly associated with better self-management behavior profiles, including: i. Workload of psychological conditions ii. Workload of physical symptoms iii. Workload of medications management iv. Workload of medical appointments v. Workload of disruptions in life	Higher capacity (*OR* < 1, *P* < 0.05) were significantly associated with better self-management behavior profiles, including: i. Self-efficacy capacity ii. Resilience capacity iii. Physical capacity iv. Emotional capacity v. Social capacity vi. Environmental capacity vii. Economic capacity	i. Workload of healthcare services acquisition and utilization ii. Workload of psychological strain iii. Workload of multiple medical knowledge acquisition and communication iv. Workload of adverse symptoms v. Workload of polypharmacy decision-making and management vi. Workload of multiple social roles conflict	i. Limited medical resource, and may modify treatment due to high medical costs. ii. Social isolation due to disease stigma. iii. Passive medical knowledge acquisition, medical decisions were made by doctor or family members. iv. Neglecting symptom management. v. Poor medication adherence and unhealthy habits. vi. Prioritizing family roles when conflicts.
Passive-engagement Profile	i. Moderate educational level and economic condition; ii. Increasing management efforts with symptoms but relaxing during stability; iii. Taking a passive role in decision-making.				i. Seeking high-quality medical resources only when necessary but can only afford basic medical costs. ii. Heightened self-monitoring due to fear of disease recurrence. iii. Passive health information seeking, reliant on doctors. iv. Enduring symptoms without seeking help. v. Relaxed management post-stabilization, moderate adherence. vi. Adapting social roles as needed.
Active-Cooperation Profile	i. Higher education level; ii. Prioritized health; iii. Abundant healthcare resources; iv. Actively engaged in treatment; v. Persist good treatment adherence.				i. Willing and able to access abundant medical resources and afford healthcare costs. ii. Demonstrating positive adaptation to long-term conditions. iii. Engaging in shared decision-making and communication. iv. Actively seeking symptom relief. v. Maintaining medication and treatment adherence alongside a healthy lifestyle. vi. Prioritizing disease management.

Abbreviation: CuCoM, Cumulative Complexity Model.

rather than a reflection of psychological distress. Patients with higher health awareness tend to adopt more proactive measures, such as self-monitoring and engaging in healthy behaviors, to manage their chronic conditions.[45]

In the qualitative phase, we identified six themes of workload within the self-management process. Of these, five themes—healthcare service, psychological strain, medical knowledge, symptom management, and polypharmacy—were consistent with the specific dimensions of workload identified in the quantitative analysis, while "social roles conflict" was an additional new theme. Furthermore, we outlined the specific coping strategies employed by patients in the three self-management behavior profiles in response to these workloads, thereby enriching the coping strategies summarized by Löffler et al.[46] Understanding these coping mechanisms helps reveal the underlying causes of poor self-management behaviors among multimorbid patients and provides insights into strategies for improving self-management within this population.

By integrating the findings from both quantitative and qualitative analyses, significant differences in self-management behavior profiles and workload-capacity balance across the three patient groups were identified. Accordingly, when designing interventions, it is imperative to tailor them according to the specific interactions between workload and capacity in each profile, thereby ensuring more precise and individualized management plans.[37,47]

Patients in the Active-cooperation Profile demonstrate an ability to effectively optimize existing resources and capacities to mitigate the impact of workload. As an illustration, the participants incorporated self-management strategies into their daily activities, such as placing medications on the dinner table or utilizing calendar markers to remind them of medical appointments. The core of the intervention for this group should be to consolidate and reinforce current self-management strategies while maintaining confidence in disease control.[48]

In contrast, patients in the Passive-engagement Profile demonstrate a lack of conscious long-term planning and proactive adjustment, frequently relying on external healthcare providers or family support. These patients are more likely to abandon continuous self-management as their workload increases, which aligns with the quantitative findings that workload weakens the protective effect of capacity. Therefore, for this profile, enhancing capacity alone is insufficient. Reducing their workload is equally crucial to improving self-management behaviors. Effective interventions could include simplifying medical tasks (eg, medication integration) and reinforcing external support (eg, motivational interviewing[49] and shared decision-making[50]), which would both reduce workload and enhance self-efficacy.

For patients in the Symptom-driven Profile, the interaction results suggested that improving their capacity is the most critical intervention strategy. The qualitative interviews revealed that this group often exhibited short-term behavioral tendencies, taking passive measures only when symptoms worsen, and lacking long-term management capacity. This leads to the accumulation of workload, resulting in a vicious cycle. Therefore, interventions for these patients should prioritize building basic disease awareness and identifying and correcting ineffective coping strategies. Helping patients establish proper self-management habits could improve their long-term self-management behaviors.[51]

Our study makes significant contributions on both theoretical and practical levels. Theoretically, it identified and characterized the typical self-management behavior profiles in patients with multimorbidity. Empirical findings validated the influence of capacity and workload on these profiles, revealing that workload weakens the protective effect of capacity. These findings not only address the gaps in prior research regarding the insufficient explanation of variations in patient self-management behavior patterns but also provide new perspectives and practical tools for future studies. From a practical standpoint, our findings offer direct guidance for designing personalized interventions for patients with multimorbidity. The prevailing disease-centered self-management models tend to neglect the integrated impact of patient capacity and workload. Our study highlights the importance of simultaneously reducing workload and enhancing capacity. For instance, optimizing clinical processes (eg, minimizing unnecessary diagnostics) to reduce patient workload, while implementing health education and social support networks to strengthen capacity. At the policy level, providing flexible healthcare options and financial support are recommended to help alleviate the economic and social burdens faced by these patients.

Further research could concentrate on examining the specific workload and capacity dimensions identified in this study, with a particular focus on how they interact in different disease clusters, such as cardiometabolic syndrome or the "diabetes-cardiac-renal" syndrome. These disease clusters present distinctive challenges in managing multimorbidity. A more nuanced understanding of how capacity-workload dynamics influence self-management behaviors in these populations could facilitate the development of more targeted and effective interventions, thereby enhancing the applicability of minimally disruptive medicine in real-world settings.[20]

Limitations

This study has several limitations. Firstly, the study was conducted within Zhejiang Province and employed convenience and purposive sampling methods, which may have introduced selection bias. To enhance the representativeness of the sample, the following strategies were employed: (1) three representative cities within Zhejiang Province were selected, each exhibiting varying levels of economic development, with both urban and rural areas included; (2) a balanced distribution of hospitalized and community-dwelling patients was ensured, with a ratio of approximately 50%; and (3) patients with varying levels of disease severity were included, based on their Charlson Comorbidity Index (CCI) scores. Secondly, during the initial phase of the study, some patients declined participation due to the complexity and time-consuming nature of the survey. To address this issue, we revised the questionnaires based on factor analysis from a pilot study (see eAppendix 2). Although this modification precluded direct comparisons with the original scale, the revised version exhibited robust internal consistency across all dimensions (Cronbach's $\alpha > 0.76$), thereby substantiating the reliability and robustness of the findings. Finally, the study did not analyze quality of life, which is another key component of the CuCoM, as it was beyond the primary scope of this research. However, future studies will incorporate this aspect to provide a more comprehensive understanding.

Conclusion

This sequential, explanatory mixed-methods study systematically examines three distinct self-management behavior profiles in patients with multimorbidity and their influencing factors from an integrated capacity-workload perspective. This empirical study enhances the validity of the CuCoM while providing valuable insights into the interaction between capacity and workload, and its impact on self-management behaviors. Furthermore, it offers concrete guidance for clinical interventions tailored to address the indeed needs of each self-management profile. For patients in the Active-cooperation Profile, interventions should focus on reinforcing existing self-management strategies and ensuring confidence in disease control by optimizing daily routines. For the Passive-engagement Profile, enhancing capacity alone is not sufficient; reducing workload and strengthening external support like motivational interviewing and shared decision-making, is crucial to sustaining self-management. In the Symptom-driven Profile, the priority should be improving capacity through building disease awareness and correcting ineffective coping strategies, while fostering long-term self-management habits to prevent a cycle of passive behavior and workload accumulation. Overall, this study offers theoretical and actionable guidance for optimizing self-management behavior among patients with multimorbidity.

Data Sharing Statement

All data relevant to the study are included in the article or uploaded as supplementary information. Aggregate data generated or analyzed during this study are included in this published article (and its supplementary information files). Raw data generated or analyzed during this study are available from the corresponding author (Jing Shao) upon reasonable request.

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Disclosure

The authors report no conflicts of interest in this work. © 2008–2020 PROMIS Health Organization (PHO). This material can be reproduced without permission by clinicians for use with their own patients. Any other use, including electronic use, requires written permission of the PHO.

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