


Chinese Community Home-Based Aging Institution Elders' Self-Management of Chronic Non-Communicable Diseases and Its Interrelationships with Social Support, E-Health Literacy, and Self Efficacy: A Serial Multiple Mediation Model

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Background: The Chinese population is aging, and chronic non-communicable diseases (NCDs) prevalence is correspondingly increasing, along with associated disability and healthcare costs. Although self-management has been associated with social support and is a recognized priority, its mediating variables have not been studied in detail, particularly among old people with chronic diseases.

Purpose: To examine the mediating role of e-health literacy and general self-efficacy in the relationship between social support and self-management of chronic NCDs in Chinese community home-based aging institution residents.

Patients and Methods: A random sample of 289 community home-based aging institution elders (≥ 60 years) with chronic NCDs in China was recruited. Questionnaire data were recorded on self-reported socio-demographics, self-management, social support, e-health literacy, and general self-efficacy. Pearson's correlation analysis identified the relationship between these factors and self-management. Serial multiple mediation model was used to test the hypothesized relationships.

Results: The self-management mean (\pm SD) score was 29.39 ± 9.60 , and the level of self-management was medium. Social support ($r = 0.283$; $P < 0.001$), e-health literacy ($r = 0.566$; $P < 0.001$), and general self-efficacy ($r = 0.477$; $P < 0.001$) were positively associated with self-management. Furthermore, social support indirectly influenced self-management through three pathways: independent mediation of e-health literacy (effect = 0.234, $P < 0.001$), independent mediation of general self-efficacy (effect = 0.515, $P < 0.001$), and chain mediation of e-health literacy and general self-efficacy (effect = 0.075, $P < 0.001$).

Conclusion: In Chinese community home-based aging institution elders, the relationship between self-reported self-management and social support is positively affected by the independent mediating effect of e-health literacy and general self-efficacy and the serial mediating effect of e-health literacy and general self-efficacy. Targeted self-management programs for elders with chronic NCDs have theoretical support, which could improve the health status and quality of life in this population.

Keywords: chronic non-communicable disease, self-management, social support, e-health literacy, general self-efficacy, serial multiple mediation analysis

Introduction

Chronic non-communicable diseases (NCDs) including cardiovascular and cerebrovascular diseases, cancer, chronic respiratory diseases, and type 2 diabetes form the largest percentage of the Chinese burden of morbidity and mortality.¹

The available estimates suggest that by 2025, chronic NCDs will impose a disease burden of nearly \$7 trillion on low- and middle-income countries.² The healthcare costs for chronic diseases account for 70% of China's total public expenditure on diseases.³ Currently, there are approximately 300 million Chinese people with one or more NCDs, and this number is rising with the aging of the population.⁴ There are 180 million old people aged 60 and above in China who suffer from chronic diseases, with more than three-fourths of the old people population suffering from the coexistence of multiple chronic NCDs.⁵ Importantly, as China is an aging society, the population base of patients with chronic NCDs is large, the average life expectancy is longer, and the public health resources are more limited.⁶ Moreover, these patients bring greater financial and emotional burdens to their family caregivers.⁷ All of this poses a huge challenge to the public health and primary healthcare systems of China.⁸ A current top priority in China's public health industry is actively promoting healthy aging and strengthening the prevention and management of old people with chronic NCDs.

China's Elderly Care Development Plan recommends creating a multi-level old-age service system based on home care, assisted by community care, and supported by professional nursing homes.⁹ The plan focuses on the need to develop and create community home-based aging institutions, completely use community resources, meet the needs of old people, and improve their health status.⁹ Community home-based aging institutions use the family as the core, depending on the community, and utilize community resources to provide places for free entertainment, learning, and exercise, as well as paid food supply, rehabilitation guidance, and simple care for old people in the community.¹⁰ Old people voluntarily choose to come to community home-based aging institutions for activities, learning, and socializing, and still go home to rest. This method of old people care meets the traditional Chinese desire of old people to care for at home and also considers the requirements of old people for healthy and high-quality care.¹¹ However, community home-based aging institutions only provide relatively simple services for the old people, the daily care, medication, and disease management of old people with chronic NCDs still mostly depend on old people and their family caregivers.¹²

According to China's Long-Term Plan for Chronic Disease Prevention and Treatment (2017–2025), the basis for the prevention and treatment of chronic diseases should be to improve patients' self-management ability.¹³ Self-management refers to maintaining and improving health and monitoring and managing diseases based on the patient's behavior.¹⁴ Self-management of chronic NCDs has been widely studied and applied in many countries with good results and has become a research hotspot in the field of chronic disease treatment.^{15,16} Although the introduction of the self-management model in China was relatively short, considerable research and development has been performed.¹⁷ The self-management of chronic NCDs can efficiently promote rehabilitation, control progress, and prevent the complications of chronic diseases.¹⁸ Self-management is a sustainable health behavior that can decrease the effect of diseases on the social functioning, emotions, and interpersonal relationships of the patients, particularly the burden on family caregivers.^{19,20} Therefore, to reduce the burden on caregivers, improve the efficiency of long-term family care, lessen the burden on social nursing homes, and achieve a healthy China, it is important to encourage self-management in old people with chronic NCDs.²¹

As an available external resource, social support is a realistic, practical, and important way to improve patient self-management and lessen the burden on primary family caregivers. Social support refers to the care, respect, and assistance that individuals feel from their close partners or social network.²² People with chronic NCDs learn how to take care of themselves and stay healthy from others who also have chronic diseases.²³ Furthermore, receiving support from doctors can positively affect self-management in patients with chronic NCDs.²⁴ However, some old people with chronic NCDs depend on social support and have a reduced sense of responsibility for self-management.²⁵ Therefore, no consensus on the effect of social support on patient self-management in old people with chronic NCDs and its underlying mechanisms has been achieved yet.

With the ongoing transition toward a more digital world, emerging digital technologies and smart health devices have transformed the way old people manage their health conditions.²⁶ The combination of chronic disease self-management and the 5G internet has become unavoidable.²⁷ However, old people with chronic NCDs still lack the opportunity and ability to get health information from the internet²⁸ and are unable to make good use of smart health devices to manage diseases.²⁹ A systematic review indicated low e-health literacy of old Chinese, and it can be affected by a number of influencing factors at the individual, interpersonal, and social/community levels.³⁰ E-health literacy is defined as the ability to find, understand, and assess health information from electronic resources and use it to resolve one's health

problems.³¹ An improvement in e-health literacy leads to an increase in patients' knowledge and confidence in disease management and encourages them to take positive health management measures.³² Informational and emotional support can contribute to e-health literacy in old people with chronic NCDs.³³ Therefore, e-health literacy may be an essential mediating variable between social support and self-management.

Lorig designed the Chronic Diseases Self-Management Program using general self-efficacy theory as the theoretical framework.¹⁴ General self-efficacy refers to an individual's overall confidence in dealing with the difficulties of various environments and facing new things.³⁴ An important requirement for self-management and a key factor for people to change their behaviors and maintain healthy functioning is a high sense of general self-efficacy.³⁵ In patients with multiple chronic conditions, self-efficacy in performing self-management mediated the relationships between socio-demographic characteristics and adherence.³⁶ Peer support can encourage general self-efficacy,³⁷ and social support indirectly affects self-management behaviors through general self-efficacy.³⁸ Furthermore, e-health literacy indirectly affects health promotion behaviors via general self-efficacy.³⁹ Therefore, general self-efficacy may be an essential mediating variable in the effect of social support on self-management in old people with chronic NCDs and may also indirectly affect self-management via e-health literacy.

Many existing studies have shown relationships between self-management, social support, e-health literacy, and general self-efficacy or relationships among the three. We have demonstrated a significant correlation between social support and self-management; however, no path relationship was found through the structural equation model between social support and self-management.⁴⁰ Meanwhile, few studies have considered the relationship between social support, e-health literacy, general self-efficacy, and self-management in old people with chronic NCDs. Based on the literature review and our previous study findings, we created a model to test the following hypotheses: Hypothesis 1: social support positively directly affects self-management, e-health literacy, and general self-efficacy; Hypothesis 2: e-health literacy mediates the indirect relationship between self-management and social support; Hypothesis 3: general self-efficacy mediates the indirect relationship between self-management and social support; Hypothesis 4: e-health literacy and general self-efficacy serially mediate the relationship between social support and self-management.

In conclusion, this study aims to construct a series multiple mediation model to explore the potential mechanisms between self-management, social support, e-health literacy, and general self-efficacy in old people with chronic NCDs. This may provide a theoretical basis for clinical intervention and improve the health status and quality of life of old people with chronic NCDs.

Materials and Methods

Study Design and Participants

From July 2021 to November 2021, a cross-sectional study was conducted. We selected old people with chronic NCDs from four community home-based aging institutions in four random districts of Changsha City (Yuelu District, Yuhua District, Kaifu District, and Furong District). Old people with at least one chronic NCD diagnosed by a professional physician, who were aged 60 or older, and who participated voluntarily are included. Old people with mental or communication impairments that make it difficult to understand the questionnaire are excluded. All investigators (three graduate nursing students and two undergraduate nursing students) were uniformly trained before the study to ensure that each investigator used a unified guiding language. A one-to-one survey was conducted in an independent quiet room of each community home-based aging institution. Before the survey, the researchers explained the purpose, significance, and precautions of the survey to old people with chronic NCDs. During the survey, for some old people with difficulty in reading or writing, the investigators explained each item one by one or helped them complete the questionnaire by taking their oral responses. All eligible patients included in the study provided a signed consent form before participation. All paper-based questionnaires completed by patients were collected on the spot and checked for missing items to ensure data integrity. In total, 300 questionnaires were distributed, of which 289 valid questionnaires were returned; the response rate was 96.33%. The study was approved by the Ethics Committee of Hunan Normal University (No: 2021291) and complied with the Declaration of Helsinki.

Instruments

General Information Questionnaire

Our research group designed the general questionnaire to obtain the sociodemographic characteristics and health-related information, including gender, age, education status, living situation, main caregiver, family history of the disease, years of chronic NCDs, number of chronic NCDs, frequency of daily dosing, and whether they use smart health devices, of old people with chronic NCDs.

Chronic Disease Self-Management Study Measures

The chronic disease self-management study measures created by Lorig at the Stanford University Patient Education Research Center in 1999¹⁴ were sinicized by Chinese scholar Fu Dongbo in 2003 to evaluate patients' self-management behavior.⁴¹ The scale assessed the self-management behavior of old people with chronic NCDs from the following three dimensions: The exercise dimension has six entries, each of which asks how much time the patient has spent walking, swimming, or doing other aerobic exercises in the past week. The communication dimension has three items, wherein each item describes the patient's habits when seeing a doctor (eg, making a list of questions to ask in advance). The cognitive symptom management dimension has six items, each reflecting the patient's attitude toward pain or other uncomfortable symptoms (eg, trying to ignore the discomfort). Each item was scored on a 5-point Likert scale, with an overall score ranging from 0 to 75 (low level: 0–25, medium level: 25–50, and high level: 50–75), with higher scores indicating better self-management skills. The Chinese version had high sensitivity and validity in old people with chronic NCDs. Cronbach's α for internal consistency was 0.79–0.85.⁴¹

Social Support Rate Scale

The social support rate scale was proposed by the Chinese researcher Xiao in 1995 and contains 10 entries in three dimensions.⁴² The objective support dimension comprises three items (eg, "Who will comfort and care for you in emergencies?"). The subjective support dimension includes four items (eg, "Which family member can you rely on for support and care?"). The supported utilization dimension has three items (eg, "Do you turn to others for help when you are in trouble?"). The total score ranges from 10 to 66, with a higher score indicating higher levels of social support. The scale had good internal consistency (Cronbach's $\alpha = 0.89$) and test-retest reliability (Cronbach's $\alpha = 0.92$).³⁸

E-Health Literacy Scale

The e-health literacy scale was developed by Norman and Skinner in 2006 and comprises three dimensions with eight entries.³¹ In 2013, Peking University sinicized the e-health literacy scale and verified its reliability and validity in the Chinese population.⁴³ The application dimension was measured using five items (eg, I know how to obtain health resource information from the internet). The discrimination dimension was measured using two items (eg, the ability to evaluate good and bad information on network health resources). The decision dimension included whether people were confident that they could use online information to make decisions, with each response ranging from 1 (ie, totally disagree) to 5 (ie, totally agree). The total scores ranged from 8 to 40, with higher scores reflecting higher e-health literacy. The Chinese version showed good reliability among old people in the community. Cronbach's α for internal consistency was 0.98.⁴⁴

General Self-efficacy Scale

Schwarzer compiled the general self-efficacy scale in 1994.³⁴ The Chinese version of the general self-efficacy scale was translated and revised by Wang Caikang in 2001.⁴⁵ This scale consists of 10 items (eg, "When things get tough, I always find a way to solve them"), with responses ranging from 1 (ie, totally incorrect) to 4 (ie, correct). The total score of the scale was the sum of the 10 items divided by 10, with a higher score representing greater general self-efficacy. The reliability and validity have already been demonstrated in 26 countries.⁴⁶ The Chinese version also had high sensitivity and validity; Cronbach's α for internal consistency was 0.85.⁴⁷

Statistical Analysis

The data were analyzed using SPSS 22.0 (IBM Corporation, Armonk, NY, USA) and double-entered independently to avoid input errors. The numerical variables were presented as means and standard deviations, whereas the categorical

variables were presented as percentages and numbers. Descriptive, univariable, and multi-factor regression analyses were used. Pearson correlation was used to test for the relationship between continuous variables. Based on the significant relationships and hypothesis model, we used Hayes's⁴⁸ PROCESS macro (Model 6) to conduct mediation analyses using social support as the independent variable, e-health literacy, and general self-efficacy as the mediating variables, and self-management as the dependent variable; statistically significant variables in the univariate analysis were included in the mediating model as the covariates. We used a bias-corrected non-parametric percentage Bootstrap test, and after 5000 repeated samples, a 95% confidence interval was calculated to test each indirect effect. If the 95% confidence interval did not include 0, it indicated that the indirect effect was significant. $P < 0.05$ was considered statistically significant.

Results

Participant Characteristics

Table 1 presents the self-reported sociodemographic characteristics of old people with chronic NCDs. Among the 289 participants, there were 108 (37.4%) females and 181 (62.6%) males. The mean age was 68.61 ± 5.36 (range: 60–86) years. Moreover, 176 (60.9%) old people had hypertension and 106 (38.2%) had diabetes; 246 old people needed to take medication more than twice a day. Moreover, the majority (79.2%) of old people with chronic NCDs had been ill for more than 5 years, and 78.2% had multiple chronic diseases. A univariate analysis was conducted to evaluate the effects of sociodemographic characteristics on the self-reported self-management of old people with chronic NCDs in community home-based aging institutions. The use of smart health devices and age were significantly associated with self-management in old people with chronic NCDs.

Table 1 Demographic Characteristics of the Study Participants
(n = 289)

Variables	N	%	P
Gender			
Male	181	62.6	0.204
Female	108	37.4	
Age (years)			
60–70	185	64	0.027
71–80	97	33.6	
81–90	7	2.4	
Education status			
Primary school	97	33.6	0.357
Junior school	96	33.2	
High school	66	22.8	
University	30	10.4	
Main caregiver			
Own	68	23.6	0.211
Spouse	114	39.4	
Child	107	37	
Living situation			
Alone	97	33.6	0.136
With spouse	88	30.4	
With child	34	11.8	
With family	70	24.2	
Family history of NCDs			
Yes	67	23.2	0.998
No	222	76.8	
Use smart health devices			
Yes	46	15.9	0.002
No	243	84.1	

Bivariate Analyses

Table 2 shows the descriptive statistics and correlation analysis of self-reported research variables of old people with chronic NCDs. Self-management was significantly positively related to e-health literacy ($r = 0.566$; $P < 0.01$), general self-efficacy ($r = 0.477$; $P < 0.01$), and social support ($r = 0.283$; $P < 0.01$) in old people with chronic NCDs. E-health literacy was positively associated with general self-efficacy ($r = 0.404$; $P < 0.01$) and social support ($r = 0.307$; $P < 0.01$), and general self-efficacy was significantly positively associated with social support ($r = 0.499$; $P < 0.01$).

Serial Mediating Effect Tests for E-Health Literacy and General Self-Efficacy

The mediating role of e-health literacy and general self-efficacy between self-management and social support in chronically ill old people was analyzed, controlling for sex and the use of smart health devices. The regression analysis revealed that social support was a direct positive predictor of e-health literacy ($\beta = 0.223$, $P < 0.001$) and general self-efficacy ($\beta = 0.423$, $P < 0.001$); e-health literacy was a direct positive predictor of general self-efficacy ($\beta = 0.184$, $P < 0.001$); e-health literacy ($\beta = 0.376$, $P < 0.001$) and general self-efficacy ($\beta = 0.448$, $P < 0.001$) were significantly positively related to self-management. The results of the regression analysis are shown in Table 3. Figure 1 shows the path coefficients of the mediation model.

Table 4 shows the indirect effects. The results show that e-health literacy and general self-efficacy have a significant mediated effect between social support and self-management, with a totally mediated effect value of 0.824. The total mediated effect consists of three indirect effect paths, which accounted for 28.4%, 62.5%, and 9.1% of the total mediated effect, respectively.

Table 2 Mean Scores and Pearson Correlation Coefficients of Main Variables (n = 289)

Variable	Mean	SD	1	2	3	4
1 Self-management	29.39	9.60	1	-	-	-
2 E-health literacy	19.15	9.60	0.566**	1	-	-
3 General self-efficacy	2.47	0.65	0.477**	0.404**	1	-
4 Social support	42.25	6.29	0.283**	0.307**	0.499**	1

Note: ** $P < 0.01$.

Abbreviation: SD, standard deviation.

Table 3 Multiple Linear Regression Analysis for e-Health Literacy, General Self-Efficacy, and Self-Management (n = 289)

Outcome Variables	Predicting Variables	β	t	P	R	R ²	F
E-health literacy	Social support	0.223	3.946	<0.001	0.413	0.171	28.379
	Smart health devices	0.197	3.645	<0.001			
	Age	-0.279	-4.949	<0.001			
General self-efficacy	E-health literacy	0.184	4.732	<0.001	0.564	0.318	42.104
	Social support	0.423	7.373	<0.001			
	Smart health devices	0.054	1.049	0.295			
Self-management	Age	-0.226	-0.333	0.739	0.693	0.481	69.501
	E-health literacy	0.376	7.725	<0.001			
	General self-efficacy	0.448	8.708	<0.001			
	Social support	-0.034	-0.668	0.505			
	Smart health devices	0.141	0.297	0.767			
	Age	-0.074	-1.604	0.110			

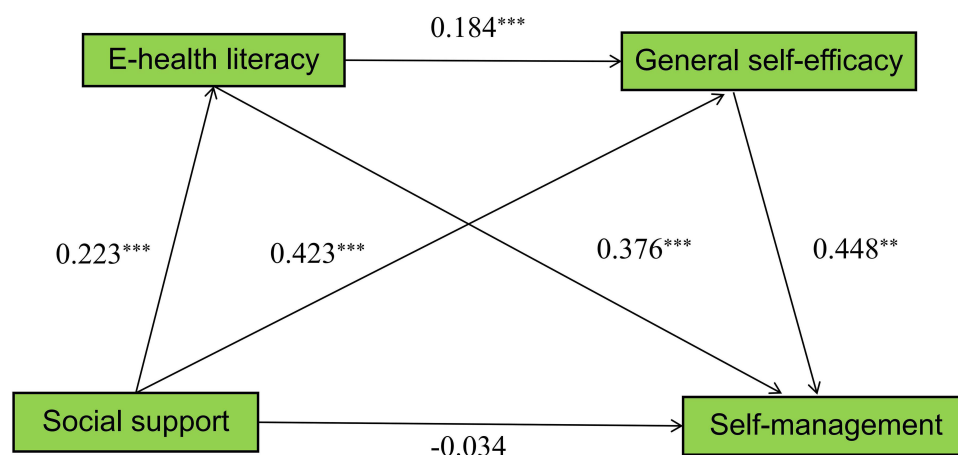


Figure 1 Serial mediation of e-health literacy and general self-efficacy on the relationship between social support and self-management. The coefficients shown are standardized path coefficients, *** $P < 0.001$.

Discussion

Our study findings revealed that old people with chronic NCDs have lower levels of self-management and e-health literacy, moderate levels of general self-efficacy, and high levels of social support, which are consistent with the findings of previous studies.^{25,32,38,49} We also assessed the effect and mechanism of social support on old people with chronic NCDs. The study findings revealed that social support directly positively affects e-health literacy and general self-efficacy but negatively affects self-management; therefore, Hypothesis 1 was not fully supported. In our study, old people with chronic NCDs received higher social support, but it had no positive promoting effect on the self-management of the old people in the community home-based aging institutions. This may be because too much social support may encourage the patient's sense of dependence, such as the weakening of self-management responsibility in the aspects of diet, medication, and emotional management.²⁵ The declining self-management ability of old people leads to an increase in the burden on caregivers. Furthermore, the negative emotions associated with long-term care, the medical costs associated with the treatment of the disease, and the complications caused by improper management all place a great burden on family caregivers, creating a vicious cycle.⁵⁰ Therefore, community home-based aging institutions can provide more opportunities for old people with chronic NCDs to participate in society and learn and use various electronic media such as health platforms, WeChat official account, TikTok, community radio to popularize knowledge about diseases, reasonable diet, mental health, physical exercise, medication matters, emergency disposal and other knowledge, to improve the e-health literacy and disease self-management ability of old people.

As shown by the serial multiple mediation model, e-health literacy indirectly mediates the relationship between social support and self-management in old people, supporting Hypothesis 2. The e-health literacy level of Chinese old people with chronic NCDs is lower than the international level.⁵¹ Improving the level of e-health literacy is beneficial for old people with chronic diseases to correctly seek, evaluate, and apply online health information, thereby actively

Table 4 Indirect Effects of e-Health Literacy and General Self-Efficacy (n = 289)

	Effect	Boot SE	LLCI	ULCI	Proportion
Total effect	0.729	0.166	0.402	1.056	
Direct effect	-0.095	0.1518	-0.3927	0.249	
Total mediation effect	0.824	0.113	0.622	1.062	100%
Ind 1: social support→e-health-literacy→self-management	0.234	0.067	0.118	0.388	28.4%
Ind 2: social support→general self-efficacy→self-management	0.515	0.513	0.377	0.703	62.5%
Ind 3: social support→e-health literacy→general self-efficacy→self-management	0.075	0.758	0.317	0.152	9.1%

Abbreviations: Boot SE, Boot-strapped standard error; LLCI, Lower level confidence interval; ULCI, Upper level confidence interval.

participating in disease self-management.⁵² Hence, community home-based aging institutions should conduct customized internet health information education and guidance activities for old people with chronic NCDs. Social media platforms and regulatory authorities should be responsible for establishing an account credit system, alerting about false information prompts, providing information protection for old people, compressing the space for false information dissemination, and cleaning the platform environment. Family members should encourage old people with chronic diseases to build confidence, help them access multiple information channels, guide them to identify false information, inform them about official health websites or WeChat official accounts, and improve their ability to identify online health information. Only 15.9% of old people in our study used smart health devices. In the future, the design of intelligent health products for old people should have simple operation functions, high efficiency, and strong practicability, which will increase the usage rate of smart health devices and also improve patients' confidence in using the devices, thereby promoting the application of intelligent health products in the self-management of chronic NCDs in the old people.

General self-efficacy mediated the relationship between social support and self-management, thus supporting Hypothesis 3, which is also consistent with the finding of a previous study.³⁸ General self-efficacy is an essential belief factor in self-management, that is, the stronger the sense of general self-efficacy, the stronger the confidence in disease management.⁵³ Serial multiple mediation models have demonstrated that e-health literacy and general self-efficacy serially mediate the relationship between social support and self-management, thus supporting Hypothesis 4, which has similarities and differences with the findings of previous studies.^{39,54} To fully encourage patients' behavioral motivation and achieve self-empowerment, the use of e-health literacy to increase patients' self-management ability should also pay more attention to patients' general self-efficacy. Moreover, medical workers and caregivers should pay attention to the psychological state of patients, provide targeted counseling when necessary, promote the correct management of diseases, strengthen patients' confidence in self-management, and ensure the continuity of self-management. The combination of internet information technology and community home-based aging institutions can lead to more intelligent and efficient old people care services, improve the level of community pension security, and reduce the burden of social public guidance.⁵⁵ It can also simultaneously promote the self-management of patients, lessen the burden of care of family members, and improve the quality of life and long-term prognosis of old people with chronic diseases.

Nonetheless, our study has some limitations. First, the subjects of the study were only recruited from Changsha City. In the future, the sample scope should be expanded to more comprehensively analyze the self-management status of old people with chronic NCDs in community home-based aging institutions of different levels and regions. Second, this study was based on a self-reported questionnaire survey of old people. When answering the questionnaire, the respondents might have estimated their responses or incorrectly judged their abilities, thus affecting the accuracy of the information to some extent. Therefore, future research could be combined with other assessment, qualitative, observational, and experimental studies to obtain a deeper information of self-management and e-health literacy in old people with chronic NCDs.

Conclusion

Our study identified some factors associated with the self-management of old people with chronic NCDs in China, clarified the multiple chain-mediated effects of e-health literacy and general self-efficacy in the relationship between self-management and social support, and provided a reference for the intervention programs aimed at improving self-management of old people. Our findings provide a new perspective and theoretical basis for reducing the burden on family caregivers and national old people care, and improving the long-term quality of life and rehabilitation effect of old people with chronic NCDs.

Data Sharing Statement

The original contributions presented in this study are included in the article, which can be further queried by the corresponding authors.

Ethics Approval and Participate

All experimental protocols in this study were approved by the Ethics Committee of Hunan Normal University (No: 2021291) and complied with the Declaration of Helsinki. Informed consent was obtained from all old people.

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Disclosure

The authors declare that the study was conducted without any business or financial relationship that could be interpreted as potential conflicts of interest.

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