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Health self-management ability and its associated factors among community- dwelling older adults in urban China: a cross-sectional study

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Abstract

Background

In the context of active aging, this study aimed to assess health self-management ability and its associated factors among community-dwelling older adults in urban China and to inform personalized interventions.

Methods

In November 2024, participants were recruited from urban communities in Xuzhou, Jiangsu Province, China, using a multistage stratified cluster random sampling method. Data were collected using the self-designed General Information Questionnaire (GIS), the Adult Health Self-Management Skills Rating Scale (AHSMSRS), the Activities of Daily Living (ADL) scale, and the eHealth Literacy Scale (eHEALS). Descriptive statistics, univariate analyses, multivariable logistic regression, and a random forest model were used to analyze the data.

Results

A total of 1,005 community-dwelling older adults in urban areas were surveyed. Of these, 368 (36.6%) had low-to-moderate health self-management ability, whereas 637 (63.4%) had high health self-management ability. The mean total score was 159.72 (SD, 21.24), corresponding to a standardized score of 84.06. After standardization, the highest and lowest subscale scores were observed for health self-management cognition (87.61) and health self-management environment (80.90), respectively. Across dimensions, self-efficacy had the highest score (88.12), whereas exercise self-management had the lowest score (77.00). Multivariable logistic regression analysis showed that gender, marital status, ADL, life satisfaction, awareness of digital health services, and eHealth literacy were significant factors associated with health self-management ability among older adults ($P < 0.05$). The random forest model ranked these factors in order of importance as follows: ADL, eHealth literacy, life satisfaction, awareness of digital health services, marital status, and gender.

Conclusions

Health self-management ability among community-dwelling older adults in urban China was generally at a moderately high level. However, relatively low scores were observed for exercise self-management and the use of public health resources, indicating room for further improvement. Particular attention should be paid to older adults with impaired ADL, inadequate eHealth literacy, dissatisfaction with life, limited awareness of digital health services, those who were unmarried, and men. Personalized interventions should be developed from psychosocial, demographic, and digital health perspectives to improve health

self-management and the ability to obtain health information among older adults, thereby helping address population aging, respond to changing health needs, and promote active aging.

Trial registration

Clinical trial number: not applicable

Background

Population aging has become a major demographic challenge facing countries worldwide in the twenty-first century. In this context, the high prevalence of chronic non-communicable diseases, the widespread occurrence of multimorbidity, and age-related declines in physical and cognitive function are profoundly reshaping the health needs of older adults. These changes are driving a shift in health service delivery from passive, disease-centered care toward a more proactive model that emphasizes prevention, participation, and health maintenance. Within this transition, health self-management ability has become a key determinant of health among older adults. The World Health Organization (WHO) projects that the global population aged 60 years and over will reach 1.4 billion by 2030 and increase to 2.1 billion by 2050[1]. As population aging continues to accelerate worldwide, the burden of aging-related diseases is also increasing. The Global Burden of Disease study indicates that chronic non-communicable diseases account for nearly two-thirds of global deaths and of the overall disease burden; this pattern is particularly pronounced among older adults, and a substantial proportion of this burden is preventable[2]. WHO data further show that approximately 75% of older adults have at least one chronic non-communicable disease[3]. However, the challenges posed by population aging are not limited to the persistent rise in chronic disease prevalence; more importantly, the high prevalence of multimorbidity is making healthcare needs increasingly complex and long term. In addition, functional decline, reduced social support, and decreased ability in activities of daily living associated with aging further weaken older adults' capacity for social participation and increase the caregiving and economic burden on individuals, families, and health systems[4]. In the face of a growing older population with increasingly complex health needs, the focus of public health must urgently shift from passive, disease-treatment-centered responses to life-course health promotion and functional maintenance. The WHO has noted that, in the management of chronic conditions, empowering individuals and communities and promoting patients' active participation in self-management are often more effective than relying solely on medical interventions [5]. Therefore, promoting the active engagement of older adults in health self-management is an important public health strategy for addressing population aging and responding to evolving health needs [6].

Health self-management emphasizes individuals' proactive role in maintaining health and well-being and encompasses health cognition, the regulation of health-related behaviors, and the effective use of health-related resources. This is consistent with the core concept of the proactive health model, which holds that individuals are primarily responsible for their own health. Health self-management ability is

not only reflected in a set of specific health behaviors but also represents a key capability, referring to older adults' proactive monitoring and management of their own health status through biological, psychological, and sociological interventions[7]. The WHO defines healthy aging as the process of developing and maintaining the functional ability that enables well-being in older age[8], further indicating that the health of older adults is not determined solely by disease status, but depends more on maintaining function and engaging in proactive health self-management. At the level of global health governance, the "active aging" framework proposed by the WHO in 2002 systematically addresses the health needs of an aging society across the three dimensions of health, participation, and security, within which health self-management ability is regarded as an important foundation for supporting older adults in maintaining functional independence and social participation[9]. This framework goes beyond the traditional view of aging as a process of decline and highlights the potential of older adults to live vital and active lives[10–11]. Existing studies have shown that good health self-management ability helps older adults better cope with chronic diseases, delay functional decline, and maintain autonomy in daily life, and that it is closely associated with enhanced subjective well-being and reduced depressive symptoms[12–13]. In this context, improving the health self-management ability of older adults is of great significance for maintaining their physical and mental health and represents an important pathway toward achieving the goals of active aging.

China is currently one of the countries with the largest older populations and the fastest pace of population aging in the world, and the challenges associated with population aging are particularly prominent [14]. By the end of 2024, the population aged 60 years and above in China reached 310 million, accounting for 22% of the total population, and the proportion of those aged 65 years and above reached 15.6%. The proportion of the population aged 65 years and above is expected to rise to 25% by 2050, indicating that China has entered a moderately aging society[15–16]. Along with the acceleration of population aging, the high prevalence of chronic non-communicable diseases, multimorbidity, and age-related declines in physical and cognitive function have become increasingly common among older adults in China. Studies have shown that approximately three-quarters of older adults in China have at least one chronic disease, and multimorbidity has become increasingly common[17]. The combined burden of chronic diseases and the aging process not only increases health risks among older adults, but also drives a shift in their health needs from disease-treatment-oriented care toward a proactive health model that emphasizes long-term management, active participation, and functional maintenance. In this context, since 2020, China has elevated active responses to population aging to a national strategy, emphasizing the importance of promoting older adults' active engagement in health, enhancing their capacity for participation, and ensuring opportunities for participation. Therefore, in the context of rapid population aging and the profound transformation of health service delivery in China, systematically assessing the level of health self-management ability among community-dwelling older adults in urban China and its associated factors has important practical significance and policy value.

With the rapid development of internet technology and the advent of the digital era, access to health information and approaches to health management have become increasingly digitalized. Digital

technologies are being continuously integrated into healthcare systems, driving innovation in models of health service delivery. In the WHO Global Strategy on Digital Health 2020–2027, it is clearly stated that digital technologies should be fully leveraged to improve human health and advance universal health coverage[18]. In this context, digital health technologies have gradually become important tools for promoting health self-management ability among older adults[19]. Whether older adults can effectively access, understand, and apply digital health technologies affects the feasibility and sustainability of their health self-management behaviors[20]. Meanwhile, China has continued to advance digital health-related policies, regarding improvements in older adults' digital literacy and the promotion of age-friendly adaptations of digital technologies as important measures to enhance equity in health services, while encouraging the use of digital health technologies to improve older adults' health self-management ability[21]. However, in practice, owing to factors such as technological complexity, system design, individual capability limitations, and service accessibility, some older adults still face substantial barriers in using digital health services, and the digital divide persists[22–23]. Therefore, improving older adults' digital health literacy and promoting age-friendly digital health technologies are considered important prerequisites for effectively enhancing older adults' health self-management ability and achieving health equity[24].

Improving older adults' health self-management ability depends critically on the systematic identification of its associated factors, thereby providing a scientific basis for targeted interventions. Current studies have mainly examined factors affecting older adults' health self-management ability from a single perspective, while empirical research on multidimensional associated factors remains limited. In addition, existing studies have largely relied on traditional statistical methods to identify significant associated factors, with insufficient attention paid to the relative importance of different factors in health self-management ability, making it difficult to provide more comprehensive evidence for the development of individualized and precision-oriented health interventions. Against this background, the present study assessed the current status of health self-management ability among community-dwelling older adults in urban China in the context of active aging and systematically analyzed its associated factors from the perspectives of psychosocial factors, demographic characteristics, and digital health. By combining traditional statistical analyses with machine learning methods, multivariable logistic regression was used to identify significant factors associated with health self-management ability among community-dwelling older adults in urban China, and a random forest model was further applied to rank the importance of these factors. This approach aims to provide empirical evidence for the development of targeted community-based health interventions, to promote older adults' active participation in health self-management, and to advance the achievement of active aging goals.

Methods

Study Participants

This study was conducted in urban communities in Xuzhou, China, in November 2024 using a cross-sectional survey design. A multistage stratified cluster random sampling method was employed to select participants. First, based on the gross domestic product levels reported in the 2023 Statistical Yearbook of the Xuzhou Municipal Bureau of Statistics, the seven urban districts of Xuzhou were classified into three economic strata (high, middle, and low), and one district was randomly selected from each stratum. Second, two to four communities were randomly selected from each selected district, yielding a total of 10 communities as survey sites. Finally, all eligible community residents aged 60 years and above in each selected community were invited to participate in the questionnaire survey. The inclusion criteria were as follows: (1) age ≥ 60 years; (2) residence in an urban community in Xuzhou for at least 1 year; (3) basic communication ability and the ability to complete the questionnaire independently; and (4) voluntary participation with written informed consent. The exclusion criteria were as follows: (1) visual or hearing impairment affecting communication; (2) cognitive impairment affecting effective communication; and (3) psychiatric disorders that prevented participation in the survey.

After receiving standardized training, trained investigators conducted face-to-face questionnaire surveys. Before the survey, the study purpose and procedures were explained to the participants in detail, and the formal survey was conducted after written informed consent had been obtained. A total of 1,050 questionnaires were distributed, and 1,005 valid questionnaires were returned, yielding a valid response rate of 95.71%. This study was approved by the Ethics Committee of Xuzhou Medical University (Approval Number: XZHMU-2021037).

Measures

The questionnaire used in this study consisted of five sections: a General Information Questionnaire, the Adult Health Self-Management Skills Rating Scale (AHSMSRS), the Activities of Daily Living (ADL) scale, the eHealth Literacy Scale (eHEALS), and a Digital Health-Related Situation section. The AHSMSRS, ADL scale, and eHEALS were adopted from previously validated instruments. The General Information Questionnaire and the Digital Health-Related Situation section were specifically developed by the research team based on relevant literature, the study objectives, and the characteristics of the study population. The full questionnaire is provided as Supplementary Material 1.

General Information Questionnaire (GIS)

The general information questionnaire collected basic information on community-dwelling older adults, including gender, age, marital status, social support, monthly disposable income, healthcare expenditure, type of basic medical insurance, participation in pension insurance, presence of chronic diseases, medication use, self-rated health status, life satisfaction, time spent paying attention to health information, proficiency in smartphone use, frequency of digital health service use, and awareness of digital health services.

Adult Health Self-Management Skills Rating Scale (AHSMSRS)

Older adults' health self-management ability was assessed using the Adult Health Self-Management Skills Rating Scale (AHSMSRS), which was developed by Huang Feifei and Zhao Qiuli in 2011[25]. The scale consists of three subscales and seven dimensions, with a total of 38 items. Specifically, the health self-management behavior subscale includes 14 items and comprises dietary self-management (5 items), exercise self-management (5 items), and disease coping (4 items). The health self-management cognition subscale includes 14 items and comprises health beliefs (9 items) and self-efficacy (5 items). The health self-management environment subscale includes 10 items and comprises use of public health resources (5 items) and environmental self-management (5 items). All items are rated on a 5-point Likert scale, and the response anchors differ across subscales. For the health self-management behavior and health self-management environment subscales, the response options were "always," "often," "sometimes," "occasionally," and "never," scored as 5, 4, 3, 2, and 1, respectively. For the health self-management cognition subscale, the response options were "agree," "somewhat agree," "uncertain," "somewhat disagree," and "disagree," as well as "confident," "somewhat confident," "uncertain," "not very confident," and "not confident," scored as 5, 4, 3, 2, and 1, respectively. The total score ranges from 38 to 190, with higher scores indicating better health self-management. Based on the grouping methods used in previous studies of older adults' health self-management ability[26], participants in the present study were categorized into low-to-moderate (38–152) and high (153–190) health self-management ability groups according to their total scores. The validity and reliability of the AHSMSRS have been confirmed among older adults in China[27–28]. The overall Cronbach's α was 0.933, and it was 0.956 in the present study, indicating excellent internal consistency. Because the number of items differed across dimensions, standardized scores were calculated to facilitate comparisons across subscales and dimensions using the following formula: standardized score = (mean score of each subscale or dimension ÷ the maximum possible score) × 100.

Activities of Daily Living (ADL) Scale

Physical functioning was assessed using the Activities of Daily Living (ADL) scale, which reflects older adults' ability to live independently and perform self-care[29]. Disability status was evaluated using the Katz Index, which assesses six activities: eating, bathing, dressing, toileting, transferring between bed and chair, and continence[30]. Each item had three response options: "independent," "partially dependent," and "completely dependent." Participants who selected "partially dependent" or "completely dependent" were considered disabled in that activity. A disability is assessed if any one of the six indicators shows impairment. According to the established classification criteria, participants were categorized into two groups: "no disability" and "disability." In the present study, the ADL scale showed good internal consistency, with a Cronbach's α of 0.826.

eHealth Literacy Scale (eHEALS)

The eHealth Literacy Scale (eHEALS) was developed by Norman et al. in 2006 and includes three dimensions and eight items used to assess an individual's ability to seek, evaluate, and apply health information obtained from the internet[31]. In the present study, older adults' eHealth literacy was assessed using the Chinese version of the eHEALS translated and culturally adapted by Guo Shuaijun et al[32]. This scale contains eight items covering three dimensions: the ability to apply online health information and services, evaluative ability, and decision-making ability. Each item was rated on a 5-point Likert scale with response options of "strongly disagree," "disagree," "uncertain," "agree," and "strongly agree," scored from 1 to 5, respectively. The total score ranged from 8 to 40. A score > 32 indicated adequate eHealth literacy[33], and higher scores indicate a higher level of eHealth literacy. In this study, the scale showed excellent internal consistency, with a Cronbach's α of 0.983.

Statistical Analysis

Statistical analyses were performed using SPSS version 27.0. Descriptive statistics were used to summarize participants' general characteristics and health self-management ability scores. Continuous variables are presented as mean ± standard deviation, and categorical variables are presented as frequencies and percentages. The chi-square test was used in univariate analyses to screen variables associated with health self-management ability. Health self-management ability was treated as the dependent variable, and variables that were statistically significant in the univariate analyses were entered into a multivariable logistic regression model. Odds ratios (ORs) and 95% confidence intervals (CIs) were calculated to identify significant factors associated with health self-management ability among community-dwelling older adults in urban China. All statistical tests were two-sided, and a *P* value < 0.05 was considered statistically significant. A random forest model was developed using R version 4.5.2 and RStudio. Based on the results of the multivariable logistic regression analysis, significant factors were included in the random forest model for importance ranking. Model performance was comprehensively evaluated using the area under the receiver operating characteristic curve (AUC), sensitivity, precision, recall, F1 score, and accuracy. The MeanDecreaseGini was used to rank the importance of the associated factors.

Results

Participant Characteristics

A total of 1,005 community-dwelling older adults in urban China were included in this study. The mean age was 67.60 ± 6.73 years. There were 472 men (47.0%) and 533 women (53.0%). Regarding marital status, most participants were married (n = 881, 87.7%). Monthly disposable income was ≤ 2,000 CNY for 408 participants (40.6%), 2,001–3,999 CNY for 226 (22.5%), 4,000–5,999 CNY for 210 (20.9%), and ≥ 6,000 CNY for 161 (16.0%).

A total of 702 participants (69.9%) had chronic diseases, whereas 303 (30.1%) did not. In terms of medication use, 580 participants (57.7%) reported taking medications and 425 (42.3%) reported not

taking medications. For activities of daily living, 766 participants (76.2%) had no disability and 239 (23.8%) had disability. Regarding the type of basic medical insurance, 511 participants (50.8%) were enrolled in Urban Employee Basic Medical Insurance, 483 (48.1%) were enrolled in Urban and Rural Resident Basic Medical Insurance, and 11 (1.1%) were uninsured. For pension insurance, 746 participants (74.2%) were enrolled and 259 (25.8%) were not. Regarding social support, 972 participants (96.7%) reported having social support and 33 (3.3%) reported having no social support. Details are shown in Table 2.

Table 2
Univariate analysis of factors associated with health self-management ability among community-dwelling older adults in urban China (N = 1005)

Variable	N (%)	Low-to-moderate level (%)	High level(%)	χ^2	*P* Value
Gender				10.054	0.002
Male	472(47.0)	197(53.5)	275(43.2)		
Female	533(53.0)	171(46.5)	362(56.8)		
Age (years)				60.567	< 0.001
60–69	665(66.1)	191(51.9)	474(74.4)		
70–79	276(27.5)	134(36.4)	142(22.3)		
≥ 80	64(6.4)	43(11.7)	21(3.3)		
Marital status				50.222	< 0.001
Married	881(87.7)	287(78.0)	594(93.2)		
Unmarried	124(12.3)	81(22.0)	43(6.8)		
Social support				6.774	0.009
No	33(3.3)	5(1.4)	28(4.4)		
Yes	972(96.7)	363(98.6)	609(95.6)		
Monthly disposable income (CNY)				17.347	< 0.001
≤ 2000	408(40.6)	173(47.0)	235(36.9)		
2001–3999	226(22.5)	85(23.1)	141(22.1)		
4000–5999	210(20.9)	71(19.3)	139(21.8)		
≥ 6000	161(16.0)	39(10.6)	122(19.2)		
Healthcare expenditure (CNY)				5.629	0.060
≤ 2000	648(64.5)	231(62.8)	417(65.4)		
2001–10000	317(31.5)	128(34.8)	189(29.7)		
≥ 10001	40(4.0)	9(2.4)	40(4.9)		
Type of basic medical insurance				36.461	< 0.001

Variable	N (%)	Low-to-moderate level (%)	High level(%)	χ^2	*P* Value
Urban Employee Basic Medical Insurance	511(50.8)	142(38.6)	369(57.9)		
Urban and Rural Resident Basic Medical Insurance	483(48.1)	219(59.5)	264(41.5)		
Uninsured	11(1.1)	7(1.9)	4(0.6)		
Pension insurance				34.372	< 0.001
Enrolled	746(74.2)	234(63.6)	512(80.4)		
Not enrolled	259(25.8)	134(36.4)	125(19.6)		
Chronic disease				17.061	< 0.001
No	303(30.1)	82(22.3)	221(34.7)		
Yes	702(69.9)	286(77.7)	416(65.3)		
Medication use				0.508	0.476
No	425(42.3)	161(43.7)	264(41.4)		
Yes	580(57.7)	207(56.3)	373(58.6)		
Activities of daily living (ADL)				149.438	< 0.001
No disability	766(76.2)	201(54.6)	565(88.7)		
Disability	239(23.8)	167(45.4)	72(11.3)		
Self-rated health status				60.508	< 0.001
Poor	111(11.0)	66(17.9)	45(7.1)		
Fair	441(43.9)	190(51.6)	251(39.4)		
Good	453(45.1)	112(30.5)	341(53.5)		
Life satisfaction				61.961	< 0.001
Dissatisfied	24(2.4)	16(4.3)	8(1.2)		
Neutral	187(18.6)	110(29.9)	77(12.1)		
Satisfied	794(79.0)	242(65.8)	552(86.7)		

Variable	N (%)	Low-to-moderate level (%)	High level(%)	χ^2	*P* Value
Time spent paying attention to health information (hours)				47.554	< 0.001
≤ 0.5	381(37.9)	187(50.8)	194(30.4)		
0.5–3	457(45.5)	119(32.3)	338(53.1)		
> 3	167(16.6)	62(16.9)	105(16.5)		
Proficiency in smartphone use				87.567	< 0.001
Not proficient	260(25.9)	157(42.7)	103(16.2)		
Average	326(32.4)	102(27.7)	224(35.2)		
Proficient	419(41.7)	109(29.6)	310(48.7)		
Frequency of digital health service use				17.196	< 0.001
Daily	178(17.7)	41(11.1)	137(21.5)		
Not daily	827(82.3)	327(88.9)	500(78.5)		
Awareness of digital health services				73.587	< 0.001
Low awareness	411(40.9)	206(56.0)	205(32.2)		
Moderate awareness	475(47.3)	150(40.7)	325(51.0)		
High awareness	119(11.8)	12(3.3)	107(16.8)		
eHealth literacy (eHEALS)				114.910	< 0.001
Inadequate	597(59.4)	299(81.2)	298(46.8)		
Adequate	408(40.6)	69(18.8)	339(53.2)		

Health self-management ability scores

The overall health self-management ability score among community-dwelling older adults in urban China was 159.72 ± 21.24, corresponding to a standardized score of 84.06. A total of 368 participants (36.6%) had low-to-moderate health self-management ability, whereas 637 (63.4%) had high health self-management ability. After standardization, subscale scores from highest to lowest were health self-management cognition (87.61), health self-management behavior (82.77), and health self-management environment (80.90). Across specific dimensions, standardized scores from highest to lowest were self-efficacy (88.12), health beliefs (87.33), disease coping (86.40), dietary self-management (85.64),

environmental self-management (84.52), use of public health resources (77.28), and exercise self-management (77.00). Details are shown in Table 1.

Table 1
Scores on the health self-management ability scale and its dimensions among community-dwelling older adults in urban China

Scale	Dimension	Items, n	Mean ± SD	Standardized score
Health self-management behavior subscale		14	57.94 ± 9.68	82.77
	Dietary self-management	5	21.41 ± 3.61	85.64
	Exercise self-management	5	19.25 ± 4.92	77.00
	Disease coping	4	17.28 ± 2.71	86.40
Health self-management cognition subscale		14	61.33 ± 7.62	87.61
	Health beliefs	9	39.30 ± 4.98	87.33
	Self-efficacy	5	22.03 ± 3.43	88.12
Health self-management environment subscale		10	40.45 ± 6.99	80.90
	Use of public health resources	5	19.32 ± 4.32	77.28
	Environmental self-management	5	21.13 ± 3.64	84.52
Total health self-management scale		38	159.72 ± 21.24	84.06

Univariate analysis of factors associated with health self-management ability

Using older adults' health self-management ability as the dependent variable, univariate analyses were conducted for 18 variables, including gender, age, marital status, and social support. The chi-square test results showed that gender, age, marital status, social support, income level, type of basic medical insurance, participation in pension insurance, presence of chronic diseases, activities of daily living, self-rated health status, life satisfaction, time spent paying attention to health information, proficiency in smartphone use, frequency of digital health service use, awareness of digital health services, and

eHealth literacy were significantly associated with older adults' health self-management ability ($P < 0.05$). Details are shown in Table 2.

Multivariable logistic regression analysis of factors associated with health self-management ability

Health self-management ability was treated as the dependent variable, with the high-level group as the reference category. A multivariable logistic regression analysis was conducted using 16 variables that were statistically significant in the univariate analyses as independent variables. The results showed that gender, marital status, activities of daily living, life satisfaction, awareness of digital health services, and eHealth literacy were significant factors associated with older adults' health self-management ability ($P < 0.05$). Compared with men, women had a higher level of health self-management (*OR* = 1.595, 95% *CI*: 1.178–2.161). Compared with unmarried older adults, married older adults had a higher level of health self-management (*OR* = 2.519, 95% *CI*: 1.591–3.988). Compared with older adults with impaired activities of daily living, those without impaired activities of daily living had a higher level of health self-management (*OR* = 4.389, 95% *CI*: 3.093–6.228). Compared with older adults who were dissatisfied with life, those who were satisfied with life had a higher level of health self-management ($OR_{\text{Satisfied}}$ = 3.079, 95% *CI*: 1.118–8.478). Compared with older adults with low awareness of digital health services, those with high awareness of digital health services had a higher level of health self-management ($OR_{\text{High awareness}}$ = 2.665, 95% *CI*: 1.352–5.253). Compared with older adults with inadequate eHealth literacy, those with adequate eHealth literacy had a higher level of health self-management (*OR* = 3.298, 95% *CI*: 2.333–4.662). Details are shown in Table 3.

Table 3
Multivariable logistic regression analysis of factors associated with health self-management ability among community-dwelling older adults in urban China

Variables	*β*	SE	Waldc^2	*P* Value	*OR*	95%*CI*
Gender						
Male (Ref.)						
Female	0.467	0.155	9.105	0.003	1.595	1.178 ~ 2.161
Marital status						
Unmarried (Ref.)						
Married	0.924	0.234	15.527	< 0.001	2.519	1.591 ~ 3.988
Activities of daily living (ADL)						
Disability (Ref.)						
No disability	1.479	0.179	68.600	< 0.001	4.389	3.093 ~ 6.228
Life satisfaction						
Dissatisfied (Ref.)						
Neutral	0.275	0.537	0.263	0.608	1.317	0.460 ~ 3.774
Satisfied	1.125	0.517	4.737	0.030	3.079	1.118 ~ 8.478
Awareness of digital health services						
Low awareness (Ref.)						
Moderate awareness	0.189	0.165	1.311	0.252	1.208	0.874 ~ 1.670
High awareness	0.980	0.346	8.015	0.005	2.665	1.352 ~ 5.253
eHealth literacy (eHEALS)						
Inadequate (Ref.)						
Adequate	1.193	0.177	45.638	< 0.001	3.298	2.333 ~ 4.662
Legend						

Importance analysis of factors associated with health self-management ability

Health self-management ability was treated as the dependent variable. A random forest model was constructed using the six variables that were statistically significant in the multivariable logistic regression analysis to further examine the importance of factors associated with health self-management ability among community-dwelling older adults in urban China. The AUCs of the random forest model in the training and test sets were 0.805 and 0.830, respectively. In the training set, sensitivity, precision, recall, F1 score, and accuracy were 0.955, 0.733, 0.955, 0.830, and 0.751, respectively; in the test set, sensitivity, precision, recall, F1 score, and accuracy were 0.942, 0.779, 0.942, 0.853, and 0.794, respectively, indicating good discriminative performance and stability. The MeanDecreaseGini was used to evaluate the importance of significant factors associated with older adults' health self-management ability, with higher MeanDecreaseGini values indicating greater importance. The random forest results showed that the most important factor associated with older adults' health self-management ability was activities of daily living, followed by eHealth literacy, life satisfaction, awareness of digital health services, marital status, and gender. Details are shown in Fig. 1.

Discussion

This study examined the current status of health self-management ability and its associated factors among community-dwelling older adults in urban China in the context of active aging. The results showed that the overall health self-management ability score among community-dwelling older adults in urban Xuzhou was 159.72 ± 21.24, corresponding to a standardized score of 84.06, indicating a moderately high overall level. The distribution of health self-management ability showed that approximately 63.4% of participants were at a high level, whereas 36.6% remained at a low-to-moderate level, suggesting that although the overall level was relatively favorable, marked within-group differences remained and substantial room for improvement still existed. Compared with studies conducted in other regions of China, the total score in this study was higher than that reported among older adults in Shanghai (150.52 ± 24.28)[34], but slightly lower than that reported among older adults in Hangzhou (161.65 ± 23.16)[35], further supporting the finding that the overall level was moderately high. Among the subscales, the health self-management cognition subscale had the highest score, whereas the health self-management behavior and health self-management environment subscales had relatively lower scores. Across specific dimensions, the standardized scores for health beliefs and self-efficacy were relatively high, whereas those for exercise self-management and the use of public health resources were relatively low. These findings indicate that community-dwelling older adults in urban China generally have a positive attitude toward health and recognize the importance of health self-management; however, their health cognition has not been fully translated into stable and sustained self-management behaviors. In particular, deficiencies were evident in areas that require proactive action and access to external resources, such as exercise self-management and the use of public health resources. The relatively low level of exercise self-management may be related to age-related declines in physical

function, an increased burden of chronic diseases, and limited exercise capacity, which may restrict participation in physical activity to certain extent. Previous studies have shown that moderate-to-vigorous physical activity is an important protective factor for the health of older adults[36], and regular physical exercise helps promote the formation and maintenance of health self-management behaviors [37]. In addition, the relatively low score for the use of public health resources may be associated with limited accessibility of community health service resources and older adults' insufficient understanding of medical insurance policies and the content of public health services, which may, in turn, affect their effective use of these resources. Related studies have indicated that public health service resources are an important external support factor associated with individuals' health self-management ability[38]. Therefore, in promoting health self-management among older adults, it is necessary not only to enhance their health cognition, but also to facilitate practical action, increase participation in physical activity, and improve the accessibility and efficiency of public health resources, so as to achieve coordinated improvements in cognition, behavior, and environment.

The random forest results showed that activities of daily living ranked first in the importance ranking of factors associated with health self-management ability, indicating that this factor was the most important associated factor of health self-management ability among community-dwelling older adults in urban China. The logistic regression analysis further supported this finding, showing that older adults without impairment in activities of daily living had significantly higher levels of health self-management. Good activities of daily living provide the necessary physical and cognitive foundation for older adults to engage in health-related activities and to obtain and understand health information. Previous research has shown that health behaviors are closely associated with older adults' activities of daily living[36], which may help enhance their initiative to participate in health management.In contrast, older adults with impaired activities of daily living often require partial or complete assistance from others in daily life, and their participation in social and health-related activities is relatively limited, placing them at a disadvantage in self-care and preventive health behaviors and resulting in relatively lower levels of health self-management[39–40]. This finding suggests that interventions aimed at improving health self-management should emphasize the assessment and maintenance of activities of daily living and create the basic conditions for participation in health self-management through functional support and capacity building.

In the context of rapid digital development, this study further found that digital health–related factors play an important enabling role in older adults' health self-management ability. The random forest model showed that eHealth literacy and awareness of digital health services ranked second and fourth, respectively, in the importance ranking, and the logistic regression results indicated that older adults with adequate eHealth literacy and higher awareness of digital health services had significantly higher levels of health self-management. Previous studies have also confirmed that older adults with higher eHealth literacy exhibit more proactive health behaviors and stronger self-management ability[41–43], and that eHealth literacy is important for promoting health self-management and improving health outcomes[44]. Higher eHealth literacy helps older adults recognize the importance of health information, enhances their

ability to actively obtain, appraise, and apply health information, and enables them to more effectively use the internet and other modern digital technologies to seek reliable health-related knowledge and information and better understand their own diagnoses, thereby promoting better health self-management behaviors[45–47]. Meanwhile, older adults with higher awareness of digital health services are more likely to access and use digital health tools for health monitoring, health decision-making, and behavioral adjustment, and to participate proactively in health self-management[48–49]. In addition, older adults' awareness of digital health services also reflects the accessibility and age-friendliness of digital health–related services. Therefore, when advancing health management services, communities should simultaneously improve older adults' eHealth literacy and actively promote the age-friendly development of digital health services, such as by optimizing interface design, simplifying operating procedures, and providing necessary user guidance, so as to ensure opportunities for participation and enhance older adults' health self-management ability.

Life satisfaction, marital status, and gender were also important factors associated with health self-management ability among community-dwelling older adults in urban China. In this study, life satisfaction ranked third in the importance ranking of the random forest model, and the logistic regression analysis showed that older adults with higher life satisfaction tended to have higher levels of health self-management. This may be because older adults with higher life satisfaction generally have more positive emotional experiences and attitudes toward life, with stronger subjective well-being, intrinsic motivation, and health awareness, which may facilitate the sustained practice of health self-management behaviors[50–51]. In addition, although marital status and gender ranked relatively lower in the importance ranking, their associations with older adults' health self-management were statistically significant. Married older adults may be more likely to implement health self-management behaviors in daily life through mutual support, companionship, and encouragement from their spouses, thereby exhibiting higher levels of health self-management[52]. Older women are often more proactive in obtaining health information and engaging in preventive health behaviors, are more likely to walk or go out with companions, and tend to participate more in health-related activities; therefore, their health self-management levels may be relatively higher[53]. These findings suggest that, in promoting older adults' proactive participation in health self-management, it is important to consider psychosocial contexts and demographic differences and to develop more targeted and personalized interventions.

Therefore, in improving health self-management ability among community-dwelling older adults in urban China, it is necessary not only to focus on older adults with impaired activities of daily living by strengthening early assessment and functional maintenance to ensure that they have the basic capacity to participate in health self-management, but also to target those with inadequate eHealth literacy and low awareness of digital health services by improving their eHealth literacy and awareness of digital health services. Promoting age-friendly digital health services can enhance older adults' ability to obtain health information. At the same time, particular attention should be given to older adults who are dissatisfied with life, unmarried, and men, as these groups tend to have relatively lower levels of health self-management, and personalized interventions should be developed accordingly. In addition, guiding

older adults to strengthen exercise self-management and improving the accessibility and efficiency of public health resources may further enhance overall health self-management ability.

Limitations

This study has several limitations. First, because of the cross-sectional design, it is difficult to draw definitive causal inferences regarding the relationships between health self-management ability and its associated factors. Second, participants were recruited from community-dwelling older adults in urban Xuzhou, Jiangsu Province, China; therefore, the regional representativeness of the sample is limited, and caution is warranted when generalizing the findings to older populations in other regions or sociocultural contexts. Third, the reliability and validity of the health self-management scale used in this study have been established only among older adults in China, and its applicability in other countries or cultural settings remains to be further examined.

Conclusions

In summary, health self-management ability among community-dwelling older adults in urban China was generally at a moderately high level; however, scores for the health self-management behavior and health self-management environment subscales were relatively low, particularly for exercise self-management and the use of public health resources, indicating that there is still room for improvement in overall health self-management ability. To improve older adults' health self-management ability, community-based interventions should not only address activities of daily living, psychosocial factors, and demographic characteristics by maintaining functional independence and enhancing psychological well-being so as to strengthen participation capacity, but also emphasize the role of digital health–related factors in improving older adults' ability to obtain health information. Based on our findings, it is recommended to begin with relatively weak areas, such as exercise self-management and the use of public health resources, while paying particular attention to older adults with impaired activities of daily living, inadequate eHealth literacy, dissatisfaction with life, low awareness of digital health services, those who are unmarried, and men. Targeted and personalized interventions should be developed for these groups to continuously improve older adults' health self-management ability, better address population aging and changing health needs, and promote the achievement of active aging goals.

Abbreviations

CI Confidence intervals

OR Odds ratios

WHO World Health Organization

ADL Activities of daily living

AUC Area under the receiver operating characteristic curve

Declarations

Ethics approval and consent to participate

This study was approved by the Ethics Committee of Xuzhou Medical University (Approval Number: XZHMU-2021037) and conducted in strict accordance with the Declaration of Helsinki. Written informed consent was obtained from all participants prior to participation in the study.

Consent for publication

Not applicable

Availability of data and materials

Upon a reasonable request, the corresponding author will make the datasets used in this study public.

Competing interests

The authors declare no competing interests.

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Trial registration

Clinical trial number: not applicable

Authors' contributions

Conceptualization and study design: QZH and XY. Data collection, data curation, and field investigation: ZZW, HWH, LYC, and ZHA. Data analysis: WW. Data interpretation: QZH and WW. Writing – original draft: QZH, WW, and ZZW. Writing – review and editing: QZH, WW, ZZW, and XY. Supervision, project administration, correspondence, and final approval of the manuscript: XY. All authors read and approved the final manuscript.

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Figures

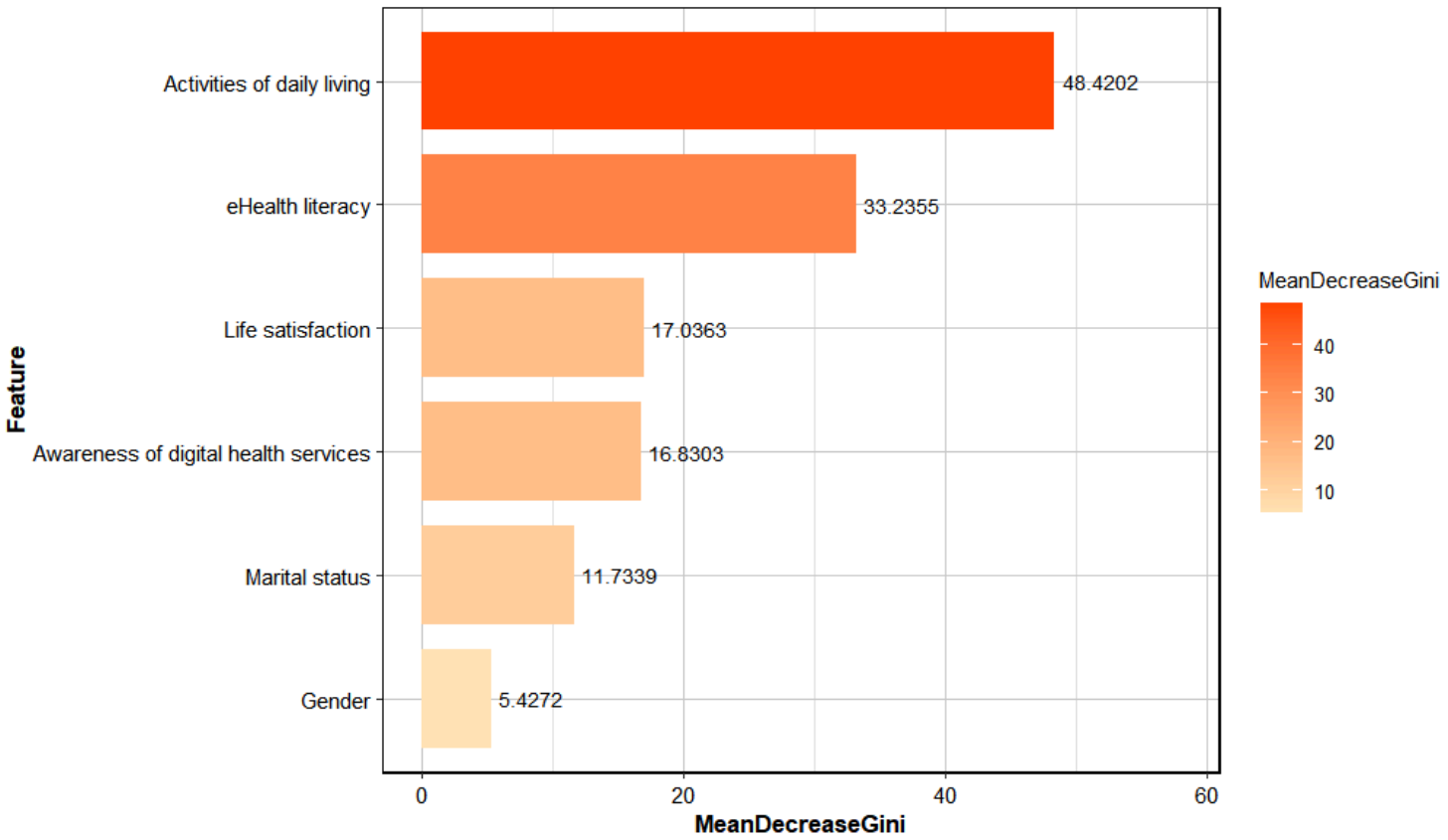


Figure 1

Importance ranking of factors associated with health self-management ability among community-dwelling older adults in urban China

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