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RESEARCH ARTICLE

The impact of Internet use on the quality of life of elderly people living in community homes under the background of smart elderly care

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ABSTRACT

An investigation and analysis of the quality of life of elderly people aging at home in the community in Chengdu was conducted, utilizing Maslow's hierarchy of needs theory, the theory of rational behavior, the Technology Acceptance Model (TAM), the theory of intergenerational solidarity, and the theory of health-related quality of life. The primary objective was to ascertain the critical factors influencing the quality of life of elderly people aging at home in the community and to develop a quality of life model. A causal model was developed and empirically tested to examine the impact of Internet use on elderly quality of life. A survey of 435 elderly people aged 60 and above residing in Chengdu revealed the following: 1) Internet use and quality of life exhibited a significant positive correlation ; 2) Intergenerational relationships, self-assessed health, and social support served as significant mediators; 3) Mediation effects were confirmed. The results confirmed all research hypotheses. They elucidated the mechanism by which Internet use enhances older adults' quality of life, primarily through fortifying intergenerational relationships, elevating self-assessed health, and broadening social support.

Keywords: Internet use; community home care;elderly people; quality of life

1. Introduction

Since World War II, the trend of global population aging has intensified, particularly in China [1, 2].By the conclusion of 2023, the population of China aged 60 and above will total 296 million, representing 21.1%, signifying China's transition into a moderately aging society[3].

The older adults population in China is increasing swiftly, with many individuals experiencing chronic illnesses and disabilities, resulting in heightened demand for elderly care services [4]. The existing traditional family-oriented elderly care model is inadequate to manage the substantial caregiving demands, particularly with the rise of empty-nest and single-parent elderly people, exacerbating the phenomenon of "aging before attaining wealth and falling ill in old age" [5].

To address the aging population, China has vigorously promoted a "smart elderly care" system. This

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system prioritizes community-based home care and integrates medical and elderly care services through information technology. The Chinese government has implemented various policies to foster the advancement of the smart elderly care sector, facilitate the integration of cloud computing, big data, and elderly care services, and mitigate the disparity between supply and demand in elderly care [6].

In the realm of intelligent elderly care, the determinants influencing the quality of life for elderly people in community home care are multifaceted and context-dependent; however, there remains variability regarding which factors are deemed most pivotal, with the majority of research concentrating on particular demographics or geographic areas. A systematic evaluation and categorization of the factors influencing the quality of life in community home care within the framework of smart elderly care is absent.

The scientific construction of a quality of life evaluation model for older adults has evolved from an initial focus on subjective satisfaction to a comprehensive assessment system that incorporates multiple indicators, including life satisfaction, health status, and social participation[7].Nevertheless, the majority of existing models inadequately integrate the novel digital and informational variables introduced by smart elderly care and exhibit a lack of adaptability to community-based home care scenarios for older adults. Consequently, it is imperative to incorporate multi-dimensional influencing factors within the framework of smart elderly care and develop a quality of life assessment model for older adults to improve accuracy and effectiveness of community elderly care services.

The impact of Internet use on the quality of life of older adults remains contentious in academia.There are presently three predominant perspectives: the first, termed the "beneficial theory," posits that the Internet can enhance life satisfaction and happiness among older adults by bolstering social support, increasing social participation, and alleviating loneliness [8-13]; the second, known as the "harmful theory," asserts that the Internet may induce adverse psychological effects such as loneliness, depression, and social isolation, particularly when usage is excessive or inappropriate; the third, referred to as the "irrelevant theory," contends that there is no significant correlation between Internet use and the quality of life of older adults, suggesting that information technology has not engendered substantial changes in happiness or health[14-16]. The impact of Internet use on the convenience and happiness of older adults, rather than its potential to exacerbate the digital divide and psychological distress, necessitates thorough discussion and empirical investigation. This study aims to elucidate its impact pathway and mechanism of action.

2. Theoretical foundation and research hypotheses

2.1. Impact of Internet use on the quality of life of older adults

Internet use is inherent to smart elderly care. Related technologies and services can significantly enhance older adults' overall life satisfaction.Social media and instant messaging help older adults broaden their social networks and strengthen social support. This, in turn, can augment self-efficacy, alleviate loneliness and depression, and ultimately enhance their overall quality of life [17, 18]. An online interactive video multimedia game intervention can enhance older adults' confidence in body balance, diminish their fear of falling[19], and foster mental health [20]. Telemedicine can enhance the mental health of older adults, particularly during public health emergencies like the COVID-19 pandemic [21].

This paper seeks to examine the impact of Internet use on the quality of life of elderly people aging at home in the community within the context of smart elderly care. Therefore, we propose the following hypotheses:

Hypothesis 1. Internet use can improve the quality of life of older adults.

2.2. The mediating role of intergenerational relationships, self-assessed health, and social support

2.2.1. The mediating role of intergenerational relationships

Community-based care for older adults is intrinsically linked to family and children; thus, this paper introduces the mediating variable of intergenerational relationships to analyze its effect on Internet use and the quality of life of older adults.

The reasons for Internet use among older adults are relatively simple. The majority of elderly individuals utilize the Internet for sending and receiving emails and for effective communication with others[22]. Senior people can utilize the Internet for entertainment and leisure, engage in online social networking to broaden their social circles, and receive affirmative feedback [23]. The population of elderly people in China is increasing rapidly. A significant number of elderly people experience difficulties in life due to their inability to utilize digital technology and smart devices.The "digital divide" issue affecting the older adult population is becoming more pronounced[24]. "Digital feedback" is considered the fundamental approach to addressing the digital divide issue. Young children can assist their parents in adapting to digital life by providing ongoing digital feedback [25]. Particularly in the realm of intelligent elderly care, seniors are unable to embrace and acquire new concepts without instruction. The parent-child generation frequently serves as the initial instructors for older adults in navigating the Internet and acquiring new knowledge. When older adults receive upward intergenerational support, it indirectly influences their self-esteem, sense of independence, and gratitude, thereby positively impacting their satisfaction [26, 27].

Therefore, the following hypothesis is proposed:

Hypothesis 2. Intergenerational relationships mediate the impact of Internet use on the quality of life of older adults.

Hypothesis 2a. Internet use positively affects intergenerational relationships.

Hypothesis 2b. Intergenerational relationships positively affect the quality of life of older adults.

2.2.2. The mediating role of self-assessed health

The prerequisite for elderly people living in the community is to possess a specific level of health. This paper introduces the mediating variable of self-assessed health to analyze its effect on Internet use and the quality of life among older adults.

Gracia was the first to perform pertinent research, demonstrating that Internet users self-reported superior health compared to non-users[28]. Older adults can utilize the Internet to foster positive connections with relatives and friends, seek health-related information, and engage in online shopping. These behaviors can assist older adults in surmounting certain physical limitations and positively influence their health and well-being[29]. A study of the older adults population in Spain revealed that Internet users reported superior self-rated health compared to non-users[28]. The English Longitudinal Survey on Ageing (ELSA) revealed that older individuals who maintained Internet usage were more inclined to acquire health-related information and implement cancer prevention strategies, consequently decreasing cancer mortality [30]. Choi et al. conducted a meta-analysis of the pertinent literature regarding Internet interventions for the mental health of older adults and discovered that Internet usage can substantially alleviate loneliness among this demographic [31].

Therefore, the following hypothesis is proposed:

Hypothesis 3. Self-assessed health plays a mediating role in the impact of Internet use on the quality of life of older adults.

Hypothesis 3a. Internet use positively affects self-assessed health.

Hypothesis 3b. Self-assessed health positively affects the quality of life of older adults.

2.2.3. The mediating role of social support

Social support, as a network, assists individuals in managing stressful life events by offering psychological comfort or material resources[32]. Social support can enhance health-promoting behaviors among elderly migrants [33], mitigate the loneliness of empty-nest seniors in rural regions, and elevate their subjective well-being and quality of life [34]. Social support is crucial in addressing the life challenges and mental health of older adults. It is a significant determinant of the mental health and subjective well-being of older adults[35]. Robust social support can significantly enhance healthy aging[36]. As Internet functionalities diversify, numerous scholars contend that Internet use surpasses temporal and spatial constraints, extending social networks beyond the realm of direct interaction, thereby enhancing interpersonal communication and fostering the evolution of social relationships and the establishment of support networks [37]. Research on silver surfers indicated that older adults who acquired Internet surfing skills exhibited more favorable attitudes toward aging and reported elevated levels of perceived social support[38].

Therefore, the following hypothesis is proposed:

Hypothesis 4. Social support mediates the impact of Internet use on the quality of life of older adults.

Hypothesis 4a. Internet use positively affects social support.

Hypothesis 4b. Social support positively affects the quality of life of older adults .

Figure 1 shows the conceptual framework that underpins the hypotheses of this study.

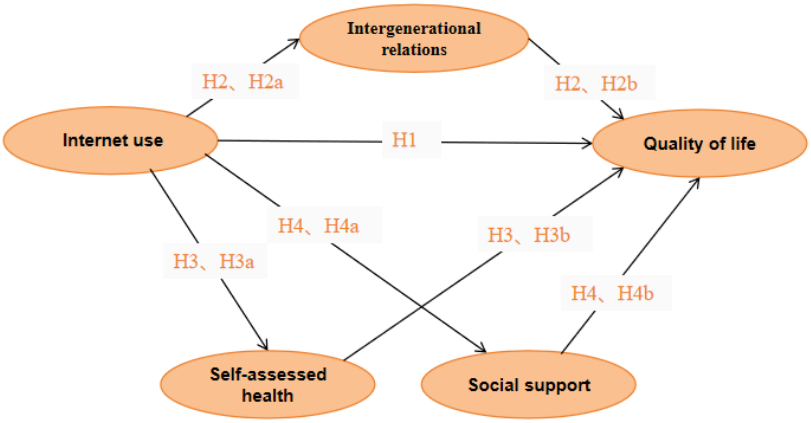

Figure 1. Conceptual framework.

3. Materials and methods

3.1. Research design

3.1.1. Population

In developing nations, the threshold for elderly status is 60 years of age. China is a developing nation and categorizes individuals over 60 years of age as elderly [39]. This paper designates Chengdu, Sichuan,

China as the research area. Chengdu, a significant city in western China, exemplifies strategies for addressing population aging, advancing community-based elderly care, and fostering smart elderly care[40, 41]. The research subjects comprise individuals aged over 60 years in Chengdu.

3.1.2. Sample size

This research employs the Taro Yamane formula for sampling surveys of finite populations.The necessary sample size is equivalent to $n = \frac{N}{1 + N \times e^2}$. Let n denote the requisite sample size, N represent the total population of research subjects, and denote the confidence level and margin of error. The default confidence level is typically 95%, with a corresponding error margin of 5%.

As of 2022, the official count of registered older adults in Chengdu, as reported by China, is 1.5 million. With a total of 1.5 million research subjects, a confidence level of 95%, and a margin of error of 5%, the Taro Yamane formula indicates that the requisite sample size is 400.

3.1.3. Sampling method

This study employed stratified quota sampling. This technique ensured the sample's distribution across Chengdu's administrative districts reflected the overall demographic structure of the older adult population.

3.2. Variable measurement

Internet use was measured across five dimensions (perceived usefulness, perceived ease of use, attitude, behavioral intention, and actual system use) with 5 observed variables (Cronbach's α = 0.909; KMO = 0.885; Bartlett's test: $p < 0.001$).

Quality of life was assessed using the WHOQOL-BREF scale[42], which includes 26 items covering four dimensions: physical, psychological, social relationships, and environment (Cronbach's α = 0.938; KMO = 0.931; Bartlett's test: $p < 0.001$).

Self-assessed health was evaluated via the European Five-Dimensional Health Scale[43], a 5-item instrument measuring mobility, self-care, usual activities, pain/discomfort, and anxiety/depression (Cronbach's α = 0.908; KMO = 0.897; Bartlett's test: $p < 0.001$).

Intergenerational relationships were measured using a 14-item scale based on the OASIS Family Intergenerational Relationship Questionnaire[44]and supplemented by items from Song Yajun[45], covering six dimensions (structure, connections, function, emotions, consensus, and norms) (Cronbach's α = 0.955; KMO = 0.967; Bartlett's test: $p < 0.001$).

Social support was measured with Xiao Shuiyuan's scale[46], comprising 10 items across three dimensions: objective support, subjective support, and utilization of support (Cronbach's α = 0.832; KMO = 0.823; Bartlett's test: $p < 0.001$).

4. Results

The necessary sample size for this quantitative study is 400, with an expected response rate of 70% [47]. A total of 580 questionnaires were distributed, and 450 were collected. After screening and excluding non-compliant samples, 435 valid questionnaires were ultimately confirmed.

4.1. Descriptive statistics

Table 1 shows the results of the frequency analysis.Table 1 indicates a total sample size of 435, which is adequate. The sample predominantly consists of retirees aged 60-64, exhibiting an equitable gender

distribution. The majority of respondents are married and reside in urban areas. The predominant education levels are high school, undergraduate, and graduate, with a relatively small proportion of individuals holding a doctorate or higher. The sample accurately reflects the urban elderly demographic; however, it inadequately represents rural communities and individuals with higher education, potentially compromising the generalizability of the findings.

Table 1. Descriptive Statistics (N = 435).

Variable	Category	Frequency	Percentage(%) □
Gender	Male	220	50.575
	Female	215	49.425
Age	60-64	259	59.540
	65-69	78	17.931
	70-74	79	18.161
	75 and over	19	4.368
Education Level	High school or below	112	25.747
	Diploma	170	39.080
	Bachelor's degree	88	20.230
	Master's degree	39	8.966
	Doctorate	26	5.977
Marital Status	Single	11	2.529
	Married	341	78.391
	Other	83	19.08
Living Situation	Urban community	411	94.483
	Rural community	24	5.517

Table 2 shows the results of the descriptive analysis.According to Table 2, the sample size is 435, and the data is adequate for subsequent analysis. The measurement range for all variables is 1 to 5 points, utilizing the Likert scale (e.g., 1 = strongly disagree, 5 = strongly agree).

Table 2. Descriptive Statistics for Continuous Variables (N = 435).

Variable	Mean	Std. Deviation
SH	3.4211	0.96640
IR	3.5862	0.90922
Subjective	3.4414	0.85263
Objective	3.6000	0.93348
Utilization	3.4261	0.69843
SS	3.4891	0.60084
IU	3.6703	0.85767
Life	3.6241	1.04098
Physiological	3.4739	0.85385
Psychology	3.6452	0.82882
Relationships	3.5525	1.00383
Environment	3.5178	0.70937
QL	3.5627	0.64152

4.2. Correlation analysis

Table 3 shows the results of the correlation analysis.Table 3 presents the pearson correlation coefficients (r values) among variables including Internet use, social support, and quality of life, with "*" denoting the significance levels: *p < 0.001 (highly significant), p < 0.01 (significant), *p < 0.05 (relatively significant). The results indicate a significant positive correlation among most variables, suggesting mutual influence and an inherent connection.

Table 3. Correlation Analysis.

	1	2	3	4	5	6	7	8	9	10	11	12	13
SH(1)	1												
IR(2)	0.556**	1											
Subjective(3)	0.451**	0.541**	1										
Objective(4)	0.464**	0.377**	0.311**	1									
Utilization(5)	0.382**	0.342**	0.266**	0.270**	1								
SS(6)	0.602**	0.584**	0.737**	0.769**	0.653**	1							
IU(7)	0.422**	0.455**	0.427**	0.162**	0.198**	0.363**	1						
Life(8)	0.491**	0.464**	0.442**	0.326**	0.284**	0.488**	0.464**	1					
Physiological(9)	0.527**	0.554**	0.457**	0.269**	0.255**	0.454**	0.472**	0.420**	1				
Psychology(10)	0.418**	0.477**	0.358**	0.299**	0.286**	0.435**	0.398**	0.312**	0.379**	1			
Relationships(11)	0.475**	0.492**	0.348**	0.316**	0.278**	0.436**	0.486**	0.328**	0.431**	0.285**	1		
Environment(12)	0.482**	0.527**	0.417**	0.287**	0.314**	0.468**	0.521**	0.445**	0.604**	0.451**	0.448**	1	
QL(13)	0.663**	0.692**	0.559**	0.417**	0.390**	0.631**	0.646**	0.718**	0.769**	0.650**	0.707**	0.783**	1

** p <0.05 ** p <0.01 *** p <0.001*

4.3. Analysis of structural equation model results

Figure 2 shows the results of the simulation fitting.As shown in Figure 2, Internet use has a positive impact on intergenerational relations (path coefficient 0.53). Internet use has a positive impact on quality of life (path coefficient 0.31). Internet use has a positive impact on self-assessed health (path coefficient 0.34). Internet use has a positive impact on social support (path coefficient 0.31). Intergenerational relations has a positive impact on quality of life (path coefficient 0.48). Self-assessed health has a positive impact on quality of life (path coefficient 0.31). Social support has a positive impact on quality of life (path coefficient 0.31).Table 4 shows the results of the model fit index assessment.

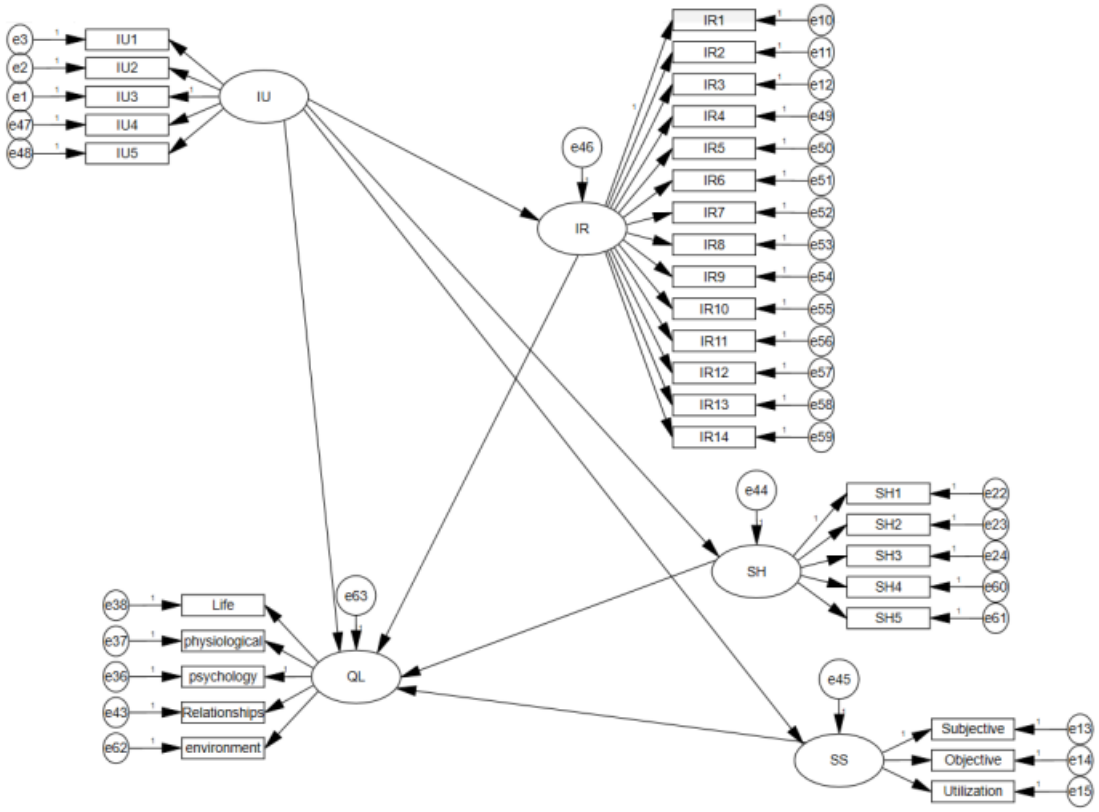

Figure 2. Results of Simulation Fitting.

Table 4. Model Fit Index Assessment.

Index	χ^2/Df	Rmsea	Gfi	Ifi	Tli	Cfi
Judgment Standard	<3	<0.10	>0.8	>0.9	>0.9	>0.9
Value	2.721	0.063	0.838	0.919	0.911	0.918

Table 5 shows the path analysis outcomes of the structural equation model, with each path significantly corroborating the research hypotheses. The affirmative impact of Internet use on intergenerational relationships (H2a) was confirmed (β=0.531, p<0.001), while the beneficial influence of intergenerational relationships on quality of life (H2b) was likewise significant (β=0.335, p<0.001).

The affirmative influence of Internet use on self-assessed health (H3a) was confirmed (β=0.484, p<0.001), as was the positive impact of self-assessed health on quality of life (H3b) (β=0.305, p<0.001).

The affirmative impact of Internet use on social support (H4a) was confirmed (β=0.623, p<0.001), and the positive influence of social support on quality of life (H4b) was likewise significant (β=0.307, p<0.001).

The beneficial impact of Internet use on quality of life (H1) was confirmed (β=0.310, p<0.001).

Table 5. Path Analysis Results.

X		Y	Standard Estimate	S.E.	C.R.	p	Hypothesis
IU	--- >	IR	0.531	0.051	10.359	***	H2a
IU	--->	SH	0.484	0.055	9.262	***	H3a
IU	--->	SS	0.623	0.044	9.480	***	H4a
IU	--->	QL	0.310	0.034	4.350	***	H 1

X		Y	Standard Estimate	S.E.	C.R.	p	Hypothesis
IR	--- >	QL	0.335	0.023	6.930	***	H2b
SH	--- >	QL	0.305	0.021	6.516	***	H3b
SS	--- >	QL	0.307	0.058	3.875	***	H4b

Table 5. (*Continued*)

4.4. Mediation analysis results

This study employed structural equation modeling (SEM) to investigate the influence of Internet use on the quality of life of older adults while also analyzing the mediating effects of intergenerational relationships, self-assessed health, and social support, as illustrated in Table 6. Table 6 shows the analysis of mediating effects.Internet use affects the quality of life of older adults both directly and indirectly. The indirect effects are mediated by intergenerational relationships, self-assessed health, and social support. The mediating effect of intergenerational relationships is the most substantial (0.098), succeeded by self-assessed health (0.076) and social support (0.052).

Table 6. Analysis of Mediating Effects.

	Effect	Bootse	Bootllci	Bootulci
Total	0.227	0.027	0.175	0.281
SH	0.076	0.014	0.051	0.105
IR	0.098	0.016	0.069	0.132
SS	0.052	0.014	0.027	0.081

4.5. Hypothesis test results

The empirical evaluation of the measurement and structural models substantiated the theoretical propositions presented in the preceding article and validated the research hypothesis based on the analytical findings. The precise conclusions are presented in Table 7.Table 7 shows a summary of the hypothesis test results.

Table 7. Summary Table of Hypothesis Test Results.

Hypothesis	Hypothesis	Test Conclusion
Hypothesis 1	Internet use can improve the quality of life of older adults .	Accepted
Hypothesis 2	Intergenerational relationships mediate the impact of Internet use on the quality of life of older adults.	Accepted
Hypothesis 2a	Internet use positively affects intergenerational relationships.	Accepted
Hypothesis 2b	Intergenerational relationships positively affect the quality of life of older adults.	Accepted
Hypothesis 3	Self-assessed health plays a mediating role in the impact of Internet use on the quality of life of older adults.	Accepted
Hypothesis 3a	Internet use positively affects self-assessed health.	Accepted
Hypothesis 3b	Self-assessed health positively affects the quality of life of older adults.	Accepted
Hypothesis 4	Social support mediates the impact of Internet use on the quality of life of older adults.	Accepted
Hypothesis 4a	Internet use positively affects social support.	Accepted
Hypothesis 4b	Social support positively affects the quality of life of older adults .	Accepted

5. Conclusion, discussion and recommendations

5.1. Research conclusions

This study systematically analyzed the impact mechanism of Internet use on the quality of life of 435 elderly people aging at home in the community in Chengdu, China, within the context of smart elderly care. The research employed statistical techniques, including structural equation modeling and mediation effect analysis, to elucidate the internal mechanisms by which Internet use enhances the quality of life for older adults through various pathways.

The study identified key factors affecting older adults' quality of life: self-assessed health, social support, intergenerational relationships, and Internet use. A quality of life model was developed by incorporating variables including self-assessed health, social support, intergenerational relationships, and Internet use.The model indicates that elevated self-assessed health scores correlate with enhanced quality of life; intergenerational relationships, particularly with children, are vital for quality of life improvement; both subjective (perceived) and objective (actual) social support positively influence quality of life; and Internet use not only offers entertainment and information access to older adults but also facilitates communication with family and the external world, thereby diminishing social isolation and enhancing quality of life.

The research identified a direct positive correlation between Internet use and quality of life. Older adults who utilized the Internet more frequently typically indicated greater life satisfaction and enhanced mental health.

Intergenerational relationships, self-assessed health, and social support mediate the association between Internet use and quality of life. The use of the Internet indirectly enhances the quality of life for older adults by bolstering social support and fostering intergenerational relationships. The Internet serves as both a resource for information and a means of maintaining connections with family and friends. Utilizing social platforms and online activities, older adults can sustain increased social interactions, thereby augmenting their sense of happiness and satisfaction. The research statistically evaluated the adequacy of the causal model in relation to the empirical data. The findings indicated that the model demonstrates a strong fit, corroborating the beneficial effect of Internet use on the quality of life for older adults.

5.2. Discussion

The quality of life of older adults is influenced by various factors, including self-assessed health, social support, and intergenerational relationships. The research indicated that self-assessed health significantly enhances quality of life, with subjective health perception being pivotal. Social support also had a robust direct impact on quality of life, corroborating the social support buffer theory[48]. Internet use markedly enhanced intergenerational relationships, which in turn positively affected quality of life, offering empirical validation for the theory of digital intergenerational solidarity [49].

The proposed "health-society-digital" model demonstrated a strong fit and explanatory power. It surpassed conventional models by systematically integrating digital technology factors. The integrated model accounted for a substantial proportion of the variance in the quality of life of older adults, highlighting the distinct mechanism of Internet use as a novel driving force.

This study has several limitations. First, the sample was predominantly composed of urban elderly participants, with limited representation from rural areas and the very elderly. This may affect the generalizability of the findings, particularly regarding the digital divide. Second, the cross-sectional design restricts causal inference. Future studies should employ longitudinal designs to better establish causality.

Additionally, gender and education differences observed in the sample warrant further exploration in light of existing literature on digital literacy and social support among older adults.

5.3. Recommendations

5.3.1. Policy recommendations

1. Promote Health-Tech Integration

The government can collaborate with technology firms to provide seniors with discounted or free smart wearable devices, such as blood pressure monitors and smartwatches. Additionally, user-friendly health management applications should be developed. Simultaneously, communities ought to establish "health data interpretation service stations" where qualified medical personnel routinely elucidate health data to older adults, thereby mitigating anxiety stemming from data misinterpretation.

2. Strengthen Mental Health Support

Incorporate psychological counselors into community elderly care service centers to offer mental health counseling for seniors, assist them in accurately perceiving health changes, and bolster their sense of self-efficacy. For instance, "mental wellness workshops" may be conducted to instruct older adults on managing the psychological stress associated with chronic illnesses.

3. Foster Digital Family Engagement

Educational institutions may provide "digital family" courses to instruct youth on fostering substantive online interactions with their grandparents, including regular video calls and the exchange of family photographs, thereby circumventing "superficial communication through emoticons". Establish "digital tutoring stations" to enlist volunteers who will offer individualized technical assistance to older adults, concentrating on addressing practical challenges such as mobile payment and fraud prevention settings. Simultaneously, "grandparent-grandchild learning day" activities may be organized to promote familial engagement in collective digital skills acquisition.

5.3.2. Suggestions for future research

Future research should augment the sample size of rural elderly people, the very elderly, and those living alone to more comprehensively illustrate the digital divide. Examine Internet usage patterns across various nations and evaluate the influence of cultural disparities on technology adoption.

Author contributions

Conceptualization, Xiangni He and Chonlavit Sutunyarak; methodology, Xiangni He and Chonlavit Sutunyarak; software, none; validation, Xiangni He; formal analysis, Xiangni He; investigation, Xiangni He; resources, Xiangni He and Chonlavit Sutunyarak; data curation, Xiangni He; writing—original draft preparation, Xiangni He; writing—review and editing, Xiangni He and Chonlavit Sutunyarak; visualization, Xiangni He; supervision, Chonlavit Sutunyarak; project administration, Xiangni He and Chonlavit Sutunyarak; funding acquisition, none. All authors have read and agreed to the published version of the manuscript.

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Abbreviations

The following abbreviations are used in this manuscript:

IU	Internet use
SS	Social support
SH	Self-assessed health
QL	Quality of life
IR	Intergenerational relations

Conflict of interest

The authors declare no conflict of interest

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