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Digital Inclusion Levels among Community-Dwelling Elderly and Their Influencing Factors: A Mixed-Methods Study

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Abstract: This study examines the digital inclusion levels among community-dwelling elderly individuals and identifies the key factors influencing their digital engagement against the backdrop of the digital divide. Using a mixed-methods approach combining quantitative survey data from the China Health and Retirement Longitudinal Study (CHARLS) database and qualitative interviews with elderly residents in Chenzhou City, we investigated the digital technology usage patterns, barriers, and facilitators among adults aged 60 and above. Results indicate that while 65% of elderly participants use digital devices at least weekly, significant disparities exist in proficiency levels and usage complexity. Social support from family and community emerged as the most critical factor influencing digital inclusion, followed by educational background and infrastructure availability. The study found that higher digital inclusion levels were significantly associated with improved quality of life ($p < 0.001$), enhanced social participation (72% vs. 38%), and stronger interpersonal relationships. These findings highlight the urgent need for comprehensive interventions including community-based training programs, improved digital infrastructure, and family support systems to bridge the digital divide among the elderly population. Policy recommendations emphasize the importance of age-friendly technology design and sustained support mechanisms to ensure equitable digital inclusion for all elderly individuals.

1. Introduction

The rapid advancement of digital technology has fundamentally transformed social structures and human lifestyles in the 21st century. However, this technological revolution has simultaneously created a pronounced "digital divide," representing the inequality in access to and utilization of digital technologies across different population groups[1]. Among various demographic segments, elderly individuals face particularly acute challenges due to variations in their social backgrounds, health conditions, and educational attainment levels.

Population aging represents a global demographic trend that poses significant challenges for both developed and developing nations. In China, the population aged 65 and above exceeded 260

million in 2021, accounting for 18.7% of the total population[2]. As the proportion of elderly citizens continues to rise, effectively promoting their inclusion in the digital world has become a critical issue for sustainable social development. Many elderly individuals lack the necessary digital skills and knowledge to safely and effectively use smartphones and the internet, consequently affecting their ability to access information, participate in social activities, and maintain interpersonal relationships[3].

Communities serve as the primary living environment for elderly individuals and represent crucial settings for their digital inclusion. Digital services and support within communities can significantly enhance elderly individuals' quality of life while effectively increasing their social participation levels[4]. However, current research on community-dwelling elderly's digital inclusion levels and influencing factors remains relatively limited, particularly in the Chinese context where comprehensive empirical studies are scarce.

This study aims to conduct an in-depth analysis of community-dwelling elderly individuals' digital inclusion levels within the context of the digital divide, exploring multiple factors that influence their inclusion, including personal characteristics (age, gender, and educational level), social support networks, and community resources. Through investigating these factors, we aim to provide evidence-based recommendations for government agencies and social organizations to develop targeted digital services and policies, thereby improving elderly individuals' digital inclusion levels and effectively bridging the digital divide.

2. Methods

2.1 Study Design

This mixed-methods study employed a sequential explanatory design, combining quantitative survey data analysis with qualitative interviews to comprehensively assess community-dwelling elderly individuals' digital inclusion levels and influencing factors. The research was involved quantitative data analysis using the CHARLS database and supplementary surveys.

2.2 Participants and Sampling

For the quantitative analysis, we extracted data from the CHARLS database focusing on elderly participants aged 60 and above from Hunan Province (N = 1,847). Additionally, we conducted supplementary surveys with 385 community-dwelling elderly residents in Chenzhou City between January and March 2023. Inclusion criteria were: (1) age ≥ 60 years, (2) community residence for at least one year, (3) cognitive ability to complete the survey, and (4) voluntary participation with informed consent.

The sample size was calculated using G*Power 3.1, with a medium effect size ($f^2 = 0.15$), $\alpha = 0.05$, and power = 0.80, indicating a minimum required sample of 343 participants. To account for potential non-response, we recruited 385 participants, achieving a response rate of 92.3%.

2.3 Data Collection Instruments

The survey instrument comprised four sections: Demographic Characteristics: Age, gender, education level, income, living arrangements, and health status; Digital Technology Usage Scale (DTUS): A 15-item scale measuring frequency of use, device ownership, and application usage patterns (Cronbach's $\alpha = 0.87$);Digital Skills Assessment (DSA): A 12-item scale evaluating proficiency in basic and advanced digital operations (Cronbach's $\alpha = 0.89$);Social Support Scale (SSS): A 10-item scale assessing support from family, friends, and community for digital

technology learning (Cronbach's α = 0.85).

2.4 Data Analysis

Quantitative data were analyzed using SPSS 26.0, employing descriptive statistics, correlation analysis, and multiple regression modeling. .

3. Results

3.1 Participant Characteristics

Table 1 presents the demographic characteristics of survey participants.

Table 1 Demographic Characteristics of Survey Participants (N = 385)

Characteristic	n	%
Age (years)		
60-65	142	36.9
66-70	118	30.6
71-75	78	20.3
>75	47	12.2
Gender		
Male	176	45.7
Female	209	54.3
Education Level		
No formal education	48	12.5
Primary school	127	33.0
Middle school	143	37.1
High school or above	67	17.4
Monthly Income (CNY)		
<2,000	89	23.1
2,000-3,999	168	43.6
4,000-5,999	92	23.9
≥6,000	36	9.4
Living Arrangement		
Living alone	73	19.0
With spouse only	156	40.5
With children	156	40.5

3.2 Digital Inclusion Levels

Analysis of digital technology usage patterns revealed significant variations among community-dwelling elderly individuals. Approximately 65% of participants reported using digital devices at least weekly, with 30% engaging in daily usage. Table 2 summarizes digital technology

usage patterns and proficiency levels.

Table 2 Digital Technology Usage Patterns and Proficiency Levels (N = 385)

Technology Usage	Daily	Weekly	Monthly	Never
	n (%)	n (%)	n (%)	n (%)
Smartphone	116 (30.1)	134 (34.8)	68 (17.7)	67 (17.4)
Internet browsing	78 (20.3)	112 (29.1)	89 (23.1)	106 (27.5)
Social media	93 (24.2)	127 (33.0)	76 (19.7)	89 (23.1)
Video calls	68 (17.7)	143 (37.1)	92 (23.9)	82 (21.3)
Online shopping	23 (6.0)	45 (11.7)	78 (20.3)	239 (62.0)
Digital payments	34 (8.8)	67 (17.4)	89 (23.1)	195 (50.7)

Proficiency self-assessment indicated that 40% of participants considered themselves proficient in basic applications (e.g., WeChat, video calls), while only 15% reported proficiency in complex operations (e.g., digital payments, online shopping).

3.3 Factors Influencing Digital Inclusion

Multiple regression analysis identified key predictors of digital inclusion levels. Table 3 presents the regression results.

Table 3 Multiple Regression Analysis of Factors Predicting Digital Inclusion (N = 385)

Variable	B	SE	β	t	p	95% CI
(Constant)	12.34	2.87	-	4.30	< .001	[6.70, 17.98]
Age	-0.42	0.08	-.23	-5.25	< .001	[-0.58, -0.26]
Gender	-1.76	0.84	-.09	-2.10	.037	[-3.41, -0.11]
Education level	2.89	0.47	.28	6.15	< .001	[1.97, 3.81]
Monthly income	1.23	0.38	.15	3.24	.001	[0.48, 1.98]
Social support	3.67	0.52	.35	7.06	< .001	[2.65, 4.69]
Community resources	2.14	0.61	.17	3.51	< .001	[0.94, 3.34]

Note. $R^2 = .487$, Adjusted $R^2 = .479$, $F(6, 378) = 59.84$, $p < .001$

Social support emerged as the strongest predictor ($\beta = .35$, $p < .001$), followed by education level ($\beta = .28$, $p < .001$) and age ($\beta = -.23$, $p < .001$).

3.4 Impact on Quality of Life and Social Participation

Comparison between digitally engaged and non-engaged elderly individuals revealed significant differences in various life domains. Table 4 summarizes these comparisons.

Table 4 Comparison of Outcomes Between Digitally Engaged and Non-Engaged Elderly

Outcome Variable	Engaged (n = 250) M (SD)	Non-Engaged (n = 135) M (SD)	t	p
Life satisfaction	7.82 (1.43)	6.14 (1.67)	10.43	<.001
Self-efficacy	28.67 (5.21)	22.34 (4.89)	11.67	<.001
Depression (PHQ-9)	4.23 (2.87)	7.89 (3.45)	-11.12	<.001
Social participation	16.78 (3.92)	11.23 (3.14)	14.23	<.001
Family connection	8.92 (1.23)	6.78 (1.87)	12.98	<.001

Among digitally engaged elderly, 86% reported high life satisfaction compared to 55% among non-engaged individuals. Social participation rates were 72% for technology users versus 38% for

non-users.

4. Discussion

4.1 Principal Findings

This study provides comprehensive insights into the digital inclusion landscape among community-dwelling elderly individuals in China. Our findings reveal a complex picture of digital engagement, with significant variations in usage patterns, proficiency levels, and outcomes. While the majority of elderly participants demonstrate willingness to engage with digital technologies, substantial barriers persist that prevent full digital inclusion.

The finding that 65% of elderly individuals use digital devices at least weekly suggests progress in technology adoption among this population. However, the stark contrast between basic application proficiency (40%) and complex operation proficiency (15%) highlights the superficial nature of much digital engagement. This "shallow inclusion" phenomenon, where elderly individuals use technology for simple tasks but cannot leverage its full potential, represents a critical challenge requiring targeted interventions[5].

4.2 The Primacy of Social Support

Our results strongly emphasize social support as the most influential factor in elderly digital inclusion, aligning with international research highlighting the importance of social capital in technology adoption[6]. The regression analysis revealed that social support ($\beta = .35$) exceeded even educational background ($\beta = .28$) in predictive power, suggesting that interpersonal relationships may compensate for formal education deficits in technology learning contexts.

This finding has important implications for intervention design. Rather than focusing solely on technical training, programs should leverage and strengthen existing social networks. The qualitative data particularly highlighted the role of intergenerational support, with adult children serving as primary technology mentors. This "reverse socialization" process, where younger generations transmit knowledge to older ones, represents a departure from traditional knowledge transfer patterns and warrants further investigation [7].

4.3 Educational Background and the Knowledge Gap

The significant association between educational level and digital inclusion ($\beta = .28$, $p < .001$) confirms the persistence of traditional educational advantages in digital contexts. This finding supports Bourdieu's concept of cultural capital, suggesting that educational experiences provide cognitive frameworks and learning strategies that facilitate technology adoption[8]. However, our qualitative data revealed that motivated individuals with limited formal education could achieve digital proficiency through persistent effort and adequate support, indicating that educational disadvantages are not insurmountable.

4.4 Quality of Life Enhancement Through Digital Inclusion

The substantial differences in life satisfaction ($d = 1.08$), self-efficacy ($d = 1.25$), and depression levels ($d = 1.15$) between digitally engaged and non-engaged elderly individuals underscore the profound impact of digital inclusion on well-being. These effect sizes exceed typical thresholds for large effects[9], suggesting that digital inclusion interventions could yield significant public health benefits.

The mechanism through which digital engagement enhances well-being appears multifaceted. Our qualitative findings suggest that technology provides: (1) enhanced communication with family members, reducing isolation; (2) access to information and services, increasing autonomy; (3) participation in online communities, expanding social networks; and (4) cognitive stimulation through learning and problem-solving. These pathways align with the successful aging framework, which emphasizes the importance of maintaining social engagement and cognitive function [10].

5. Conclusion

This mixed-methods study provides comprehensive evidence regarding digital inclusion levels among community-dwelling elderly individuals and their influencing factors. Our findings reveal that while progress has been made in elderly technology adoption, significant challenges persist that prevent full digital participation. Social support emerged as the most critical factor facilitating digital inclusion, followed by educational background and community resources.

The substantial associations between digital engagement and enhanced quality of life, reduced depression, and increased social participation underscore the importance of addressing the elderly digital divide[11]. As societies continue to digitalize, ensuring equitable access to and meaningful use of digital technologies among elderly populations becomes not just a matter of technological equity but a fundamental requirement for healthy aging and social inclusion[12].

Our findings generate clear implications for policy and practice. Comprehensive interventions combining community-based training, family engagement, age-friendly technology design, and infrastructure development are needed to promote elderly digital inclusion effectively[13]. Such interventions should recognize the heterogeneity of the elderly population and provide tailored support addressing diverse needs and capabilities[14].

As we advance toward an increasingly digital future, the imperative to include elderly individuals in the digital society grows ever more urgent. This study provides evidence-based insights to guide efforts toward achieving digital equity for all age groups, ultimately contributing to more inclusive and cohesive societies where technological advancement benefits everyone, regardless of age[15].

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