

The Relationship Between Loneliness and the Overuse of WeChat Among Chinese Elderly: The Chain Mediation Role of Sensation Seeking and Fear of Missing Out

Shoukui Cui¹, Junjie Jiang^{2,3}, Liping Mu^{4,5}

¹Department of Media and Communication, Faculty of Arts and Social Sciences, Universiti Malaya, Kuala Lumpur, 50603, Malaysia; ²School of Psychology, Southwest University, Chongqing, 400715, People's Republic of China; ³Changyu School of Guangming District, Shenzhen, 518107, People's Republic of China; ⁴Research Institute of Social Development, Southwestern University of Finance and Economics, Chengdu, 610074, People's Republic of China; ⁵College of International Law and Sociology, Sichuan International Studies University, Chongqing, 400031, People's Republic of China

Correspondence: Liping Mu, Email mu_lp625@sina.com

Background: With the advent of new media technology, WeChat, as China's largest social networking platform, has significantly impacted people's lives. Growing concerns exist about social media usage, particularly regarding mental health issues stemming from problematic smartphone use. However, limited research has explored the relationship between social media usage and mental health among older adults in China, particularly the mechanisms influencing this relationship. This study addresses this gap by investigating the relationship between excessive WeChat use and loneliness among older adults, examining the mediating roles of sensation seeking and fear of missing out (FoMO).

Methods: To clarify the intermediary role of sensation seeking and FoMO in the relationship between elderly loneliness and problematic phone use, this study employed the loneliness scale, brief sensation seeking scale, the scale of FoMO and WeChat overuse scale in a questionnaire survey on the Chinese elderly aged 55 to 89 (N=913). A chained mediation model was constructed, with descriptive statistics, Pearson correlation analysis, and mediation effect tests performed.

Results: The results indicate that the relationship between loneliness and excessive WeChat use among Chinese elderly is mediated by sensation seeking and FoMO.

Conclusion: The findings reveal that loneliness, sensation seeking and FoMO and problematic mobile phone use (WeChat) are interconnected; (ii) sensation seeking and FoMO are the two important intermediary mechanisms between loneliness and problematic mobile phone use; and (iii) sensation seeking and FoMO can act as mediators in the relationship between loneliness and problematic mobile phone use among the elderly. In the difference test of demographic variables, it was found that women had more WeChat overuse behavior than men, and urban residents demonstrated significantly higher levels of overuse than their township residents. The study has revealed the psychological mechanism between loneliness and problematic mobile phone use among the elderly, which provides guiding suggestions for the prevention and intervention of such behaviors in the elderly.

Keywords: loneliness, sensation seeking, fear of missing out, WeChat overuse, Chinese elderly

Introduction

Thanks to the popularity of smartphones and mobile Internet technologies, online social tools such as Facebook and WeChat have undergone rapid development in recent years. People are increasingly reliant on information and communication technologies. Digital technology has become an indispensable part of their daily lives.¹ The rapid development of modern information technology has enabled digital communication among the elderly. Exploration of the relationship between the use of social media and the mental health of the elderly is conducive to their digital adaptation. At present, China is seeing an intensifying aging trend. In December 2023, the 2022 National Development Bulletin of the Aging in

China shows that by the end of 2022, China reached 280.04 million, accounting for 19.8% of the total population. Relevant data indicate that by 2040, the proportion of the elderly population aged 60 and above in China is expected to rise to 28%, which highlights a grim pension situation. In addition, as of December 2023, the number of mobile Internet users in China had reached 1.087 billion. The proportion of mobile Internet users aged 50 and above increased from 30.8% in December 2022 to 32.6%. This indicates a deeper penetration of the Internet among the middle-aged and elderly groups (China Internet Information Center, 2023).

Loneliness, as a negative emotional experience, is a specific risk factor for the mental health of the elderly (eg depression).² Due to the deterioration of physical and psychological functions, the elderly usually suffer a strong sense of loneliness and many maladaptations,^{2,3} which aroused social concern regarding their health and adaptation. According to the Need to Belong Theory, people seek stable and positive interpersonal relationships to foster a sense of belonging.⁴ Social media provides a low-cost and accessible means of communication, which can help reduce loneliness among the elderly.⁵ For many elderly individuals, using social media platforms like WeChat primarily serves the purpose of staying connected with family and friends,⁶ thereby fulfilling their attachment and belonging needs. However, research shows that elderly individuals often face significant challenges, such as physical decline, living alone, the loss of family and friends, and retirement, which limit their emotional support and help-seeking options. Consequently, they may turn to social media as a means to gain emotional support and alleviate feelings of loneliness,⁷ and the increasing difficulty of disengaging from mobile phones has led to the rise of mobile phone addiction.^{8,9}

WeChat, the most widely used social media platform in China, provides significant convenience to elderly users due to its user-friendly features. However, excessive use of WeChat can negatively impact both physical and mental health.¹⁰ This overuse, often referred to as WeChat dependency or addiction, is characterized by an excessive focus on the platform, leading to impaired control over usage behaviors and poor time management. Consequently, such issues can adversely affect social functioning.¹¹ Research indicates that elderly individuals, who are in later life stages with declining physical capabilities, may experience mental health problems such as depression, loneliness, anxiety, sleep disturbances, and cognitive impairments due to problematic phone use.¹² According to Compensatory Internet Use Theory, excessive internet use acts as a form of psychological compensation.¹³ For the elderly, overuse of social media may reflect insufficient social engagement and interaction, exacerbating emotional instability, increasing anxiety, and causing a retreat from face-to-face interactions. Over time, this can result in a fear of real-life social encounters and heightened loneliness.¹⁴ Furthermore, current research on problematic phone use primarily focuses on adolescents,¹⁵ despite varying usage purposes¹⁶ and problematic manifestations¹⁷ across different age groups.

According to the commonly used Interaction Person-Affect-Cognition-Execution (I-P-A-C) model to analyze vector addiction, personal traits (Person's characteristics), affective and cognitive responses (Affective and cognitive responses), and individual executive function factors (Execution) can lead to social network overuse.¹⁸ Research indicates a strong correlation between sensation-seeking and social media usage.¹⁹ For the elderly, WeChat offers substantial social and informational stimuli, which may fulfill their needs for novelty and social interaction.²⁰ However, this sensation-seeking behavior could lead to excessive WeChat use, resulting in unhealthy dependency among the elderly.²¹ Additionally, FoMO is closely linked to social media usage,²² potentially driving the elderly to check WeChat more frequently and exacerbating overuse. Despite these insights, research specifically targeting the elderly remains limited. Therefore, this study aims to explore the relationship between loneliness and excessive WeChat use among the elderly, focusing on the roles of sensation-seeking and FoMO. By addressing this research gap, the study seeks to enhance our understanding of elderly psychological and behavioral patterns, providing a theoretical foundation for developing intervention strategies to improve their quality of life and mental health. This research is particularly relevant for addressing China's growing aging issue.

Literature Review

Historical Reasons for Loneliness Among the Elderly in China Today

Loneliness, a psychological feeling generated when an individual's interpersonal relationship does not reach the desired level, is often accompanied by negative psychological experiences such as emptiness, boredom, helplessness and

depression.²³ With the increasing social changes in China and the rise of empty-nest families, loneliness has constituted a grave threat to the elderly to achieve their “happiness dream”.^{24,25} Since the reform and opening up in 1978, social changes in China have significantly impacted the loneliness experienced by older adults.²⁶ Rapid industrialization has gradually undermined traditional filial piety, leading to a decline in the respect that adult children show their parents.^{27,28} Moreover, many adult children’s economic approach to filial piety often neglects their parents’ emotional needs, contributing to increased loneliness among the elderly.²⁹ The relaxation of household registration policies has resulted in frequent migration of young and middle-aged individuals between cities and rural and urban areas. This mobility frequently leaves elderly individuals as “empty nesters”,³⁰ separated from their children, and struggling with impaired family functions and inadequate social support, which exacerbates their loneliness.³¹ Conversely, elderly individuals who migrate with their children become part of the “floating population”. They experience loneliness due to unfamiliar environments, limited social circles, and restricted social security benefits at their temporary residences.³² Furthermore, the rising divorce rate in China, driven by shifting attitudes towards marriage and family, has increased the number of single elderly individuals.³³ Lacking adequate family support and close friends, these individuals often face heightened loneliness.^{34,35} Although social media has somewhat alleviated loneliness by enhancing online interactions and providing emotional support,³⁶ excessive reliance on it can diminish real-life social interactions and worsen psychological issues.³⁷ Therefore, a balanced and healthy use of social media is crucial for older adults.

Loneliness and Overuse of WeChat Among the Elderly

Loneliness, a prevalent emotional state among the elderly, is closely linked to excessive social media use. Marttila and Räsänen³⁸ found that loneliness significantly predicts social network addiction, while Ndasauka et al³⁹ confirmed a positive correlation between loneliness and excessive social network use. According to the compensatory network use theory, loneliness plays a crucial role in the development of problematic mobile phone use. Individuals experiencing loneliness often turn to mobile or online communication as a means of compensation and escape from distress, which can lead to excessive mobile use.⁴⁰ This tendency suggests that those with higher levels of loneliness may seek emotional compensation through social media, potentially intensifying the replacement effect of virtual interactions over real-life support. Frequent social network use can result in elderly individuals spending excessive time in virtual interactions, reducing opportunities for face-to-face interactions and weakening their real-life social support network, thereby perpetuating a cycle of loneliness. Research also indicates that individuals with higher loneliness levels, due to limited social interactions and support, struggle with a sense of belonging and seek coping strategies.^{41,42} For instance, around 21.3% of Chinese university students⁴³ and approximately 14.8% of individuals aged 12 to 18 in Spain have reported smartphone addiction issues,⁴⁴ linked to a lack of social interactions and belonging. Although research on smartphone addiction is prevalent among younger populations, it is relatively scarce among the elderly, highlighting the need to explore the relationship between loneliness and social media use in this demographic. Based on the I-P-A-C model, compensatory network use theory, and empirical research, this study proposes hypothesis

H1: Loneliness positively predicts excessive WeChat use among the elderly.

Mediating Role of Sensory-Seeking

Sensation seeking refers to the pursuit of varied, novel, complex, and intense sensory experiences, encompassing both sensory and psychological aspects. This trait often drives individuals to seek ways to fulfill these needs, which can lead to risk-taking behaviors.⁴⁵ As a stable personality characteristic, sensation seeking significantly influences daily behaviors. The I-PACE model identifies sensation seeking as a crucial factor in smartphone addiction.¹⁸ Meta-analyses have confirmed that individuals with high sensation-seeking tendencies are more likely to engage in stimulating and novel activities, which impacts problematic smartphone use.⁴⁶

In addition to its impact on smartphone addiction, sensation seeking’s influence varies across different age groups. Older adults generally have lower risk assessment capabilities and less accurate self-risk evaluation compared to adolescents.⁴⁷ While sensation seeking itself remains relatively stable across ages, older adults may perceive the risks of excessive internet use differently from younger individuals. For instance, empirical research reveals a strong positive

correlation between sensation seeking and internet dependence among high school students,⁴⁸ with similar findings in other adolescent studies.⁴⁹ Furthermore, a study of 327 adults (ages 19 to 76) found that Facebook users had significantly higher scores in sensation seeking, boredom sensitivity, and disinhibition compared to non-users,⁵⁰ underscoring sensation seeking as a key factor in problematic social media use.

The Uses and Gratifications Theory provides insight into why individuals might turn to specific media types, such as excessive phone use, to meet their inherent needs.⁵¹ Those experiencing higher levels of loneliness often focus on interpersonal relationships and are more prone to boredom or stress from novelty and challenges. To address these social needs and alleviate boredom, they may engage more with their phones, potentially leading to uncontrolled use. Empirical studies demonstrate a significant positive correlation between loneliness and sensation seeking in adolescent smartphone addiction.^{50–52} Lonelier individuals are more inclined to seek sensory stimulation and engage in risk-taking behaviors.⁵³ Consequently, this study proposes hypothesis

H2: sensory seeking plays a mediating role between loneliness and excessive use of WeChat among the elderly.

The Mediation Effect of Fear of Missing Out

Fear of Missing Out (FoMO) is a pervasive anxiety characterized by the concern of missing out on beneficial experiences that others may be enjoying in one's absence. This anxiety drives individuals to seek continuous connection with others' ongoing activities,⁵⁴ manifesting both online and offline. Offline, FoMO may involve reluctance to miss friends' gatherings, while online, it is evident in frequent social media logins and content refreshing. Internally, FoMO is marked by a strong desire to know others' activities.⁵⁴ Research indicates that individuals with high FoMO are more likely to use social media and develop tendencies toward smartphone addiction.^{55,56} When access to social media is restricted, FoMO levels rise significantly, and an inability to use smartphones notably increases anxiety.¹⁵ Consequently, individuals with high FoMO often overuse smartphones to meet basic psychological needs, leading to smartphone addiction.⁵⁷ Previous studies show that loneliness is a strong predictor of FoMO.⁵⁸ Lonely individuals, who often lack a sense of belonging and have lower interpersonal satisfaction, are more concerned about missing important information on social media. Their heightened desire to establish meaningful connections amplifies their fear of missing out on others' activities, making them more susceptible to excessive social media use.

In this context, WeChat, a key platform for social interaction and information access, becomes particularly relevant. The inability to use WeChat can lead to concerns about missing social activities and content,⁵⁹ further influencing the frequency of social media use⁶⁰ and potentially resulting in maladaptive behaviors,⁶¹ such as excessive use. FoMO helps explain why individuals are drawn to social media platforms like WeChat and predicts problematic social networking behavior.⁶² Thus, this study proposes hypothesis

H3: FoMO is the intermediary mechanism of the relationship between loneliness and WeChat overuse.

Chain-Mediated Role of Sensation-Seeking and Missed Anxiety

In studies examining excessive WeChat use among older adults, sensation seeking and fear of missing out (FoMO) are crucial mediating variables. Although these psychological traits have been well-documented in younger populations,⁶³ their chain mediating effects in older adults warrant further exploration. Research indicates that higher sensation seeking is associated with greater concern over missing information or social opportunities.⁶⁴ For instance, sensation seeking is positively correlated with FoMO in studies on social media addiction,⁶⁵ suggesting that individuals seeking novel experiences are more susceptible to FoMO. This intense sensation seeking can drive individuals to use social media more frequently to alleviate concerns about missing information, creating a reinforcing cycle.

A significant positive correlation between sensation seeking and FoMO has also been observed in college students,⁶³ indicating that sensation seeking fosters excessive social media use and heightens anxiety about missing out. Similarly, Wang et al's⁶⁴ study found that sensation seeking positively predicts FoMO, with those seeking novel experiences experiencing greater anxiety over missed social opportunities, particularly among adolescents and college students. In older adults, sensation seeking and FoMO have been shown to positively influence problematic social media use.^{47,66}

Despite differing social needs and usage habits compared to younger individuals, sensation seeking and FoMO significantly impact WeChat use among older adults experiencing loneliness. Loneliness may prompt older adults to increase their WeChat usage to compensate for insufficient real-world social interactions. Thus, sensation seeking and FoMO as mediators can amplify WeChat use in this context. Based on these findings, this study proposes Hypothesis H4:

H4: sensation seeking and FoMO in the relationship with loneliness and WeChat overuse chain mediation effect.

Specifically, loneliness enhances sensation seeking, which subsequently increases FoMO, ultimately leading to excessive WeChat use.

Research Methods

Subjects

To ensure a robust sample size and account for challenges the elderly face with online surveys, this study employed a primarily offline, supplemented by online, approach for data collection. Offline paper surveys were distributed and collected mainly in the Sichuan-Chongqing area of China for researcher convenience and location. Online surveys were conducted through convenience sampling in elderly community WeChat groups, targeting individuals aged 55 and above. This age group is crucial in China due to retirement age norms, which marks a shift to increased leisure and digital activities, as noted by Zhang and Goza.⁶⁷ As individuals in this age undergo significant age-related changes, their interaction with technology evolves, reflecting broader cultural and social shifts towards digitalization.⁶⁸ The choice of 55 as a starting point allows for an analysis of how digital engagement varies across this diverse and growing segment of the population, providing insights into their unique media usage and preferences in the context of China's aging society.⁶⁹ A total of 913 valid questionnaires, including 397 male (56.5%), and 516 female (43.5%). Among them, 460 participants resided in urban areas (50.38%), while 453 were from townships (49.62%). The age range was from 55 to 89 years, with a mean age of 63.17 years and a standard deviation of 6.85. Regarding age distribution, 47.4 were aged 55–60 years, 36.3% were 60–70 years, 15.3% were 70–80 years, and 1% were over 80 years. All surveyed Chinese elderly adults signed the informed consent form before participating in the study.

Research Tools

Loneliness Scale

The short loneliness Scale (UCLA-6) was compiled by Hays and DiMatteo⁷⁰ (the Cronbach's α coefficient for this scale is 0.83) and later revised by Zhou.⁷¹ This scale targets the elderly in the Chinese community with good reliability and validity, which meet the requirements of psychological measurement. It can be used for the survey on loneliness among the elderly in the community in China. The revised scale consists of six topics, such as "I feel neglected", "although there are people around me, no one pays attention to me", and "I lack companionship". Each item is rated on 4 point scale ranging from "1" (never) to "4" (always). The total score on the scale ranges from 6 to 24 points. The higher the score, the greater the levels of loneliness. The Cronbach's α coefficient for this scale is 0.78.

Brief Sensation-Seeking Scale

The brief version of sensation seeking scale, as revised by Chen,⁷² consists of eight items. These items are divided into four dimensions: pursuit of new experience, boredom, pursuit of new stimulation and lack of self-control, with each dimension containing two items. Participants rate each item on a 5-point Likert scale, from "1" (completely) to "5" (completely). The total score range for the scale is from 8 to 40. The higher the score, the greater the sensation seeking. The Cronbach's α coefficient for this scale in this study was 0.78.

Fear of Missing Out Anxiety Scale

The revised FoMO scale by Przybylski (the Cronbach's α coefficient for this scale is 0.87) and Li,⁷³ comprises eight items. These items are divided into two dimensions: fear of missing out on content and FoMO. Participants rate each item on a 5-point Likert scale, from "1" (completely disagree) to "5" (completely agree). The total score range for the scale is from 8 to 40. The higher the score, the stronger the FoMO. The Cronbach's α coefficient for this scale in this study was 0.81.

WeChat Overuse Scale

The WeChat overuse scale compiled by Hou et al⁷⁴ consists of 10 items with three dimensions: emotional regulation, prominence and conflict. Participants rate each item on a 5-point Likert scale, from “1” (never) to “5” (always). The dimensions are as follows: 1–3 is the emotional adjustment dimension, 4–7 tolerance dimension, and 8–10 conflict dimension. The total score ranges from 10 to 50. The higher the score, the higher the degree of WeChat use; that is, the higher the levels of excessive use of WeChat. The Cronbach’s α coefficient for this scale in this study was 0.899.

Data Analysis

This study utilized SPSS 25.0 software for data collection and analysis. Descriptive statistics (mean and standard deviation) and standardization were first applied to the independent variable (loneliness in the elderly), mediating variables (sensation seeking, fear of missing out), and the dependent variable (excessive use of WeChat). Pearson correlation analysis followed to examine the relationships between problematic behaviors and the independent and mediating variables, with correlations represented by coefficients r and $p < 0.05$ indicating statistical significance. Next, the PROCESS macro model 6 in SPSS was used to test the mediating and chain-mediating effects of sensation seeking and fear of missing out on the relationship between loneliness in the elderly and excessive use of WeChat, with standardized path coefficients denoted by β , and $p < 0.05$ indicating statistical significance. Finally, the bias-corrected percentile Bootstrap method was employed, based on previous research showing its superiority over the traditional Sobel method.⁷⁵ Gender, education level, and length of residence were included as covariates, and indirect effects were considered statistically significant if the 95% confidence interval (CI) did not include 0.

Results and Analysis

Common Method Deviation Test

Restricted by objective conditions, the data of all variables in this study were collected by the self-report of the participants, and the relationship between variables may be affected by common method bias. According to the suggestions of corresponding controls were carried out in terms of procedures, such as protecting the anonymity of the participants and reducing the guess about the purpose of the measurement.⁷⁵ Data were tested for common method bias using the Harman univariate test. Results show that six-factor features have roots greater than 1, and the first-factor variance interpretation rate of 24.13% is below the 40% critical criterion, indicating that this study falls within an acceptable range regarding common methodological bias.

Descriptive Statistics and Correlation Analysis

To assess whether the sample conforms to a normal distribution, we conducted normality tests for each measurement item using skewness and kurtosis. Skewness measures the asymmetry of the data distribution, while kurtosis assesses its peakedness. According to Kline,⁷⁶ data can be considered approximately normally distributed if the absolute value of skewness is within 3 and the absolute value of kurtosis is within 8. The analysis results for each measurement item (Table 1) show that the absolute values of skewness and kurtosis fall within these standard ranges. This indicates that the data for each measurement item in this study approximates a normal distribution.

Descriptive statistics show that the average scores of loneliness, sensation seeking, FoMO and WeChat overuse among Chinese elderly are higher than the general level. The results of the direct correlation analysis of the variables are shown in Table 2. Significant positive associations were found between loneliness, sensation seeking, FoMO, and WeChat overuse. To examine the differences in WeChat overuse between groups, we conducted independent sample t-tests with gender and long-term residence as control variables. The results shown in Table 3 indicate that WeChat overuse is significantly higher among urban elderly compared to township residents ($t=2.68$, $p < 0.01$), and among females compared to males ($t=-2.81$, $p < 0.001$).

Chain Mediation Test of Sensation-Seeking and Fear of Missing Out

Before testing the chain mediation model, the direct effects of loneliness and excessive use of WeChat were analyzed, while gender, education level and long-term residence were controlled. The results showed a significant positive

Table 1 Descriptive Statistics for Each Dimension and Results of Normality Tests for Measurement Items

Variable	Items	M	SD	Skewness	Kurtosis	Population M	Population SD
Loneliness	UCLA1	2.18	0.816	0.061	-0.79	2.021	0.559
	UCLA2	2.09	0.81	0.197	-0.724		
	UCLA3	1.96	0.77	0.307	-0.622		
	UCLA4	2.03	0.795	0.261	-0.669		
	UCLA5	1.95	0.821	0.466	-0.51		
Sensation seeking	UCLA6	1.91	0.844	0.49	-0.663	2.697	0.624
	BSSSC1	3.24	0.933	-0.459	-0.122		
	BSSSC2	2.93	0.932	0.096	-0.571		
	BSSSC3	3.01	1.032	-0.043	-0.747		
	BSSSC4	2.97	1.069	-0.047	-0.825		
	BSSSC5	2.68	1.009	0.119	-0.626		
	BSSSC6	2.5	1.006	0.306	-0.487		
	BSSSC7	2.51	1.035	0.184	-0.793		
Fear of missing out	BSSSC8	1.72	0.941	1.229	0.735	2.466	0.771
	FOMO1	1.91	1.003	0.848	-0.176		
	FOMO2	1.94	1.005	0.783	-0.29		
	FOMO3	2.09	1.112	0.71	-0.512		
	FOMO4	2.19	1.147	0.534	-0.893		
	FOMO5	2.91	1.209	-0.215	-1.13		
	FOMO6	2.8	1.223	-0.004	-1.144		
	FOMO7	2.97	1.243	-0.212	-1.101		
WeChat overuse	FOMO8	2.92	1.235	-0.12	-1.118	2.176	0.758
	C1	2.39	0.999	0.331	-0.37		
	C2	2.45	1.044	0.304	-0.437		
	C3	2.92	1.04	0.012	-0.607		
	C4	2.24	1.129	0.596	-0.532		
	C5	2.06	1.048	0.725	-0.239		
	C6	1.71	0.98	1.29	0.878		
	C7	1.96	1.063	0.849	-0.235		
	C8	2.36	1.155	0.521	-0.61		
	C9	1.68	0.929	1.214	0.645		
	C10	1.99	1.085	0.9	-0.039		

Abbreviations: M, mean; SD, standard deviation.

Table 2 Correlation Analysis Among the Various Variables

Variable	M	SD	1	2	3	4
1.Loneliness	15.73	3.81	1			
2.Sensation seeking	21.56	5.01	0.12**	1		
3.Fear of missing out	25.26	7.72	0.34**	0.35**	1	
4.WeChat overuse	21.75	7.59	0.21**	0.29**	0.52**	1

Notes: ** $p < 0.01$.

Abbreviations: M, mean; SD, standard deviation.

predictive effect of loneliness on WeChat overuse after controlling for demographic variables ($\beta = 0.21$, $p < 0.001$). Bootstrap analysis was performed using the SPSS macro program, according to Hayes.⁷⁷ Use Model 6 to control for gender, education level, and long-term residence as control variables, loneliness as independent variables, sensation seeking and FoMO as mediation variables, and WeChat overuse as dependent variables. The results of the regression analysis of the relationship between variables in the model are shown in Table 4.

Table 3 Test of WeChat Overuse in Gender and Residence

Variable	Number of People	M	SD	t	p
City	460	22.37	7.50	2.68**	<0.01
Villages and towns	453	21.12	7.62		
Male	397	20.95	7.27	-2.81**	<0.01
Female	516	22.36	7.77		

Notes: N = 913; ** p < 0.01.

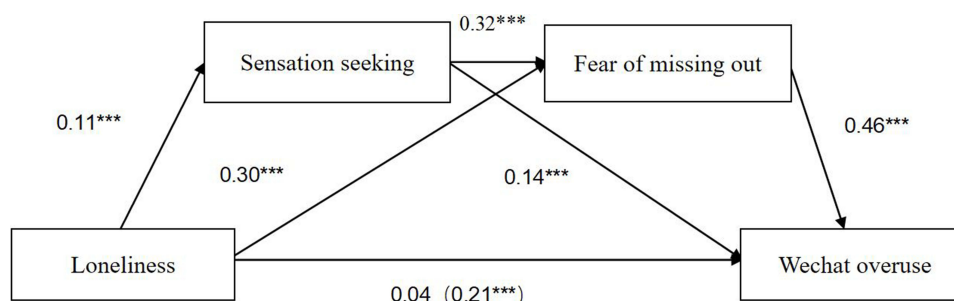
Abbreviations: M, mean; SD, standard deviation.

Table 4 Regression Analysis of Variables in the Model

Regression Equation		Fitting Index			Significance	
Outcome Variable	Predictive Variable	R	R ²	F	β	t
WeChat Overuse	Gender	0.25	0.06	15.20***	-0.18	-2.74**
	Education				-0.04	-1.07
	Long-term residence				-0.12	-3.02**
	Loneliness				0.21	6.59***
Sensation Seeking	Gender	0.14	0.02	4.66***	0.12	1.71
	Education				0.05	1.40
	Long-term residence				0.05	1.14
	Loneliness				0.11	3.41***
Fear of Missing Out	Gender	0.47	0.22	51.79***	-0.02	-0.29
	Education				-0.12	-3.59***
	Long-term residence				-0.04	-1.00
	Loneliness				0.30	9.99***
WeChat Overuse	Sensation seeking	0.55	0.31	67.16***	0.32	10.77***
	Gender				-0.21	-3.62***
	Education				0.00	0.04
	Long-term residence				-0.12	-3.39***
	Loneliness				0.04	1.49
	Sensation seeking				0.14	4.58***
	Fear of missing out				0.46	14.76***

Notes: β is the standardized regression coefficient. ** p < 0.01, *** p < 0.001.

The results of the chain mediation effect analysis are shown in Figure 1. Loneliness significantly positively predicted WeChat overuse in the elderly ($\beta = 0.21$, $p < 0.001$); After including sensory-seeking and FoMO in the regression equation, loneliness significantly positively predicted sensation seeking ($\beta = 0.11$, And $p < 0.001$) and FoMO ($\beta = 0.30$, $p < 0.001$); sensation -seeking significantly positively predicted FoMO ($\beta = 0.32$, And $p < 0.001$) and overuse of WeChat ($\beta = 0.14$,

**Figure 1** Path of chain mediation effect test.

Notes: *** p < 0.001.

Table 5 A Bootstrap-Test for the Mediation Effect

Effect	Efficiency Value	BootSE	BootLLCI	BootULCI	Relative Mediating Effect
Total Effect	0.21	0.03	0.15	0.28	
Total Standardized Mediation Effect	0.17	0.02	0.13	0.21	79.33%
Indirect Effect 1	0.02	0.01	0.01	0.03	7.16%
Indirect Effect 2	0.14	0.02	0.10	0.17	64.36%
Indirect Effect 3	0.02	0.01	0.01	0.03	7.82%
(C1)	-0.12	0.02	-0.16	-0.09	
(C2)	0.00	0.00	-0.01	0.01	
(C3)	0.12	0.02	0.09	0.16	

$p < 0.001$); FoMo significantly positively predicted WeChat overuse ($\beta = 0.46$, $p < 0.001$). At this point, the direct mediation effect of loneliness positively predicting WeChat overuse in the elderly was not significant ($\beta = 0.04$, $p > 0.05$).

The results of the significance test of the mediation effect are shown in Table 5. Sensation seeking and FoMo played a significant mediating role between loneliness and WeChat overuse in the elderly. The total standardized mediation effect value was 0.17, accounting for 79.33% of the total effect of loneliness on WeChat overuse (effect value 0.21). The mediation effect is composed of indirect effects generated by three paths: loneliness, sensation seeking and WeChat overuse (indirect effect 1 with an effect value of 0.02); loneliness, FoMo and indirect WeChat overuse (path effect 2 with an effect value of 0.14); loneliness, sensation seeking, FoMo and WeChat overuse path (indirect effect 3 with an effect value of 0.02). As shown in Table 5, the three indirect effects, in turn, accounted for 7.16%, 64.36%, and 7.82% of the total effects. None of the 95% confidence intervals for the indirect effects above contained 0, indicating that all three indirect effects reached a significant level. By selecting the indirect effect comparison option in model 6, the differences between the indirect effects of different pathways were investigated: comparison 1 indicates the Bootstrap 95% confidence interval of the difference between indirect effect 1 and indirect effect 2; in the same way, the comparison was conducted between indirect effect 1 and indirect effect 2 and between the indirect effect 2 and indirect effect 3.

Discussion

Problematic smartphone use among the elderly, driven by new media technology, significantly impacts their quality of life and well-being in later years. This study developed a chain mediation model to explore the relationship between loneliness and excessive WeChat use among Chinese seniors, focusing on the mediating roles of sensation seeking and fear of missing out. The results show that loneliness directly predicts excessive WeChat use, with sensation seeking and fear of missing out serving as chain mediators. This supports the hypothesis that loneliness promotes excessive WeChat use among the elderly by increasing sensation seeking and fear of missing out. Additionally, demographic analyses reveal that females use WeChat more excessively than males, and urban residents exhibit significantly higher usage compared to rural residents. These findings are consistent with previous research highlighting demographic differences, such as gender and education level, in internet addiction among the elderly.⁶⁶ The study also shows that females are more engaged in activities such as voice and video calls, liking, commenting, sharing information, posting on Moments, and sharing photos.^{78,79} Urban residents, benefiting from better educational levels, internet infrastructure, access convenience, and broader social networks, demonstrate more frequent and excessive WeChat use compared to rural residents.⁸⁰

The Direct Effect of Loneliness on WeChat Overuse

In our study examining the relationship between loneliness and excessive WeChat use among Chinese elderly, the results strongly supported Hypothesis 1, demonstrating that loneliness significantly predicts excessive WeChat use. This finding indicates that lonely elderly individuals are more likely to seek emotional compensation and social interaction through excessive WeChat use, which aligns with existing literature on the impact of loneliness on elderly social behavior.^{41,81} Elderly individuals experiencing increased loneliness often exhibit higher levels of smartphone addiction compared to younger

populations. This is due to diminished positive psychological resources, inadequate self-control over phone use, and a lack of external monitoring.^{23,82} Thus, this insight provides new perspectives for empirical research across different age groups.

Building on this understanding, our study also found significant demographic differences in excessive WeChat use. Specifically, excessive WeChat use is notably higher among urban elderly compared to their rural counterparts, and female elderly individuals use WeChat excessively more than males. This disparity can be attributed to varying levels of loneliness and social support experienced by different demographics. Urban elderly, despite having more social resources, often face greater loneliness due to fragmented social networks and weaker community connections.⁷⁸ This can lead them to rely more on virtual platforms like WeChat to fulfill their emotional needs. Moreover, female elderly individuals, who generally have stronger social interaction needs, may turn to WeChat more frequently for emotional support, resulting in higher levels of excessive use.⁸³

Additionally, to fully understand the relationship between loneliness and excessive WeChat use, it is crucial to consider the “escaping pain” mechanism. Relevant theories suggest that intense loneliness may drive individuals to use WeChat excessively as a means of escaping real-life problems, which can, in turn, exacerbate their loneliness.⁸⁴ Future research should delve into the internal mechanisms underlying this relationship within this theoretical framework to develop effective strategies for addressing loneliness among the elderly.

Mediation Effects of Sensation-Seeking and Fear of Missing Out

The study confirms that sensation seeking mediates the relationship between loneliness and excessive WeChat use, thus supporting Hypothesis 2. This finding aligns with previous research showing a significant positive correlation between loneliness⁸⁵ and sensation seeking.⁴⁶ Sensation seeking, characterized by a desire for new experiences and higher risk-taking, is a predictor of excessive social media use. Among the elderly, sensation seeking is influenced by personal characteristics and life environment. Prior studies have focused more on technology acceptance and resistance rather than sensation seeking related to internet overuse.^{86,87} This study enriches the theoretical framework of elderly internet use by emphasizing the importance of sensation-seeking traits and their impact on internet behavior.

Additionally, the study finds that FOMO partially mediates the relationship between loneliness and excessive WeChat use, validating Hypothesis H3. This is consistent with findings that loneliness predicts FOMO,⁸⁸ and that FOMO, in turn, predicts excessive social media use.⁶¹ The results confirm that loneliness not only predicts FOMO but also contributes to excessive WeChat use, enhancing the application of the I-PACE model in understanding social network overuse among the elderly. Thus, elderly individuals experiencing high levels of loneliness may feel increased anxiety during social activities due to their loneliness.

According to the Social Cognitive Theory of Mass Communication, social media use can reinforce cognitive, emotional, attitudinal, and behavioral aspects of users.^{89,90} The abundance of information heightens individuals’ awareness of missed activities, leading to feelings of tension, anxiety, and exclusion, which contribute to the emergence of FOMO.⁹¹ Consequently, problematic phone use may serve as a coping mechanism for elderly individuals to alleviate FOMO.

In summary, loneliness triggers sensation seeking and FOMO, which are significant emotional conditions leading to problematic phone use. Loneliness may act as an emotional impetus for problematic phone use among the elderly. Sensation seeking and FOMO are crucial emotional mechanisms through which loneliness induces online problematic behaviors, such as excessive phone and internet use.⁹² This research supports this perspective and underscores the need for targeted interventions that address both sensation seeking and FOMO within the context of elderly internet use.

Chain Mediation Role of Sensation-Seeking and FoMO

The research results indicate that sensation seeking and fear of missing out (FOMO) fully mediate the relationship between loneliness and excessive use of WeChat among Chinese elderly individuals. This validates Hypothesis H4 and offers a novel perspective on social behaviors in older adults. According to Optimal Arousal Theory, individuals with higher sensation-seeking levels experience a greater need for stimulation and heightened anxiety about missing new experiences.⁹³ Within this framework, loneliness acts as a precursor to FOMO, which significantly influences excessive WeChat usage. Specifically, FOMO may stem from the information anxiety triggered by sensation seeking, providing a new explanation for the causes of FOMO.

Building on these findings, previous studies have demonstrated the predictive role of sensation seeking in FOMO,⁶⁴ revealing significant associations between high FOMO levels and intense loneliness. In social contexts, loneliness can prompt individuals to avoid anxiety-inducing situations, leading to social withdrawal and further exacerbating their loneliness.⁹⁴ Additionally, those with high sensation-seeking tendencies often engage in stimulating and novel activities. As loneliness intensifies, these individuals may experience increased FOMO due to unmet sensory needs. If this anxiety is not managed, it may result in psychological maladjustments, including exacerbated loneliness.⁹⁵ Consequently, these individuals might turn to social media platforms like WeChat to alleviate negative emotions or fulfill social needs, which can lead to excessive use.

Therefore, the chain-mediating effects suggest that elderly individuals in China with higher levels of loneliness are more likely to exhibit stronger FOMO. Furthermore, higher sensation-seeking levels are strongly associated with excessive social media use, particularly on WeChat. This underscores the importance of reducing loneliness, expanding social networks, and increasing social activities among the elderly. Such interventions can help mitigate sensation-seeking and FOMO tendencies, thereby reducing excessive social media use. These measures not only improve the mental health of older adults but also enhance their overall quality of life.

Research Limitations and Implications

Research Limitations

This study examines the relationship between loneliness and excessive WeChat use among Chinese elderly individuals, yet several limitations must be acknowledged. Firstly, the cross-sectional design limits causal inferences. The absence of time-series data restricts our ability to establish causal relationships between loneliness and excessive WeChat use, affecting the accuracy of the study's conclusions. Future research should employ longitudinal designs to better identify causal links between these variables. Secondly, reliance on self-reported measures may introduce social desirability bias and memory distortions, which could affect data validity. To enhance reliability, future studies should incorporate multi-source data, such as reports from peers, children, and third-party observers. Additionally, while loneliness is positively correlated with short video addiction, other factors, such as self-control, also influence this addiction and may interact with it in complex ways. Future research should explore these variables to understand their effects on the relationship between loneliness and short video addiction. Finally, validating these findings across diverse cultural contexts and samples, and considering potential moderating and mediating variables such as social support, psychological resilience, and self-efficacy, will advance theoretical understanding and inform effective prevention and intervention strategies, thereby improving the quality of life for elderly individuals.

Implications and Future Directions

Despite these limitations, the study provides significant theoretical and practical insights. Theoretically, it enhances our understanding of how loneliness influences excessive WeChat use among Chinese elderly individuals, showing that higher loneliness may lead to greater dependence on WeChat to address psychological needs. This phenomenon, along with the applicability of the I-PACE model to elderly individuals, highlights the model's relevance across different age groups. The study also confirms the chain mediation effects of sensation-seeking and fear of missing out (FOMO) in the relationship between loneliness and excessive WeChat use, deepening our understanding of these mechanisms.

Practically, the study underscores the importance of addressing loneliness to mitigate excessive WeChat use among the elderly. Strategies to prevent over-reliance on WeChat should consider loneliness as a key factor. Alleviating loneliness is crucial for reducing excessive WeChat use. Additionally, the mediating effects of sensation-seeking and FOMO suggest that reducing loneliness may help in managing excessive WeChat use. For instance, enhancing social activities and organizing community events can improve social support networks and psychological well-being. Since increased loneliness drives higher demand for social media, interventions should focus on addressing loneliness to effectively curb excessive WeChat use. Thus, this study holds significant theoretical and practical implications.

Conclusion

This study investigates the relationship between loneliness and problematic WeChat use among elderly individuals in China, identifying relevant mediating mechanisms. The results reveal a significant positive correlation between loneliness, sensation seeking, fear of missing out, and problematic WeChat use. Specifically, loneliness exacerbates excessive WeChat use by intensifying sensation seeking and fear of missing out, with these factors acting as chain-mediators between loneliness and WeChat overuse. These findings underscore the role of loneliness in driving WeChat overuse among the elderly, highlighting sensation seeking and fear of missing out as key mediators. Loneliness leads elderly individuals to seek more social stimulation, contributing to problematic WeChat use. Additionally, high levels of sensation seeking and fear of missing out are associated with increased dependency on and excessive use of WeChat. The study also highlights demographic differences and suggests that further validation is required. Overall, these findings offer valuable insights into how loneliness, personality traits, and cognitive factors influence excessive use of digital technologies among the elderly and provide a theoretical basis for future interventions aimed at mitigating the negative effects of excessive use of smart social tools.

Data Sharing Statement

All data generated or analysed during this study are available in this published article.

Ethical Approval and Consent to Participate

This study and its associated research programs received approval from the Ethics Committee of Human Research Ethics Committee of Malaya University, Malaysia. All research methods and procedures strictly adhered to the principles outlined in the Declaration of Helsinki and were approved by the aforementioned ethics committee. Informed consent was obtained from all participants, and they were fully briefed about the survey's objectives and their rights. The consent process adhered to the ethical standards and guidelines established by the ethics committee.

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Author Contributions

Each author made significant contributions to this research project, including involvement in the conception, study design, data acquisition, data analysis and interpretation, or other critical aspects of the study. All authors participated in drafting, revising, and critically reviewing the article, ultimately providing their approval for the version to be published. Furthermore, all authors have mutually agreed on the choice of the journal for submission and have committed to be accountable for all aspects of this work.

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