



# Internet use and life satisfaction among Chinese older adults: the mediating effects of social interaction

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## Abstract

Internet use has been suggested to have a crucial effect on older adults' quality of life; however, few studies have investigated the underlying mechanisms in the relationship between internet use and life satisfaction among older adults. Employing multiple linear regression models and mediation analysis with 2019 Chinese Social Survey (CSS) data, this study analyzed the associations between the internet use and life satisfaction of Chinese older adults. Additionally, it explored the mediating role of social interaction, including online and offline social interactions. The results showed that internet use was positively associated with older adults' life satisfaction, and offline social interaction significantly mediated internet use. Our findings indicate that internet use could improve older adults' quality of life by promoting offline social interaction. Therefore, the government, communities, and families should create conditions for older adults to integrate into online society and participate in offline social interaction.

**Keywords** Internet use · Life satisfaction · Social interaction · Older adults · China

## Introduction

The life satisfaction of older adults in the internet era is becoming a crucial issue in China. China is experiencing rapid population aging, with the number of people aged 60 and above increasing from 76.64 million (7.43%) in 1982 to 264 million (18.70%) in 2020; half of this population is aged 60–69 (DPES, 2020; NBS, 2021). With China's rapid socioeconomic development and the popularization of the internet, older adults' quality of life may be tied to internet access. In December 2020, the number of internet users in China reached 989 million (70.4% of the population); however, only 11.2% of older adults (aged 60 years and above) had access to the internet, and this figure was significantly lower than the number of younger adults (20.5%) aged 30 to

39 in the same period (CINIC, 2021). Therefore, it would be of great significance to examine the impact of internet use on life satisfaction and the underlying mechanisms among older adults in the context of China's in-depth promotion of digital construction and intelligent service strategies for older adults.

Many older adults are encountering a severe “digital divide” (nonaccess to the internet) in China. The Unified Theory of Acceptance and Use of Technology (UTAUT) suggests that performance expectancy, effort expectancy, social influence, and facilitating conditions influence the internet use of older adults (Venkateshet al., 2003). According to the UTAUT model, older adults' gender, age, education level, socioeconomic status, and attitudes moderate the relationship between the determinants and acceptance of internet use, and there could be disparities on these bases. For instance, low-income older people are likely to lack the material resources needed for internet access, while less educated older people may face ability challenges; people's perception of social fairness may also play a critical role in the era of the internet (Yang et al., 2021). It has been frequently reported that many older adults in China are encountering a “digital divide”, manifesting in difficulties accessing e-commerce, including health care services, transportation, and shopping (groceries and necessities), especially during

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the COVID-19 pandemic. Experiencing the “digital divide” in today’s internet age may have significant implications for older adults’ life satisfaction, a vital indicator of subjective well-being, and successful aging (Dumitrache et al., 2018).

There is a growing interest in how internet use impacts older adults’ life satisfaction (Schulz et al., 2015; Degli Antoni & Franco, 2022; Zhang et al., 2022), and the reported findings have been mixed. Despite older adults lagging behind younger adults regarding internet use (Schehl et al., 2019) and being notably affected by the “digital divide” (Hargittai & Dobransky, 2017; Berkowsky et al., 2018), studies have reported that the internet is increasingly becoming an essential medium for older people to connect with society and improve their quality of life (Bae, 2022; Sagong & Yoon, 2022). The findings generally show positive correlations, and internet use has been shown to improve the quality of life, mental health, and life satisfaction of older adults (Nie et al., 2016; Neves et al., 2018; Lyu et al., 2022; Zhong et al., 2022). However, studies have also reported that internet use shows little benefit for or even a negative impact on older adults’ mental health or life satisfaction (Benvenuti et al., 2020; Schwaba & Bleidorn, 2021; Yang et al., 2021; Zhang et al., 2022). Heterogeneous influences of internet use on subjective well-being were also found across age, gender and socioeconomic status (Peng et al., 2019; Yang et al., 2021; Dong et al., 2022; Lyu et al., 2022; Zhou et al., 2022).

The need for social interaction is one of the fundamental reasons for using the internet. According to the Selective Optimization with Compensation Model (SOC), internet use for older adults may result from selection, optimization, or compensation, which will positively impact life satisfaction (Nimrod, 2019). Social interaction is considered a vital determinant of well-being among older adults, as it can significantly affect their physical and mental health and life satisfaction (House et al., 1988; Antonucci et al., 2017; Szabo et al., 2019; Yang et al., 2021). With the internet, communication has largely transformed from physical and face-to-face exchanges to internet-based mediums. Advantages of this include time efficiency and an expansive range of contacts (Castellacci & Tveito, 2018). While the internet may be a vital medium for such interaction, the “digital divide” affects a sizeable proportion of older adults in China, constraining them to offline interactions. In addition, two primary forms of social interaction—offline and online—may contribute to higher life satisfaction to different extents (Himawan et al., 2021). Some studies have ascertained that offline interaction, including volunteering, organization membership, and recreation with friends and relatives, can improve older adults’ life satisfaction (Khvorostianov, 2016; Luo et al., 2020). With the advent of the internet, online social interaction has become increasingly popular.

Compared with offline social interactions, online social interactions are better at helping individuals overcome social and spatial barriers, allowing older adults, especially those with limited mobility, to participate in social interactions through the internet (Sen et al., 2022).

## The present study

While prior studies elucidate the association between internet use and quality of life among older adults, there are limited studies on the mediating role of social interaction in that association. Given that social interaction may be offline- or online-based, and each form has a different range of influence, this study intends to examine the associations between the internet use and life satisfaction of older adults with particular attention to the mediation effect of social interaction, including online and offline interactions, in the context of China. To achieve this objective, we utilized China’s large-scale social survey data. We hypothesized that internet use positively affects the life satisfaction of older adults and that social interaction (online and offline) plays a mediating role in this association.

## Method

### Participants

The data used in this study are from the 2019 Chinese Social Survey (CSS), a national survey initiated by the Institute of Sociology of the Chinese Academy of Social Sciences in 2005. The CSS 2019 was themed “Social Quality and Social Class Changes,” and several questionnaire modules were administered, including modules on living conditions and social participation. Given the purpose of this study, participants aged 60 and older were selected. The final sample consisted of 2105 respondents, including 1116 females and 989 males.

### Measures

#### Life satisfaction

Life satisfaction was measured with five questions in the 2019 CSS. These included the following: (1) Are you satisfied with your family relationships? (2) Are you satisfied with your family’s financial situation? (3) Are you satisfied with your education? (4) Are you satisfied with your leisure/entertainment/cultural activities? (5) Are you satisfied with your social life? (6) Overall, are you satisfied with your life? Ten options from 1 (extremely dissatisfied) to 10 (extremely satisfied) were available for each question. Life satisfaction

was obtained by calculating the total score of the five questions, which ranged from 6 to 60, with a higher score indicating higher levels of life satisfaction (Cronbach's  $\alpha = 0.80$ ).

### Internet use

Internet use was measured with the question “do you use the internet frequently?” with “yes” coded as 1 and “no” coded as 0.

### Social interaction

Social interaction, including online and offline social interactions, was the mediating variable in this study. Online social interaction was measured with the question “In the past two years, which of the following online social groups have you interacted with?” Twelve options were given, including relatives, friends, neighbors, and colleagues. The total number of online groups older adults interacted with was calculated to reflect their online social interactions. Offline social interaction was measured with the question “In the past two years, with which of the following groups have you participated in offline activities?” Seven options were available, including religious organizations, clubs, and alumni associations. The total number of offline groups older adults interacted with was calculated to reflect their offline social interactions.

### Covariates

Referring to previous studies (Nie et al., 2016; Peng et al., 2019), age, gender, marital status, residence type, education, occupational status, personal annual income, number of children, family size, and perception of fairness were included as covariates in this study. Regarding education, China is a developing country, and the education level of most people is still low, especially among older adults (Cheng et al., 2021). Thus, based on concurrent validity with previous studies (Xu et al., 2019), “education” was treated as a dummy variable. “Number of children,” representing the amount of social support that older adults can access, and “family size,” indirectly reflecting older adults' living patterns (e.g., multigenerational living or living alone), were also controlled as covariates. In terms of “perception of fairness,” more recent studies have highlighted that perception of social fairness is a crucial factor affecting people's life satisfaction (Di Martino & Prilleltensky, 2020), particularly in the era of the internet (Yang et al., 2021). Thus, we also controlled the “perception of fairness” in this study. Perception of fairness was measured with the question “What is your assessment of the current overall level of fairness

and justice in society?” Ten options were available, ranging from 1 (very unfair) to 10 (very fair).

### Procedure

The 2019 CCS randomly selected 745 neighborhood units, comprising 10,283 adults aged between ages 18 and 69. To ensure anonymity and confidentiality, all respondents completed the questionnaires anonymously. The investigators told them that they could leave the interview at any time if they felt uncomfortable about the questions and that the data would be used only for research purposes. Based on our objective of examining the relationship between internet use and older adults' life satisfaction, samples below 60 years old ( $N = 8005$ ) and those with missing values in the variables of interest ( $N = 173$ ) were excluded from the analysis.

### Statistical analyses

All analyses were conducted in STATA Version 15.0. To explore the relationship between internet use and life satisfaction, we used multiple linear regression models (OLS). Mediation analysis was used to examine the mediating role of social interaction in the association between internet use and life satisfaction. We also conducted sensitivity analyses to check the robustness of the results. We first used Propensity Score Matching (PSM) to test the robustness of the relationship between internet use and life satisfaction. Then Causal Mediation Analysis was used to examine the robustness of the mediating roles of online vs. offline social interaction.

## Results

### Descriptive results

Table 1 shows the characteristics of the variables used in this study. The average age of older adults was 64.59, and the sample ranged from ages 60 to 69. Approximately 47% of older adults were male, over 85% had a spouse, and about 32% lived in urban areas. Only 28.12% of older adults frequently used the internet. The mean value of life satisfaction among older adults was generally high (40.22). Offline social interaction was reported, on average, at a higher rate than online social interaction (1.82, and 0.67, respectively).

### OLS results

Table 2 shows the OLS results of the impact of internet use on life satisfaction among older adults. Model 1 showed that after adjusting for older adults' sociodemographic variables,

**Table 1** Descriptive analysis of the sample ( $N=2105$ )

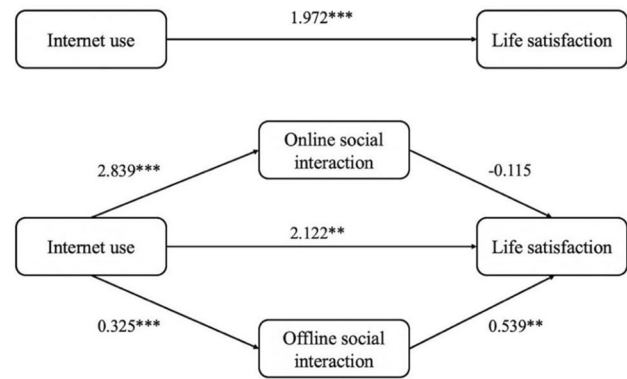
Variables	Mean (%)	SD	Ranges
<b>Dependent variable</b>			
Life satisfaction	40.22	10.70	6–60
<b>Independent variable</b>			
Internet use	28.12		0–1
<b>Mediating variables</b>			
Online social interaction	1.82	1.69	1–10
Offline social interaction	0.67	1.12	0–7
<b>Covariates</b>			
Age	64.59	2.73	60–69
Gender (male)	47.41		0–1
Marriage (having a spouse)	85.89		0–1
Residence type (urban)	32.11		0–1
Education ( $\geq$ Junior high school)	46.41		0–1
Occupation (having a job)	48.46		0–1
Income (Chinese Yuan)	18221.82	32649.01	0–100000
Number of children	2.19	1.09	0–10
Family size	5.18	2.72	1–20
Fairness perception	7.00	2.30	1–10

Notes: SD = Standard deviation; For categorical variables, % refers to the percentages of the categories in parentheses of the first column

**Table 2** OLS results of the influence of internet use on life satisfaction among older adults ( $N=2105$ )

Variable	Model 1		Model 2	
	Coefficient	S.E.	Coefficient	S.E.
Age	0.101	(0.080)	0.092	(0.080)
Male (female)	-0.382	(0.455)	-0.339	(0.456)
Having a spouse (no)	0.238	(0.614)	0.246	(0.613)
Urban (rural)	0.857	(0.613)	0.749	(0.613)
Junior high school and above (no)	1.882***	(0.505)	1.722***	(0.509)
Having a job (no)	-0.220	(0.491)	-0.153	(0.491)
Income (Chinese Yuan, logarithm)	0.482***	(0.127)	0.472***	(0.127)
Number of children	0.046	(0.218)	0.030	(0.218)
Family size	0.019	(0.084)	0.016	(0.084)
Fairness perception	1.803***	(0.092)	1.799***	(0.092)
Internet use	1.972***	(0.528)	2.240**	(0.769)
Online social interaction			-0.161	(0.206)
Offline social interaction			0.553**	(0.206)
Intercept	15.019**	(5.261)	15.662**	(5.268)
R-squared	0.194		0.197	

Notes: S.E. = Standard Errors; \*\*\*  $p < 0.001$ , \*\*  $p < 0.01$ , \*  $p < 0.05$

**Fig. 1** The mediating effects of online and offline social interaction on the relationship between Internet use and life satisfaction among older adults

Notes: Covariates in Table 1 were controlled; \*\*\*  $p < 0.001$ , \*\*  $p < 0.01$ , \*  $p < 0.05$

**Table 3** PSM results of the influence of Internet use on life satisfaction

Matching method	ATT	S.E.	T
Nearest neighbor matching	1.876	0.662	2.83
Caliper matching method	1.786	0.626	2.85
Nuclear matching	1.937	0.610	3.17

Notes: ATT = Average Treatment Effect on the Treated; S.E. = Standard Error

internet use was positively associated with life satisfaction ( $\beta = 1.972$ ,  $p < 0.001$ ). After adjusting for online and offline social interaction in Model 2, the influence of internet use on older adults' life satisfaction had no substantial changes ( $\beta = 2.240$ ,  $p < 0.01$ ). The mean values of variance inflation factor (VIF) in Model 1 and Model 2 were less than 2, indicating no multicollinearity problem.

## Mediation analysis results

The mediation analysis results suggest that offline social interaction had a significant mediating effect on the association between internet use and life satisfaction, whereas the mediating effect of online social interaction was not statistically significant. To better understand the results, we used Fig. 1 to visually display the mediating effects of social interaction (online/offline social interaction).

## Sensitivity analyses

We employed PSM to check the robustness of the association between internet use and life satisfaction. Three different matching methods, including nearest neighbor matching, caliper matching, and kernel matching, were performed to check for the consistency of the findings. Table 3 shows the PSM results of the influence of internet use on older adults' life satisfaction, which were consistent with

**Table 4** Causal mediation analysis results of the mediating effects of online and offline social interaction

Effect	Online social interaction		Offline social interaction	
	Coefficient	95% CI	Coefficient	95% CI
<i>Panel A: Bootstrap mediation analysis</i>				
Direct effect	2.240 <sup>a</sup>	[0.732, 3.747]		
Indirect effect	-0.448	[-1.441, 0.552]	0.180	[0.047, 0.338]
<i>Panel B: Causal mediation analysis</i>				
Direct effect	1.995	[0.564, 3.495]	1.818	[0.882, 2.798]
Indirect effect	-0.036	[-1.113, 0.972]	0.161	[0.040, 0.299]

Notes: <sup>a</sup> refers to the direct effect of online and offline social interaction; S.E. = Standard Error; CI = Confidence Interval; Covariates in Table 1 were controlled

the OLS results. Taking the results of caliper matching as an example, internet use was positively associated with life satisfaction among older adults (average treatment effect on the treated = 1.786). The estimated results of the three matching methods were consistent, indicating that the relationship between internet use and life satisfaction was very robust.

We also used the Causal Mediation Analysis to examine the robustness of the mediating effects of social interaction on internet use and life satisfaction. The results are presented in Table 4. It showed that offline social interaction mediated the impact of internet use on older adults' life satisfaction, consistent with the results in Fig. 1.

## Discussion

Based on the 2019 CSS, the present study adopted a relatively large sample of Chinese older adults to examine social interaction (online/offline social interaction) as one of the pathways linking internet use and life satisfaction. The study found that internet use was positively associated with life satisfaction among Chinese older adults and offline social interaction mediated the relationship between internet use and life satisfaction. The findings of this study supported our hypotheses that internet use positively affects older adults' life satisfaction and that social interaction plays a mediating role in this association.

Our finding is consistent with previous studies conducted in China or developed countries, which have suggested that internet use has a positive effect on older adults' well-being (Mealor & Van Belle, 2015; Nie et al., 2016; Lu & Kandilov, 2021; Dong et al., 2022). Although many Chinese older adults are currently faced with the challenge of

the “digital divide,” with the continuous advancement of the internet and the widespread use of smartphones, more older people will become internet users. Many reasons have been proposed to explain the positive correlation between internet use and life satisfaction. First, the convenience and immediacy of the internet in interpersonal and social communication may allow older adults to establish contact with others, making it easier for them to meet new friends and maintain close interactions (Sims et al., 2017). This helps increase perceived social support, reduce loneliness, and ultimately improve life satisfaction among older adults. Moreover, individuals in their later years may be unable to leave home due to problems such as poor health and declining physical function. Therefore, internet use could result from older adults' selection or optimization for maintaining intimate social relationships, which is central to the argument presented by the SOC model. Given the convenience of communicating with others, including friends and relatives, and the opportunities for continued participation in social life that the internet offers, it is easier for older adults to improve their life satisfaction through internet use.

We also found that offline social interaction mediated the association between internet use and older adults' life satisfaction, while online social interaction had no significant mediating effect. Previous studies have suggested that online and offline social interaction serve mutually exclusive purposes (Himawan et al., 2021). Online relationships are more superficial than offline relationships, and the effectiveness of online social interaction requires support from real-life backgrounds; that is, online social support is not a substitute for offline social support but can serve as an auxiliary method (Li et al., 2015; Ybarra et al., 2015; Nimrod, 2019). The internet is a powerful tool for empowerment (Amichai-Hamburger et al., 2008), which could give older people more opportunities to access more resources and social relationships. Therefore, internet use enables older people to keep in touch with others and obtain more offline social interactions, such as communicating with those with whom they have social ties and engaging in social activities (Cotten et al., 2013). However, it is also possible that older people have more leisure time and resources to expend on both offline and online interactions. The limitations of the dataset prevent an additional investigation into these nuances.

Currently, older adults' internet use is limited by the ease of useability and constraint of enabling resources (Degli Antoni & Franco, 2022). As the internet offers a new way for older adults to connect with others, it is vital to develop means to make the internet more useable for older adults to reduce the “digital divide” they experience. To this end, companies need to invest in developing such means. Furthermore, due to differences in regional development and



family economic conditions, many older adults do not have internet devices or are unable to afford the cost of internet services. Therefore, it is essential for internet service providers to expand their service coverage, particularly in rural areas, to integrate more older adults who currently lack internet access.

At the community level and in residence units, relevant training could be provided to help older adults use smart devices to access the internet. Due to their low level of education, many older Chinese adults do not know how to use the internet. Such training or assistance would be of utmost importance. In addition, communities should create opportunities for older adults to engage in offline social interactions. At the global level and within the context of this research study, family members need to provide necessary financial support and basic assistance for older adults in using the internet, such as providing devices and basic instruction. Moreover, family members can also encourage older adults to participate in more offline social interactions.

There are some limitations to this study. First, participants in our sample were generally younger, consider other studies on aging adults, which may affect the generalization of our findings to a certain extent. Second, the average life satisfaction in our sample was high, which may mean that the study underestimates the effect of internet use on life satisfaction. Third, because people with higher life satisfaction generally have relatively higher socioeconomic status, are more likely to use the internet and have more social interaction, we cannot estimate the causal relationship between internet use and life satisfaction based on cross-sectional data. Although PSM and Causal Mediation Analysis were employed to check for robustness, we still cannot completely rule out the endogeneity factor or reverse relationship. Fourth, it is worth noting that we only analyzed the impact of frequent internet use (compared with infrequent internet use) on life satisfaction. Due to data limitations, this study was unable to examine how the ability and length of internet use affect life satisfaction. Fifth, although the CSS investigated many social interactions that older Chinese adults may engage in, we are still not sure that all possible types of socialization were included. Sixth, we only examined the mediating role of online and offline social interaction in the relationship between internet use and life satisfaction, while several other factors, such as time usage and information acquisition, may play a crucial role in this association as well. Further research is needed to explore other mechanisms linking internet use and life satisfaction among older adults. Finally, since these data were based on the Chinese context, the findings and conclusions may not be generalizable to other cultural settings.

## Conclusion

The Chinese government attaches great importance to the well-being of older people and vigorously advocates for healthy and active aging strategies, aiming to create a favorable social environment for the upcoming serious situation of an aging population in China. Based on data from China, we found that internet use not only directly affects older adults' life satisfaction but also improves their life satisfaction by promoting offline social interaction. As technology has advanced, the internet has penetrated all aspects of Chinese society, impacting older adults' lives. Our findings provide crucial theoretical enlightenment for further understanding the association between internet use and older adults' life satisfaction and provide empirical evidence for promoting the well-being of older adults through online tools.

**Authors' contributions** Xinfeng Cheng originated the research idea, analyzed the data and reviewed the manuscript; Tingshuai Ge interpreted the results and reviewed the manuscript; Theodore D. Cosco edited the manuscript. All authors have read and approved the final manuscript.

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**Data availability** The CSS 2019 dataset used in this study is publicly available ([http://css.cssn.cn/css\\_sy/](http://css.cssn.cn/css_sy/)).

**Code availability** Not applicable.

## Declarations

**Competing interests** The authors declare that they have no conflict of interest.

**Ethics approval** The data collection was approved by the Ethics Committee of the Institute of Sociology of the Chinese Academy of Social Sciences.

**Consent** Each participant was informed of the purpose of this survey. The participation of each participant in the study was voluntary, and they were assured that their privacy would be strictly protected.

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