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Medical service satisfaction and depression among middle-aged and older Chinese adults: moderating role of distinct Internet-using patterns

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Abstract

Background Patient satisfaction is a powerful predictor of an individual's mental health, according to previous research. However, there has not been a thorough study on the relationship between depression and overall medical service satisfaction (OMSS) in middle-aged and older adults. Moreover, little is known about how different Internet-using patterns affect this relationship.

Methods We selected 4,523 participants from the China Family Panel Studies (CFPS) 2020 dataset who were aged 45 and older. The relationship between OMSS and depression was examined using logistic regression analysis, distinct Internet-using patterns were investigated using latent class analysis, and the moderating effects of these patterns were examined using SPSS PROCESS macro analysis.

Results The results showed OMSS was negatively related to depression in middle-aged and older adults (β = -0.181, $p < 0.001$). For skilled Internet users, there was a significant positive moderating effect (β = -0.272, SE = 0.096, $p < 0.01$), for unskilled users, there was a significant negative moderating effect (β = 0.497, SE = 0.156, $p < 0.01$). Yet, there is no moderating effect of a controlled Internet-using pattern on the correlation between OMSS and depression.

Conclusions This study highlights the potential value of improving medical service satisfaction in reducing depressive symptoms in middle-aged and older adults. Additionally, in order to maximize the benefits of healthcare for mental health, the study suggests that Internet-using patterns could be a significant area for intervention.

Keywords Medical service satisfaction, Depression, Internet-using patterns, Latent class analysis, Middle-aged and older adults

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Introduction

Depression is a common mental illness that is marked by a high rate of occurrence, significant disability, increased risk of suicide, and a significant illness burden. Over time, depression has evolved into a major public health concern, endangering both physical and mental health. Significant disease burden has progressively developed into a notable public health issue that endangers people's physical and mental health [1]. According to recent data from the World Health Organization, over 280 million individuals globally are affected by depression [2]. In light of the demographic challenges posed by China's rapidly aging population, it is noteworthy that over 54 million individuals in the country are currently contending with depressive disorders, constituting approximately 17% of the global population affected by mental health conditions [3]. A national epidemiological survey in China showed that the lifetime prevalence of depression was higher in the middle-aged and older population than in other age groups [4]. Forecasts suggest that China's economic burden from depression will keep rising [5]. Consequently, research focusing on depression among middle-aged and elderly individuals in China holds significant implications for advancing mental health outcomes on a global scale.

Overall medical service satisfaction (OMSS) is a significant influence factor on individuals' pursuit of a healthy and fulfilling life [6]. A high level of OMSS has been shown in numerous studies to be linked to improvements in clinical indicators for particular diseases [7–9]. According to Expectation-confirmation theory (ECT), when people have high expectations for a certain service, but the actual experience fails to meet such expectations, their satisfaction with the service decreases [10]. And the feelings of disappointment and helplessness that come with such unmet expectations can lead to depression. The relationship between patient satisfaction and depression has been examined, for example, a cross-sectional study in Lithuania found that respondents who were more satisfied with primary healthcare services were associated with less depression [11]; a study of hypertension patients in Chinese elderly caring social organizations found that institutional satisfaction was negatively related to depression [12]. In contrast to research on patient satisfaction, OMSS is thought to be one of the most reliable indicators of the general subjective assessment of the healthcare system [13]. The reason is that the OMSS directly demonstrates how the general population uses medical services and whether or not they trust the healthcare system, as opposed to being limited to just the patient population [14]. Furthermore, it is critical to comprehend the connection between OMSS and depression in middle-aged and older adults, given the fact that the demand for medical services among this population is growing [15].

In addition to OMSS, Internet usage is another possible risk factor for mental health problems in middle-aged and older people. Due to the rapid development of information technology in recent years, more and more middle-aged and older adults have access to the Internet. Statistics show that the number of middle-aged and older adults Internet users has now exceeded 329 million, accounting for more than 30.8% of all Internet users in China [16]. According to the theory of Resocialization [17], individuals in middle and old age still need to produce new values to adapt to society and promote self-improvement through continuous learning. The use of the Internet as a new skill of life can play an important role in the resocialization process, which in turn can be beneficial to the mental health of middle-aged and older adults, as confirmed by some studies [18, 19], the Internet can improve mental health levels by widening access to psychological therapies, engaging in social activities, staying in touch with the community, and gaining a sense of psychological fulfilment and social belonging in a virtual world [20]. However, not all of these users benefit from the Internet, constrained by factors such as the ability to recognize information and access skills. Some studies indicated that long-term, over-frequent Internet use may be detrimental to depressive symptoms [21, 22]. And the majority of existing studies indicate that depression in middle-aged and older adults is influenced by the type of device used, how often it is used, and why it is used [21, 23, 24]. Based on this, we can see that different patterns of Internet-using are likely to have very different effects on depression in middle-aged and older adults. For the middle-aged and older Internet users, more focused mental health interventions will surely result from the integration of various Internet use behaviors and the identification of distinct patterns of use. Many research studies have attempted to classify and analyze various patterns of Internet use, the majority of these studies have concentrated on child or adolescent populations that are comparatively more likely to have access to the Internet and form problematic online behaviors [25–27]. While relatively few studies have addressed the growing number of middle-aged and older Internet users in relation to digital development [28]. Therefore, it is important to discuss the Internet-using patterns of middle-aged and older adults in order to understand the impact of their proficiency in Internet use skills on their mental health.

Meanwhile, the Technology Acceptance Model (TAM) indicates a possible connection between OMSS and Internet usage. Increases in Perceived Ease of Use are thought to boost Perceived Usefulness, according to TAM [29].

Individuals with higher Internet skill levels have been linked to an increased perception that using the Internet is easy (Perceived Ease of Use enhancement) [30]. They are more likely to learn about medical services, including the consultation process, information about specialists, and health-related topics with the Internet [31]. This enhances a person's OMSS and makes the consultation more efficient [32], so that they could have a higher tendency to perceive the value of information found on the Internet (Perceived usefulness enhancement). In other words, it is possible that a person's Internet usage habits have an impact on OMSS, which further influences depression. Nevertheless, little research has examined how Internet usage specifically influences the relationship between OMSS and depression.

Therefore, the current study aimed to identify specific characteristics of Internet users as well as investigate the relationship between OMSS and depression in Chinese middle-aged and older adults. Further determining the potential moderating impact of distinct Internet-using patterns in more detail. Based on the above analysis, we propose the following research hypotheses: (1) OMSS is negatively related to depression in middle-aged and older adults; (2) Internet-using patterns have a moderating effect on OMSS and depression in these individuals, with the potential moderating effect differing depending on individual Internet-using patterns.

Methods

Participants and procedure

The data utilized in this study came from the 2020 China Family Panel Studies (CFPS), a baseline survey that was started in 2010 and was surveyed longitudinally for five rounds in 2012, 2014, 2016, 2018, and 2020. The purpose of the survey was to look into changes in Chinese society's health, education, population, and economy on an individual, family, and community level. Furthermore, a multi-stage (county, community, and household) probability proportional to size (PPS) strategy with implicit stratification was employed in the research process in order to more accurately represent the state of Chinese society [33]. 42,590 people and 14,960 households from 25 provinces, municipalities, and autonomous regions in China were surveyed for the baseline study.

Between July 2020 and December 2020, 33,474 valid individual samples were collected during the fifth wave (CFPS 2020). We chose 4,856 Internet users who were 45 years of age or older to participate in the study because of study requirements. Finally, a total of 4,523 valid samples, including 3,495 middle-aged adults (aged 45 and above to 60) and 1,028 older adults (aged 60 and above), were obtained for analysis after responses such as "I don't know," "refused to answer," or "not applicable" were filtered out, along with missing values in the selected core variables.

Each respondent acknowledged having read the informed consent document and provided their voluntary consent to participate in the study. Additionally, the project has received approval from Peking University's Biomedical Ethics Committee (review batch number: IRB0000105214010).

Measurements

Overall medical service satisfaction

OMSS was defined as the public's overall satisfaction with medical service providers, including eight dimensions of providers' technical skills, providers' interpersonal skills, appointment wait times, office wait times, emergency care, costs of care, insurance coverage, hospital availability, and other resources [34]. In this study, OMSS refers to the conditions of medicine, doctors, hospitalizations, travel distance and transportation convenience, etc. "Are you satisfied with the overall medical service provided by the healthcare facility you usually visit?" is the question from CFPS 2020 that was used in this study to measure OMSS of middle-aged and older adults. Values on a five-point Likert scale, representing very unsatisfied, unsatisfied, fair, satisfied, and very satisfied, were used. A higher score indicates greater OMSS.

Depression

Researchers measured respondents' depression using the 8-item Center for Epidemiological Studies Depression Scale (CESD-8) in the CFPS 2020 questionnaire [35]. Since 2018, the CFPS group has condensed the 20 questions from the original CESD scale into the CESD-8 in an effort to maximize the low subject acceptance brought on by the scale's excessive number of questions. Good validity, reliability, and suitability for the Chinese population have been demonstrated for the CESD-8 [36, 37]. Every item was scored from 1 to 4, which stood for never (< 1 day), occasionally (1 day to 2 days), frequently (3 to 4 days), and most of the time (5 to 7 days). After reverse coding the two measures of positive mood, total scores were 8 to 32. A higher score indicates a higher level of depression, and vice versa. The Cronbach's alpha of this scale in the current sample was 0.78. Furthermore, the study established a dichotomous variable at the 17-point cut-off to determine whether participants had depression. Respondents were classified as having depression if their score was higher than or equal to 17 [38].

Latent class indicators

Major Internet-using device Based on the answers to the following two questions from the CFPS 2020 survey, this

study defines this variable: "In general, how often do you use mobile devices (e.g., mobile phones, tablets) to access the Internet each day?" and "In general, how often do you use a computer to access the Internet each day?" Mobile devices, coded as 1, are the primary Internet-using device if respondents indicated that they spend more time using them than computers to access the Internet; if not, non-mobile devices, coded as 2, are the primary Internet-using device.

Internet-using purposes Respondents were asked about the Internet-using purposes related to five aspects: playing online games, online shopping, watching short videos, e-learning, and using WeChat (social activities). Three categories were identified for Internet-using purposes [39]: social use, information seeking, and instrumental use. In this study, social use included using WeChat, information seeking included watching short videos, instrumental use comprised playing online games, online shopping, and e-learning. If the respondents' purposes of use consisted of two or more categories, the Internet-using purposes were relatively more, code as 1; if the respondents' purposes of use consisted of only one category, the Internet-using purposes were relatively less, code as 2.

Internet-using frequency Respondents were asked if they used the Internet almost every day in the past week for 4 online activities, including playing online games, shopping online, watching short videos, and e-learning. Based on previous research [40] and specific question settings in the CFPS survey, we determined the following coding approach: If respondents answered "yes" to one of these four questions, they were considered to have a relative high frequency, code as 1; conversely, if they answered "no" to all of these questions, they were considered to have a relative low frequency, code as 2.

Daily internet-using duration We summed the two lengths of time based on the two questions in 2.2.3.1., to determine the total minutes that respondents spent online each day. We truncated this continuous variable with a Winsorize cutoff of 1% above and below in order to remove any potential effects of outliers. Additionally, this study generated a binary variable using the mean splitting method. If the amount of time spent on the Internet exceeded the mean, it was considered to be a relatively long time and was coded as 1; if it was less than the mean, it was considered to be a relatively short time and was coded as 2.

Covariates

Based on earlier research [23, 38], a number of covariates, such as socioeconomic status, health behavior, health outcome, intergenerational support, and social support, were taken into account in this study. Demographic information included the following: age (1 = 45 ~ 59, 2 = 60 ~ 74, 3 = ≥ 75), sex (1 = male, 2 = female), residence (1 = urban, 2 = rural), education (1 = illiterate, 2 = primary school, 3 = middle school, 4 = high school and above), marital status (1 = /single(single/divorced/widowed), 2 = partnered (married/partnered)) and employment status (1 = yes, 0 = no). Subjective income status and subjective social status (both score ranging from 1 to 5, with higher scores indicating higher income status and social status, respectively) were included in socioeconomic status. Physical activity, siesta, smoking, and drinking were all included in health behavior (1 = yes, 0 = no). Health outcome was measured by presence or absence of chronic diseases (1 = yes, 0 = no). Intergenerational support (continuous variable) is the sum of the scores for instrumental and financial support [41]. Social support included pension (1 = yes, 0 = no) and medical insurance (1 = yes, 0 = no).

Statistical analysis

Statistical analyses were conducted using STATA version 17.0 for data cleaning and regression analysis, Mplus version 8.0 for latent class analysis, and the SPSS PROCESS macro for moderation effect analysis [42]. Based on particular posterior probabilities, latent class analysis (LCA) divided participants into various Internet use pattern groups and determined the ideal number of latent subgroups. The characteristics of the participants, the distribution of depression symptoms, and different Internet-using patterns were reported using either means (with standard deviations [SD]) or frequencies with percentages. Chi-square tests assessed the covariates stratified by depression status. The associations between OMSS and depression were investigated using binary logistic regression, both before and after covariates adjustment. In order to ascertain whether each Internet-using pattern group among middle-aged and older had a moderating effect between OMSS and depression, we treated the Internet-using pattern variable as a dummy variable and applied a moderation model. We looked into the simple effect in more detail. Each two-sided statistical test had a significance level of $p < 0.05$.

LCA is a kind of structural equation modeling that calculates the probability that a class member will support a specific item. To our knowledge, the best way to choose a fit model with the most classes is to use fitting indicators like the sample size-adjusted BIC (ssBIC), the Akaike

information criteria (AIC), and the Bayesian information criterion (BIC), where smaller values indicate a better fit. The Lo-Mendell-Rubin likelihood ratio test (LMRT) data helps to determine if the class k model or the class (*k*-1) model is better fit for the data. A model of class (*k*-1) should be rejected in favor of a model with at least class k, according to an LMRT with a low *p-value* [43].

Results

Participant characteristics

A summary of the participant characteristics and the distribution of depression are presented in Table 1. Among the 4,523 respondents, 19.9% had depression (mean score on the OMSS = 3.63), and 80.1% had no depression (mean score on the OMSS = 3.78). Specifically, those who were younger, female, living in rural areas, had lower levels of education, were single, self-reported lower income status, self-reported lower social status, did not engage in physical activity, did not smoke, did not drink alcohol, had chronic disease(s), had no pension, had no medical insurance, and had a lower OMSS were more likely to suffer from depression ($p < 0.05$).

Latent class model of internet-using pattern groups

The results of fitting the latent class models (one to six classes) for the consequence indicators are shown in Table 2. Eventually, the 3-class model was determined to be the best fitting due to the following factors: the lowest BIC and ssBIC values, 0.971 as the largest entropy value, and a significant (LMRT) result showed that the 3-class model was more appropriate than the other models.

The probabilities of engaging in various Internet-using behaviors according to latent classes are detailed in Table 3 and illustrated in Fig. 1. Figure 1 highlights that the likelihood of accessing the Internet primarily through mobile devices was high across all three groups. In detail, individuals in class 1 ($n = 1{,}978$, 43.7%) exhibited a broad range of Internet use purposes, the highest frequency of use, and the longest duration of use, earning them the label "Skilled use group". Those in class 2 ($n = 1{,}813$, 40.1%) also reported a wide variety of Internet use purposes and the second highest frequency of use, yet they spent the least amount of time online, leading to their classification as the "Controlled use group". Lastly, individuals in class 3 ($n = 732$, 16.2%) were characterized by fewer purposes for using the Internet, the lowest frequency of use, and the shortest duration of use, and were therefore labeled as the "Unskilled use group".

Different Internet-using patterns between subgroups

Table 4 shows the different Internet-using patterns between subgroups. The chi-square test results show that the Internet-using pattern has significant differences in age, residence, education, employment status, subjective income status, subjective social status, physical activity, siesta, intergenerational support, and pension.

Association between OMSS and depression

The relationship between OMSS and depression is shown in Table 5 both with and without adjusting for significant covariates. Before controlling for covariates ($\beta = -0.231$, $p < 0.001$) and after controlling for covariates ($\beta = -0.181$, $p < 0.001$), regression results showed that OMSS was negatively related to depression in middle-aged and older adults, indicating that the higher OMSS was, a lower risk of depression had.

The moderating role of each internet-using pattern

Moderation analyses were applied to examine the interaction between OMSS and Internet-using patterns on depression in middle-aged and older adults. As reported in Table 6, analyses showed that skilled use pattern had a significant positive moderating effect ($\beta = -0.272$, SE = 0.096, $p < 0.01$) between OMSS and depression, while unskilled use pattern had a significant negative moderating effect ($\beta = 0.497$, SE = 0.156, $p < 0.01$). Nevertheless, there was no evidence of the controlled use pattern's moderating effect.

The two significant interactions between OMSS and Internet-using patterns were further probed (Fig. 2). The relationship between OMSS and depression was found to be statistically significant for skilled use pattern ($\beta_{simple} = -0.335$, SE = 0.072, $p < 0.001$) but not for non-skilled use pattern ($\beta_{simple} = -0.063$, SE = 0.064, $p = 0.323$), according to simple slope analysis. Furthermore, the relationship between OMSS and depression was found to be statistically significant for non-unskilled use pattern ($\beta_{simple} = -0.239$, SE = 0.051, $p < 0.001$) but not for the unskilled use pattern ($\beta_{simple} = 0.258$, SE = 0.147, $p = 0.080$).

Discussion

The objective of this study was to explore the association between OMSS and depression, as well as to identify the specific characteristics of Internet users among middle-aged and older adults. Utilizing the most recent wave of the CFPS 2020 data, we aimed to identify the potential moderating effect of different Internet-using patterns on this association. Our findings indicated that 19.9% of participants reported depression scores above the cutoff. After adjusting for covariates, the results demonstrated a negative correlation between OMSS and depression among middle-aged and older adults. Most notably, we further uncovered how different Internet use patterns affect the relationship between OMSS and depression,

Table 1 Characteristics of the study sample ($n=4523$)

Variables	*n* (%)	Depression		*p value**
		Yes ($n=901$)	No ($n=3622$)	
Age				0.001
45 ~ 59	3495(77.3%)	733(21.0%)	2762(79%)	
60 ~ 74	964(21.3%)	162(16.8%)	802(83.2%)	
≥ 75	64(1.4%)	6(9.4%)	58(90.6%)	
Gender				< 0.001
Male	2448(54.1%)	421(17.2%)	2027(82.8%)	
Female	2075(45.9%)	480(23.1%)	1595(76.9%)	
Residence				< 0.001
Urban	2710(60.0%)	478(17.6%)	2232(82.4%)	
Rural	1813(40.0%)	423(23.3%)	1390(76.7%)	
Education				< 0.001
Illiterate	520(11.5%)	152(29.2%)	368(70.8%)	
Primary school	951(21.0%)	225(23.7%)	726(76.3%)	
Middle school	1624(35.9%)	299(18.4%)	1325(81.6%)	
High school and above	1428(31.6%)	225(15.8%)	1203(84.2%)	
Marital status				< 0.001
Single	395(8.7%)	132(33.4%)	263(66.6%)	
Partnered	4128(91.3%)	769(18.6%)	3359(81.4%)	
Employment status				0.612
Yes	3129(69.2%)	617(19.7%)	2512(80.3%)	
No	1394(30.8%)	284(20.4%)	1110(79.6%)	
Subjective income status, mean (SD)	2.88(1.01)	2.59(1.08)	2.95(0.98)	< 0.001
Subjective social status, mean (SD)	3.13(1.00)	2.91(1.10)	3.18(0.97)	< 0.001
Physical activity				< 0.001
Yes	2016(44.6%)	335(16.6%)	1681(83.4%)	
No	2507(55.4%)	566(22.6%)	1941(77.4%)	
Siesta				0.401
Yes	3065(67.8%)	600(19.6%)	2465(80.4%)	
No	1458(32.2%)	301(20.6%)	1157(79.4%)	
Smoking				0.020
Yes	1378(30.5%)	246(17.9%)	1132(82.1%)	
No	3145(69.5%)	655(20.8%)	2490(79.2%)	
Drinking				0.009
Yes	724(16.0%)	119(16.4%)	605(83.6%)	
No	3799(84.0%)	782(20.6%)	3017(79.4%)	
Chronic diseases				< 0.001
Yes	903(20.0%)	270(30.0%)	633(70.0%)	
No	3620(80.0%)	631(17.4%)	2989(82.6%)	
Intergenerational support, mean (SD)	1.32(3.91)	1.16(3.72)	1.36(3.95)	0.149
Pension				< 0.001
Yes	1197(26.5%)	192(16.0%)	1005(84.0%)	
No	3326(73.5%)	709(21.3%)	2617(78.7%)	
Medical insurance				0.002
Yes	4258(94.1%)	828(19.4%)	3430(80.6%)	
No	265(5.9%)	73(27.5%)	192(72.5%)	
OMSS, mean (SD)	3.75(0.77)	3.63(0.86)	3.78(0.75)	< 0.001

* *p* value was calculated using chi-square test accordingly

Table 2 Model fit information for competing class models

Number of classes	AIC	BIC	ssBIC	LMRT *P* value	Entropy	Minimum class probability
1	18833.767	18859.724	18846.724			
2	17565.721	17623.474	17594.875	< 0.001	0.678	31.8%
3 [a]	17485.701	17575.538	17531.052	< 0.001	0.971	16.2%
4	17470.685	17592.607	17532.232	0.382	0.801	2.3%
5	17473.943	17627.949	17551.686	0.499	0.625	5.7%
6	17483.943	17670.034	17577.883	0.016	0.403	6.2%

AIC Akaike information criterion, *BIC* Bayesian information criterion, *ssBIC* sample size-adjusted BIC, *LMRT* Lo-Mendell-Rubin adjusted likelihood ratio test. The optimal model is highlighted in bold

[a] Selected as final model

Table 3 The probabilities of each Internet-using behavior with 3-class model

Variables	Code	Skilled use group (43.7%)	Controlled use group (40.1%)	Unskilled use group (16.2%)
Major Internet-using device	1[a]	89.6%	97.0%	94.2%
	2[a]	10.4%	3.0%	5.8%
Internet-using purposes	1[b]	98.3%	95.7%	0%
	2[b]	1.7%	4.3%	100%
Internet-using frequency	1[c]	76.5%	64.2%	0%
	2[c]	23.5%	35.8%	100%
Daily Internet-using duration	1[d]	100%	0%	33.2%
	2[d]	0%	100%	66.8%

1a = mobile devices, 2a = non-mobile devices, 1b = relatively more purposes, 2b = relatively less purposes, 1c = relative high frequency, 2c = relative low frequency, 1d = relative long time, 2d = relative short time

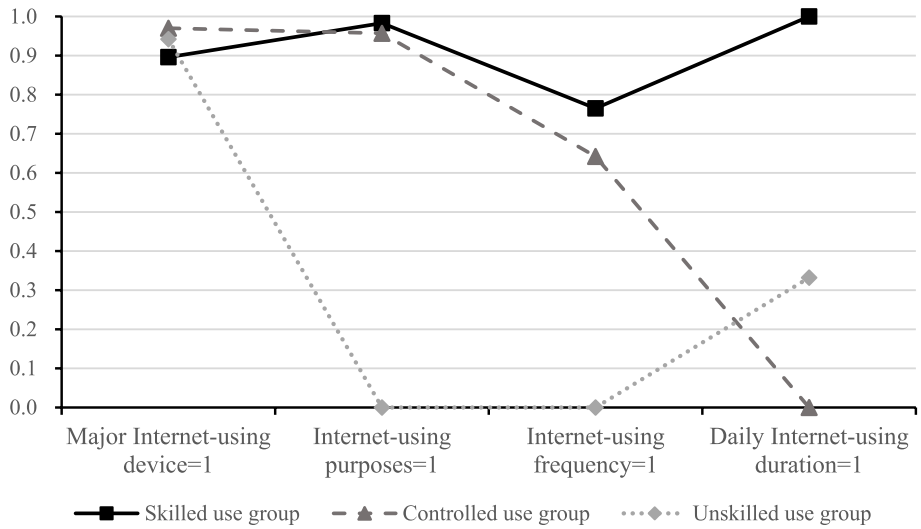

Fig. 1 Classification chart of 3 Internet-using pattern groups

Table 4 Different Internet-using patterns between subgroups ($n=4523$)

Variables	Internet-using pattern			
	Skilled use ($n=1978$)	Controlled use ($n=1813$)	Unskilled use ($n=732$)	*p value**
Age				< 0.001
45 ~ 59	1561(44.7%)	1479(42.3%)	455(13.0%)	
60 ~ 74	395(41.0%)	318(33.0%)	251(26.0%)	
≥ 75	22(34.4%)	16(25%)	26(40.6%)	
Gender				0.334
Male	1051(42.9%)	985(40.2%)	412(16.9%)	
Female	927(44.7%)	828(40.0%)	320(15.3%)	
Residence				< 0.001
Urban	1356(50.0%)	929(34.3%)	425(15.7%)	
Rural	622(34.5%)	884(48.8%)	307(16.7%)	
Education				< 0.001
Illiterate	144(27.7%)	267(51.3%)	109(21.0%)	
Primary school	339(35.6%)	451(47.4%)	161(17.0%)	
Middle school	670(41.3%)	688(42.4%)	266(16.3%)	
High school and above	825(57.8%)	407(28.5%)	196(13.7%)	
Marital status				0.453
Single	183(46.3%)	155(39.2%)	57(14.5%)	
Partnered	1795(41.6%)	1658(40.2%)	675(16.4%)	
Employment status				< 0.001
Yes	1319(42.2%)	1384(44.2%)	426(13.6%)	
No	659(47.2%)	429(30.8%)	306(22.0%)	
Subjective income status, mean (SD)	2.85(0.98)	2.87(1.01)	3.00(1.07)	0.002
Subjective social status, mean (SD)	3.09(0.97)	3.13(1.02)	3.25(1.03)	0.001
Physical activity				< 0.001
Yes	1056(52.4%)	667(33.1%)	293(14.5%)	
No	922(37.2%)	1146(45.7%)	439(17.1%)	
Siesta				0.026
Yes	1381(45.1%)	1207(39.4%)	477(15.5%)	
No	597(40.9%)	606(41.6%)	255(17.5%)	
Smoking				0.133
Yes	576(41.8%)	582(42.2%)	220(16.0%)	
No	1402(44.6%)	1231(39.1%)	512(16.3%)	
Drinking				0.251
Yes	337(46.5%)	276(38.1%)	111(15.4%)	
No	1641(43.2%)	1537(40.5%)	621(16.3%)	
Chronic diseases				0.352
Yes	392(43.4%)	377(41.7%)	134(14.9%)	
No	1586(43.5%)	1436(40.0%)	598(16.5%)	
Intergenerational support, mean (SD)	1.11(3.49)	1.18(3.81)	2.22(4.94)	< 0.001
Pension				< 0.001
Yes	535(44.7%)	380(31.7%)	282(23.6%)	
No	1443(43.3%)	1443(43.3%)	450(13.4%)	
Medical insurance				0.374
Yes	1864(43.8%)	1713(40.2%)	681(16.0%)	
No	114(43.1%)	100(37.7%)	51(19.2%)	
OMSS, mean (SD)	3.75(0.77)	3.74(0.79)	3.80(0.72)	0.198

* *p* value was calculated using chi-square test accordingly

Table 5 The association between OMSS and depression

Variables	Model 1			Model 2		
	β	*SE*	*t*	*β*	*SE*	*t*
OMSS	-0.231	0.046	-5.05***	-0.181	0.048	-3.79***
Age (Ref = 45 ~ 59)						
60 ~ 74				-0.077	0.133	-0.58
≥ 75				-0.847	0.461	-1.84
Gender (Ref = male)						
Female				0.320	0.101	3.18**
Residence (Ref = urban)						
Rural				0.248	0.087	2.83**
Education (Ref = illiterate)						
Primary school				-0.286	0.129	-2.20*
Middle school				-0.526	0.124	-4.24***
High school and above				-0.580	0.135	-4.29***
Marital status (Ref = Single)						
Partnered				-0.735	0.121	-6.07***
Subjective income status				-0.249	0.045	-5.45***
Subjective social status				-0.139	0.044	-3.12**
Physical act				-0.224	0.086	-2.61**
Smoking				-0.023	0.107	-0.21
Drinking				-0.050	0.120	-0.42
Chronic diseases (Ref = yes)						
No				0.725	0.090	8.06***
Pension (Ref = yes)						
No				-0.251	0.129	-1.95
Medical insurance (Ref = yes)						
No				-0.326	0.151	-2.16*

Model 1 is an unadjusted model, Model 2 adjusts for meaningful covariates related to depression, such as age, gender, residence, etc

* represent $p < 0.05$

** represent $p < 0.01$

*** represent $p < 0.001$

Table 6 Moderating role of Internet-using patterns in the influence of OMSS on depression

Variables	*β*	*SE*	*t* value	95% *CI*
OMSS	-0.063	0.064	-0.99	-0.188 ~ 0.062
Skilled use pattern(W_1)	1.040	0.360	2.88**	0.334 ~ 1.745
OMSS * W_1	-0.272	0.096	-2.84**	-0.460 ~ -0.085
OMSS	-0.209	0.064	-3.28**	-0.334 ~ -0.084
Controlled use pattern(W_2)	-0.252	0.360	-0.70	-0.958 ~ 0.454
OMSS * W_2	0.064	0.096	0.67	-0.123 ~ 0.251
OMSS	-0.239	0.051	-4.70***	-0.338 ~ -0.139
Unskilled use pattern(W_3)	-1.920	0.606	-3.17**	-3.108 ~ -0.731
OMSS * W_3	0.497	0.156	3.19**	0.192 ~ 0.802

The independent variable was OMSS and the dependent variable was depression; Internet-using patterns (including skilled use pattern, controlled use pattern, and unskilled use pattern) were moderator variables. The moderating effect analyses controlled for all the meaningful covariates

* represent $p < 0.05$

** represent $p < 0.01$

showing that the skilled use pattern and unskilled use pattern play positive and negative moderating roles, respectively, in the effect of OMSS on depression. However, the controlled use pattern did not exhibit a moderating effect on the association between OMSS and depression. This study highlights the significant role of OMSS in promoting mental health among middle-aged and older adults, which may vary depending on different Internet-using patterns.

Our results show that there is a negative association between OMSS and depression. Similarly, many previous studies have shown that satisfaction with medical service affects an individual's level of mental health, but most have focused on patient satisfaction [11, 12, 44, 45]. For our study result, a possible explanation could be that high-quality medical services can identify and treat symptoms related to depression, such as chronic pain, sleep disturbances, and medication side effects

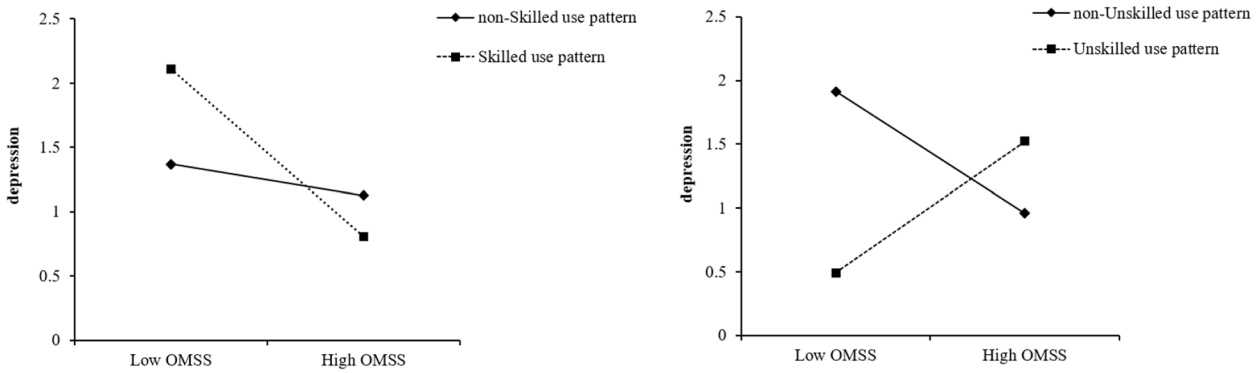

Fig. 2 The interaction effect of OMSS and Internet-using patterns on depression

[46]. Additionally, satisfying healthcare experiences can enhance individuals' self-efficacy and positive health perceptions, thereby alleviating depression symptoms [47]. Furthermore, if middle-aged and older adults can obtain good social support through medical services [48], such as establishing trust with providers, participating in support groups, or connecting with others through the healthcare system, this could reduce feelings of loneliness and social isolation, both of which are significant risk factors for depression [49, 50].

It's noteworthy that our study revealed that the skilled Internet-using pattern positively moderated the effect of OMSS on depression among middle-aged and older adults, meaning that skilled use pattern significantly enhanced the impact of OMSS on depression. With the advancement of digitalization, much medical service information, such as consultation routes, specialist details, and procedures, is easily accessible online. This means that middle-aged and older adults who are proficient in using the Internet are more likely to accurately understand their health conditions and treatment options [51], thereby helping to alleviate symptoms of depression. Moreover, skilled Internet users may obtain emotional support and practical advice through social media and online support groups, which are known important factors in preventing and treating depression [52]. Skilled Internet users among middle-aged and older adults might also have a stronger sense of self-efficacy and control over health management [53, 54], potentially leading to higher OMSS and a lower risk of depression.

Conversely, the study also demonstrated the negative moderating effect of the unskilled Internet-using pattern on the relationship between OMSS and depression among middle-aged and older adults, meaning the unskilled use pattern significantly weakened the effect of OMSS on depression. The relationship between low OMSS and high risk of depression might be more pronounced in this group due to the dual challenges of accessing healthcare services and using information technology. This is primarily attributed to the digital divide caused by unskilled Internet use, leading to numerous obstacles in seeking and receiving healthcare services [55, 56]. Currently, in China, many medical services, including appointments, consultations, and electronic health record management, offer online service options. However, due to low Internet proficiency, complex operations of Internet hospital systems, and distrust in online medical services, what should be convenient services like online appointments, inquiries, and prescription refills become inconvenient for them, further affecting their OMSS [57]. In order to enhance the digital skills of the middle-aged and older adults and promote their better use of network support services to fully utilize the advantages of the Internet, the community can provide digital skills training and cybersecurity education; medical service organizations can collaborate with relevant technology companies to simplify the design of online healthcare platforms to ensure that middle-aged and elderly users can easily get used to the services; and the government can introduce policies to incentivize healthcare and technology companies to develop suitable online services for the middle-aged and the elderly and set up funds to support the relevant projects.

Interestingly, our findings did not reveal any significant moderating effects of the controlled Internet-using pattern on the relationship between OMSS and depression among middle-aged and older adults. This may suggest that although the controlled Internet-using pattern can help avoid excessive reliance on the Internet or reduce potential issues of Internet addiction, considered healthy digital habits in daily life, it may not provide sufficient social support, medical consultation, or mental health resources, which are crucial for improving satisfaction with healthcare services and alleviating symptoms of depression. Therefore, how to encourage controlled Internet use among middle-aged and older adults while enhancing the efficiency of using Internet resources to meet their medical health and mental health needs would

be an urgent issue to address. Following studies endeavors ought to investigate whether this outcome is consistent across diverse populations and delve deeper into the factors contributing to its manifestation.

This study has practical implications. Firstly, given the frequent occurrence of mental illness epidemics, it concentrates on middle-aged and older adults as a particular risk group, instead of limiting its analysis to patients with a specific illness, and investigates the direct correlation between OMSS and depression in this population, providing additional evidence regarding the influence of medical service satisfaction on the mental health of middle-aged and older adults. Secondly, rather than focusing solely on a single Internet use behavior, as most previous studies have done, this article uses LCA to comprehensively analyze Internet use patterns, considering multiple variables such as the device, purposes, frequency, and daily duration of Internet use. By examining the differences in Internet use patterns among middle-aged and older adults in the current digital development context, it provides a basis for future targeted psychological health interventions for different user groups. Most importantly, this study innovatively explores how different Internet-using patterns moderate the relationship between OMSS and depression among middle-aged and older adults, offering insights and directions for future related research.

However, there are several limitations to this study. First, the use of the database is limited to the CFPS survey, and future research could consider including additional databases to obtain more representative results. Second, the measures of Internet use and depression symptoms were self-reported, which may introduce recall bias and inaccuracies in capturing Internet use behaviors. Third, due to the diverse combinations and measurements of Internet use patterns, it's necessary to interpret our results within a specific context compared to similar studies. Additionally, the cross-sectional nature of the data and the theoretical derivation of the relationship between OMSS and depression cannot fully exclude potential endogeneity issues, such as reverse causality. More rigorous study designs, such as natural experiments, instrumental variables, or longitudinal data validation, are needed to determine the causal relationship between the two.

Conclusions

Our research findings indicate a negative correlation between OMSS and depression among middle-aged and older adults. Furthermore, the skilled and unskilled Internet-using patterns play positive and negative moderating roles, respectively, in the influence of OMSS on depression, while no moderating effect was observed for the controlled Internet-using pattern. Our results offer new insights into the prevention and intervention of mental health issues among middle-aged and older adults and highlight the potential mechanisms of internet use patterns. They underscore the importance of enhancing clinical attention towards middle-aged and older adults with internet usage behaviors.

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Authors' contributions
Lunxin Liu: Conceptualization, formal analysis, methodology, software, visualization, writing—original draft and writing—review & editing. Boya Liu: Conceptualization, formal analysis, validation, visualization, writing—original draft and writing—review & editing. Jing Zheng and Lang Wang: Writing—review & editing. Zhiliu Liao: Conceptualization, supervision and writing—review & editing. Hong Xu: Supervision.

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Data availability
Data are available from the authors by request from the website (http://www.isss.pku.edu.cn/cfps/).

Declarations

Ethics approval and consent to participate
The current study is used a secondary analysis of CFPS. The CFPS study has received approval from Peking University's Biomedical Ethics Committee (review batch number: IRB00000105214010). Each respondent acknowledged having read the informed consent document and provided their voluntary consent to participate in the study.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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References

1. Malhi GS, Mann JJ. Depression. Lancet. 2018;392:2299–312.
2. Feng M-Y, Bi Y-H, Wang H-X, Pei J-J. Influence of chronic diseases on the occurrence of depression: A 13-year follow-up study from the survey of health, ageing and retirement in Europe. Psychiatry Res. 2023;326:115268.
3. Liu S, Page A. Reforming mental health in China and India. Lancet. 2016;388:314–6.
4. Lu J, Xu X, Huang Y, Li T, Ma C, Xu G, et al. Prevalence of depressive disorders and treatment in China: a cross-sectional epidemiological study. Lancet Psychiatry. 2021;8:981–90.
5. Zhang Z, Sun K, Jatchavala C, Koh J, Chia Y, Bose J, et al. Overview of stigma against psychiatric illnesses and advancements of anti-stigma activities in six Asian societies. Int J Environ Res Public Health. 2019;17:280.
6. Wang W, Cao Y. How individual social capital affects residents' satisfaction with medical services: based on the evidence from urban residents in China. Front Psychol. 2022;13:1077144.

7. Anderson PM, Krallman R, Montgomery D, Kline-Rogers E, Bumpus SM. The relationship between patient satisfaction with hospitalization and outcomes up to 6 months post-discharge in cardiac patients. J Patient Exp. 2020;7:1685–92.
8. Boulding W, Glickman SW, Manary MP, Schulman KA, Staelin R. Relationship between patient satisfaction with inpatient care and hospital readmission within 30 days. Am J Manag Care. 2011;17:41–8.
9. Krauss P, Reinartz F, Sonnleitner C, Vazan M, Ringel F, Meyer B, et al. The Relation of Patient Expectations, Satisfaction, and Outcome in Surgery of the Cervical Spine: A Prospective Study. Spine. 2022;47:849.
10. Oliver RL. A cognitive model of the antecedents and consequences of satisfaction decisions. J Mark Res. 1980;17:460–9.
11. Kavalnienė R, Deksnyte A, Kasiulevičius V, Šapoka V, Aranauskas R, Aranauskas L. Patient satisfaction with primary healthcare services: are there any links with patients' symptoms of anxiety and depression? BMC Fam Pract. 2018;19:90.
12. Ji K, Bai Z, Tang L, Yan H, Zhu Y, Chen G, et al. Institutional satisfaction and anxiety mediate the relationship between social support and depression in hypertension patients in elderly caring social organizations: a cross-sectional study. Front Psychol. 2021;12:772092.
13. Blendon RJ, Kim M, Benson JM. The public versus the World Health Organization on health system performance. Health Aff Proj Hope. 2001;20:10–20.
14. Zheng W, Liang Y, Lee WS, Ko Y. The mediation effect of perceived attitudes toward medical service on the association between public satisfaction with the overall medical service and self-rated health among the general population in China: a cross-sectional study. Int J Environ Res Public Health. 2023;20:3369.
15. Liu TY, Qiu DC, Chen T. Effects of social participation by middle-aged and elderly residents on the utilization of medical services: evidence from China. Front Public Health. 2022;10:824514.
16. Jin Y, Hu W, Feng Y. Internet use and the life of older adults aged 50 and above in digital era: findings from a national survey. Popul Res. 2024;48:40–55.
17. Palmore E. Socialization to Old Age. Soc Forces. 1976;55:215–6.
18. Wang Y, Zhang H, Feng T, Wang H. Does internet use affect levels of depression among older adults in China? A propensity score matching approach. BMC Public Health. 2019;19:1474.
19. Yang H, Zhang S, Zhang S, Xie L, Wu Y, Yao Y, et al. Internet use and depressive symptoms among older adults in China. Front Psychiatry. 2021;12:739085.
20. Zhang C, Wang Y, Wang J, Liu X. Does internet use promote mental health among middle-aged and older adults in China? Front Psychol. 2022;13:999498.
21. Lam SSM, Jivraj S, Scholes S. Exploring the relationship between internet use and mental health among older adults in england: longitudinal observational study. J Med Internet Res. 2020;22:e15683.
22. Mu A, Liu Z. Internet use and depressive symptoms among Chinese older adults: two sides of internet use. Front Public Health. 2023;11:1149872.
23. Du X, Liao J, Ye Q, Wu H. multidimensional internet use, social participation, and depression among middle-aged and elderly Chinese individuals: nationwide cross-sectional study. J Med Internet Res. 2023;25:e44514.
24. Xie L, Yang H, Lin X, Ti S, Wu Y, Zhang S, et al. Does the internet use improve the mental health of Chinese older adults? Front Public Health. 2021;9:673368.
25. Mok J-Y, Choi S-W, Kim D-J, Choi J-S, Lee J, Ahn H, et al. Latent class analysis on internet and smartphone addiction in college students. Neuropsychiatr Dis Treat. 2014;10:817–28.
26. Park S, Lee H. Patterns of online activities and related psychosocial factors in adolescence: a latent class analysis. Int J Ment Health Addict. 2019;17:1147–61.
27. Pontes HM, Macur M. Problematic internet use profiles and psychosocial risk among adolescents. PLoS ONE. 2021;16:e0257329.
28. Park S, Kim B. Readiness for utilizing digital intervention: Patterns of internet use among older adults with diabetes. Prim Care Diabetes. 2020;14:692–7.
29. Davis FD. Perceived usefulness, perceived ease of use, and user acceptance of information technology. Mis Q. 1989;13:319–40.
30. Hargittai E. Second-Level Digital Divide: Differences in People's Online Skills. First Monday. 2002;7.
31. Liu H, Gong X, Zhang J. Does internet use affect individuals' medical service satisfaction? Evidence from China Healthcare. 2020;8:81.
32. Wang X, Luan W. Research progress on digital health literacy of older adults: a scoping review. Front Public Health. 2022;10:906089.
33. Xie Y, Hu J. An introduction to the China Family Panel Studies (CFPS). Chin Sociol Rev. 2014;47:3–29.
34. Ware JE, Snyder MK, Wright WR, Davies AR. Defining and measuring patient satisfaction with medical care. Eval Program Plann. 1983;6:247–63.
35. Van de Velde S, Bracke P, Levecque K, Meuleman B. Gender differences in depression in 25 European countries after eliminating measurement bias in the CES-D 8. Soc Sci Res. 2010;39:396–404.
36. Gyasi RM, Hajek A, Owusu R, James PB, Boampong MS, Accam BT, et al. Sleep and happiness in urban-dwelling older adults in ghana: a serial multiple mediation model of generalized anxiety and depressive symptoms. Am J Geriatr Psychiatry. 2023;31:953–64.
37. Li X, Yang H, Jia J. Impact of energy poverty on cognitive and mental health among middle-aged and older adults in China. Humanit Soc Sci Commun. 2022;9:253.
38. Zhang C, Liang X. Association between WeChat use and mental health among middle-aged and older adults: a secondary data analysis of the 2020 China family panel studies database. BMJ Open. 2023;13:e073553.
39. Szabo A, Allen J, Stephens C, Alpass F. Longitudinal analysis of the relationship between purposes of internet use and well-being among older adults. Gerontologist. 2019;59:58–68.
40. Xu Y, Huang Y. Chinese middle-aged and older adults' internet use and happiness: the mediating roles of loneliness and social engagement. J Appl Gerontol. 2021;40:1846–55.
41. Zhou A, Song Y, Li X, Hu B, Chen Y, Cui P, et al. Functional limitation and happiness among older adults: the multiple mediating role of intergenerational support and intergenerational relationship. Front Public Health. 2023;11:1249216.
42. Hayes A. Introduction to mediation, moderation, and conditional process analysis. J Educ Meas. 2013;51:335–7.
43. Wang M, Li T, Xie Y, Zhang D, Qu Y, Zhai S, et al. Clustered health risk behaviors with comorbid symptoms of anxiety and depression in young adults: moderating role of inflammatory cytokines. J Affect Disord. 2024;345:335–41.
44. Chen Q, Beal EW, Okunrintemi V, Cerier E, Paredes A, Sun S, et al. The association between patient satisfaction and patient-reported health outcomes. J Patient Exp. 2019;6:201–9.
45. Fröjd C, Lampic C, Larsson G, von Essen L. Is satisfaction with doctors' care related to health-related quality of life, anxiety and depression among patients with carcinoid tumours? A longitudinal report. Scand J Caring Sci. 2009;23:107–16.
46. Miller-Matero LR, Hecht LM, Miller MK, Autio K, Pester BD, Tobin ET, et al. A brief psychological intervention for chronic pain in primary care: a pilot randomized controlled trial. Pain Med. 2021;22:1603–11.
47. Maeda U, Shen B-J, Schwarz ER, Farrell KA, Mallon S. Self-efficacy mediates the associations of social support and depression with treatment adherence in heart failure patients. Int J Behav Med. 2013;20:88–96.
48. Ding S, Liu G, Xu F, Ji K, Zhao L, Zheng X, et al. The satisfaction of elderly people with elderly caring social organizations and its relationship with social support and anxiety during the COVID-19 pandemic: a cross-sectional study. BMC Public Health. 2023;23:1206.
49. Erzen E, Çikrikci Ö. The effect of loneliness on depression: a meta-analysis. Int J Soc Psychiatry. 2018;64:427–35.
50. Zhang Y, Kuang J, Xin Z, Fang J, Song R, Yang Y, et al. Loneliness, social isolation, depression and anxiety among the elderly in Shanghai: findings from a longitudinal study. Arch Gerontol Geriatr. 2023;110:104980.
51. E Y, Yang J, Niu L, Lu C. The impact of internet use on health status among older adults in China: The mediating role of social support. Front Public Health. 2023;11.
52. Mohd TAMT, Yunus RM, Hairi F, Hairi NN, Choo WY. Social support and depression among community dwelling older adults in Asia: a systematic review. BMJ Open. 2019;9:e026667.
53. An S, Lee J. Older adults' health promotion via mobile application: the effect of self-efficacy and social stigma. Korean J J Commun Stud. 2019;63:113–42.
54. Duplaga M. The association between Internet use and health-related outcomes in older adults and the elderly: a cross-sectional study. BMC Med Inform Decis Mak. 2021;21:150.

55. Olphert W, Damodaran L. Older people and digital disengagement: a fourth digital divide? Gerontology. 2013;59:564–70.
56. Robotham D, Satkunanathan S, Doughty L, Wykes T. Do we still have a digital divide in mental health? A five-year survey follow-up. J Med Internet Res. 2016;18:e309.
57. Qin H, Xiao M, Hu L. Research on the current status of aging-appropriate in Internet hospital. Chin Hosp. 2022;26:47–9.

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