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The Association between Internet Use and Depression Risk among Chinese Adults, Middle-Aged and Older, with Disabilities

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Abstract: Background: Globally, nearly 15% of people suffer from various kinds of disabilities, and China has the largest disabled population in the world. The poor mental health status of people with disabilities has become an essential issue in most countries. The main aim of this study was to explore the potential impact of internet use on depression risk among middle-aged and older adults with different types of disabilities. Methods: The data used in this study were obtained from the 2018 China Health and Retirement Longitudinal Study (CHARLS) collected by Peking University. A binary logit model was used to analyze the impact of internet use on the depression risk among adults with disabilities, and the substitute variable method and the propensity score matching method were used to examine the robustness of the results. Results: (1) Internet use was negatively associated with depression risk among disabled people, and the higher the frequency of their internet use, the lower the probability of their depression risk. (2) Different social activities related to the internet had different impacts on the depression risk, and the decline in depression risk was mainly related to watching videos, watching news, and chatting via the internet. (3) Internet use reduced the depression risk of adults with physical disabilities, but had no impact on those with other types of disabilities. Conclusions: Our study suggests that internet use may have a positive spillover effect on decreasing the depression risk of disabled people, but the reduction effect is significantly affected by the social activities related to the internet and the types of disabilities.

Keywords: internet use; depression risk; disability; middle-aged and older adults; China

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1. Introduction

Disability is a general term used to denote impairments, activity limitations, and an individual's restriction in participating in various activities, which are the result of the interaction between human physical characteristics and the society in which adults with disabilities live [1]. Referring to the International Classification of Functioning, Disability, and Health (ICF), disability mainly consists of "functional impairments", "activity limitations", and "participation restriction" (WHO, Geneva, Switzerland, 2019). The data released by the World Health Survey (WHS) estimated that more than 1 billion people worldwide suffer from various disabilities, accounting for 15% of the world's population [2]. As a developing country, China has the largest disabled population in the world. It was estimated by the China Disabled Persons' Federation that the number of disabled people had reached 85.02 million in 2010, implying that 6.2% of the total population are suffering from various disabilities, and this proportion is gradually increasing (CDPF, 2021). Individuals with functional limitations and physical impairments are usually disadvantaged in their participation in society, which is contradictory to fundamental human rights and

affects their health and well-being [3–6]. Compared to the non-disabled population, people with disabilities are at a higher risk for mental health issues due to the many challenges caused by poor health, lower education levels, employment difficulties, lower income levels, higher incidences of poverty, and limited social participation [7,8]. Previous studies have found that people with disabilities suffer from more serious anxiety and depression owing to physiological diseases, and nearly all disabled people have varying psychological problems. For instance, the quality of life of disabled people is significantly lower than that of healthy people [9], and they are more likely to experience symptoms of anxiety and depression [10,11], which lead to the deterioration of their overall mental health status.

More importantly, in the context of accelerating global population aging, the number of disabled people in the older population will also rise, which will limit their social participation, and thus worsen their mental health level. The data showed that nearly one out of every five older adults with ADL disability is associated with depression in the United States, and that the prevalence of depression among the elderly with disabilities reached 20% [12]. Depression is more common among older people in Republic of Korea; nearly 20–70% of older people were affected by varying degrees of depression [13]. The depression seen amongst disabled people in China is also not encouraging. The detection rate of depression was 17.40% in 2021, and this rate was even higher among middle-aged and elderly adults with disabilities, reaching 54.5% [14]. Numerous studies have confirmed that depression was associated with increasing medical costs [15], mortality [16], a lower quality of life, and lower levels of well-being [17,18]. How to encourage middle-aged and older adults with disabilities to actively participate in social activities and improve their mental health status has become a significant issue that the Chinese government has to address.

Fortunately, the development of the information society provides a convenient opportunity for individuals with disabilities to communicate and participate in social activities, the basic manifestation of which is the popularity and widespread use of the internet. According to the data issued by the China Internet Network Information Center (CINIC), the total number of internet users in China increased to 1.032 billion in 2021, and the internet penetration rate reached 73.0%. Among older adults, more than 119 million utilize the internet, with an internet penetration rate of 43.2% (CINIC, 2021). Middle-aged and elderly people can receive massive amounts of information, communicate instantly, and use a variety of convenient services without leaving their home via the use of the internet. Internet technology is reshaping the form by which people with disabilities can participate in social activities, and has excellent health spillover effects. Previous studies have showed that internet use has a positive impact on depression, mental health, social participation, and the subjective well-being of the elderly [19–22]. White (2002) mentioned that the use of the internet can improve the elderly's participation in online leisure activities and social activities, and this is beneficial to reducing loneliness and depression [23], thereby improving their life satisfaction and subjective well-being [24,25]. Cotten et al. (2012) found that internet use was positively related to the mental health of retired adults, which could reduce the risk of depression of retired elderly people by 20–28% [26].

Against this background, some scholars began to focus on the impact of internet use on the mental health of disabled adults, but existing studies have not reached a consensus on the health spillover effects of internet use. Most studies suggested that internet use can significantly reduce the risk of depression among older people with disabilities. Using a randomized controlled trial, Cotten et al. (2013) found that internet use could significantly reduce the risk of depression symptoms among elderly disabled people [27]. Duplaga and Szulc [28] held that internet use could decrease the loneliness experienced by individuals with disabilities by 40%. Birnie and Horvath [29] found that those who were not active in the physical world may utilize the internet more frequently and benefit from it. For those people with disabilities, online communication may be regarded as a compensation for the lack of social interaction. Lee and Cho [30] found that frequent internet use could significantly reduce the depression levels of disabled people, and the use of social media

could help them establish social support networks and healthy psychological tendencies. A few scholars, however, have drawn different conclusions, believing that there is a huge digital divide for disabled people. The proportion of disabled people using the internet is significantly lower than that of the general population [20,31,32], and internet use was found to be positively associated with depression levels, loneliness, and stress [33].

Overall, the existing literature has some shortcomings. First of all, many scholars have discussed the effect of internet use on the mental health of the elderly in high-income countries, but more empirical evidence is needed from middle- and low-income countries. Moreover, although a few studies concentrated on the impact of internet use on the mental health and depression levels of disabled people, they ignored that the different purposes of internet use may have different effects on depression risk, and this has not been addressed in any previous studies. Third, the digital divide caused by disabilities varies significantly with the types of disabilities, so internet use may have different impacts on the risk of depression among older adults with different types of disabilities. However, few works in the literature have explored the possible differential effects of internet use on different types of disabilities. Finally, there is a digital gap between urban and rural areas, and the internet penetration rate in rural areas is only 57.6%, far below the average of 73.0%, which may have different impacts on the mental health of people with disabilities.

This article aims to respond to the above questions, and the possible contributions are as follows: First, we used the nationally representative China Health and Retirement Longitudinal Survey (CHARLS) to measure the internet use of middle-aged and elderly people with disabilities from three aspects—internet use, frequency of internet use, and social activities related to internet use—and further systematically explored the association between internet use and the risk of depression among them in the information society. We aimed to provide instant and verified evidence to allow the government to actively address the problem of "ageing brought about by disability" and "disability caused by ageing". In addition, we classified the disabled people based on the types of their disabilities, and analyzed the impact of internet use on people with different types of disabilities so as to provide evidence regarding maximizing the positive spillover effects of internet use on health. Finally, we analyzed the possible age and urban–rural differences.

2. Materials and Methods

2.1. Data Source

The data used in our study were obtained from the 2018 China Health and Retirement Longitudinal Study (CHARLS). CHARLS is a national and continuous largescale social survey project conducted by the Chinese Social Science Research Centre at Peking University, which aims to collect demographic, internet access, health status, and other information from middle-aged Chinese people (aged $\geq$ 45). The database consisted of 7 modules, including "Demographic Information", "Family", "Cognition and Depression", "Healthcare & Insurance", "Work, Retirement & Pension", "Household Income & Expenditures" and "House Property". According to the research purpose, this study mainly used the "Demographic Information", "Cognition and Depression" and "Healthcare & Insurance" modules of the 2018 CHARLS to analyze the impact of internet use on depression risk among middle-aged and older adults with disabilities.

We cleaned the data as follows: firstly, we matched all modules and removed the duplicate samples to obtain a sample size of 19,816. Secondly, we only kept the samples with disabilities to obtain a sample size of 5329. Finally, after removing the samples with extreme values of household income and missing values of all controlled variables, a final sample size of 5220 was used to analyze the association between internet use and depression risk in middle aged and older adults with disabilities. Figure 1 presents the process of sample selection.

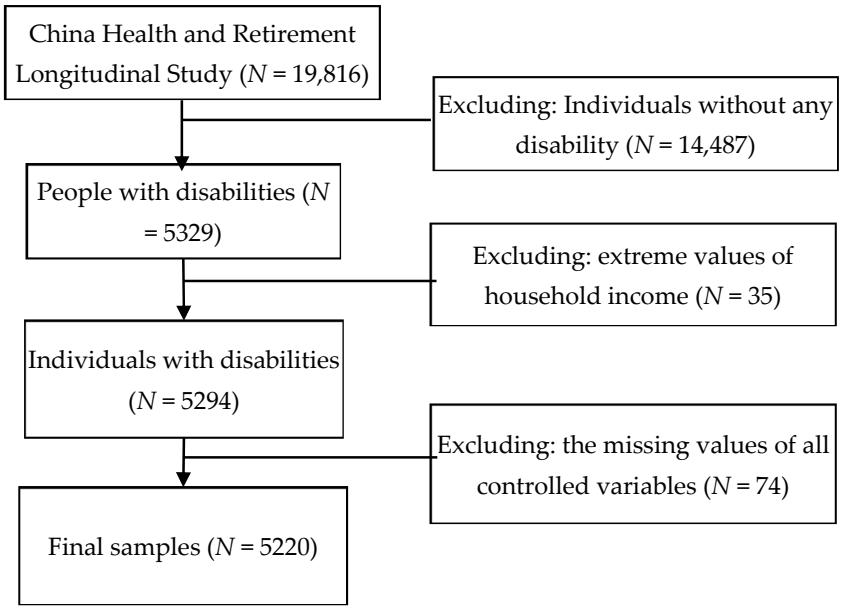

Figure 1. Flowchart of samples selection.

2.2. Variables

Dependent variables. We used depression to represent the mental health level of middle-aged and older adults with disabilities. Depression has been proven to be the most vital predicting indicator of mental health. Residents with depressive symptoms are more likely to suffer from serious psychological problems [34]. In our study, we adopted the 10-item Center for Epidemiologic Studies Depression Scale (CES-D-10) to assess the depression status of individuals. The CESD-10 included 10 questions, and each question inquired as to the respondent's mood during the previous week. Each respondent was asked to answer each question with one of four options ("Rarely or none of the time" = 0, "Some or a little of the time" = 1, "Occasionally or a moderate amount of the time" = 2, and "Most or all the time" = 3). After positive emotional responses were reverse-scored, we finally obtained a summed score of 0–30. Referring to previous studies, the cut-off point of CES-D-10 was 10, and the respondents whose score exceeded 10 were deemed to be more likely to suffer from depression [35]. Therefore, we generated a dummy variable of "depression", and when a respondent's score exceeded 10 we assigned a value of 1, and 0 was valued when the score was less than 10. In this study, the Cronbach's alpha for CES-D-10 scale was 0.802, which demonstrated sufficient reliability and validity in CES-D-10. Table 1 shows that nearly half of the middle-aged and older adults with disabilities had depressive symptoms.

Independent variables. According to the design of the 2018 CHARLS questionnaire, we selected three indicators, "internet use", "the frequency of internet use", and "social activities related to internet", to measure the internet use status of middle-aged and elderly adults with disabilities. First, we selected the question "Did you use the internet in the last month?" to measure the internet use of individuals, and we assigned a value of 1 if the respondents answered "yes"; otherwise, the value was 0. We selected the question "How often in the last month did you use the internet? Almost daily, almost every week, not regularly, or never?" to measure the respondent's internet use frequency. We gave a value of 0, 1, 2, or 3 if the respondent chosen "never", "not regularly", "almost every week", or "almost daily", respectively. Finally, we selected the question "What do you usually do on the internet?" to measure social activities related to internet use. There were four options for the response to this question in the questionnaire: "Chatting", "Watching news", "Watching videos", and "Playing games". The specific definitions are presented in Table 1.

Table 1. Measurements of selected variables and descriptive statistics.

Variables	**Measurements and Coding**	**Mean**	**SE**
Age	Year	63.82	9.35
Logarithm of household income	CNY	9.454	1.811
Number of chronic diseases		2.06	1.07
Variables		Frequency	Percent
Depressive symptoms	No = 0	2650	50.77
	Yes = 1	2570	49.23
Internet use	No = 0	4608	88.28
	Yes = 1	612	11.72
Frequency of internet use	Never = 0	4608	88.28
	Not regularly = 1	98	1.88
	Almost every week = 2	109	2.09
	Almost daily = 3	405	7.75
Social activities related to internet			
Chatting	Yes = 1	265	5.12
	No = 0	4908	94.88
Watching news	Yes = 1	311	6.01
	No = 0	4862	93.99
Watching video	Yes = 1	269	5.20
	No = 0	4904	94.80
Playing games	Yes = 1	92	1.78
	No = 0	5081	98.22
Gender	Female = 0	2558	49.00
	Male = 1	2662	51.00
Marital status	No spouse = 0	906	13.76
	Married with a spouse = 1	4764	82.64
Residence	Urban area = 0	999	19.21
	Rural area = 1	4202	80.79
Ethnicity	Other = 0	456	8.74
	Han = 1	4764	91.26
Smoking	No = 0	2825	54.12
	Yes = 1	2395	45.88
Drinking	No = 0	3496	66.97
	Yes = 1	1724	33.03
Self-rated health	Poor = 0	4335	83.82
	Good = 1	837	16.18
Education level	Illiterate = 1	2589	49.60
	Elementary = 2	1159	22.20
	Middle school = 3	1003	19.21
	High school and above = 4	469	8.98
Health insurance	No insurance = 0	208	3.98
	Insured by health insurance = 1	5012	96.02
Pension	No pension = 0	731	14.00
	Insured by pension = 1	4489	86.00
Working status	No work = 1	2172	41.61
	Having a job = 2	3048	58.39

Note: For the categorical and dummy variables, the percentage is reported; for the continuous variables, the average values are reported.

Controlled variables. To reduce potential estimation deviation caused by omitted variables, four types of variables were controlled: (1) demographic characteristics variables, including age, gender, marital status, residence, and ethnicity; (2) variables related to health, including number of chronic diseases, self-rated health, smoking, and drinking; and (3) socioeconomic variables, including education condition, household income (logarithm), pensions, health insurance, and work status. Considering that the differences in internet use in different provinces may have an impact on depression levels, we controlled the provinces in which the middle-aged and older people were located. The definitions and descriptive results were presented in Table 1.

2.3. Models

Because the dependent variable, depression status, is a dichotomous variable with values of 0 to 1, the logit model was used to estimate the impact of internet use on the depression risk of middle-aged and older adults with disabilities. The basic model was set as:

$$P(y = 1|x_i) = \log \frac{p}{1-p} = \beta_0 + \beta_1 Internet_i + \sum_{i=1}^{k} \beta_k x_{ik} + \varepsilon_i$$

$P(y = 1|x_i)$ represents the probability of experiencing depression risk among middle-aged and elderly adults with disabilities; β_0 is the intercept term; $Internet_i$ represents the internet use level of the i^{th} individual; β_1 is the correlation coefficient of the impact of internet use on the depression risk of middle-aged and elderly adults with disabilities; $\sum_{i=1}^{k} \beta_k x_{ik}$ represents a series of control variables; and ε is a random error term.

3. Results

3.1. Descriptive Results

Table 2 shows the results of the Chi-square test for depression symptoms and internet use among middle-aged and older adults with disabilities. As shown in Table 2, there were significant differences between the symptoms of depression of disabled adults who used the internet and those who did not utilize the internet ($p < 0.001$).

Table 2. The results of the Chi-square test between depression and internet use.

Variables	Depressive Symptoms		Chi-Square	*p*-Value
	Yes	No		
Internet use			29.37	<0.001 ***
Yes	213 (34.80)	399 (65.20)		
No	2357 (50.36)	2251 (49.64)		
Frequency of internet			31.92	<0.001 ***
Never	2357 (50.36)	2251 (49.64)		
Not regularly	45 (45.92)	53 (54.08)		
Almost every week	48 (44.04)	61 (55.96)		
Almost daily	132 (33.33)	264 (66.67)		
Chatting			15.46	<0.001 ***
Yes	99 (37.36)	166 (62.64)		
No	2442 (49.76)	2466 (50.24)		
Watching news			44.11	<0.001 ***
Yes	96 (30.87)	215 (69.13)		
No	2445 (50.29)	2417 (49.71)		
Watching video			33.39	<0.001 ***
Yes	86 (31.97)	183 (68.03)		
No	2455 (50.06)	2449 (49.94)		
Playing games			16.31	<0.001 ***
Yes	26 (28.26)	66 (71.74)		
No	2515 (49.50)	2566 (50.50)		

Note: *, **, *** indicate $p < 0.1$, $p < 0.05$, $p < 0.01$, respectively.

3.2. Regression Results

3.2.1. The Association between Internet Use and Depression Risk among Middle-Aged and Older Adults with Disabilities

We used the maximum likelihood method (MLE) to estimate the association between internet use and depression status among individuals with disabilities. Column (1) of Table 3 showed that internet use was negatively associated with depression in people with disabilities when we did not include any control variables (marginal effects = −0.143, $p < 0.01$). Column (2) indicated that the marginal effect decreased to −0.055 after controlling for other confounding variables ($p < 0.05$). Columns (3) and (4) of Table 3 reported the relationship between the frequency of internet use and depression in disabled adults. The

results suggested that compared to disabled people who never used internet, those who used the internet almost daily had a lower depression risk ($p < 0.05$), which was consistent with the results of Columns (1) and (2).

Table 3. Regression results for the association between internet use and depression risk among middle aged and older adults with disabilities.

	(1)	(2)	(3)	(4)
Variables	**Marginal Effect**	**Marginal Effect**	**Marginal Effect**	**Marginal Effect**
Internet use	−0.143 ***	−0.055 **		
	(0.027)	(0.027)		
Frequency of internet use (Ref: Never)				
Not regularly			−0.055	−0.013
			(0.073)	(0.068)
Almost every week			−0.074	−0.078
			(0.084)	(0.082)
Almost daily			−0.161 ***	−0.060 **
			(0.028)	(0.030)
Age		−0.005 ***		−0.005 ***
		(0.001)		(0.001)
Gender		−0.090 ***		−0.086 ***
		(0.019)		(0.019)
Marital status		−0.063 ***		−0.063 ***
		(0.018)		(0.018)
Residence		0.073 ***		0.070 ***
		(0.021)		(0.021)
Ethnicity status		0.022		0.024
		(0.024)		(0.024)
Elementary		−0.045 ***		−0.046 ***
		(0.018)		(0.018)
Middle school		−0.078 ***		−0.078 ***
		(0.020)		(0.020)
High school and above		−0.109 ***		−0.108 ***
		(0.028)		(0.028)
Smoking		0.010		0.010
		(0.010)		(0.010)
Drinking		−0.029 *		−0.031 **
		(0.016)		(0.016)
Number of chronic diseases		0.093 ***		0.093 ***
		(0.006)		(0.006)
Self-rated health		−0.226 ***		−0.226 ***
		(0.019)		(0.019)
Health insurance		0.013		0.013
		(0.016)		(0.016)
Pension insurance		0.001		0.001
		(0.010)		(0.010)
Household income		−0.032 ***		−0.032 ***
		(0.004)		(0.004)
Working status		−0.020		−0.020
		(0.015)		(0.015)
Province	Yes	Yes	Yes	Yes
Observations (N)	5220	5127	5220	5127

Note: (1) Robust standard errors are reported in parentheses. (2) *, **, *** indicate $p < 0.1$, $p < 0.05$, $p < 0.01$, respectively. (3) The baseline variables for education level are "Illiteracy".

Among the controlled variables, increasing age, male gender, individuals married with a spouse, drinking wine, higher education levels, better self-rated health, and higher household incomes were negatively associated with depression risk ($p < 0.01$). In contrast,

living in rural areas and having chronic diseases were positively associated with depression risk among disabled adults ($p < 0.01$).

3.2.2. Robustness Test

We used the substitute variable method to check the robustness of the regression results. Referring to the 2018 CHARLS questionnaire design, we selected the questions "Does your residence have a broadband internet connection?" and "Do you use WeChat?" as substitute variables for internet use. Table 4 reports the regression results for the impact of having a broadband internet connection and WeChat use on depression risk. The results in Column (1) showed that disabled people who had access to broadband internet in their residence had a lower probability of depression risks ($p < 0.01$). Column (2) in Table 4 suggested that using WeChat was negatively associated with depression symptoms relative to those who did not use WeChat ($p < 0.1$). The results in Table 4 are consistent with those in Table 3.

Table 4. Regression results of robustness test.

	(1)	(2)
Variables	**Marginal Effects**	**Marginal Effects**
Broadband internet connection in residence	−0.051 ***	
	(0.014)	
WeChat use		−0.048 *
		(0.028)
Controlled variable	Yes	Yes
Province	Yes	Yes
Observations	5079	5056

Note: (1) Robust standard errors are reported in parentheses. (2) *, **, *** indicate $p < 0.1$, $p < 0.05$, $p < 0.01$, respectively. (3) Due to space limitations, the regression results of the controlled variables were not reported.

In order to effectively reduce the potential selective bias between internet use and depression risk, the PSM method was used to estimate the association between internet use and depression risk. The results of Table 5 show that the ATT coefficients for K-nearest neighbor matching and kernel matching were −0.0838 and −0.0574, respectively, which means that internet use was negatively associated with depression risk. The ATT coefficients were consistent with the regression coefficient shown in Table 3, which indicates that internet use could significantly decrease the probability of depression risk after overcoming the potential selective deviation.

Table 5. The results of the PSM analysis.

Matching Types		**Treated**	**Controlled**	**Difference**	**S.E.**	**t-Value**
K-nearest neighbor matching	Unmatched	0.3604	0.5032	−0.1428	0.0262	−5.46 ***
	Matched	0.3604	0.4442	−0.0838	0.0403	−2.08 **
Kernel matching	Unmatched	0.3604	0.5032	−0.1428	0.0262	−5.45 ***
	Matched	0.3604	0.4178	−0.0574	0.0289	−1.98 **

Note: (1) *, **, *** indicate $p < 0.1$, $p < 0.05$, $p < 0.01$, respectively. (2) Due to space limitations, the regression results of the controlled variables were not reported.

3.2.3. The Association between Social Activities Related to Internet Use and Depression Risk among Adults with Disabilities

Columns (1)–(4) of Table 6 report the association between social activities related to internet use and depression risk among middle-aged and older adults with disabilities. The results showed that watching videos, reading the news, and chatting via the internet were found to be negatively associated with depression risk. However, playing games via the internet had no significant impact on depression risk.

Table 6. Results of association between social activities related to internet use and depression risk.

	(1)	(2)	(3)	(4)
Variables	**Marginal Effect**	**Marginal Effect**	**Marginal Effect**	**Marginal Effect**
Chatting	−0.056 *			
	(0.031)			
Watching news		−0.093 ***		
		(0.031)		
Watching videos			−0.099 ***	
			(0.032)	
Playing games				−0.096
				(0.059)
Other variables	Yes	Yes	Yes	Yes
Provinces	Yes	Yes	Yes	Yes
Observations	5127	5127	5127	5127

Note: (1) Robust standard errors are reported in parentheses. (2) *, **, *** indicate $p < 0.1$, $p < 0.05$, $p < 0.01$, respectively. (3) Due to space limitations, the regression results of the controlled variables were not reported.

3.2.4. The Association between Internet Use and Depression Risk among People with Different Types of Disabilities

Table 7 reports the association between internet use and depression risk among people with different types of disabilities. The results suggest that internet use had different effects on depression risk among people with different types of disabilities. Internet use had a greater impact on the risk of depression in adults with physical disabilities ($p < 0.05$). Conversely, in terms of hearing-related, vision-related, and other types of disabilities, internet use had no impact on depression risk.

Table 7. The association between internet use and depression risk for different types of disabilities.

	(1)	(2)	(3)	(4)
Variables	**Physical Disability**	**Hearing Disability**	**Vision Disability**	**Other Disabilities**
Internet use	−0.128 **	−0.076	−0.003	0.001
	(0.050)	(0.047)	(0.038)	(0.057)
Other variables	Yes	Yes	Yes	Yes
Provinces	Yes	Yes	Yes	Yes
Observations	1448	1989	2596	1232

Note: (1) Robust standard errors are reported in parentheses. (2) *, **, *** indicate $p < 0.1$, $p < 0.05$, $p < 0.01$, respectively. (3) Due to space limitations, the regression results of the controlled variables were not reported.

3.2.5. Heterogeneous Analysis

Columns (1) and (2) of Table 8 report the age differences regarding the impact of internet use on the depression risk of disabled adults. The regression results showed that internet use had a greater effect on elderly people with disabilities than on non-elderly people. Columns (3) and (4) of Table 8 report the regional differences in the impact of internet use on depression risk. The results suggest that internet use could significantly decrease the probability of depression risk among urban adults with disabilities by 8.1%, but it had no impact on the rural group.

Table 8. Regression results of heterogeneous analysis.

	(1)	(2)	(3)	(4)
Variables	**Middle Aged Adults**	**Older Adults**	**Rural Area**	**Urban Area**
Internet use	−0.005	−0.143 ***	−0.035	−0.081 *
	(0.034)	(0.046)	(0.034)	(0.044)
Other variables	Yes	Yes	Yes	Yes
Provinces	Yes	Yes	Yes	Yes
Observations	1700	3427	4130	997

Note: (1) Robust standard errors are reported in parentheses. (2) *, **, *** indicate $p < 0.1$, $p < 0.05$, $p < 0.01$, respectively. (3) Due to space limitations, the regression results of the controlled variables were not reported.

4. Discussion

Previous studies have mainly explored the impact of internet use on the health of the elderly; almost no studies have analyzed the potential association between internet use and depression risk among people with disabilities [26,36]. This study analyzed in detail the association between internet use and depression risk among Chinese middle-aged and elderly adults with disabilities by using the 2018 CHARLS data. We found the following: (1) Internet use was negatively associated with depression risk, and the higher the frequency of internet use, the lower the probability of the depression risk. (2) Different social activities related to internet use had different impacts on the depression risk. The decline in depression risk was mainly related to watching videos, watching the news, and chatting via the internet, but playing video games had no impact. (3) Internet use was found to significantly reduce the risk of depression among middle-aged and elderly adults with physical disabilities, but had no impact on those with hearing-related, vision-related, and other types of disabilities. (4) The association between internet use and depression risk was mainly reflected in older adults with disabilities and those living in urban areas, but had no impact on middle-aged and rural disabled residents.

Disability is an increasingly serious public health problem throughout the world, especially for elderly adults [37]. Individuals with functional limitations or physical impairments are usually at a disadvantage regarding their health and subjective well-being [9,10]. The advance of the information society has provided a chance for disabled people to participate more in social life. The internet integrates multiple functional advantages, such as human–computer communication, information sharing, and leisure entertainment [38]. People with disabilities can take part in social communication, carry out information searches, and enjoy leisure entertainment online through the internet, which can reduce their risk of loneliness and depression [27,29,30]. A study from Poland showed that internet use could reduce the loneliness of disabled people by 40% [28], and Cotten, et al. [39] drew a similar conclusion. Conversely, some studies report that internet use has a negative impact on the mental health of disabled people in the information society, and a significant positive correlation was found between internet use and depression, loneliness, and stress [31,33]. Our study supports the first view. We found that internet use could significantly reduce the risk of depression for middle-aged and elderly people with disabilities, and the higher the frequency of internet use, the greater the reduction in depression risk. A possible reason for this may be that, through the internet, people with disabilities can use social media to keep in touch with their relatives and friends, enjoy leisure and entertainment, search for health information, and improve their health awareness and health literacy, all of which can help them improve their overall health status [38,40]. For example, some scholars found that during the prevention and control of the COVID-19 pandemic, elderly patients with poor health received timely and effective treatment through online consultations. Moreover, they also learned relevant knowledge regarding disease prevention through the internet, and they decreased their depression risk through online leisure and entertainment during quarantine [41].

In addition, we found that the association between internet use and the risk of depression was constrained by different social activities related to internet use. Online chatting was found to help people overcome time and space barriers, maintain a stable interpersonal network, and obtain emotional support (e.g., by improving family members' communication and strengthening relationships with neighbors), thereby alleviating their sense of helplessness and loneliness [42]. Watching the news and videos was found to not only help increase their leisure and entertainment activities, but also helped them obtain health-related medical information, which is helpful in improving their health level [38]. One study found that the COVID-19 pandemic further increased the internet penetration rate, and a large number of middle-aged and elderly people acquired knowledge about infectious diseases and improved their health literacy through their use of the internet [41]. However, playing games was found to have a limited effect on reducing their depression risk because this would occupy the time that people should have spent on exercise or

social participation. Some studies found that the frequency of playing games online was negatively correlated with one's level of happiness [28]. Compared with healthy people, people with disabilities were more likely to indulge in the entertainment functions of the internet [43], which is also related to certain unhealthy behaviors and can decrease the positive spillover effects of internet use relating to health.

We also found that internet use had different effects on the depression risk in relation to different types of disabilities. Internet use had the greatest effect on reducing the depression risk of people with physical disabilities, but had no effect on the those with hearing-related, vision-related, and other types of disabilities. A possible reason for this may be that people with hearing-related, vision-related, and other disabilities experience a stronger digital divide, and they may be unable to effectively communicate and participate in social life through the internet; thus, internet use has no impact on their depression levels. In contrast, people with physical disabilities are merely limited in their daily activities; their disabilities do not affect their use of the internet. Moreover, a relatively higher education level is conducive to building online interactions, searching for information, and enjoying the leisure and entertainment functions of the internet, which can significantly reduce the risk of depression. Previous studies have shown that disabled people have strong heterogeneity, and the digital divide varies based on the type of the disability [31,44]. Our findings further confirm that the impact of internet use on the health of people with disabilities is affected by different types of disabilities.

Finally, we found that there were significant age differences and urban–rural differences regarding the association between internet use and depression. Internet use mainly reduced the risk of depression among older adults and people living in urban areas, which is consistent with the findings of previous studies [36]. The internet penetration rate in urban areas was found to be significantly higher than in rural areas, so people with disabilities in urban areas have more convenient access to internet services. As a consequence, these groups are more likely to use the internet for social interaction, learning, participation in social activities, and other activities, contributing to a higher positive impact of internet use on their depression level [41]. Macro data also confirm this difference. At present, the internet penetration rate in rural China is only 57.6%, far lower than the average rate of 73.0% (CINIC, 2021). Therefore, strengthening the internet infrastructure, improving the penetration rate of the internet in rural areas, and achieving the positive spillover effect of internet use on individuals' health should be a core strategy of the Chinese government.

5. Conclusions

In conclusion, our study suggests that internet use can significantly reduce the risk of depression, and the reduction effect in depression risk is significantly related to the frequency of internet use. However, the association between the internet use and depression risk of disabled people was affected by different social activities related to internet use and the type of disabilities. Watching videos, chatting, and watching the news via the internet was found to decrease the depression risk among disabled people. Moreover, internet use mainly affected those with physical disabilities, and it was found to have no impact on people with other types of disabilities. Finally, we found that there were age differences and urban–rural differences in the association between internet use and depression risk. Internet use had a greater impact on the elderly and those who lived in urban areas.

This study had several limitations. First of all, the sectional data of 2018 CHARLS were used to analyze the association between internet use and depression risk among middle-aged and older adults with disabilities, so this study essentially intended to elucidate a correlation relationship. Although we used the PSM method to overcome the possible selective bias to some extent, we did not address the endogenous problem caused by missing variables and reverse causality. Thus, we failed to obtain a causal relationship. Moreover, we used the frequency and social activities close to the internet to measure internet use among middle-aged and elderly people with disabilities. Unfortunately, we lacked indicators such as the duration of internet use, which reflect the intensity of an

individual's internet use, and which may also have an impact on their depression level. Finally, we explored the association between internet use and depression risk in people with different types of disabilities, but disability severity was not fully considered; it is clear that the impact of internet use on depression is affected by disability severity. Unfortunately, we failed to take this indicator into consideration due to data limitations, and we will continue to conduct related studies once the data are available.

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