Care for Women’s health:

Does Internet Use lead to Improvement of Health Status Among Rural Women?

Lifang Peng and Na Zhang\*[[1]](#footnote-1)

Department of Business Management, School of Management, Xiamen University, Xiamen, 361005, China;

lfpeng@xmu.edu.cn

\* Correspondence: zhangna1@stu.xmu.edu.cn

**Abstract**

Following data from the 2018 China Family Panel Studies, which included 7202 rural women over the age of 16, this study examines the impact of internet use on their health condition. Findings indicate that internet use can enhance the physical and mental well-being of rural women, showing improvements in self-rated health, depression scores, and cognition levels and hold up to endogenous and robustness testing. Additionally, the moderating impact analysis revealed that as they age, the strength of the relationship between internet use and self-rated health weakens. Social trust was also found as a key route mechanism for internet use to support physical and mental health. Information accessibility is also assumed to play a role in mediating the relationship between internet use and self-rated (physical) health, unlike the case for the relationship between internet use and mental health status in rural women. Policies should ensure rural women’s access to the internet and a community network environment that actively promotes learning and social contact, given the health benefits provided by its reasonable use.

**Keywords**

Internet use; Rural women; Self-rated health; Mental health; Information accessibility; Social trust; China

**1.Introduction**

Currently, no scholarly consensus has been reached on the internet’s effects on the overall health of adults. Only a single aspect of health, such as physical health (Beck, 2014; Whittaker et al., 2016; Zheng et al., 2016) or depression scores (Larose et al., 2001; Primack et al., 2017; Kim, 2018; Erceg et al., 2018; Yang et al., 2021;), has been the focus of most extant literature, despite both physical and mental wellness being crucial elements of overall health. And some studies have shown that Internet use can benefit both physical and mental health. For example, Wang & Wang (2016) and Ernsting *et al.* (2017) found that using smartphones and health apps to change and manage health behaviors can improve physical and mental health. Additionally, Nie *et al.* (2017) found that using the Internet to communicate with friends and family can lower depression levels.

Women's health is crucial to the development of families and societies in many developing nations. For instance, women are now the majority in Chinese rural development and construction due to the country's rapidly aging population, intensifying tendency of agricultural feminization, and the hollowing out of rural areas. (Liu, 2015). For families, society, and healthy villages to sustainably develop, rural women's health and reasons for poverty must be addressed. The effects of the Internet on rural dwellers' lives and livelihood are noteworthy, and is further underscored post COVID-19.

Additionally, several studies cover the potential for heterogeneity within various groups or geographical regions. According to heterogeneity analysis, internet usage clearly affects groups such as men, seniors, and those with at least a senior high school diploma (Han & Zhao, 2021). However, only a few studies specifically target women, particularly rural ones. Consequently, questions of how internet use affects rural women’s health condition and its underlying mechanism have been relatively unexplored, remaining largely as part of the “background”.

To fill this gap, this study uses the data from China Family Panel Studies (CFPS) collected in 2018 to investigate the relationship and mechanism between internet use and health status of rural women.

Following the abovementioned discussion, the following research questions are proposed:

1) Do rural women's health conditions improve as a result of Internet use? and

2) If so, how does it impact rural women's health?

To address these questions, a research model that builds on the Health Capital Model and on existing literature was developed. The research model makes three contributions to the body of literature. First, the concept of “health” should include multiple dimensions, thus the use of three variables for measurement. Second, the underlying processes of internet use's impact on rural women's health status is explained, emphasizing how, unlike other peer-effect research, information accessibility plays no mediating role in the link between internet use and rural women's mental health status. Third, this study considers the moderating effect of "age," which suggests that over time, the effect of internet use on rural women wanes. Hence, this study offers some recommendations to assist public and private organizations in developing efficient policies.

The rest of this study is divided into the following sections: a comprehensive literature review is offered in Chapter 2. The research model and hypotheses for this study are forwarded in Chapter 3. The study methodology and empirical findings of the data analysis are discussed in Chapter 4. Last, key conclusions, real-world ramifications, potential future research, and limits are discussed the final chapter.

**2. Literature Review**

Health is a multidimensional concept— The World Health Organization clearly defines it as “the perfect state of physical, mental and social adaptation, not just the absence of disease”, giving a more comprehensive explanation of health from multiple perspectives. Currently, various studies have examined the impact of the internet use on individual health, with some focusing on physical health, mental health and on both. However, a definite consensus is yet to be reached. Specifically, two viewpoints exist in the stream of literature, namely “Beneficial Internet” and “Harmful Internet”, shown in Table 1 below.

On one hand, some scholars believe that Internet use has a positive role in promoting individual health. The Internet, as a source of health information, facilitates the dissemination of knowledge and helps more people change their health behaviors (Beck, 2014) or help patients alleviate the fear and the loss of self-esteem caused by lack of understanding their illness (Whittaker et al., 2016). The familiarity and skill of using the Internet has increased its use for a variety of purposes, including health and increasing capital (McCloud et al., 2016). Online health services available on the Internet also effectively promotes individual health literacy, thus enhancing self-management of health (Mano, 2014). Furthermore, Internet use is an important tool to help individuals access health-related social support (Oh et al., 2013).

On the other hand, Internet use may have an otherwise negative impact on health. Many studies are about the effects of unhealthy internet use on physical and mental health. For instance, a study among in-school adolescents in South Korea found that shorter sleep duration and excessive Internet use are associated with poor health (Do et al., 2013) and that normal, but inappropriate internet use may lead to dry eyes, declining eyesight, and cervical pain (Zheng et al., 2016). Some studies also focus on other effects such as problematic Internet use (Brunborg et al., 2011), Internet addiction disorder (IAD) (Chou, 2001), Internet dependence and compulsive Internet use (Lavin et al. 1999; Sherer,1997) which potentially result in depression, low self-control, low self-esteem, sensation-seeking, and difficulties in sustaining interpersonal connections (Tangney, et al., 2004; Ko et al., 2007; Armstrong et al., 2000; Whang et al., 2003).

Furthermore, various studies have also analyzed heterogeneous effects from the perspective of different gender, age groups, and education levels. Most of these explored the relationship between Internet use and the health of older adults and found Internet use’s improvement of the physical health of the elderly (Nakagomi et al., 2022) but may also decrease the depression scores of the older adults (Li et al., 2020; Yang et al., 2021;) and even found that the internet use has a significantly positive impact on health outcomes of rural adults in China’s text. For adolescents, the effect of internet use relies on a variety of factors, particularly on the type of use seen (Lahti et al., 2021).

Table 1. Literature Review.

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Beneficial Internet** | **Harmful Internet** | **Our Study** |
| **Physical Health** | * As a source of health information-get knowledge and change health behaviors (Beck,2014) * Health interventions--health behaviors, such as smoking cessation (Whittaker et al.,2016) * Online health services improve health literacy and self-management of health (Mano, 2014) | * Excessive Internet use--sleep deprivation (Do et al., 2013); * Encourages prolonged sitting and increases the risk of obesity (Matusitz et al., 2012) * Dry eyes, declining eyesight and cervical pain from normal, but inappropriate use (Zheng et al., 2016) * Problematic and unhealthy Internet use-- insomnia (Brunborg et al., 2011) | **√** |
| **Mental Health** | * As a source of health information--alleviates the fear and the loss of self-esteem (James et al., 2007) * Provides individuals with skills and enhance capacity (McCloud et al.,2016) * Helps individuals acquire social support (Oh et al., 2013) | * Widens the gap between “information-rich: and “information-poor” users and increases the anxiety and poorer health (Korp, 2005) * Internet addiction disorder (IAD) (Chou, 2001); Problematic Internet use, pathological Internet use (Davis, 2001); Internet dependence, compulsive Internet use (Lavin et al. 1999; Sherer, 1997); * Depression, low self-control, low self-esteem, sensation-seeking, and interpersonal difficulties (Tangney, et al., 2004; Ko et al., 2007; Armstrong et al.,2000; Whang et al.,2003) | **√** |
| **Which groups?** | Adolescents (Ko et al., 2007; Do et al., 2013);  The elderly (Wang, 2018; Yang et al., 2021);  Adults (Beck et al., 2014; Wang et al., 2013);  Rural/urban residents (Li et al., 2020; Jiang & Street, 2017). | | Rural Women |

Overall, many exploratory studies show that using the internet helps adult health. However, the literature on the connection between the Internet and health outcomes still has some gaps. First, only a few studies address “health” as a multidimensional concept. Second, rural women are particularly vulnerable to poor health due to a lack of medical resources and knowledge about disease prevention and control, harsh natural environment, and because they often juggle multiple responsibilities such as looking after the family, helping the elderly, and working. Despite the importance of investigating if and how the internet contributes to the health of rural women, only a few research specifically address this issue.

This study looks at the connection between Internet use and health outcomes for rural women to fill these gaps. Furthermore, this study confirms the robustness of the measurement error of variables and employs PSM to address any potential endogenous issues brought on by sample self-selection bias. Moreover, it investigates if social capital and the availability of health information also have an intermediary effect on rural women's health.

**3. Research Model and Hypotheses**

By integrating Health Capital Model and related studies, we developed a research model (as shown in Fig.1) to explore the underlying mechanisms of internet use affecting rural women’s health. First, we argued that internet use significantly improves rural women’s health status (H1) with age hypothesized as a moderator (H4). We then proposed that information accessibility (H2) and social trust (H3) mediate said relationship.

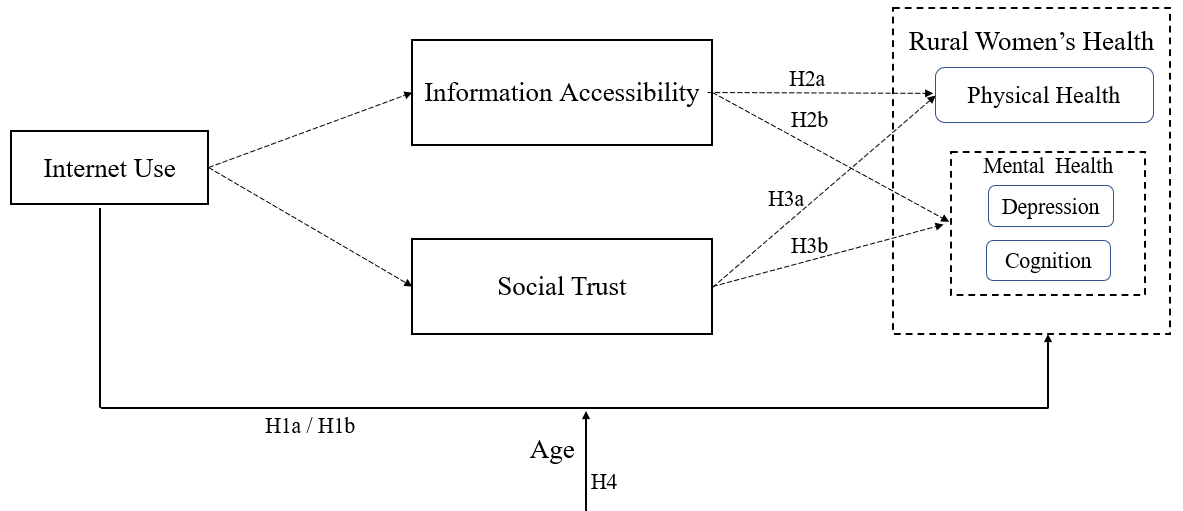


Fig. 1. Research model

**3.1 Internet use**

According to the human capital model of the demand for health, health is an important part of human capital and assumes individual health level as a capital stock that can continuously produce benefits. To ensure a certain level of health, individuals will have health needs and find some ways to increase their health stock. Limited by their own time and economic conditions, individuals choose the beneficial way based on the principle of utility maximization to achieve the ideal health condition. With the popularity of the Internet in rural areas, it could be regarded as an important resource and a convenient way for individuals to and meet their health needs, especially since rural residents who use the internet are in good health (Jiang & Street, 2017; Oh et al., 2013; Li et al., 2020). Hence, the following hypotheses is posited:

H1a: Internet use positively influences the physical health of rural women.

H1b: Internet use positively influences the Mental health of rural women.

**3.2 Mediating roles of information accessibility and social trust**

Individuals must master health knowledge and maintain high health literacy to manage their own health (Grossman, 1972). Therefore, they may use the Internet as a source of health information to obtain knowledge and change their health status (Takahashi et al., 2011). Online access to health-related information has more advantages than otherwise (Trotter & Morgan, 2008; Kontos et al., 2012) due to the speed and ease the internet disseminates health information foregoing temporal and geographic restrictions. Most importantly, these benefits provide opportunities for people in remote rural areas (Jiang & Street, 2017). and can also form larger and more useful social networks through information sharing, thereby increasing communication between friends and relatives and promoting mental health and well-being (Bessière et al., 2010; Wellman et al., 2001; Katz & Rice, 2002). Thus, the following hypotheses are formulated:

H2a: Information accessibility mediates the relationship between internet use and rural women’s physical health status.

H2b: Information accessibility mediates the relationship between internet use and rural women’s mental health status.

Social capital plays an intermediary role in the relationship between internet use and health (Lyu & Sun, 2020; Subramanian, S.V. et al.,2003; Rostila,2007). Most studies define social capital to encompass both structural and cognitive components— The structural component of social capital involves the extent and intensity of interactional ties and activities in society, while the cognitive component evaluates the perceived level of interpersonal trust, sharing, and reciprocity (Coleman, 1990; Portes, 1998; Harpam et al., 2002). Kawachi and Berkman (2000) found that higher levels of interpersonal trust among community residents may promote health. Subramanian *et al.* (2002) assessed the effects of social trust on health and found that the higher levels of community social trust, the lower the probability of poor health status. The protective function of social trust on mental health is also generally universally upon by the literature (Rostila, 2007).

Together, the following hypotheses are then forwarded:

H3a: Social Trust mediates the relationship between internet use and rural women’s physical health status.

H3b: Social Trust mediates the relationship between internet use and rural women’s mental health status.

**3.3 Moderating role of Age**

The health stock owned by individuals at birth depreciates and loses with age (Grossman, 1972): the older they are, the lower their health capital stock is. As individuals age and mature, physical functions continue to decline and health deteriorates (Li & Ding, 2022). Compared to other age groups, older adults have relatively low internet usage (Lyu & Sun, 2020). We posit that age leads to a weaker effect of internet use on health, thus formulating the following hypothesis:

H4: Age negatively moderates the effect of internet use on rural women’s health.

**4. Data and Methodology**

**4.1 Data Sources**

Data was extracted from the China family tracking survey (CFPS) conducted by the Institute of Social Science Survey (ISSS) at Peking University in 2018. This dataset was chosen for several reasons.

First, the CFPS surveys 25 provinces (municipalities and autonomous regions) across the country where a multi-stage probability proportional sampling method was used to sample approximately 57,000 individuals from 15,000 households, with the survey item mainly focusing on economic and social development and changes. The data therefore provides a more comprehensive representation of Internet usage.

Second, as one of the 10 countries with high performance in maternal and child health, China has made remarkable achievements in the field of women's health. During the past decade, the delivery of women's health services has been greatly strengthened in China and has further improved based following the white paper "Gender Equality and Women's Development in China.". However, there remains a disparity between rural and urban health levels, according to the All-China Women's Federation and National Bureau of Statistics' Survey on Social Status of Women in China. Hence, studying rural women’s health in the Chinese context provides implications for other developing countries.

Third, China’s internet users in rural areas have sharply increased since the “Internet +” plan was forwarded in 2015. By December 2021, the number of Internet users in rural areas had reached 284 million, and the internet penetration rate in rural areas was at 57.6% (CINIC, 2020). Therefore, statistics on internet usage in rural areas is relatively representative.

This study targeted rural women aged 16 and above. After processing the missing values, outliers, and invalid data such as "don't know" and "refuse to ask and answer" in the sample, 7202 effective samples were involved with 2892 for using the Internet and 4310 for otherwise.

**4.2 Variables Selection**

**4.2.1 Dependent Variables**

The health level was determined as the dependent variable. According to the definition of the WHO (Rosini, 2002) and other extant studies (Lyu & Sun, 2020; Wang, 2018), this paper used physical health (self-rated health) (Zhou et al., 2014; Zhang & Xu, 2019; Han & Zhao, 2021) and mental health (depression and cognition) (Yang et al., 2021; Han & Zhao, 2021) to measure health levels.

Physical health used the self-rated health results in CFPS with items such as "what do you think of your health status?" measured a 5-point Likert scale ranging from 1 (Extremely Healthy) to 5 (Unhealthy). Moreover, this study defined health outcomes with values of 1 to 2 as very healthy, 3 as healthy, 4 to 5 as unhealthy, and separately assigned a new value of 3, 2, and 1. The self-rated health result was a comprehensive assessment of the severity of disease, family disease history, and the stability of health status. This method fulfilled statistical standards. Hence, other studies on adult health also used analogous measures (Zhou et al., 2014; Yang et al., 2021).

Mental health was measured through emotion and cognition. In the 2018 CFPS, the former was measured through the depression score of an eight-item version of the scale used by the Center for Epidemiological Studies (CES-D). The CES-D scale measured the frequency of negative emotions (I feel depressed, I feel hard to do anything, I don't sleep well, I feel lonely, I feel sad, I feel that life can't go on) and positive emotions (I feel happy, I live a happy life) in the past week. Items included answers such as "almost no (less than 1 day)" "sometimes (1 to 2 days)" "often (3 to 4 days)" and "most of the time (5 to 7 days)". They were assigned to 0 to 3 respectively (the descending order of number meant positive emotion). The total score of the above questions ranged 0 to 24 where the larger the score, the more serious the depression was.

Cognition includes both memory and intellectual integrity (Yu et al., 2020) and is the process of acquiring and processing information through sensation, memory, reasoning, and decision-making. It also reflects the basic characteristics of social adaptation. Due to data availability limitations, cognition was measured thorugh a quiz on memory in CFPS. The quiz included items such as " How well do you remember the main things that happen to you in a week " with answers such as "only a little", "only a few", "half", "most", and " completely" assigned from 1 to 5 respectively. A higher score meant better respondent cognition.

**4.2.2 Independent Variable**

Internet use was the key independent variable in this study. The questionnaire in the 2018 CFPS included questions such as "Do you use mobile devices (e.g., cell phones and tablets) to access the Internet?” and “Do you use a computer to access the Internet?". A value of 1 was assigned if the respondent answered yes to one of the questions, while a value of 0 was assigned if otherwise. Furthermore, to ensure the robustness of the model’s estimation results, "frequency of using the Internet for entertainment" was chosen as a proxy variable for the analysis, with answers ranging from very frequent (4), more frequent (3), less frequent (2), and never (1).

**4.2.3 Control Variables**

Individual and household-level variables were selected as control variables to reduce omitted variable bias. According to the human capital model of health needs, individual factors such as age, marital status, educational attainment, employment, medical insurance, and personal health behaviors may significantly affect the health status of adults. Household factors include the number of family members and total household income. Additionally, dummy variables were used to control for region, considering that the degree of development and Internet penetration varied across different regions. Also, the variance inflation factor test was conducted, with its mean value being 1.15 and the variance inflation factor values of all variables well below the critical value of 10, indicating that there was no serious multicollinearity among these regression models. A covariance test was also performed where the results are all close to 1, proving the non-existence of the multicollinearity.

The descriptive statistics of the variables are shown in Table 2. In the full sample, rural women had a mean self-rated health of 1.909 (Healthy= 2), a mean self-reported depression score of 6.503 (out of 24, S.D.= 4.291), and a mean cognitive level of 1.916 (Average = 2). 40.2% of rural women used the Internet with their mean age being 47 years. For education, rural females had a lower level of education (below elementary school) and most were married or in an actual relationship (81.4%) while 75% were employed. Most of them also had health insurance (92.4%). Moreover, the average household size is less than 5 people.

Table 2. Descriptive statistics of variables.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Variables** | **Definition** | **Min** | **Max** | **Mean** | **SD** |
| **Dependent Variables** |  |  |  |  |  |
| Self-rated health | Unhealthy = 1, healthy = 2, very healthy = 3 | 1 | 3 | 1.909 | 0.797 |
| Mental health (Depression) | Depression (CES-D scale) total score 0 ~ 24 | 0 | 24 | 6.503 | 4.291 |
| Mental health (Cognition) | Memory, assigned 1~3 (Poor, Average, Good) | 1 | 3 | 1.916 | 0.838 |
| **Independent Variables** |  |  |  |  |  |
| Internet use | No = 0, Yes = 1 | 0 | 1 | 0.402 | 0.49 |
| Frequency of Internet Entertainment | Very frequently = 4, Frequently = 3, Less = 2, Never = 1 | 1 | 4 | 3.347 | 1.017 |
| **Control Variables** |  |  |  |  |  |
| Age | years | 16 | 92 | 47.489 | 16.509 |
| Education | No formal education = 0 Middle school and below = 1 junior college or above = 2 | 0 | 2 | 0.647 | 0.57 |
| Marital status | Single = 0, Not single = 1 | 0 | 1 | 0.814 | 0.388 |
| Work | No = 0, Yes = 1 | 0 | 1 | 0.75 | 0.433 |
| Exercise | Frequency of exercise in the past week | 0 | 50 | 2.24 | 3.336 |
| Medical insurance | No = 0, Yes = 1 | 0 | 1 | 0.924 | 0.265 |
| **Household characteristics** |  |  |  |  |  |
| Number of family members | Continuous variable | 1 | 21 | 4.532 | 2.109 |
| Total household income | Continuous variable（ln） | 5.298 | 15.241 | 10.615 | 1.02 |
| **Residency location** |  |  |  |  |  |
| Western region | No = 0, Yes = 1 | 0 | 1 | 0.379 | 0.485 |
| Eastern region | No = 0, Yes = 1 | 0 | 1 | 0.275 | 0.447 |
| Rural north areas | No = 0, Yes = 1 | 0 | 1 | 0.12 | 0.325 |
| Rural midlands | No = 0, Yes = 1 | 0 | 1 | 0.246 | 0.431 |

Note: Provinces and regions are divided according to the division standard of regions by the National Bureau of statistics of China.

**4.3 Analytical Methods**

**4.3.1 Main Empirical Strategy**

Here, the health level was measured by three ordered classification variables where the specific models were as follows:

=+++ (1)

=+++ (2)

=+++ (3)

Here, the subscript i referred to the individual. represented the self-rated health level. was a dummy variable and represented Internet use, was the control variables. was the intercept term,  and represented the regression coefficients, and was the error term.

The ordinary least squares estimation was used to first conduct basic regression, and then the ordered probit estimation was used to perform robustness test. Dependent variables were treated as continuous data in OLS estimation, and as ranking variables in ordered probit model.

**4.3.2 Robustness Analysis**

Robustness testing means checking the robustness of the explanatory power of the assessment methods and indicators (Erceg-Hurn et al., 2008). We used alternative measures and substitutions of core explanatory/ or explained variables to perform model robustness tests.

The ordered probit model was used as an alternative measure to estimate the results because the explanatory variables were five categories.

Regarding substitutions of variables, the study used ratings of the importance of entertainment to individuals when using Internet as the core explanatory variable, rather than using the Internet for robustness testing. The question in the 2018 CFPS was “How important is it for you to be social when using the Internet?”

As for core explained variables, this paper synthesized the four indicators of self-rated physical health, self-assessed health change, prevalence of illness in the past two weeks and incidence of chronic diseases to obtain the comprehensive indicators of physical health by Principal Component Analysis (PCA). The mental health indicators (depression and cognition) are also obtained through principal component analysis, thus optimizing the measurement error of physical and mental health.

* + 1. **Endogenous Problem**

To control the sample selection bias as much as possible for model estimation, PSM (Propensity Score Matching) model was used to estimate the net effect of internet use on rural women’s health. The model was developed by Rosenbaum and Rubin in 1983, and effectively eliminates selection and mixing bias.

**4.3.4 Moderating Effect and Mediating Effect Model**

**(1) Moderating Effect**

According to the Health Capital Model proposed by Grossman in 1972, Individuals will lose their health stock as they age, which is why we multiplied “age” with the primary predicting variables to construct the moderating effects.

**(2) Mediating Effect Model**

Here, two corresponding mediating variables were proposed based on the WHO definition of health: information accessibility and social trust. Information accessibility was measured by the question "Importance of using the Internet to access information" where respondents responded through a 5-point Likert scale (1 = very unimportant to 5 = very important). Social trust was a dichotomous variable, measured by the question "Do you think most people can be trusted, or do you think it is better to be more careful with people?" The specific models were as follows:

=+++ (1)

=+++ (4)

=+++ (5)

Here, was the intermediary variable. was the regression coefficient which stood for the overall effect of internet use on physical health among rural women. was the effect on the intermediary variable.  represented the effect of on physical health after controlling internet use, and was the effect of internet use on physical health after controlling .

The stepwise regression was used in Mediation analysis where the result would be significant if both and were likewise. Further Sobel test should be conducted if one of them was not significant.

All the data analyses were conducted using STATA (version 15.0). Table 3 show the corresponding methods below.

Table 3. Methods corresponding to different contents

|  |  |
| --- | --- |
| **Contents** | **Methods** |
| Basic regression | OLS |
| Robustness test | Ordered Probit / Probit / PCA |
| Endogenous Problem | PSM (Propensity Score Matching) |
| Moderating effects and Mediation analysis | OLS / Stepwise regression |

**5. Empirical Results**

**5.1 Basic Regression**

The ordinary least squares (OLS) results with different models are presented in Table 4. Internet sue was found to have a significant association both self-rated health and Mental health (depression and cognition), therefore verifying both H1a and H1b. Models 1, 3, and 5 show the results when no control variables were considered. Results from Model 2 reveals that among rural women, internet users' self-rated health was 0.217 units (*p* 0.01) better than non-users' after controlling for various factors. Model 4 shows that rural women who use the internet, compared with women who do not, had significantly lower depression scores by 0.33 (*p* 0.05). Model 6 reveals that rural women who use the internet had significantly higher cognition levels (*p*0.01) than women who were otherwise.

Moreover, the results in all models were statistically significant at least on the 5% level, suggesting that internet use improved the self-rated health and cognition level and also reduced the depressive symptoms of rural women. Apart from internet usage, various sociodemographic factors also had an impact on self-rated health, depression, and cognition. We found that rural women who were better educated, employed, or had some family savings had better health, lower depression levels, and higher cognitive levels.

However, the estimated effect could potentially be biased since internet use may be selective and endogenous with health status. These results should be considered in conjunction with additional robustness assessments, as detailed below.

Table 4. Results of the ordinary least square

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Variable** | **Model (1)** | **Model (2)** | **Model (3)** | **Model (4)** | **Model (5)** | **Model (6)** |
| **Self-Rated Health** | **Self-Rated Health** | **Depression** | **Depression** | **Cognition** | **Cognition** |
| Internet Use | 0.374\*\*\* （0.019） | 0.217\*\*\*（0.022） | -1.218\*\*\* （0.102） | -0.311\*\* （0.122） | 0.469\*\*\* （0.019） | 0.248\*\*\* （0.023） |
| Education |  | 0.064\*\*\* （0.019） |  | -0.811\*\*\* （0.105） |  | 0.277\*\*\* （0.019） |
| Marital status |  | -0.024 （0.027） |  | -0.896\*\*\* （0.149） |  | -0.007 （0.028） |
| Work |  | 0.122\*\*\* （0.022） |  | -0.402\*\*\* （0.119） |  | 0.071\*\*\* （0.022） |
| Exercise |  | -0.001 （0.003） |  | -0.054\*\*\* （0.015） |  | 0.005 （0.003） |
| Medical insurance |  | -0.104\*\*\* （0.037） |  | -0.626\*\*\* （0.199） |  | 0.023 （0.038） |
| Number of family members |  | 0.028\*\*\* （0.005） |  | -0.093\*\*\* （0.026） |  | -0.005 （0.005） |
| Total household income |  | 0.029\*\*\* （0.010） |  | -0.428\*\*\* （0.056） |  | 0.072\*\*\* （0.011） |
| Province dummies |  | Yes |  | Yes |  | Yes |
| Adj- | 0.053 | 0.070 | 0.019 | 0.066 | 0.075 | 0.110 |

\*\*\**,* \*\**, and* \* *indicate significance at 1, 5, and 10%, respectively. Standard errors are presented in parentheses.*

**5.2 Robustness Test**

The robustness tests of the model were run using both substitution measures and the replacement of the core explanatory variables. The ordered Probit models were employed as replacement measures for the estimate of the results since the explanatory variables were categorical ones. Table 5 below shows the regression results with all models being statistically significant at least on the 5% level, coinciding with the findings of the baseline regression.

Table 5. Ordered probit estimation of Internet use on rural women’s health outcomes

|  |  |  |  |
| --- | --- | --- | --- |
| **Variable** | **Model (1)** | **Model (2)** | **Model (3)** |
| **Self-Rated Health** | **Depression** | **Cognition** |
| Internet Use | 0.312\*\*\* （0.032） | -0.060\*\*（0.029） | -0.346\*\*\* （0.033） |
| Education | 0.243\*\*\* （0.028） | -0.179\*\*\* （0.025） | 0.402\*\*\* （0.029） |
| Marital status | -0.030 （0.039） | -0.187\*\*\* （0.038） | -0.007 （0.028） |
| Work | 0.186\*\*\* （0.032） | -0.093\*\*\* （0.029） | 0.113\*\*\* （0.033） |
| Exercise | -0.0003 （0.004） | -0.014\*\*\* （0.004） | 0.007 （0.004） |
| Medical insurance | -0.150\*\*\* （0.055） | -0.163\*\*\* （0.047） | 0.034 （0.057） |
| Number of family members | 0.040\*\*\* （0.007） | -0.021\*\*\* （0.006） | -0.006 （0.007） |
| Total household income | 0.045\*\*\* （0.016） | -0.098\*\*\* （0.014） | 0.106\*\*\* （0.016） |
| Province dummies | Yes | Yes | Yes |
| Pseudo- | 0.034 | 0.017 | 0.054 |

\*\*\**,* \*\**, and* \* *indicate significance at 1, 5, and 10%, respectively. Standard errors are presented in parentheses.*

Table 6 shows the results of the robustness test when using “the importance of the internet for social interaction” as the core explanatory variable. Models 2, 4, and 6 reveal that “the importance of the Internet for social interaction” positively impacts on the health status of rural women, which is also consistent with baseline regression results.

Table 6. Robustness Test: the substitution of the core explanatory variable

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Variable** | **Model (1)** | | **Model (2)** | | **Model (3)** | | **Model (4)** | | **Model (5)** | | **Model (6)** | |
| **Self-Rated Health** | | **Self-Rated Health** | | **Mental health** | | **Mental health** | | **Cognition** | | **Cognition** | |
| Internet Use | 0.217\*\*\*（0.022） | |  | | -0.311\*\* （0.122） | |  | | 0.248\*\*\* （0.023） | |  | |
| The importance of the Internet for social interaction |  | | 0.034\*\*\*（0.127） | |  | | -0.109\* （0.063） | |  | | 0.034\*\* （0.014） | |
| Education | 0.064\*\*\* （0.019） | | 0.183\*\*\* （0.032） | | -0.811\*\*\* （0.105） | | -1.146\*\*\* （0.161） | | 0.277\*\*\* （0.019） | | 0.320\*\*\* （0.036） | |
| Marital status | -0.024 （0.027） | | -0.140\*\*\* （0.047） | | -0.896\*\*\* （0.149） | | -0.168 （0.233） | | -0.007 （0.028） | | -0.039 （0.053） | |
| Work | 0.122\*\*\* （0.022） | | -0.061\* （0.353） | | -0.402\*\*\* （0.119） | | -0.034 （0.175） | | 0.071\*\*\* （0.022） | | -0.019 （0.039） | |
| Exercise | -0.001 （0.003） | | -0.003 （0.005） | | -0.054\*\*\* （0.015） | | -0.053\*\* （0.025） | | 0.005 （0.003） | | 0.003 （0.006） | |
| Medical insurance | -0.104\*\*\* （0.037） | | -0.038 （0.058） | | -0.626\*\*\* （0.199） | | -0.741\*\*\* （0.289） | | 0.023 （0.038） | | 0.105 （0.065） | |
| Number of family members | 0.028\*\*\* （0.005） | | 0.015\* （0.008） | | -0.093\*\*\* （0.026） | | -0.133\*\*\* （0.039） | | -0.005 （0.005） | | 0.001 （0.008） | |
| Total household income | 0.029\*\*\* （0.010） | | 0.048\*\* （0.019） | | -0.428\*\*\* （0.056） | | -0.398\*\*\* （0.093） | | 0.072\*\*\* （0.011） | | 0.096\*\*\* （0.021） | |
| Province dummies | | Yes | | Yes | | Yes | | Yes | | Yes | | Yes | |
| Adj- | | 0.070 | | 0.039 | | 0.066 | | 0.063 | | 0.110 | | 0.062 | |

\*\*\**,* \*\**, and* \* *indicate significance at 1, 5, and 10%, respectively. Standard errors are presented in parentheses.*

Although most studies suggest that self-rated health has been a relatively accurate reflection of an individual's actual health, some scholars argue that self-rated health indicators are not objective enough (Sullivan & von Wachter, 2009). Therefore, we propose to use principal component analysis to obtain a comprehensive index of physical health (which is also done for mental health). The corresponding regression results are reported in Table 7, again coinciding with baseline regression results.

Table 7. Robustness Test: Measurement problems in health

|  |  |  |
| --- | --- | --- |
| **Variable** | **Model (1)** | **Model (2)** |
| **Self-Rated Health (PCA)** | **Mental health (PCA)** |
| Internet Use | 0.121\*\*\* （0.016） | -0.034\*\*\* （0.013） |
| Control Variables | Yes | Yes |
| Adj- | 0.0303 | 0.0585 |

\*\*\**,* \*\**, and* \* *indicate significance at 1, 5, and 10%, respectively. Standard errors are presented in parentheses.*

These findings imply that the models used in this study’s estimation results are robust.

**5.3 PSM to Eliminate Sample Selection Bias**

A PSM model was employed to assess the net association of internet use on the health status of rural women to circumvent sample self-selection bias. First, a balanced test of the sample pie’s quality was ran to guarantee a good match. Any significant discrepancy between the two groups of samples after matching deemed the estimation invalid and the matching deemed bad (Wang, 2021). Three methods were then used for estimation: K-nearest neighbor matching, radius neighbor matching, and kernel matching. Results are shown in Tables 8 and 9 herein.

The information shown in Table 8 indicates that the bias (%) after matching for all variables is less than 5% except for the “marriage” variable. According to the findings of the t-test means, most variables in the treatment and control groups were not significant after matching. This basically addresses the problem of sample selection bias. Table 9 exhibited the PSM estimation results. After controlling for sample selection bias, the net association of internet use on self-rated health, depression and cognition of rural women were at 18.7% (*p* 0.01), -34.5% (*p*0.1) and 24.3% (*p*0.01), respectively when using the K-nearest neighbor matching method. The other two methods provide similar results.

Table 8. Quality balance test for sample matching

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Variable** | **Unmatched  Matched** | **Mean** | | **Bias (%)** | **Reduce Bias (%)** | **t-Test** | |
| **Treated** | **Control** | **t** | **p > |t|** |
| Education | U | 0.994 | 0 .408 | 116.5 | 99.5 | 46.57 | 0.000 |
| M | 0.989 | 0.986 | 0.6 | 0.21 | 0.838 |
| Work | U | 0.76 | 0.746 | 3.4 | 5.1 | 1.35 | 0.176 |
| M | 0.76 | 0.774 | -3.2 | -1.17 | 0.241 |
| Medical insurance | U | 0.928 | 0.93 | -1.1 | 2.9 | -0.44 | 0.66 |
| M | 0.927 | 0.93 | -1.1 | -0.38 | 0.704 |
| Marital status | U | 0.876 | 0.849 | 7.6 | -66.7 | 3.02 | 0.003 |
| M | 0.875 | 0.919 | -12.7 | -5.16 | 0.000 |
| Exercise | U | 2.071 | 2.341 | -8.1 | 51.2 | -3.19 | 0.001 |
| M | 2.075 | 2.207 | -4 | -1.47 | 0.142 |
| Number of family members | U | 4.812 | 4.34 | 22.5 | 94.4 | 8.88 | 0.000 |
| M | 4.798 | 4.825 | -1.3 | -0.44 | 0.659 |
| Total household income | U | 10.959 | 10.412 | 56.6 | 95.7 | 22.06 | 0.000 |
| M | 10.95 | 10.927 | 2.4 | 0.99 | 0.324 |

\*\*\**,* \*\**, and* \* *indicate significance at 1, 5, and 10%, respectively. Standard errors are presented in parentheses.*

Table 9. Propensity score matching estimation results

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Independent variable** | **Sample** | **Treated** | **Control** | **ATT** | **S.E.** | **T Stat** |
| Self-Rated Health | Unmatched | 2.095 | 1.751 | 0.344 | 0.019 | 17.68 |
| Matched（1） | 2.093 | 1.907 | 0.187 | 0.034 | 5.53\*\*\* |
| Matched（2） | 2.09 | 1.887 | 0.203 | 0.032 | 6.33\*\*\* |
| Matched（3） | 2.095 | 1.893 | 0.202 | 0.032 | 6.21\*\*\* |
| Depression | Unmatched | 5.908 | 6.993 | -1.08 | 0.107 | -10.09 |
| Matched（1） | 5.919 | 6.265 | -0.345 | 0.185 | -1.86\* |
| Matched（2） | 5.917 | 6.286 | -0.368 | 0.178 | -2.07\*\* |
| Matched（3） | 5.908 | 6.245 | -0.336 | 0.182 | -1.85\* |
| Cognition | Unmatched | 2.17 | 1.722 | 0.448 | 0.02 | 22.21 |
| Matched（1） | 2.168 | 1.925 | 0.243 | 0.035 | 7.03\*\*\* |
| Matched（2） | 2.166 | 1.906 | 0.26 | 0.032 | 7.98\*\*\* |
| Matched（3） | 2.17 | 1.918 | 0.251 | 0.033 | 7.63\*\*\* |

Note: (1) K-nearest neighbor matching used “one-to-four” matching, (2) radius neighbor matching with a radius of 0.01 and (3) kernel matching used default values for both kernel function and bandwidth.

**5.4 Moderating Effect and** **Mediating Effect Analysis**

**5.4.1 Moderating Effect Analysis**

Table 10 shows the results of the moderating effect of “Age”. Following Model 1, the effect of the internet use on self-rated health is both positive and significant (*p* 0.01), but the interaction term between age and internet use is negative and significant (*p*0.05). This result suggests that the strength of the effects of internet use on self-rated health decreases with age. Similar analysis can be done to Models 2 and 3, with the strength of the effects of internet use on depression and cognition also decreasing with age.

Table 10. Moderating Effect of “Age”

|  |  |  |  |
| --- | --- | --- | --- |
| **Variable** | **Model (1)** | **Model (2)** | **Model (3)** |
| **Self-Rated Health** | **Depression** | **Cognition** |
| Internet Use | 0.310\*\*\* （0.079） | -0.794\* （0.439） | 0.324\*\*\* （0.083） |
| Age | -0.012\*\*\* (0.001) | 0.015\*\*\* （0.006） | -0.006\*\*\* (0.001) |
| Internet Use \* Age | -0.007\*\* (0.002) | 0.018\* （0.010） | -0.004\*\* (0.002) |
| Education | 0.034\* （0.028） | -0.611\*\*\* （0.113） | 0.215\*\*\* （0.021） |
| Marital status | -0.033 （0.028） | -0.917\*\*\* （0.155） | -0.007 （0.029） |
| Work | 0.104\*\*\* （0.022） | -0.394\*\*\* （0.122） | 0.064\*\*\* （0.023） |
| Exercise | 0.007\*\* （0.003） | -0.065\*\*\* （0.153） | 0.008\*\*\* （0.003） |
| Medical insurance | -0.064\* （0.036） | -0.689\*\*\* （0.199） | 0.042 （0.038） |
| Number of family members | 0.012\*\*\* （0.005） | -0.069\*\*\* （0.027） | -0.012\*\* （0.005） |
| Total household income | 0.025\*\* （0.016） | -0.423\*\*\* （0.056） | 0.070\*\*\* （0.011） |
| Province dummies | Yes | Yes | Yes |
| Adj- | 0.109 | 0.069 | 0.118 |

\*\*\**,* \*\**, and* \* *indicate significance at 1, 5, and 10%, respectively. Standard errors are presented in parentheses.*

**5.4.2 Mediating Effect Analysis**

Uncertainty exists in the extant research on the mechanisms behind the link between internet use and health. We chose information accessibility and social trust as the mediating variables for additional investigation and used a stepwise regression method to confirm its mediating mechanism according to the human capital model and previous literature. Tables 11 and 12 report the mediating effects of information accessibility and social trust.

The regression coefficient of internet use to self-rated health is 0.217 (*p*0.01), and to information accessibility is 1.801(*p*0.01), indicating that internet use has a significantly positive association with information accessibility. Moreover, when both internet use and information accessibility are simultaneously included in the model, the direct impact of internet use on self-rated health is 0.043 (*p* 0.01) and the regression coefficient of information accessibility is 0.139 (*p*0.01), indicating that the association between internet use and self-rated health is partially mediated by information accessibility, thereby strongly supporting H2a.

However, the mediating role of information accessibility on the relationship between internet use and rural women’s mental health status is unclear since the mediating effect of information accessibility on the relationship between internet use and depression is not significant. This may imply that information access does not alleviate rural women’s depression despite improving cognition. Internet use may reduce the depression scores by increasing the contact frequency and life fun (Yang et al., 2021; Benvenuti et al., 2020).

Table 11. Mediation of Information Accessibility

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Variables** | **Self-Rated Health** | | | **Depression** | | | **Cognition** | | |
| **Step One** | **Step Two** | **Step Three** | **Step One** | **Step Two** | **Step Three** | **Step One** | **Step Two** | **Step Three** |
| Internet Use | 0.217\*\*\*（0.022） | 1.801\*\*\* （0.039） | 0.139\*\*\* （0.026） | -0.311\*\* （0.122） | 1.801\*\*\* （0.039） | -0.288\*\* （0.144） | 0.248\*\*\* （0.023） | 1.801\*\*\* （0.039） | 0.139\*\*\* （0.027） |
| Control Variables | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Information accessibility |  |  | 0.043\*\*\* （0.008） |  |  | -0.012 （0.042） |  |  | 0.061\*\*\* （0.008） |
| Adj- | 0.070 | 0.448 | 0.076 | 0.066 | 0.448 | 0.066 | 0.110 | 0.448 | 0.118 |

\*\*\**,* \*\**, and* \* *indicate significance at 1, 5, and 10%, respectively. Standard errors are presented in parentheses.*

Table 12. Mediation of Social Trust

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Variables** | **Self-Rated Health** | | | **Depression** | | | **Cognition** | | |
| **Step One** | **Step Two** | **Step Three** | **Step One** | **Step Two** | **Step Three** | **Step One** | **Step Two** | **Step Three** |
| Internet Use | 0.217\*\*\*（0.022） | 0.094\*\*\* （0.036） | 0.212\*\*\* （0.225） | -0.311\*\* （0.122） | 0.094\*\*\* （0.036） | -0.272\*\* （0.122） | 0.248\*\*\* （0.023） | 0.094\*\*\* （0.036） | 0.244\*\*\* （0.023） |
| Control Variables | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Social Trust |  |  | 0.087\*\*\* （0.019） |  |  | -0.923\*\*\* （0.101） |  |  | 0.080\*\*\* （0.019） |
| Adj- | 0.070 | 0.048  (Pseudo-) | 0.076 | 0.077 | 0.048  (Pseudo-) | 0.066 | 0.110 | 0.048  (Pseudo-) | 0.113 |

\*\*\**,* \*\**, and* \* *indicate significance at 1, 5, and 10%, respectively. Standard errors are presented in parentheses.*

**6. Discussion**

**6.1 Principal Findings**

Using data from 2018 CFPS, the study explored how internet use affected rural women’s health status by using various methods to do robustness testing and mechanism investigation. Subsequent evidence posits that internet use has a significant and positive effect on the self-rated health of rural women, coinciding with other existing findings (Yang & He, 2020; Zhu et al., 2021; Neter et al., 2018). Furthermore, internet use was found to improve the mental health of rural women (Bessière et al.,2010; Han & Zhao,2021). And those who were better educated, employed, or had some family savings had better health, lower depression levels, and higher cognitive levels.

This study also examined the moderating effect of age among the rural women. The estimation results by age indicate that the strength of the effects of internet use on self-rated health, depression, and cognition level decreases with age. Although many studies show that internet use can improve the health and well-being of older adults (Mellor et al. 2008; Cotten et al. 2012; Van Boekel et al.2017), the impact of internet use on rural women grows weaker over time. This may be because in rural areas, older women are less likely to use the internet due to their low education level and poorer internet skills, barring them from the benefits of online resources (Jacobs et al., 2017). Particularly, older women in rural areas are especially at risk for depression and other health problems because they frequently live alone as widows or care for a disabled spouse or family member, have concurrent medical illness, poorer health, and a tendency toward economic deprivation (ERS, 2005).

Moreover, the analysis of the mediating effect model identified information accessibility and social trust as the important path mechanisms for internet use to promote self-rated health. Rural women can search for health information online and get social capital and support from online communities. However, the mediating role of information accessibility on the relationship between internet use and rural women’s depression is not significant, meaning rural women are not able to improve depression through online health information. According to Bessière *et al.* (2010), there exists a link between increasing depression and using the Internet for health-related activities. The rise could be attributed to more introspection, unwarranted concern, or excessive focus on medical issues. In contrast, communicating with friends and family online was linked to reductions in depressive symptoms.

**6.2 Policy Implication**

The findings of this study provide various significant policy implications. First, it is important to speed up internet access in rural areas, especially as their economic development and information infrastructures considerably lags behind those of cities (Yan & Schroeder, 2020). Additionally, the government must do more to educate rural women on how to use the internet and take a hands-on approach to support less-educated women for them to benefit from internet use.

Second, public and private health organizations need to reorient and discover better ways to engage the “new age rural woman” given that anyone with internet connection may quickly access reams of material on just about any health-related subject. However, rural women are having an extremely difficult time locating accurate online health information because they typically have inadequate health literacy and are unable to search for and comprehend pertinent information. Thus, easier or more pro-active approaches should be figured out for them. Such positive interaction can encourage the ethical use of health information and empower women to manage their own health conditions (Pandey et al., 2003). And because of the widespread use of short videos like TikTok videos, health science videos can educate rural women about health through simple formats and content.

Third, policy should pay particular attention to the mental health of rural women. The mediating effect analysis of information accessibility highlighted the insufficiency of merely increase rural women’s access to the internet — we should significantly enlarge the entertainment and leisure functions offered by Internet services, suitably grow them, and then cater to their many needs. There is also a need to create a community network environment which actively promotes learning and social interaction. This will help rural women feel less depressed and lonely while enhancing their capacity to participate in online social activities.

Last but not least, the government should ensure that rural women are better educated and given fair employment opportunities. Despite the desirability of gender equality in the labor market, there is little disagreement that significant gender differences remain in key labor outcomes (Bao & Leibbrandt, 2020). Encouraging rural women to use the Internet for self-employment or entrepreneurship, which can also increase their health capital to some extent.

**6.3 Limitations**

Some study limitation should be highlighted. First, considering limited data resources, of which were self-reported, the issue of sample bias might exist. In the future, collecting clinical data to further study the relationship between internet use and the health status might solve this dilemma. Second, we were unable to explore the impact of various internet usage patterns on health status. Third, it should be noted that the mediating role of information accessibility on the relationship between internet use and rural women’s depression is not significant, which means the mediating effect has not been fully explored. Further examinations about the impact mechanism and the differences between rural women and men are encouraged in future studies.

**7. Conclusion**

This study examines the relationship between Internet use and self-rated health, depressions and cognition among rural women as along with the moderating effect and its mediation process. Findings show a strong and positive correlation between Internet use and rural women’s health, with endogenous and robustness tests confirming these conclusions. These findings hold true even after sample selection bias was removed using PSM. Moreover, the moderating role of age among the rural women was also investigated. According to the estimation results broken down by age, internet use has weaker effects as people get older on the degree of depression, self-rated health, and cognition. Finally, mediation analysis shows that there is some partial mediation between Internet use and rural women’s health, and that information accessibility and social trust is an essential channel connecting both.

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