

Media use behavior mediates the association between family health and intention to use mobile health devices among older adults: a cross-sectional study

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Table of Contents

Original Manuscript..... 5

Supplementary Files..... 30

 Figures 31

 Figure 1..... 32

 ????????s 33

 ???????? 0 34

Media use behavior mediates the association between family health and intention to use mobile health devices among older adults: a cross-sectional study

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Abstract

Background: With the advancement of society and the development of technology, health medical treatment has entered the mobile era and a serious digital divide issue has emerged in the engagement of elder people with mobile health. Family health and media use behavior are important factors in promoting elder people's use of mobile health devices, but no research has been conducted on the mediating role of media use behavior in the relationship between elder people's family health and their intention to use mobile health devices at present. This study aims to explore the associations among elder people's intention to use mobile health devices, family health, and media use behavior.

Objective: The purpose of this study was to explore the influence of family health and media use behavior on the intention of the elderly to use mobile health devices in China, and to provide reasonable and feasible suggestions to help the elderly bridge the digital divide.

Methods: Data from 3,712 older adults over 60 years old were obtained from the Psychology and Behavior Investigation of Chinese Residents (PBICR) in 2022. Linear regression models were applied to measure the correlation between family health, media use behavior, and intention to use mobile health devices after the adjustment for covariates. We used the Sobel-Goodman mediation test to examine the mediation role of media use behavior on the relationship between family health and intention to use mobile health devices. Statistical significance was defined as $P < 0.05$.

Results: There was a positive correlation among family health, media use behavior, and intention to use mobile health devices ($r = 0.077 \sim 0.178$, $P < 0.001$). Media use behavior partially mediated the relationship between the total score of family health and intention to use mobile health devices (Sobel test: $Z = 5.451$, $P < 0.001$), which mediated 22.46% after adjusting the covariates. However, in the fractal dimension of family health, media use behavior fully mediates the relationship between family health resources and mobile health devices use intention (Sobel test: $Z = -7.284$, $P < 0.001$). Subgroup analysis further revealed that media use behavior had no mediating effect between the total score of family health and the intention of using mobile health devices of the elderly with low education level, but there was a complete mediating effect between the family health resources and the intention to use mobile health devices of the elderly with different education levels.

Conclusions: This study discovered that family health and media use behavior was pivotal in encouraging older adults to use mobile health devices. Media use behavior moderates the relationship between family health and mobile health devices, and more complex mechanisms of influence exist among older adults with poor education. In the future, the positive impact of family health should be fully exploited, with particular emphasis on the important role of family health resources in increasing older adults' media exposure and stimulating their interest in using mobile health devices. Furthermore, measures such as vigorously developing elder digital education and developing elderly-oriented media products are conducive to breaking down educational

and cultural barriers, reducing the technological difficulties of using media devices for the elderly and enhancing their willingness to use mobile health devices.

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Media use behavior mediates the association between family health and intention to use mobile health devices among older adults: a cross-sectional study

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Abstract

Background: With the advancement of society and the development of technology, health medical treatment has entered the mobile era and a serious digital divide issue has emerged in the engagement of elder people with mobile health. Family health is closely related to the health level of family members, and media use is an important means to integrate mobile health care, so both of them are important factors to promote the use of mobile health devices for the elderly. However, no research has been conducted on the mediating role of media use behavior in the relationship between elder people's family health and their intention to use mobile health devices at present. This study aims to explore the associations among elder people's intention to use mobile health devices, family health, and media use behavior.

Objective: The purpose of this study was to explore the influence of family health and media use behavior on the intention of the elderly to use mobile health devices in China, to assess in depth whether media use behavior mediates the association between family health and intention to use mobile health devices among older adults, and to provide reasonable and feasible suggestions to help the elderly bridge the digital divide.

Methods: Data from 3,712 older adults over 60 years old were obtained from the Psychology and Behavior Investigation of Chinese Residents (PBICR) in 2022. Linear regression models were applied to measure the association between family health, media use behavior, and intention to use mobile health devices after the adjustment for covariates. We used the Sobel-Goodman mediation

test to examine the mediation role of media use behavior on the relationship between four dimensions of family health (family social and emotional health processes; family health lifestyle; family health resources; family external social supports) and intention to use mobile health devices. Statistical significance was defined as $P < 0.05$.

Results: There was a positive association among family health, media use behavior, and intention to use mobile health devices ($r=0.077\sim0.178, P<.001$). Media use behavior partially mediated the relationship between the total score of family health and intention to use mobile health devices (Sobel test: $z=5.451, P<.001$), which mediated 22.46% after adjusting the covariates. However, in the fractal dimension of family health, media use behavior fully mediates the relationship between family health resources and mobile health devices use intention (Sobel test: $z=-7.284, P<.001$). Subgroup analysis further revealed that media use behavior had no mediating effect between the total score of family health and the intention of using mobile health devices of the elderly with low education level, but there was a complete mediating effect between the family health resources and the intention to use mobile health devices of the elderly with different education levels.

Conclusions: This study discovered that family health and media use behavior was pivotal in encouraging older adults to use mobile health devices. Media use behavior mediates the relationship between family health and intention to use mobile health devices, and more complex mechanisms of influence exist among older adults with poor education. In the future, the positive impact of family health should be fully exploited, with particular emphasis on the important role of family health resources in increasing older adults' media exposure and stimulating their interest in using mobile health devices. Furthermore, measures such as vigorously developing elder digital education and developing elderly-oriented media products are conducive to breaking down educational and cultural barriers, reducing the technological difficulties of using media devices for the elderly and enhancing their willingness to use mobile health devices.

Keywords: older adults; family health; media use; intention to use mobile health devices; China

Introduction

Background

According to the United Nations report "World Population Prospects 2022", in 2050, the world population is expected to reach 9.7 billion, with 1.5 billion people over 65 years old, accounting for 16% of the total population[1], and the rate of population aging is deepening. As a populous nation, China is also experiencing profound and complicated changes in its population development. According to the bulletin of China's Seventh National Population Census, there are 264 million older adults over 60 years old in China, accounting for 18.7% of the total population[2]. Due to the accelerating aging rate in China, the future development of China's medical services faces significant obstacles. More than 180 million older adults in China suffer from chronic diseases and 75% of them have multiple chronic illnesses[3]. As a high-risk group and susceptible group, the elderly have brought a tremendous amount of financial and operational pressure on China's medical and health field.

Mobile health devices usually refer to the mobile health programs and wearable devices[4]. As a portable device that continuously monitors various physiological conditions by using Internet communication technology, mobile health devices can track and record users' daily lifestyle and health status data in real time[5], which is helpful for users to adjust their health behaviors based on the prompt feedback of health information[6]. The use of mobile health devices not only meets the new demand for self-monitoring and self-management of medical services in the medical service market with the increased health awareness of consumers, but also facilitates the early diagnosis, intervention, clinical treatment and monitoring of various diseases through real-time supervising of

vital signs. Due to mobile health devices not being embraced by the elderly[7], their powerful functions and inherent advantages can not be fully exploited. As an inevitable product of the Internet era and aging society, mobile health has great potential to provide a promising solution to satisfy the growing demands for medical services in developing countries[8]. As the most frequent and heaviest users of health services[9], it is necessary to form a new social trend for the elderly to integrate with mobile health[10].

Previous research has proved that mobile health can benefit elder people's health, well-being and longevity bonus in the digital era, but it also brings a new social governance issue--the digital divide of the elderly[11, 12]. Due to the difficulty in obtaining or using information infrastructure and the low level of digital education, the elderly have experienced the digital divide, making it difficult to keep up with social, economic and technological progress[13]. According to the 50th Statistical Report on the Development of the Internet in China published by China Internet Network Information Center (CNNIC), the elderly aged 60 and above are the main group of non-netizens, accounting for 41.6%[14]. Personal, family, social and technological factors conspired to contribute to the alienation of older people from using new media, like the Internet[15]. Studies have shown that the interaction between the elderly and their family or friends is their motivation to actively seek health information on the Internet [16]. Older adults rely primarily on their families for social support, and family cohesion significantly affects their health status[17, 18].

Family health, a resource at the level of the family unit that develops from the intersection of the health of each family member, their interactions and capacities, as well as the family's physical, social, emotional, economic, and medical resources[19]. As an interdisciplinary concept, assessing family health requires a comprehensive consideration of multiple factors, including family functioning, emotional support, financial resources, and access to external services[20]. Literature shows that family support can encourage the elderly to seek medical services[21], and family function and health can be used as crucial indicators for evaluating the mental health of the elderly[22]. Communication among family members, such as children, grandchildren and peer groups, will affect the elderly's willingness to use smart senior care[23]. Up to now, many articles mostly discuss family health from a single dimension[24-26], but there is still a research gap on how family health specifically influences the intention of the elderly to use mobile health devices.

The development of mobile health is unseparated from the technical support of the media. Media technology not only forms visual data for the health conditions detected by mobile health devices[27], but also provides a platform for the public to exchange and share medical information. For older adults, their acceptance of new health services and access to health information are both impacted differently by the use of media devices[28, 29]. A Chinese empirical analysis demonstrates that media use is essentially correlated with the level of health of older adults[30]. Social media communication can be regarded as an intervention measure to alleviate the loneliness of older adults by increasing the level of social support and social contact, thus promoting positive responses to emerging technologies[31, 32]. In addition, the use of mobile phones and other media has a great impact on the differences in medical care, and increasing the contact and continuous use of media by the elderly will help promote the great potential of mobile medical technology in the health care of the elderly[33].

In summary, it is urgent and realistic to narrow the digital divide among older adults, and the willingness of the elderly to use mobile health devices through surveys reflects their acceptance of new health technologies and their integration into the mobile health era to a certain extent. Previous studies on influencing the intention to use mobile health devices among older adults mainly concentrated on the behavioral motivations and mechanisms of users' usage intention, focusing on the impact of technical and social aspects on actual usage behavior[34]. Research on influencing factors mainly involved age, gender, education degree, BMI, income, health status, etc[35-37], but there are few studies on the external environmental factors such as family and social influences, especially for the elderly population in China. Studies have shown that family internet access

improves older adults' cognitive function and promotes the frequency of media use[38], and family support can also help older adults overcome the barriers to the use of mobile health services [39]. Given the significant influence of family factors on the active health information-seeking behavior of the elderly[40-43], it is necessary to further study the relationship between family health, media use behavior, and the intention to use mobile health devices of the elderly, as well as the mediating role of media use behavior between family health and the intention of the elderly to use mobile health devices, so as to push the elderly to enter the "digital age" from the family level, promote the use of mobile health in the health care field, improve the healthy aging of society, and contribute to the realization of the outline of the "Healthy China 2030 Plan".

Objectives

In this study, data on family health, media use behavior, and intention to use mobile health devices among older adults were obtained from a cross-sectional study on psychology and behavior investigation of Chinese residents (PBICR). This study aimed to explore the influence of family health and media use behavior on the intention of the elderly to use mobile health devices in China, and to assess whether media use behavior mediates the association between family health and intention to use mobile health devices among older adults. Based on the literature review, the following hypotheses were formulated: family health directly affects the intention to use mobile health devices and indirectly affects the intention to use mobile health devices through media use behavior; that is, media use behavior mediates the relationship between family health and intention to use mobile health devices.

Methods

Study design and Setting

The data for this study were derived from the psychology and behavior investigation of Chinese residents (PBICR), a large-scale cross-sectional survey initiated by the Peking University School of Public Health in 2022.. The survey covers 148 cities spread throughout 23 provinces, 5 autonomous regions, and 4 municipalities directly under the central government in China. The survey adopts multi-stage sampling, stratified sampling method in cities, districts, counties and communities, and quota sampling method from the community level to the individual level.

The survey was conducted by well-trained investigators, and the electronic questionnaires powered by <https://www.wjx.cn/> were distributed to the public one-on-one, face-to-face on the spot, and the questionnaire can be obtained by scanning the QR code. If the face-to-face investigation cannot be realized due to the limitation of the COVID-19 epidemic, the investigator distributes the electronic questionnaire one-on-one and face-to-face to the respondent with the help of instant communication tools such as WeChat, and carries out the online video investigation through Tencent meeting, WeChat video and other means[44].

In PBICR survey, the investigators were trained in the sampling method, the research tools, and quality control, only if investigators adhered the trained survey procedures were considered qualified and able to participate in the study. In addition, two researchers were selected to conduct logical checks during data processing, and unqualified questionnaires were excluded according to established questionnaire screening criteria. In the present study, we further screened the data to eliminate questionnaires that were completed for too short a time or that contained outliers or missing values.

A total of 23,414 questionnaires were collected for the 2022 PBICR survey, and 21,916 valid samples were obtained after logical checking and outliers elimination. The scope of this study will be limited to the age group 60 and above, and the final sample includes 3,712 older adults after sorting.

Participants

A total of 21916 questionnaires were collected, and the screening criterion was the elderly, age greater than or equal to 60 years old, no missing data and logic errors, and 3,712 valid survey data were obtained after summary and screening.

Inclusion criteria: (1) Aged 18~60; (2) Had the nationality of the People's Republic of China; (3) Chinese permanent resident population with an annual travel time ≤ 1 month; (4) Participated in the study and fill in the informed consent form voluntarily; (5) Participants can complete the questionnaire survey by themselves or with the help of investigators; (6) Participants can understand the meaning of each item in the questionnaire.

Exclusion criteria: (1) Persons with unconsciousness, or mental disorders; (2) Persons with cognitive impairment; (3) Those who were participating in other similar research projects; (4) Reluctant collaborators.

Ethics Statement

The study was conducted in accordance with the Declaration of Helsinki. All experimental protocols were approved by Shaanxi institute of international trade and commerce (No. JKWH-2022-02) and second xiangya hospital of central south university (No.2022-K050). The cover page of the questionnaire will explain the study's purpose and assure anonymity, confidentiality, and the right to refuse to participate in the study. Informed consent was obtained from all participants involved in the study.

The questionnaire cover used in this study explained the purpose of the study and assured anonymity, confidentiality and the right to refuse participation in the study. All participants voluntarily are required to sign an informed consent form before participating in the study. The respondents will not profit from the survey directly, but their responses will provide a more comprehensive and systematic understanding of the physical and mental health status of the public. The data of this study will be managed and used in strict accordance with the Statistics Law of the People's Republic of China. The research data is for academic use only, and when the research results are published, no information about the individual will be disclosed or adversely affected.

Measurements

General situation survey information

The basic demographic information of the elderly includes gender, age rank, nationality, religion, BMI rank, political status, status of occupation, education level, chronic diseases and family type (conjugal family, core family, backbone family, other family).

Family types are defined as follows: "Conjugal Family: A family consisting of only husband and wife; Core Family: A family consisting of parents and unmarried children; Backbone Family: A family consisting of parents and married children; Other Family: Other families including joint families, single-parent families, dink family, single family, etc."

Family Health Scale-Short Form (FHS-SF)

Family health was assessed using The Short-Form of the Family Health Scale in the Chinese Version (FHS-SF) developed by Crandall and Weiss[20]. Fei Wang and Yunchou Wu et al. introduced the FHS-SF cross-culturally to form a Chinese version of the FHS-SF as a quantitative tool for assessing family health problems in China[45]. The scale consists of 10 items, including four dimensions of family social and emotional health processes, family health lifestyle, family health resources and family external social supports. Five-point Likert scale was used for each item of FHS-SF, and the response options ranged from strongly disagree to strongly agree, and the items with negative wording were scored in reverse. The final score ranged from 10 to 50, with higher scores indicating higher levels of family health. According to the analysis of Fei Wang and Yunchou Wu et

al., the Cronbach α of the FHS-SF was .83, the Cronbach α of the four subscales ranged from .70 to .90, the retest reliability of the scale was 0.75[45].

In this study, the CR of the four dimensions are 0.912, 0.848, 0.781 and 0.806, respectively, all of which are greater than the reliability threshold of 0.7. Their AVE are 0.775, 0.736, 0.553 and 0.677, respectively, all of which are greater than 0.5. The Cronbach α of the FHS-SF was .90, and the factor loadings ranged from 0.73 to 0.90, all of which are within an acceptable range.

Media Use Behavior Scale

The frequency of media use is measured by the Media Use Behavior Scale developed by the PBICR of Peking University. The scale refers to media including newspapers, radio, television, Internet, mobile phones, etc. This scale consists of 6 items, which are related to social contact, self-presentation, social behavior, leisure and entertainment, access to information and business transactions. Their options indicate the degree of media use frequency, ranging from "infrequent" to "frequent", with a score of 1 to 5. The total score ranges from 6 to 30, with higher scores indicating more frequent use of the medium[44].

In this study, the CR of Media Use Behavior Scale is 0.894 and the AVE is 0.585. The Cronbach α of the Media Use Behavior Scale was .89, and the standardized factor loadings of the validation factor analysis were above 0.50, all within acceptable limits.

Intention to Use Mobile Health Devices

The intention to use mobile health devices was assessed in the form of completions. Respondents were supposed to fill in a number from 0 to 100 according to their personal subjective consciousness, forming a continuous variable. A higher number represents a greater intention to use a mobile health devices.

Data Analysis

Continuous variables are tested for normality using the Kolmogorov-Smirnov test and are reported as the median and interquartile range; categorical variables are reported in frequency (%). Non-parametric methods were used to test the difference of characteristics in the total score of the intention to use mobile health devices, in which the Mann-Whitney U test was used for dichotomous variables and the Kruskal-Wallis H test was used for multi-categorical variables. The partial correlation coefficient between Family health scores, Media use behavior scores and Intention to use mobile health devices scores was calculated by regression model. Linear regression models are used to measure the association between Family Health scores and Media Use Behavior Scale / Intention to use mobile health devices scores with and without adjustment for covariates, and the association between Media Use Behavior Scale and Intention to use mobile health devices scores and are reported as coefficients and 95% confidence intervals (CIs). The covariates were identified based on previous studies and general knowledge. We analyzed the mediating role of Media Use Behavior Scale scores on the association of Family Health scores with Intention to use mobile health devices scores through the Sobel-Goodman Mediation Test while controlling for all the selected covariates. The significance of the indirect effect, direct effect and the total effect were obtained by the Bootstrap algorithm.

All *P* values were 2-sided, with an $\alpha \leq .05$ used to define statistical significance. Data were analyzed by using IBM SPSS Statistics 26 and R version 4.1.3.

Subgroup analysis

According to existing empirical studies, there is a positive association between education and health. People with higher education tend to pursue healthy lifestyles and may also spend more on health-related expenses due to the corresponding increase in income[46]. Education also leads to different levels of Internet participation. The higher the education level, the greater the possibility of

using the medium to search for health information.[47]. In different educational and cultural background, individuals have different levels of concern about health risks, which further affects their acceptance of healthcare technology[48]. Besides, our preliminary analysis showed that the total score of family health was significantly different under different education levels($P<.001$). Based on the influence of education level on health behavior and media use as described in the existing literature and the results, this paper will analyze education level as a subgroup and comprehensively consider the mediating role of media use behavior of older adults with different education levels between family health and their intention to use mobile health devices.

Result

General characteristics

A total of 3712 elderly people over 60 years old were included in this study, with an average age of 69.23 ± 6.13 , with the majority of older adults (81.79%) aged 60 to 74. The basic demographic data of 3712 elderly people are shown in Table 1. There were 1839 males (49.54%) and 1873 females (50.46%), with the majority of Han Nationality and non-religious people (90.79% and 92.03%, respectively), and the majority of elderly people with political views were masses (84.89%). There were significant differences in the willingness to use mobile health devices among older adults with different politics statuses, the status of occupations, and chronic disease conditions ($P<.001$), and there were no significant differences in the willingness to use mobile health devices among older adults with different family types ($P>.05$) (Table 1)

Table 1 Characteristics of respondents (n=3712)

Grouping of characteristics ^a	All□n=3712□	The total score of the intention to use mobile health devices M(IQR)	P value
Gender	n□%□		.312
Male	1839(49.54)	66.00(36.00)	
Female	1873(50.46)	64.00(35.00)	
Age Rank			.451
60≤Age≤74	3036(81.79)	65.00(34.00)	
75≤Age≤89	662(17.83)	64.50(37.00)	
Age≥90	14(0.38)	61.00(60.00)	
Nationality			.084
Han Nationality	3370(90.79)	64.00(35.00)	
Minority Nationality	342(9.21)	68.00(34.00)	
Religion			.014
No	3416(92.03)	65.00(35.00)	
Yes	296(7.97)	61.00((35.00)	
BMI Rank			.001
Normal□18.5≤BMI□24□	2355(63.44)	66.00(34.00)	
Underweight□BMI□18.5□	373(10.05□	60.00(39.00)	
Overweight□24≤BMI□28□	841(22.66)	66.00(36.00)	
Obese□BMI≥28□	143(3.85)	60.00(38.00)	
Political Status			<.001
The Masses	3151(84.89)	64.00(35.00)	
Communist Party Members	512(13.79)	69.00(39.00)	

Probationary Party Members	10(0.27)	59.00(36.00)	
Other Parties	39(1.05)	60.00(38.00)	
Occupation Status			<.001
On The Job	98(2.64)	70.00(44.00)	
Retire	2071(55.79)	67.00(33.00)	
Rolling Stone	392□10.56)	68.00(34.00)	
Unemployed	74(1.99)	55.00(41.00)	
Job-waiting/Jobless	1077(29.02)	60.00(38.00)	
Education Level			.004
Primary School And Below	1817(48.95)	63.00(37.00)	
Middle School/Vocational School/High School	1426(38.42)	65.00(34.00)	
College And Above	469(12.63)	70.00(35.00)	
Chronic Disease			<.001
No	1552(41.81)	69.00(35.00)	
Yes	2160(58.19)	62.00(36.00)	
Family Type			.973
Conjugal Family	887(23.90)□	64.00(37.00)	
Core Family	325(8.76)	64.00(40.00)	
Backbone Family	1854(49.94)	65.50(33.00)	
Other Family	646(17.40)	65.00(37.00)	

^aMean(SD) deviation was used to describe the continuous variable, and number (%) was used to describe the categorical variable.

Association analysis

After controlling the covariates, the intention to use mobile health devices was positively associated with the total score of family health($r=.077,P<.001$) and the score of media use behavior($r=.178, P<.001$), and family health total score was positively associated with media

use behavior score ($r=.079, P<.001$) (Table 2).

Table 2 Partial correlations coefficients (r) among Family health, Media use behavior, and Intention to use mobile health devices

$r(P)$	Family health total score	Media use behavior scores	Intention to use mobile health devices
Family health total score			
Media use behavior scores	0.079($P<.001$)		
Intention to use mobile health devices	0.077($P<.001$)	0.178($P<.001$)	

The model was adjusted for religion, BMI rank, political status, the status of occupation, education degree, and chronic diseases are bolded if they achieved statistical significance at $P\leq.05$

Relationship between Family health and Media use Behavior Score/Intention to use mobile health devices

According to linear regression models before adjustment, the four dimensions of family health (family socialization, family healthy lifestyle, family health resources, family external social support) and the total score were significantly associated with media use behavior, and were also significantly related to intention to use mobile health devices except for family health resources. After adjusting for gender and age rank, as well as political status, nationality, religion, BMI rank, occupation status, education level, family type, chronic diseases except for family health resources ($P<.001$) (Table 3).

Table3 Linear regression analysis for Media use behavior/Intention to use mobile health devices associated with Family Health

	Media use behavior scores				Intention to use mobile health devices			
	Unadjusted		Adjusted		Unadjusted		Adjusted	
	$\beta(95\%CI)$	P value	$\beta(95\%CI)$	P value	$\beta(95\%CI)$	P value	$\beta(95\%CI)$	P value
Family social	.42[-0.35,0.49]	<.001	.32[-0.25,0.39]	<.001	.88[-0.56,1.20]	<0.001	.84[-0.52,1.16]	<.001
Family healthy lifestyle	.55[-0.45,0.66]	<.001	.45[-0.36,0.55]	<.001	1.28[-0.81,1.74]	<0.001	1.28[-0.81,1.75]	<.001

Family health resources	-.26[-0.32,-0.20]	<.001	-.25[-0.31,-0.20]	<.001	-.19[-0.46,0.07]	0.155	-.15[-0.41,0.12]	.291
Family external social supports	.61[0.15,0.71]	<.001	.53[0.43,0.62]	<.001	1.43[0.98,1.88]	<0.001	1.45[1.00,1.89]	<.001
Total	.09[0.07,0.12]	<.001	.07[0.04,1.00]	<.001	.30[0.17,0.42]	<0.001	.30[0.18,0.43]	<.001

Note: β beta coefficient, CI confidence interval
Adjusted: Adjusting for gender and age rank, political status, nation, religion, BMI rank, status of occupation, education degree, family type, chronic diseases.

Relationship between Media use behavior score and Intention to use mobile health devices

According to linear regression models before adjustment, media use behavior was significantly associated with intention to use mobile health devices; and after adjusting for gender and age rank, political status, nationality, religion, BMI rank, occupation status, education level, family type, chronic diseases ($P<.001$) (Table 4).

Table 4 Linear regression analysis for Intention to use mobile health devices. associated with Media use behavior

		Intention to use mobile health devices			
		Unadjusted		Adjusted	
		β (95%CI)	<i>P</i> value	β (95%CI)	<i>P</i> value
Media use behavior score		.94[0.80,1.08]	<.001	.84[0.69,0.99]	<.001

Note: β beta coefficient, CI confidence interval
Adjusted: Adjusting for gender and age rank, political status, nation, religion, BMI rank, status of occupation, education degree, family type, chronic diseases.

Mediation analysis

Family health total score was positively associated with the intention to use mobile health devices among older adults. Mediating analysis including media use behavior showed that the relationship between the total score of family health and intention to use mobile health devices was mediated through media use behavior. Media use behavior partially mediated the association between family health and intention to use mobile health devices in this study, and this mediating variable accounted for 22.46% of the association when adjusting the covariates. The total score of family health was related to media use behavior ($\beta=.088$, $P<.001$) and intention to use mobile health devices ($\beta=.244$, $P<.001$). Media use behavior was also related to the intention to use mobile health devices($\beta=.810$, $P<.001$). The final mediation models of the independent variable (total score of family health), the mediating variable (media usage behavior), and the dependent variable (intention to use mobile health devices) are shown in Figure.1.

The four dimensions of family health were positively associated to use mobile health devices among older adults, with the dimension of family health resources having a non-significant association. The mediation analysis with media use behavior showed that the direct and total effects of family health resources were not significant and that media use behavior was a full mediator when adjusting the covariates; media use behavior partially mediated the relationship between a family social, family healthy lifestyle, family external social support and intention to use mobile health devices, with mediating effects of 35.18%, 31.78%, and 31.33%, respectively, under adjusted covariates (Table 5).

Table 5 Mediation analysis

$\beta(P)$	Family social	Family healthy lifestyle	Family health resources	Family external social supports	Total
a coefficient	0.401(<.001)	0.545(<.001)	-0.284(<.001)	0.616(<.001)	0.088(<.001)
b coefficient	0.790(<.001)	0.789(<.001)	0.844(<.001)	0.770(<.001)	0.810(<.001)
Indirect effect	0.317(<.001)	0.431(<.01)	-0.239(<.001)	0.475(<.001)	0.071(<.001)
Direct effect	0.584(<.001)	0.925(<.001)	0.048	1.042(<.001)	0.244(<.001)
Total effect	0.901(<.001)	1.356(<.001)	-0.191	1.516(<.001)	0.316(<.001)
The proportion of total effect that is mediated□%□	35.18	31.78	125.13	31.33	22.46

Sobel test	7.754(<.001)	7.497(<.001)	-7.284(<.001)	-7.284(<.001)	5.451(<.001)
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Sobel-Goodman Mediation Test in adjusted models for religion, BMI rank, political status, occupation status, education level, and chronic diseases.

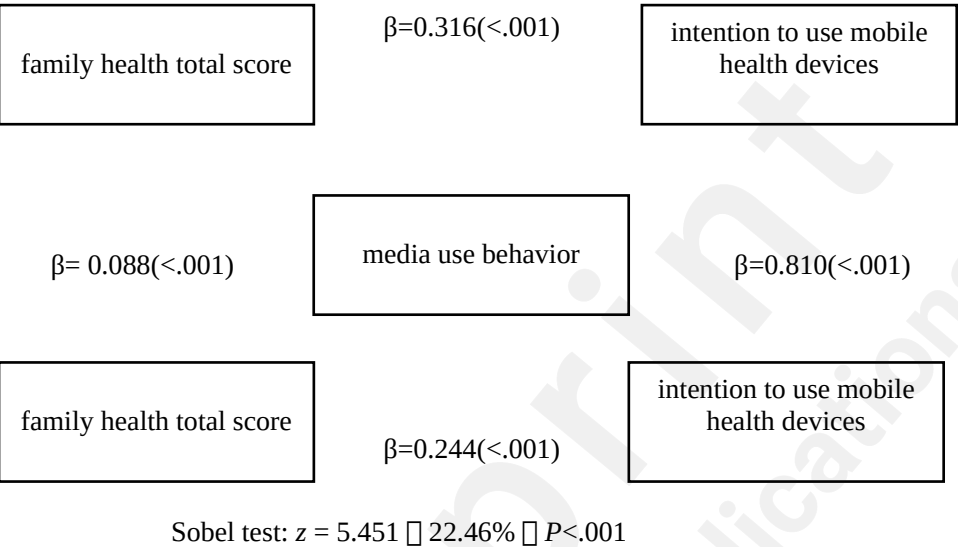


Figure.1. Mediation Analysis.
The Sobel test was used to test the hypothesis that the indirect role was equal to 0, adjusting the covariates (religion, BMI rank, political status, occupation status, education level, chronic diseases). Values are bolded if they reach statistical significance at $P\leq.05$.

Subgroup analysis

Subgroup analyses of education degrees are shown in Table 6. In primary school and below the elderly population, media use behavior had no mediating effect between the total score of family health and intention to use mobile health devices($z=-0.942$; indirect effect=-0.019, $P>.05$;

direct effect=0.252, $P<.01$); Mediating effect of media use behavior between a family healthy lifestyle and intention to use mobile health devices was not significant($z=1.953$, $P>.05$). Media use behavior fully mediated the association between family health resources scores and intention to use mobile health devices scores in different education degrees elderly population: Primary School And Below degree elderly population($z=-5.832$; indirect effect=-0.331, $P<.001$; direct effect=0.218, $P>.05$), Middle School/Vocational School/High School degree elderly population ($z=-3.439$; indirect effect=-0.136, $P<.001$; direct effect=-0.066, $P>.05$) and college and above degree elderly population($z=-2.516$; indirect effect=-0.212, $P<.05$; direct effect =0.026, $P>.05$)

Table 6 Subgroup analysis of education degree of mediation models for Family health associated with Intention to use mobile health devices mediated by Media use in older adults

Education degree	$\beta(P)$	Family social	Family healthy lifestyle	Family health resources	Family external social supports	Total
Primary School And Below	a coefficient	0.099($P<.05$)	0.140 ($P<.05$)	-0.302($P<.001$)	0.246 ($P<.001$)	-0.018($P>.05$)
	b coefficient	1.059($P<.001$)	1.057 ($P<.001$)	1.093 ($P<.001$)	1.046 ($P<.001$)	1.078 ($P<.001$)
	Indirect effect	0.105($P<.05$)	0.148($P<.05$)	-0.331($P<.001$)	0.257($P<.001$)	-0.019($P>.05$)
	Direct effect	0.489($P<.05$)	0.904($P<.01$)	0.218($P>.05$)	0.808($P<.05$)	0.252($P<.01$)
	Total effect	0.593($P<.01$)	1.052($P<.01$)	-0.112($P>.05$)	1.065($P<.01$)	0.232($P<.05$)
	Proportion of total effect that is mediated	17.71	14.07	295.54	24.13	-8.19
	Sobel test	2.052($P<.05$)	1.953($P>.05$)	-5.832($P<.001$)	3.485($P<.001$)	-0.942($P>.05$)
Middle School / Vocational School / High School	a coefficient	0.508 ($P<.001$)	0.718 ($P<.001$)	-0.250($P<.001$)	0.706 ($P<.001$)	0.123 ($P<.001$)
	b coefficient	0.484 ($P<.001$)	0.477 ($P<.001$)	0.541 ($P<.001$)	0.458 ($P<.001$)	0.508 ($P<.001$)
	Indirect effect	0.246($P<.001$)	0.343($P<.001$)	-0.136($P<.001$)	0.323($P<.001$)	0.063($P<.001$)
	Direct effect	0.598($P<.05$)	0.992($P<.01$)	-0.066($P>.05$)	1.200($P<.01$)	0.227($P<.05$)
	Total effect	0.845($P<.01$)	1.334($P<.001$)	-0.201($P>.05$)	1.524($P<.001$)	0.290($P<.01$)
	Proportion of total effect that is	29.11	25.71	67.66	21.19	21.72

College And Above	mediated					
	Sobel test	3.624(P<.001)	3.563(P<.001)	-3.439(P<.001)	3.455(P<.001)	3.375(P<.001)
	a coefficient	0.589 (P<.001)	0.713 (P<.001)	-0.218 (P<.01)	1.057 (P<.001)	0.175(P<.001)
	b coefficient	0.808 (P<.001)	0.874 (P<.001)	0.974 (P<.001)	0.737 (P<.001)	0.864(P<.001)
	Indirect effect	0.476(P<.001)	0.624(P<.001)	-0.212(P<.05)	0.779(P<.001)	0.151(P<.001)
	Direct effect	1.260(P<.01)	1.183(P<.05)	0.026(P>.05)	1.926(P<.001)	0.425(P<.01)
	Total effect	1.736(P<.001)	1.807(P<.01)	-0.186(P>.05)	2.704(P<.001)	0.576(P<.001)
	Proportion of total effect that is mediated	27.42	34.53	1139.78	28.81	26.22
	Sobel test	3.409(P<.001)	3.428(P<.001)	-2.516(P<.05)	3.310(P<.001)	3.193(P<.01)

Sobel-Goodman Mediation Test in adjusted models for religion, BMI rank, political status, status of occupation, chronic diseases.

Discussion

Principal Results

Previous studies have shown that family factors play an important role in the frequency of media use and the acceptance of mobile health among older adults[49]. Our study confirmed that family health can increase older adults' willingness to use mobile health devices, and high frequency of media use behavior is a powerful driver of mobile health device use, which is also deeply influenced by family health. The results are consistent with previous research regarding the digital divide among older adults, those older adults with higher family health scores engage in more frequent media contact behaviors, as the higher connectivity to the Internet makes them easier to adapt to a big data-based mHealth environment, thus leading to a willingness to use mobile health devices. Before conducting the mediation analysis, through univariate analysis, this study found that long-lived and unemployed elderly people over 90 years old had a lower willingness to use mobile medical devices. The result corroborated the differences in the digital divide among age groups, and the older age groups suffering from inequalities in social and economic support[50], which may further affect their access to and use of media devices.

In addition to the above descriptive findings, this study further revealed how family health affects the willingness to use mobile health devices through media use behavior. First of all, this study supports the positive effects of media use behavior, which partially mediates the effect of aggregate levels of family health on the intention to use mobile health devices. According to the results of the sub-dimension, it was found that media use behavior was a fully mediating variable on the family health resources dimension. That is, older adults with a lack of family health resources completely lost their willingness to use mobile health devices due to their inability to access or use the media. This finding emphasizes the practical importance of family health resources in integrating older adults into the Internet and enjoying the freedom of mobile health technology. Reducing resource-related health inequities is a significant indicator of healthcare system effectiveness[51], and financial support from family is critical in the daily lives of seniors. To alleviate the imbalance in the distribution of resources among families in different regions at the societal level, the government should assist socioeconomically disadvantaged older adults gain more access to various devices through economic empowerment and policy development[52].

Based on the important function of media contact between family health resources and willingness to use mobile health devices in the elderly population, the desire to use mobile health devices among the elderly can be motivated further by utilizing the positive influence of family health resources to increase the frequency of media exposure. Above all, effective communication within the family is a catalyst for improving older adults' technology literacy and information-seeking skills[16].

Family members should help seniors build their confidence in utilizing Internet technology while alleviating their anxiety and fear of new technologies. For example, encourage the elderly to adapt and learn information technology such as WeChat and health-related mobile applications through straightforward and repeated demonstrations[53]. Besides, family support may mitigate the economic hardship of using healthcare services by influencing older adults' subjective perceptions of financial accessibility[54]. We can make full use of the financial support within the family and economic resources outside the family, while encouraging family members to render suitable financial assistance to each other and at the same time ensuring the elderly with stable financial security and expanding their disposable quota by gradually increasing the pensions of retirees, which increases their purchasing power for media devices and their ability to use technological devices in the field of health care to some extent.

In addition, the subgroup analysis further revealed that media use behavior had no mediation effect between total family health score and intention to use mobile health devices among older adults with primary school education or below, but partially mediated the association among those with primary school education and above, which was consistent with the study hypothesis. As the elderly population with low education level area relatively weak in cognitive function and a lack of personal health literacy[55, 56], the mechanisms by which they are influenced by family, social, and economic environments in the acceptance of new health technologies is more complicated. Those older adults with a high school education or higher consider they have an above-average ability to learn and are thus less uncomfortable with the changing social environment brought about by technological developments[57]. Furthermore, elderly people with poor education also lack access to information technology education or the ability to operate mobile devices[58]. For them, exposure to media devices or mobile health devices is homogeneous to a certain extent. Hence, they lack a progressive transition from regular media contact behaviors to mobile health device use.

Disparities in Internet participation levels owing to education are one of the impediments preventing older adults from using media devices to access the mHealth era. To help the elderly to cross the "digital divide" and improve the effective use of mobile health devices, relevant education measures might be considered to improve their ability to use smart technology. According to the in-depth "Smart Senior Care" action plan in China[59], communities can carry out health education through a combination of technology-supported learning and conventional lectures, such as using touch-screen tablet courses for a healthy diet and nutrition guidance, to improve their interest in the Internet while delivering health and hygiene knowledge[60], which bridges the transition from traditional modes of access to mobile health care. The above adaptive behaviors and learning behaviors can further improve the efficiency and effectiveness of mobile healthcare applications[61]. For another, the design of mobile health devices in the mHealth era should be adapted to the cognitive ability and mindset of the elderly, and give full consideration to their e-health literacy,

such as improving usability and highlighting the responsiveness of operations, and building monitoring functions in line with the physical activities of the elderly, etc[62], to further improve their satisfaction with mobile healthcare applications[63]. Moreover, due to stereotypes about older people, there are serious ageist mechanisms on digital platforms that treat all of them as users who are not interested in technology[64], which results in an unfavorable digital environment for older people. In general, the development and application of Internet technology cannot and should not overlook the realistic capacity and objective demands of the elderly[65]. Digital platforms need to create more inclusive algorithms and use statistical models of social digital media practices that cater to all literacy levels[64], such as reducing complex and lengthy text that is hard to understand, avoiding in-depth and complex hierarchical options, and adopting simple page designs[66], to mitigate the impact of technological differences on the accessibility of digital healthcare for older adults.

Strength and Limitations

This study makes significant contributions to the literature by assessing the association between family health, media use behavior, and intention to use mobile health devices among older adults, using cross-sectional study data from PBICR. The present study confirms our hypothesis that media use behavior mediates the relationship between family health level and intention to use mobile health devices among older adults. In addition, we conducted a subgroup analysis of education level, and the results showed that the influences of family health on the willingness to use mobile health devices through media use behavior were not significant among older adults with lower education levels, which indicated an elaborate mechanism of action. All of the above studies contribute to the theory of research on the digital gap among older individuals.

After comprehensive consideration, the results of this study still have several limitations. First, considering the exploratory cross-sectional design of this study, no causal inference could be made. Second, The majority of the seniors included in this study were young old aged 60 to 74 years old, and there was a lack of representativeness in covering the whole age range of older adults considering the differences in the social background caused by age factors. Third, the results obtained in this study may be related to its economic basis and psychological factors. Considering the emerging technology of mobile health devices as a health system, its development path is still part of the exploration in progress. It is likely that many more different latent factors remain to be discovered.

Conclusions

In conclusion, this study confirms the significant effects of family health and media use behavior on older adults' intention to use mobile health devices. Media use

behavior mediates the effect of family health on intention to use mobile health devices, with more complex mechanisms of influence among low-literate older adults. These findings indicate that family health, especially adequate family health resources, can effectively improve the media exposure of the elderly, thus further boosting their interest in adopting mobile health devices. For example, encouraging teaching by family members can alleviate older adults' resistance to mobile technology, and financial support from within and outside the family facilitates the possibility of using mobile devices to obtain health information. Similarly, developing aging digital education and "elderly-oriented" new media products is conducive to breaking the barriers of education and culture, eliminating technological barriers to the use of media devices, and providing digital services with quality, warmth and sentiment for the elderly in the era of mobile healthcare.

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We hereby declare that any portion of this article does not use the generative AI.

Data Availability

The data sets generated and analyzed during this study are not publicly available because the data still need to be used for other research but are available from the corresponding author on reasonable request.

Authors' Contributions

JHC, YBW and JYC designed and conducted this study. YBW collected data. YSM, AQL and XXY participated in the data screening. DYZ and WDY conducted data analysis. JHC and YSM wrote the first draft of the paper. JYC contributed to supervising data analysis and developing the manuscript. All authors made contributions to the critical revision of the manuscript. The author(s) read and approved the final manuscript.

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Conflicts of Interest

None declared.



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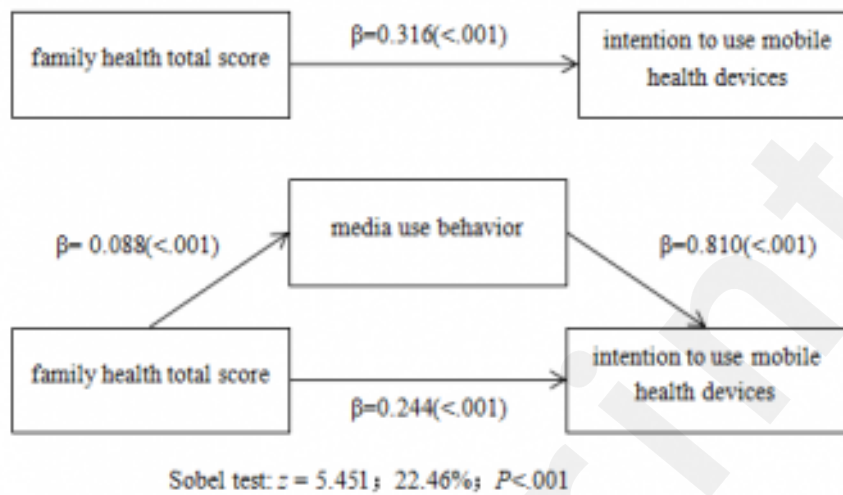
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Supplementary Files

Figures

Mediation Analysis.



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checklist --Association of Family Health and Intention to Use Mobile Health Devices with Media Use Behavior among Chinese.
URL: <http://asset.jmir.pub/assets/d811cccef82a23e1b33d8aacb43cc8a8.pdf>

