Impact of Digital Development and the Digital Divide on Elderly Consumer Behavior

Abstract ： In today's digitized era, the elderly experience both the progress of the times and digital obstacles in healthcare, transportation, and consumption. Using the China Digital Inclusive Finance Development Index and CHARLS panel data, our study explores the impact of digital development on elderly consumption and health. Findings indicate that digital development significantly boosts elderly consumption, especially in healthcare, due to improved information access and payment convenience, promoting urban-rural equity. Digital support services enhance elderly health, but a notable digital divide exists. Internet access benefits elderly individuals, while filial care helps bridge this gap. Heterogeneity issues persist, with minimal digital dividends for the oldest elderly. Government efforts are needed to establish convenient digital channels for elderly individuals, particularly in remote central and western regions.

Key Words：Digital Finance; Digital Divide; Elderly Health; Consumption

1 Introduction

In recent years, the aging population has become a highly discussed social issue, being one of the fundamental national conditions in the new journey of building a socialist modernization. According to the data from the seventh population census [1], the proportion of the population aged 60 and above has increased by 5.44 percentage points, and the proportion of the population aged 65 and above has increased by 4.63 percentage points. Among them, the population aged 65 and above is 191 million, with an aging rate of 13.50%.

In the era of widespread internet use, digital lifestyles such as mobile payments, online medical consultations, and digital information continue to develop, greatly facilitating life. However, the rapid development of digital technology has also led the elderly into technological difficulties, widening the gap in the online world for the elderly. Especially during the outbreak and control of the epidemic, some elderly people may be prohibited from entering supermarkets because they do not know how to use their phones to scan health codes. Due to the constraints of their thoughts and physical abilities, the elderly find it more challenging than other social groups to use digital media services for their own lives, deepening the digital divide among the elderly.

Therefore, a question worth exploring is what kind of impact digital development has on the lives of the elderly. Can the elderly enjoy the dividends of digitization in various aspects of their lives? What characteristics do elderly individuals need to better overcome the digital divide? Will digital development have negative effects on elderly individuals who cannot access the internet? This article mainly focuses on the close relationship between the lives of the elderly and digital development, specifically addressing issues related to consumption and healthcare.

Digital finance is an important component of the digital economy and is deeply integrated into the lives of residents. Alipay and WeChat have greatly reduced the shopping costs for consumers and have also had a significant impact on the patterns of consumption. The development of digital finance provides strong impetus for the development of residents' consumption and gives all groups, including the elderly, the opportunity to enjoy universal financial services [2].

As the elderly population continues to grow, the silver economy market potential is considerable. The development of the silver economy is a crucial element for sustainable economic development and positive aging strategies [3]. Meanwhile, consumption, as an important basis for measuring people's aspirations for a better life, raises the question of whether the development of digital finance can enhance the consumption level of the elderly. In theory, with the development of digital inclusive finance and the emergence of more convenient payment methods such as WeChat Pay and Alipay, as well as the popularity of online shopping platforms such as Taobao

and JD, the consumption enthusiasm of the elderly will be enhanced to some extent. However, on the other hand, due to the existence of the digital divide, the encroachment of emerging consumption methods on traditional consumption raises the question of whether the consumption space of the elderly will be suppressed as a result?

2 Literature Review

Traditional consumption theories have many hypotheses, and the Fisher intertemporal choice model believes that consumption depends on a person's lifetime income, achieving smooth consumption through intertemporal choices. The life cycle hypothesis suggests that income undergoes systematic changes in people's lives, with retirement being a significant factor. Therefore, savings can allow consumers to transfer income from high-earning periods to low-earning periods, achieving smooth consumption. The permanent income hypothesis posits that rational consumers, aiming for utility maximization, make consumption decisions based not on temporary current income but on the long-term sustainable income level.

However, in the real situation of household consumption, there are often various constraints, and intertemporal consumption cannot be smoothed. Constraints may include issues such as payment convenience, liquidity constraints, and problems related to precautionary savings.

The relationship between the development of digital inclusive finance and consumption has been extensively validated. Researchers such as Yi Xingjian and Zhou Li [5] concluded that the development of digital inclusive finance in China significantly promotes residents' consumption by alleviating liquidity constraints and facilitating convenient payments. He Zongyun [6] hypothesized and verified possible mechanisms through which the development of digital finance drives residents' consumption. The results showed that digital finance, through convenient payments and accelerated decision-making, reduces uncertainty and unleashes consumption potential. Researchers like Jian Guan [7] further studied the promotional effects and main pathways of digital inclusive finance on household consumption. They found that digital finance development primarily promotes basic living consumption, followed by healthcare consumption, and lastly, cultural and entertainment consumption.

Focusing on the rural revitalization strategy, some scholars [8] studied the impact of digital finance on rural residents' consumption. Empirical analysis of secondary indicators of digital inclusive finance indicated that increasing coverage, depth of use, and digitization significantly benefit the consumption of rural residents in China.

However, the consumption tendencies and needs of the elderly differ significantly from those of young people. Firstly, the consumption tendencies of young people largely depend on their expected income, while the elderly, due to limited income sources and growth potential, are considered to rely mainly on current income. Secondly, the consumption tendencies of the elderly are lower. According to Maslow's hierarchy of human needs, consumption goods can be classified into survival needs consumption, developmental needs consumption, and pleasure needs consumption. The elderly have significantly higher demand for the first category of consumption than young people, and the elasticity of consumption to income is lower for the elderly. Thirdly, the consumption behavior of the elderly is more frugal than that of young people. Fourthly, the elderly have greater demand for medical-related consumption. In addition, the elderly pursue the convenience of consumption, and there is a certain level of collectivism and blindness.

Therefore, it is still worth exploring and further verifying whether digital development can promote household consumption among the elderly. Additionally, due to the fact that the elderly no longer receive wages, it is necessary to redefine the disposable income of the elderly and reanalyze the factors influencing their consumption decisions.

Hypothesis 1: The development of digital finance can promote household consumption among the elderly.

Hypothesis 2: Digital finance can promote household consumption among the elderly by promoting basic consumption.

Since existing research indicates that the development of digital finance primarily promotes basic living consumption in households, and basic consumption accounts for a higher proportion in elderly households, it can more significantly promote household consumption by promoting basic consumption.

Hypothesis 3: The development of digital finance can promote elderly residents' consumption by improving payment convenience.

Regarding the impact on the health of the elderly, many scholars [9] have conducted research on the health of the elderly and influencing factors, delving into significant factors such as individual physical characteristics, socio-economic characteristics, personal behavior, and accessibility of medical insurance. Combining the background of digital development, Wang Lianjie [10] conducted empirical analysis using CGSS data and found that internet use has a more pronounced effect on the health of elderly individuals without spouses, those with higher education levels, and those with party membership. Cheng Yunfei [11] and others focused on the impact of the silver digital divide on the health of the elderly, concluding that frequent internet use significantly improves the self-rated health of the elderly.

3 Research Design

1.Empirical Model

In this study, the primary analysis focuses on the impact of digital development on the health and consumption of the elderly. To explore these relationships, we set up a time-individual two-way fixed-effects linear model. To avoid interference from correlations among households within regions, standard errors are clustered at the regional level.

When analyzing the impact on consumption, individual i represents a household, and the logarithm of the consumption amount for household i in city j at time t is considered as $ln(Consume)_{ijt}$. To prevent reverse causation, the degree of digital development is lagged by one period. The model established for consumption is as follows:

$$ln(Consume)_{ijt} = \beta_0 + \beta_0 \cdot IF_{j,t-1} + \beta_2' \cdot X_{ijt} + \mu_i + \lambda_t + \varepsilon_{ijt} \qquad (1)$$

where, IF_{jt-1} represents the lagged degree of digital development, X_{it} denotes control variables, μ_i represents household fixed effects, λ_t represents timed fixed effects, ε_{ijt} is the random disturbance term。

2.Variable Selection

(1) Dependent Variable: Resident Consumption

In this study, resident consumption refers to the household consumption in the studied year, representing the final consumption of goods and services by permanent households. It excludes non-consumption expenditures such as transfer payments and does not consider fixed capital investments, such as housing purchases.

Following the classification standards of the National Bureau of Statistics for resident consumption expenditures, consumption is divided into eight categories: Food, Tobacco and Alcohol Consumption; Clothing Consumption; Residence Consumption; Daily Necessities and Services Consumption; Transportation and Communication Consumption; Education, Culture, and Entertainment Consumption; Medical Healthcare Consumption; and Other Goods and Services Consumption. Additionally, for further analysis of different consumption types, food, clothing, and daily necessities are grouped into basic consumption.

(2) Control Variables:

In this study, core control variables affecting resident consumption are controlled, primarily divided into three aspects: individual characteristics of the household head, economic conditions of the household, and regional characteristics. Individual characteristics include the gender, age, education level, and health condition of the household head. Household features include family size, household income, and household assets. Regional features include the traditional financial development level (the ratio of year-end financial institution loans to regional GDP) and the economic development level (per capita GDP) of the region.

Concerning the relationship between elderly consumption and income, as mentioned earlier, it is assumed that consumption is related to current income rather than expected income. Since the elderly no longer receive wages, their disposable income cannot be measured using traditional employee compensation. This study corrects for this by considering the main economic sources of the elderly, which include pensions, labor income, and economic support from children, with significant variations between urban and rural areas. Urban elderly rely mainly on pensions and support from children, while rural elderly depend on support from children and labor income. Therefore, in this study, based on the main economic sources of the elderly, we construct the current disposable income of the elderly. The income is composed of personal income and family income, including wages, pension income, government subsidies, operational income, and economic support from children. Property income is not considered to avoid reverse causation. Additionally, considering the special circumstances of the elderly and the life cycle hypothesis, the non-financial asset portion of the elderly's family (to avoid reverse causation), representing wealth, is included as part of the control variables. This includes land assets, housing assets, productive fixed assets, and durable goods assets.

3. Data Sources

The data used in this study primarily come from two sources: the "Peking University Digital Inclusive Finance Index" and the "China Health and Retirement Longitudinal Study" (CHARLS).

(1) Peking University Digital Inclusive Finance Index

Regarding the degree of digital development, official data for reference is not yet available. In this study, the "Peking University Digital Inclusive Finance Index" is used to approximate the overall digitalization of society. Digital finance reflects internet usage on the consumption side. The combination of digital technology and financial services breaks down the physical barriers of the traditional financial service coverage model. Most residents with digital terminals can directly access the necessary financial services, promoting the development of inclusive finance in China. Therefore, describing internet usage on the consumption side is appropriate.

The China Digital Inclusive Finance Index is jointly compiled by the Peking University Digital Finance Research Center and Ant Financial Services Group. The specific compilation process is detailed in Guo Feng et al. (2019)[4]. It started in 2011 and has been used to analyze the development status and economic effects of digital finance in China. The index utilizes big data from Ant Financial's transaction accounts and is updated multiple times over time, providing considerable representativeness and reliability. The digital inclusive finance index system includes coverage breadth, usage depth, and digitization degree. Coverage breadth is mainly reflected in indicators such as account coverage (Alipay accounts). Usage depth is measured based on the actual usage of digital financial services, including payment services, monetary fund services, insurance services, investment services, etc., using both total usage indicators and activity indicators. Regarding digitization degree, factors such as convenience, cost, and credit are the main factors influencing users' use of financial services. Specific data indicators are shown in Figures 1 and 2.

In terms of the median, the national Digital Inclusive Finance Index increased from 33.6 in 2011 to 334.8 in 2020, experiencing substantial growth. The indices for various provinces also showed significant increases, indicating a leap forward in China's digital inclusive finance business. Digital inclusive finance demonstrated unique advantages and strong resilience during the epidemic. Despite a significant decline in the economic and social growth rate in China, the Digital Inclusive Finance Index maintained strong growth, playing a crucial role in China's fight against the epidemic and alleviating the economic impact[10]. Regional and inter-provincial differences in digital inclusive finance are quite apparent, with the highest level of development in the eastern region, followed by the central region, and the lowest in the western region. However, in terms of growth rate, the western and central regions have experienced significant acceleration in development, indicating the inclusiveness of China's digital finance development. Compared to previous years, the growth of usage depth in digital finance has become an important driving force for the growth of the Digital Inclusive Finance Index. China's digital inclusive finance has entered a new stage of deep expansion.
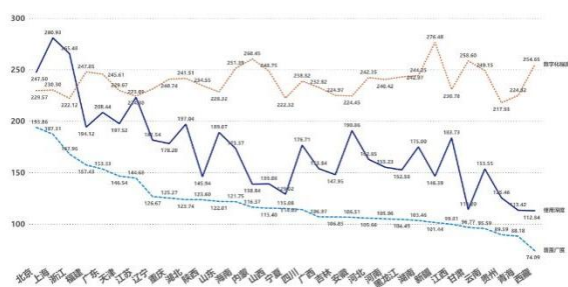

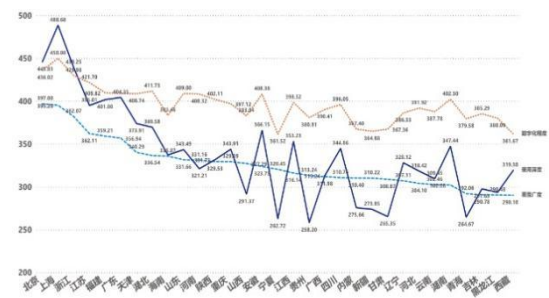Figure 1: National Digital Inclusive Finance Index in 2013   Figure 2: National Digital Inclusive Finance Index in 2020

(2) China Health and Retirement Longitudinal Study (CHARLS) Dataset

The data used in this study are derived from the "China Health and Retirement Longitudinal Study" (CHARLS) for the years 2013, 2015, and 2018. The survey, organized by Peking University, covers approximately 17,000 individuals from around 10,000 households in 450 villages across 150 counties in the country. The purpose of this questionnaire survey is to collect micro-level data on individuals and families aged 45 and above, aiming to analyze population issues, especially those related to aging.

The CHARLS questionnaire covers several major aspects, including individuals, families, and communities, addressing topics such as work, income, consumption, assets, health, medical care, retirement, insurance, and community environment.

The sampling rules for CHARLS involve filtering questionnaires for sampled households, retaining households with members aged 45 and above, and randomly selecting one family member aged 45 and above as the main respondent. Both the selected individual and their spouse are interviewed.

In terms of data cleaning, this study focuses on the elderly population, retaining samples of individuals aged 60 and above. Missing information for some personal details was supplemented, and samples with missing variable values were excluded. Samples with negative values in consumption and income data were removed, and a 1% to 99% truncation was applied. Outliers were corrected. The consumption data in CHARLS are categorized into weekly, monthly, and yearly data. Samples with complete missing data in any of these three sections were removed. Finally, the study obtained 11,126 individual samples for researching health issues in 2013, 2015, and 2018, and 5,725 household samples for researching consumption issues. A description of the sample data is provided below:

Table 1   Descriptive Statistics

Variables	2013		2015		2018	
	Mean	Dev.	Mean	Dev.	Mean	Dev.
Household consumption	9.750	1.043	9.800	1.103	10.05	1.078
Head of household's age	67.93	6.578	67.99	6.477	69.17	6.818
Gender (Female = 1)	0.504	0.500	0.515	0.500	0.528	0.499
Years of education	8.690	6.200	8.884	6.144	9.124	6.092
Health condition	3.053	0.934	3.010	0.979	3.074	1.017
Marital status	0.687	0.464	0.692	0.462	0.658	0.474
Whether there is social security (Yes = 1)	0.966	0.181	0.916	0.277	0.970	0.170
Internet usage (Yes = 1)	0.0179	0.133	0.0275	0.163	0.0636	0.244
Number of household members	3.154	1.887	2.325	1.113	2.502	1.460
Household income	8.199	2.332	7.480	2.580	8.580	2.090
Household assets	7.701	1.633	7.678	1.627	7.623	1.639
Living with children (Yes = 1)	0.539	0.498	0.301	0.459	0.346	0.476
Traditional financial development	0.844	0.467	0.981	0.489	1.165	0.557
Regional economic level	41,108	24,315	47,605	26,846	56,838	32,298
Sample size	4120		4843		5725	

4 Empirical Analysis

In the following text, the impact of digital development on the consumption of the elderly will be analyzed, along with an examination of the transmission mechanisms and individual heterogeneity behind it.

1. Baseline Regression

Firstly, a two-way fixed-effects model (1) is employed for the full sample using linear least squares regression, and the model is deemed suitable after a Hausman test. From the regression results, it can be observed that the digital inclusive finance index is significantly positively correlated with the household consumption of the elderly. This indicates that digital development indeed has a positive impact on the household consumption of the elderly, aligning with the expected results.

Table 2   Baseline Regressions

Variables	(1) Household consumption	(2) Household consumption	(3) Household consumption	(4) Household consumption
Digital financial development	0.0050**	0.0049**	0.0049**	0.0049**
	(0.0024)	(0.0023)	(0.0022)	(0.0021)
Head of household's age		-0.0214	-0.0291*	-0.0290*
		(0.0160)	(0.0175)	(0.0175)
Head of household's		-0.0669	-0.0838	-0.0845

	(1)	(2)	(3)	(4)
gender		(0.0884)	(0.0875)	(0.0874)
Years of education		0.0117	0.0098	0.0096
		(0.0101)	(0.0098)	(0.0098)
Health condition		0.0354***	0.0392***	0.0394***
		(0.0129)	(0.0120)	(0.0120)
Marital status		0.2737***	0.1726***	0.1723***
		(0.0463)	(0.0462)	(0.0461)
Social security situation		0.1730***	0.1419***	0.1409***
		(0.0448)	(0.0427)	(0.0431)
Internet usage		0.1357**	0.0926	0.0946
		(0.0621)	(0.0622)	(0.0616)
Whether children live together		0.2037***	0.1324***	0.1323***
		(0.0280)	(0.0292)	(0.0292)
Family size			0.1076***	0.1075***
			(0.0095)	(0.0095)
Financial support from children			0.0000***	0.0000***
			(0.0000)	(0.0000)
Family income			0.0216***	0.0218***
			(0.0047)	(0.0047)
Family assets			0.0873***	0.0875***
			(0.0094)	(0.0095)
Traditional financial development level				-0.0547
				(0.0697)
Regional economic condition				0.0000
				(0.0000)
Constant	9.3403***	10.0986***	9.5681***	9.6137***
	(0.2222)	(1.0993)	(1.2087)	(1.2092)
Household fixed effects	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes
Observations	14,629	14,565	14,565	14,565
R^2	0.0226	0.0398	0.0835	0.0837

Note: Standard errors clustered at the region level are reported in parentheses; ***, **, * denote statistical significance at the 1%, 5%, and 10% levels, respectively, based on hypothesis tests, and the same conventions apply in the subsequent text.

For every one standard deviation increase in digital finance, consumption increases by 9.44%, and this increase remains stable. Considering the significance level of control variables, it is found that characteristics of the household head, such as gender, do not have a significant impact on consumption, which is consistent with the results of the random sampling in CHARLS. Age has a significantly negative impact on consumption, and worse

health is associated with increased consumption, possibly due to increased medical expenses. At the household level, family size, elderly person's income, and family assets all have a significant positive impact on consumption, aligning with the expected results. However, among regional characteristics, variables related to traditional financial development and regional economic level (per capita GDP) do not have a significant impact. The possible reason is that these two variables are relatively static compared to household economic characteristics, and they have not undergone significant changes and influences yet. Moreover, some of their effects might be absorbed by time effects and individual effects.

2. Endogeneity and Robustness Analysis

The main causes of endogeneity include omitted variables, reverse causality, and measurement errors. Due to the scientific sampling of CHARLS data, its good representativeness, and the absence of significant biases after data cleaning, measurement errors are considered negligible in the model.

Regarding omitted variables, differences in expectations of future risks and changes in consumption preferences within families are difficult to measure but may be correlated with both digital finance development and consumption, leading to endogeneity. This study uses household panel data, constructing a two-way fixed-effects model. Individual effects control for individual characteristics that do not change over time, while time effects control for time-specific characteristics, reducing bias due to omitted variables.

Concerning reverse causality, where the growth in residents' consumption may promote digital development, this study addresses the issue by lagging digital finance development by one period to mitigate endogeneity problems. To address endogeneity more effectively, instrumental variables in this study include the spherical distance between the city of residence and Hangzhou, as well as the spherical distance between the city of residence and the provincial capital. Additionally, economic development indicators in the local area are controlled to reduce omitted variable bias. The analysis and test results for instrumental variables are detailed below:

Table 3 Independent variable

变量	(1) Household consumption	(2) Digital financial development	(3) Household consumption
Digital Inclusive Finance Index	0.0048**		0.0233**
	(0.0022)		(0.0102)
Distance to the national average of digital financial development (excluding this city) on a spherical surface from Hangzhou		-0.7373***	
		(0.2723)	
Distance to the national average of digital financial development (excluding this city) on a spherical surface from the provincial capital		-0.8427*	
		(0.4376)	
Controlling for head of household characteristics	Yes	Yes	Yes
Controlling for family characteristics	Yes	Yes	Yes
Family fixed effects	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes
Number of observations	14,565	14,536	12,557

R^2	0.0834	0.9959	0.0755
First-stage F-statistic			10.04
Hansen test p-value			0.791

The instrumental variables used are the spherical distance from the city to Hangzhou, interacted with the national average of the digital finance development index (excluding the current city) for the same year. Following a weak instrumental variable test, the F-value in the first-stage regression exceeds 10, rejecting the null hypothesis of weak instrumental variables. Additionally, the p-value of the Hansen statistic testing exogeneity is greater than the critical value, not rejecting the exogeneity assumption. The instrumental variable chosen in this study is thus deemed effective. In subsequent research, the spherical distance to Hangzhou will be the primary instrumental variable.

Moreover, the estimation results of the regression indicate a high correlation between the instrumental variable and the core explanatory variable. Other control variables exhibit weak correlations with the explanatory variable, indicating minimal multicollinearity issues. Even with the inclusion of instrumental variables, digital finance development continues to significantly promote resident consumption. The estimated coefficient becomes more significant, and the growth magnitude is not substantial, suggesting the model's robustness.

3.Analysis of Transmission Mechanism

(1) Payment Convenience

Table 4 Regression of secondary classification indicators in digital finance

Variables	(4) Household consumption	(5) Household consumption	(6) Household consumption	(7) Household consumption
Digital financial development	0.0049**			
	(0.0021)			
Coverage breadth		0.0035*		
		(0.0023)		
Usage depth			-0.0002	
			(0.0017)	
Degree of digital support services				0.0011**
				(0.0005)
Controlling for head of household characteristics	Yes	Yes	Yes	Yes
Controlling for family characteristics	Yes	Yes	Yes	Yes
Family fixed effects	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes
Number of observations	14,565	14,565	14,565	14,565
R^2	0.0836	0.0833	0.0830	0.0835

The three secondary indicators of digital finance all encompass the nature of "payment convenience," with coverage breadth emphasizing universality, usage depth highlighting the richness and depth of payment services, and digital support service level emphasizing the convenience, low cost, and mobility of QR codes.

The research results indicate that the coefficients of the two secondary indicators, "coverage breadth" and "digital service support," are significant, but the regression result for "usage depth" is not significant. In studies on overall resident consumption, the regression results for all three indicators were significant. Therefore, it can be inferred that for elderly households, the widespread coverage of electronic accounts and convenient mobile payments can promote the level of consumption. However, due to the limited understanding of digital finance by the elderly, the in-depth development of internet finance payment services does not significantly promote consumption, resulting in a weak effect on consumption.

This result also confirms that the convenience of payment does indeed promote consumption, but the depth of payment services has a minimal effect on consumption for the elderly.

(2) Analysis of Consumption Structure

Digital finance development has a promoting effect on the consumption of the elderly, but it is worth exploring which category of consumption is specifically affected.

In previous studies [5] analyzing resident consumption, it was found that digital development and digital finance have a promoting effect on basic consumption, specifically on food and clothing consumption, while the promoting effect on developmental and enjoyment-type consumption is relatively small. The likely reason is that digital development greatly facilitates online shopping, and residents' online shopping is mainly concentrated in basic consumption. The convenience of digital finance and the internet drives the demand for residents' basic consumption. However, for developmental and enjoyment-type consumption, due to their specific consumption scenarios and characteristics, the impact of digitalization is relatively small.

Next, regression analysis will be conducted for elderly data.

Table 5 Category of consumption

Variables	(1) Household consumption	(2) Food	(3) Transports	(4) Medical	(5) Basic	(6) Developed
Digital financial development	0.0266**	-0.0093	0.0689***	0.0734*	0.0025	0.0272*
	(0.0120)	(0.0252)	(0.0251)	(0.0402)	(0.0208)	(0.0150)
Controlling for head of household characteristics	Yes	Yes	Yes	Yes	Yes	Yes
Controlling for family characteristics	Yes	Yes	Yes	Yes	Yes	Yes
Family fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	12,557	12,596	12,616	12,616	12616	12616
R^2	0.0729	0.0238	0.1180	0.0286	0.0288	0.0661
First-stage F-statistic	11.71	11.72	11.76	11.76	11.72	11.76

In CHARLS regression results, distinctive characteristics of elderly consumption are evident. They often scrutinize their spending on food and basic consumer goods, placing great importance on frugality. However, their demand for medical services is high, and they may find it challenging to resist the allure of misleading health care product promotions, leading to impulsive consumption. With the development of digitization, the elderly are exposed to an increased number of such messages and have additional avenues for consumption. In comparison to the existing fixed patterns of basic consumption, the new forms of consumption exhibit a strong appeal to the elderly population.

4.Heterogeneity Analysis

(1)Age Heterogeneity

Table 6 Analysis of age heterogeneity

Dependent variable: Household consumption	(1) Young Elderly（60-69）	(2) Old Elderly（70+）
Digital financial development	0.0282*	0.0247
	(0.0159)	(0.0151)
Controlling for head of household characteristics	Yes	Yes
Controlling for family characteristics	Yes	Yes
Family fixed effects	Yes	Yes
Time fixed effects	Yes	Yes
Number of observations	6,225	3,566
R^2	0.0738	0.0799
First-stage F-statistic	10.02	14.58

Younger elderly people can benefit from digital development, while older elderly individuals, with reduced consumption demands and a lower internet usage rate, may not reap the dividends of digitization, leading to distinct differences. Additionally, the consumption growth of older elderly individuals is significantly more sensitive to health conditions.

(2) Urban-rural heterogeneity

Table 7 Analysis of Urban-rural heterogeneity

Variables	(1) Household consumption	(2) Household consumption	(3) Household consumption
Digital financial development	0.0266**	0.0132*	0.0472**
	(0.0120)	(0.0080)	(0.0214)
Controlling for head of household characteristics	Yes	Yes	Yes
Controlling for family characteristics	Yes	Yes	Yes
Family fixed effects	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes
Number of observations	12,557	4,916	7,641
R^2	0.0729	0.1075	0.0530

In the sample regression analysis of urban-rural division, it was found that the development of digital finance has a significant positive impact on the household consumption of elderly people in both rural and urban areas. The positive impact on the household consumption of elderly people in rural areas is even more significant, contrary to the results obtained in the CFPS household survey.

The consumption level of elderly people is generally lower compared to adults, and there are significant differences in the types and quality of consumer goods in rural areas compared to urban areas. Therefore, the development of digitization and digital finance provides more possibilities for the consumption of elderly households in rural areas, playing a more significant role in promoting and has a positive significance for eliminating urban-rural differences and promoting fairness.

(3) Regional Heterogeneity

The eastern region of China (Beijing, Tianjin, Hebei, Liaoning, Shanghai, Fujian, Shandong, Hainan, Guangdong, Zhejiang, Jiangsu) was the first to start developing digitization, and digital finance has matured in these areas. Although the western region is slightly behind, under the strong national push for construction, it has shown rapid development in recent years. The following will analyze the heterogeneity of the promoting effect of digitization on the eastern and central-western regions.

Table 8 Analysis of Regional heterogeneity

Variables	(1) Household consumption	(2) Household consumption	(3) Household consumption	(4) Household consumption	(5) Household consumption	(6) Household consumption	(7) Household consumption
	Overall	East	Midwest	Easet	Midwest	East	Midwest
Controlling for head of household characteristics	0.0039*	0.0047**	0.0036**				
Controlling for family characteristics	(0.0022)	(0.0039)	(0.0027)				
Family fixed effects				0.0037**	0.0018*		
Time fixed effects				(0.0031)	(0.0036)		
Number of observations						0.0014*	0.0008
						(0.0010)	(0.0006)
R^2	0.0008** (0.0003)						
Controlling for head of household characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controlling for family characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Family fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	14,565	5,767	8,798	5,767	8,798	5,767	8,798
R^2	0.0805	0.0940	0.0743	0.0940	0.0740	0.0940	0.0743

From the regression results, it is evident that in recent years, while digital finance has been flourishing, there are significant regional disparities. The economically developed eastern region has effectively promoted household consumption through the development of digital finance. On the other hand, in the less developed central-western regions, despite the recent vigorous development of digitization, the overall level is lower, and the positive impact of digital development on elderly people remains limited.

6 Conclusion

In the digital age, with the flourishing development of digital technology, the lives of the elderly have been enriched, but it has also brought about a digital divide. This article empirically analyzes the impact of digital development on the consumption and health of the elderly. The main conclusions are as follows:

1. Digital development promotes the consumption of elderly families

Digital development has stimulated the consumption of the elderly, especially in communication and healthcare. This is different from the assumption that it would significantly promote basic consumption. As the elderly have relatively fixed habits regarding basic consumption, with less flexibility, digital development mainly improves the accessibility of information for the elderly, their demand for digital services, and the convenience of payment. As a result, there is a significant increase in healthcare consumption.

Therefore, it is crucial to develop the healthcare service market for the elderly, considering digital channels for promotion and utilizing digital channels and assistance from their children to provide healthcare services, meeting the healthcare needs of the elderly.

2. The digital divide still exists

There is a noticeable difference in the impact of digital development on health between the elderly who can access the internet and those who cannot, creating a visible gap among the elderly. Proper use of digital devices can bring convenience to life, enrich information, and diversify entertainment and social interaction, positively influencing health and consumption. To bridge the digital divide for the elderly, there is a need for digital training, the development of user-friendly software and programs, tailored to the needs of the elderly.

Additionally, elderly individuals living with their children can better experience the positive impact of digital development on consumption. It is essential to promote intergenerational support, help the elderly overcome the digital divide, and address the physical and mental needs of the elderly, allowing them to benefit more from the digital age.

3. Significant differences among different groups

Rural areas benefit more from the consumption dividends brought by digitalization and digital finance compared to urban areas, to some extent breaking down the differences between urban and rural areas. However, in terms of the impact of digitalization on health, rural areas still lag behind urban areas. Moreover, the promotion of consumption through digital finance is less significant in the central and western regions compared to the eastern regions. Therefore, improving digital infrastructure in rural and central/western regions is crucial to make digital

technology accessible to all, promoting the integration of the elderly into the digital age and having a positive impact on bridging the gap.

Additionally, the elderly in the higher age group receive minimal digital dividends. Government departments should continue to establish convenient channels for the elderly in the digital age, reducing obstacles caused by their inability to use electronic devices.

In this preliminary study, there are still many aspects that need improvement. Further refinement can be made in the discussion of endogeneity, such as attempting more instrumental variable experiments. The specific transmission mechanisms and causal analysis of digital development on the elderly and consumption, health still deserve further exploration. The feasibility of methods like mediation analysis has not been discussed and could be a focus in future research to address these issues.