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Research on the influencing factors of demand for elderly care services based on data of elderly care service information system

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ABSTRACT

Elderly care has emerged as a pressing concern for society as a whole in the setting of global aging. The elderly care service information system can play an important role in the study of elderly care issues. This study uses Anderson's Behavioral Model and Maslow's Hierarchy of Needs Theory as the analytical framework and guide, applies multiple logistic regression analysis, and is based on the data from the elderly care service information system to study the factors influencing the demand for elderly care services and the interaction between the influencing factors in terms of predisposing factors, enabling factors and need factors. Compared with physiological demand, age, living status and self-care ability have a significant impact on physiological demand. Environmental demands are significantly influenced by age, educational level, living status, child support situation and self-care ability, while gender does not have a significant effect on either type of demand. The main effects model fits better with the addition of the interaction term. There is a significant interaction effect between the three types of factors. Finally, this study proposes suggestions from two perspectives: the supply of elderly care services and the construction of the elderly care service information system.

Keywords: Elderly care service information system, demand for elderly care services, Anderson's Behavioral Model, Maslow's Hierarchy of Needs Theory, logistic regression.

INTRODUCTION

According to the UN definition of an aging country (region), China officially became a country with an aging population back in 2000. Today, China has a large and aging population as well as a similar situation in many developed Western countries. Against this backdrop, the issue of old age has become a social issue that has received a high and widespread level of attention from the government and academia. More and more scholars are beginning to study the issue of elderly care, including the demand for elderly care services. At present, the supply of elderly care services still lags behind the demand for elderly care services (Heng & Zhi, 2020), and presents problems such as insufficient total number of services, insufficient professional service personnel, single service content and lack of effective integration of resources (Baumbusch et al., 2019).

With the advantages of effectively integrating fragmented service resources and providing accurate and personalized services, the elderly care service information system plays an important role in solving the imbalance between the supply and demand of elderly care services, and meeting the needs of the elderly for elderly care services in all aspects. However, most elderly care services have not yet been able to meet the specific needs of the elderly in a point-to-point manner, which means that the elderly care services are not precise and personalized. Some of the elderly's needs are not met through the information system, and the services provided by the information system may not be satisfactory to the elderly.

The main target group of elderly care services information systems is the elderly. Only by grasping the characteristics and needs of the elderly and the links between the two can we provide better quality and more appropriate services to them to maximize the effectiveness of the elderly care services information system. Therefore, this paper explores how each influencing factor affects the demand for elderly care services in an elderly group, starting from the personal characteristics and needs of the elderly and using the service data in an elderly care services information system. It also investigates the interaction effects on this basis in order to promote the development of elderly services and to solve the important livelihood issue of elderly care more efficiently.

This study uses the Anderson's Behavioral Model and Maslow's Hierarchy of Needs as the analytical framework and guidance, and adopts a multiple logistic regression analysis. Based on the data from the elderly care information system, the study investigates the factors influencing the demand for elderly care services and the interaction between the influencing factors in terms of predisposing factors, enabling factors and need factors. Moreover, this study proposes countermeasures based on the research results, aiming to help the relevant entities in the field of elderly care to improve their elderly care services, and to guide the construction and improvement of the elderly care service information system.

This study analyses the current needs of the elderly in elderly care services to further explore the factors that influence the needs of the elderly in elderly care services and the interaction between each factor. The findings of the study can provide

references for the construction of elderly care service information systems. At the same time, this study directly analyses and mines the service data in the elderly care information system, and adds interaction terms to improve the model, to provide a further and objective reflection of the current situation of demand.

LITERATURE REVIEW

Research on the Demand for Elderly Care Services

Exploration and research into the demands of the elderly care services continue, although research began early and a great deal of experience has been accumulated in some countries. Lee et al. researched the differences in the demands of vulnerable groups and their caregivers and health care providers for IoT services in the home, and the findings pointed out that the elderly and people with disabilities were most in need of services in both emergency management and safety and security (Lee et al., 2020). Mazurek et al. found that the companionship of others and psychological distress are needed that most older people have but are not well satisfied. The needs that are satisfied include accommodation, daily household skills, and food. In addition, older people with higher levels of psychological distress have poorer cognitive functioning and more unsatisfied needs (Mazurek et al., 2015). Naruse et al. found that older people have a greater need for domestic care in the area of daily living (Naruse et al., 2011). Machizawa et al. pointed out that older people's physical demand for independence, cultural participation, social connection, self-fulfilment and maintenance of self-esteem have an impact on their preferences for elderly care services (Machizawa & Lau, 2010).

Research on the Influencing Factors of Demand for Elderly Care Services

Scholars have conducted numerous studies on the factors influencing the demand for elderly care services from a micro perspective, exploring in depth the effects of various factors, including age, gender, ethnicity, economic level, self-care ability, health, marital status, number of children, residential status, and literacy. Travers et al. found that factors such as race and ethnicity affect the use of care services by older people (Travers et al., 2020). Stein et al. found that older people's unmet care needs were significantly associated with their having depression, and also with gender, the residential care facility they were in, relatives' ability to care and health status (Stein et al., 2016). Eric De Jonge et al. pointed out the important role of economic factors in the demand for elderly care services, with older people preferring to use services that cost less (Eric De Jonge et al., 2014). Kempen et al. found that gender, whether or not they lived alone and income level also play a role in older people's choice of home care (Kempen & Suurmeijer, 1991).

In addition, some studies focus on the factors that influence the demand for different types of elderly care services. Barnay et al. researched the specific impact of personal characteristics on the physical demand of older persons (Barnay & Juin, 2016). Meinow et al. pointed out that older people with cognitive impairment have a greater need for home care services (Meinow et al., 2005).

Research on Elderly Care Services Information System

In the area of information systems for elderly care services, there has been a preponderance of research on system construction, usually practice-oriented applied research. Cho proposed to use big data from NHIS to carry out work related to the care needs assessment of older people directly in the community care system (CC system), both to improve the accuracy of the assessment results and to respond to the need for contactless work in crisis situations such as the new crown epidemic (Cho, 2020). Menghi et al. have designed an older person-centred product service platform that tailors services to older people and optimises local health resources, aiming to improve independence and quality of life for older people (Menghi et al., 2019). Willard et al. designed an online community care platform (OCC-platform) with care, health and communication functions, focusing on the needs of frail older people for an elderly care platform, aiming to support and serve frail older people by encouraging self-care and providing reliable information, products and services (Willard et al., 2018).

Review

Overall, it can be seen that some research has been carried out in the literature on both the demand for elderly care services and the elderly care services information systems. But there are still some shortcomings. Firstly, for studies on the factors influencing the demand for elderly care services, the sample data is mostly obtained through questionnaires or interviews, and the findings are easily affected by the professionalism and subjectivity of the investigators as well as the perception of the respondents. Therefore, this study uses service data from the information system of elderly care services for the study, which is not only an objective data sample but also a sufficient amount of data. Secondly, research on information systems for elderly care services has mostly focused on the systems themselves, ignoring the elderly population as users of the systems. So this study takes a new research perspective. Thirdly, although there have been many studies exploring the factors that influence the demand for elderly care services. They mostly stay on the main effects of the influencing factors, and the interaction effects generated by the influencing factors are also important. So this paper improves the model from that perspective to study the interaction between the influencing factors.

Based on the background of the previous study and the analysis and combing of the current state of research, this study raises and attempts to answer the following four questions:

- (1) What are the characteristics of the demands for elderly care services?
- (2) What factors can affect the demand for elderly care services?
- (3) What is the specific impact of each factor on the demand for elderly care services?

(4) How does the inclusion of interaction terms for different categories of influencing factors affect the model?

METHODS

Study Model

Andersen's Behavioral Model was developed in 1968 by the US medical sociologist and health services researcher Ronald M. Andersen. The original model pointed out that three dimensions of predisposing factors, enabling factors and need factors can affect an individual's health service utilization behavior. Among them, predisposing factors refer to the tendency of individuals to choose health services due to the influence of their own social and cultural characteristics; enabling factors refer to the individual's ability to obtain service resources; need factors refer to health service needs arising from individual bodily functions or health conditions. After evolution, many scholars have added three aspects of environmental factors, behavioral factors and result factors on this basis, forming a four-dimensional model as a whole. Although Anderson's Behavioral Model is mostly used in the field of health services to analyze the behavior of health service utilization and explore the factors that affect the utilization of health services (Andersen, 1995), the use of elderly care services by the elderly is also a behavior, which is similar to the behavior of health service utilization. Today the model is widely used to study the use of services by the elderly. For example, a study based on the Andersen's Behavioral Model to study the impact of physical function trajectories on later long-term care utilization among the Taiwanese elderly (Hsu, 2013). Another study used the Andersen's Behavioral Model of health care utilization to analyze the association of health care costs with predisposing, enabling, and need factors in the German elderly population (Heider et al., 2014). In addition, the model incorporates possible influencing factors into a simple, clear and reasonable analysis framework, which guides empirical research to a certain extent and effectively avoids the random and unscientific selection of influencing factors. After many revisions and improvements, the model has been considerable maturity.

For the above reasons, this paper draws on Andersen's Behavioral Model. The explanatory variables select various factors that may have an impact on the elderly care service demand, and then construct a research model for this paper, as shown in Figure 1.

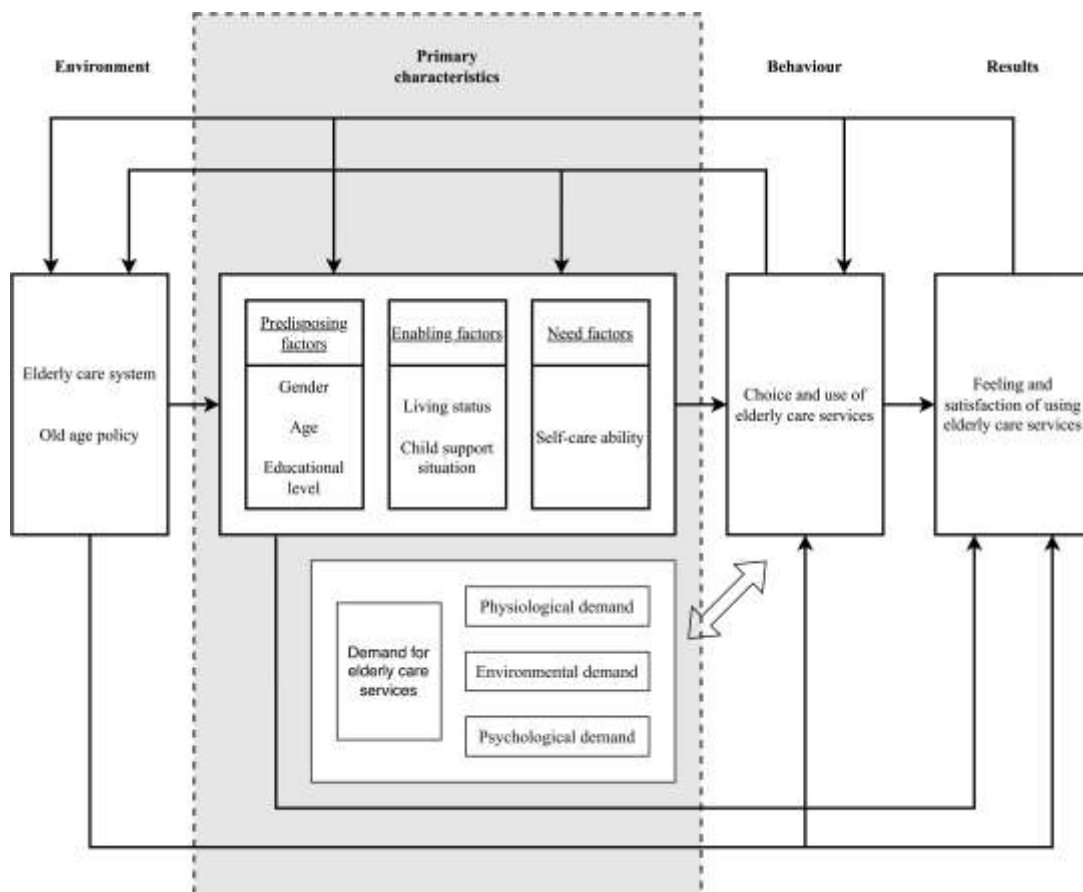


Figure 1: Research model on factors influencing the demand for elderly care services

Under the specific situation of the elderly choosing elderly care services, the environment in the four-dimensional model refers to the elderly care service system and related policies in the region where the elderly live, and the primary characteristics are three dimensions: predisposing factors, enabling factors and need factors. Behavior refers to the choice and use of elderly care services by the elderly, and the result is the feeling and satisfaction of the elderly after using elderly care services. The arrows in the above model indicate that the environment, primary characteristics, and behavior all affect the final result, and the final result in turn affects the above three dimensions. The environment and the primary characteristics will determine the behavior

of elderly care services, and the behavior will further affect the results. At the same time, the behavior and the result will have negative feedback on the primary characteristics and environment, and the result will also have an impact on the behavior.

In terms of needs classification, this paper takes Maslow's Hierarchy of Needs Theory as a reference. Maslow's Hierarchy of Needs Theory believes that human needs are hierarchical, and there is a process of development from low level to high level. It divides people's innate needs into five levels, namely, physiological, security, belonging and love, respect and self-realization. Because the boundaries of some elderly care service items are not clear enough at present, they cannot specifically correspond to the five levels of the Hierarchy of Needs Theory. Therefore, based on the basic idea of the hierarchy of needs theory and combined with previous research (Stein et al., 2016), this paper divides the needs of the elderly into physical demand, environmental demand and physical demand. Physiological demand refer to the needs of the elderly to ensure their own body cleanliness, physical health, food and clothing, etc. environmental demand refer to the needs of the elderly in terms of living environment and cleaning, placement and maintenance of household items in order to gain self-respect. physical demand are the needs of the elderly in social interaction, learning and entertainment in order to resolve the loneliness caused by the lack of social roles and reduced participation in social activities.

Research Hypothesis

People's subjective consciousness is generated under the action of numerous and complex objective factors, and the same is true for the elderly's demand for elderly care services. Since the research data in this paper comes from the elderly care service information system, which mainly includes service records and personal characteristic data of the elderly, it is difficult to conduct in-depth research on the environment, behavior and results in the above theoretical model based on this data. Therefore, under the guidance of Anderson's Behavioral Model, this paper mainly studies from the perspective of the primary characteristics of the elderly. The hypothesis is developed from three aspects: predisposing factors, enabling factors and need factors of the primary characteristics dimension.

Predisposing factors

The predisposing factors mainly refer to demographic factors. Combined with the model and previous research, the variables included in this paper are gender, age, and educational level.

As far as gender is concerned, due to the different physiological structures and perspectives and degrees of perception of the outside world between male and female elderly, female elderly are usually in a vulnerable group, and their self-protection ability is lower than that of men (Roth & Basow, 2004). In addition, women usually have a higher average life expectancy than men and have a correspondingly higher proportion of chronic diseases (Lee et al., 2020). Elderly people of both sexes often have different needs for elderly care services. Therefore, this study assumes that:

H1: gender will significantly affect the demand for elderly care services. Compared with male elderly, female elderly have more physical and environmental demand.

Regarding age, age reflects the physical condition of the elderly to a certain extent. With the continuous growth of age, the physical activity of the elderly gradually declines and the risk of disease increases. At the same time, the psychological will also produce more loneliness. In turn, there will be a demand for diversified elderly care services. Many studies believe that from the perspective of the demand for elderly care services, the older the elderly, the higher the demand (Lengenfelder et al., 2019; Bock et al., 2014). The specific differences are reflected in the types of elderly care services. Research has found that the older the elderly have higher physical demand such as leisure and entertainment. Therefore, this study assumes that:

H2: age will significantly affect the demand for elderly care services, and older elderly have more physical demand than younger elderly.

Looking at the educational level, generally speaking, with the improvement of the level of education, people's minds will be relatively open, and it will be easier to accept new things in society. And different educational levels affect the demand for different types of resources, for example, the literate elderly can go out to see a doctor, get a haircut, eat, etc. alone, while those who are illiterate often need help from others if they want to strengthen their social connection and obtain medical services (Shi et al., 2021), which will generate more needs in this regard. Therefore, this study assumes that:

H3: the educational level will significantly affect the elderly's demand for elderly care services. The elderly with low educational level have more physiological demand than the elderly with high educational level.

Enabling factors

Enabling factors refer to the resource conditions that affect the elderly's access to and use of elderly care services, including from both individuals and families. This article is condensed into two variables: living status and child support situation.

Regarding the living status, the family plays a vital role in the elderly care stage, and the family is often an important spiritual and material support for the elderly care (Heller & Factor, 2008). To a certain extent, the living style of the elderly determines the convenience of receiving help and care from family members and the satisfaction of their spiritual, emotional and material life, which in turn affects their demand for elderly care services and the type of demand. In addition, social development determines that the elderly will pay more attention to the needs for spiritual comfort after the material needs are guaranteed

(Wenfeng & Bingkun, 2021), especially the elderly who live alone are prone to loneliness and have more physical demand. Therefore, this study assumes that:

H4: the living status will significantly affect the demand for elderly care services, and the elderly living alone have greater physical demand.

As for the variables of child support situation at the individual level, elderly care services are actually a commodity for the elderly, which determines that the elderly must have a certain purchasing power in order to obtain services. Many studies have confirmed that material basis and economic ability are the basis for the demand for elderly care services (Li & Tracy, 1999; Ahn & Kim, 2004). The child support situation reflects the financial resources of the elderly from the side. The elderly who do not rely on their children for financial support usually have their own financial resources and have more space and freedom in economic control, which affects the type and frequency of their purchase of elderly care services. According to the Hierarchy of Needs Theory, the economically well-off elderly will continue to pursue more advanced needs after their physiological demand are basically satisfied, that is, the elderly who do not rely on their children for financial support usually have more environmental demand. Therefore, this study assumes that:

H5: child support situation will significantly affect the demand for elderly care services. The elderly who do not rely on their children for financial support have more environmental demand than those who rely on their children for financial support.

Need factors

Need factors refer to the needs of individuals due to their physical health. This paper mainly includes the variable of the elderly's self-care ability.

Regarding self-care ability, many studies have pointed out that physical condition is a rigid constraint for the elderly to form the demand for elderly care services (Høy et al., 2007; Nie et al., 2008). Compared with young people, the self-care ability of the elderly will decline, weaken or even lack. The elderly without self-care ability will not only be restricted in free activities, but also require long-term care to meet their basic physiological demand. Therefore, this study assumes that:

H6: self-care ability will significantly affect the demand for elderly care services, and the physically disabled elderly have more physiological demand.

Interaction effects

There are many factors that affect the demand for elderly care services. According to Anderson's Behavioral Model, among the above three types of factors, different factors have different effects on the demand for elderly care services, both directly and indirectly. Considering that the impact of the above-mentioned factors on the demand for elderly care services is likely to be affected by other factors, this paper adds pairwise interaction terms between different categories of factors on the basis of the original model, trying to improve the regression model and study the interaction of factors. Therefore, this study assumes that:

H7: the interaction between different categories of factors will have a significant impact on the elderly's demand for elderly care services.

Based on the above, the research hypotheses are summarized in Table 1 below.

Table 1: Summary of research hypothesis

No.	Hypothetical content
H1	Gender will significantly affect the demand for elderly care services. Compared with male elderly, female elderly have more physical and environmental demand.
H2	Age will significantly affect the demand for elderly care services, and older elderly have more physical demand than younger elderly.
H3	The educational level will significantly affect the elderly's demand for elderly care services. The elderly with low educational level have more physiological demand than the elderly with high educational level.
H4	The living status will significantly affect the demand for elderly care services, and the elderly living alone have greater physical demand.
H5	Child support situation will significantly affect the demand for elderly care services. The elderly who do not rely on their children for financial support have more environmental demand than those who rely on their children for financial support.
H6	Self-care ability will significantly affect the demand for elderly care services, and the physically disabled elderly have more physiological demand.
H7	The interaction between different categories of factors will have a significant impact on the elderly's demand for elderly care services.

Data Collection

The data in this paper comes from an elderly care service information system adopted by a city in Sichuan Province, China. The system acts as an intermediary platform to connect with the government, the elderly and elderly care service providers (elderly care institutions, communities, enterprises, etc.), the government issues pensions and pensions in the form of points through this system. As the only official old-age care system designated by the local government, the old-age service information system covers all the elderly in the area. As a regulator, the government strictly controls the quality of service

institutions, and every service record in the system is objective and true, and can reflect the real needs of the elderly. Based on the above, we believe that it is more appropriate to use the service data in the elderly care service information system for research, and the sample data is both representative and authentic. This paper selects the service data of the elderly in a certain area in the system in the past three years as the research data, with a total of 142,477 items.

Variable Measurement

On the one hand, service data can reflect behavior. The service data selected in this paper is essentially behavioral data, and the service data in the elderly care service information system is the consumption records of the elderly on products such as "elderly care services". What these consumption records reflect is the consumption behavior of the elderly towards "elderly care services". On the other hand, behavior further reflects needs. Management believes that the generation of human behavior is based on needs and motivations. Demands can make people generate behavioral motivations, and motivations induce people to act to meet needs. The reason why the elderly "choose to use elderly care services" is driven by their own elderly care needs. Because the original data presented in the old-age service information system is the content of specific service items, it is not classified according to needs. Therefore, this paper reclassifies the service items in the service data according to Maslow's Hierarchy of Needs Theory. The new field is named "Demand Type", which is used as an explained variable, and the values are "Physiological Demand", "Environmental Demand" and "Psychological Demand". The correspondence between the types of elderly care service needs and specific service contents is shown in Table 2.

Table 2: The type of elderly care service needs corresponds to the specific service contents

Demand type	Specific service contents
Physiological Demand	Nail cutting service, hair cutting service, excrement cleaning service, hair washing service, foot washing service, hair washing service, health examination, hospital care, caregiver care training, body massage, meal feeding service, meal delivery service, etc.
Environmental Demand	Installation of light bulbs, water and electricity security inspection, gas security inspection, glass cleaning, range hood cleaning, cleaning, air conditioning cleaning, door-to-door washing services, etc.
Psychological Demand	Reading and newspapers, accompanying chat, holiday condolences, etc.

Then, based on the actual situation of the data, combined with the Anderson's Behavioral Model, this study extracts six variables from the system in three aspects: predisposing factors (Gender, Age, Educational level), enabling factors (Living status, Child support situation) and need factors (Self-care ability) as explanatory variables. The original data is uniformly entered into the system by the relevant personnel of the pension service information system and updated regularly.

In order to make the model estimation more accurate, the collinearity diagnosis is carried out before the regression, which can effectively avoid the influence caused by the special correlation between the explanatory variables. It is generally believed that when $0 < \text{VIF} < 10$, there is no multicollinearity. The results show that the tolerance of each variable is greater than 0.1 and the variance inflation factor VIF is less than 2, so the collinearity diagnosis result is good, and the next logistic regression modeling can be carried out.

The values and assignments of the explained variables and explanatory variables are shown in Table 3. All variables here are categorical variables.

Table 3: Variable value and assignment

Variable category	Variable name	Variable encoding
explained variable	Demand Type	0 = Physiological demand; 1 = Environmental demand; 2 = Psychological demand
	<i>Predisposing factors</i>	
	Gender	0 = Female; 1 = Male
	Age	0 = 60-69 years; 1 = 70-79 years; 2 = 80-89 years; 3 = Above 90 years old
explanatory variables	Educational level	0 = Uneducated; 1 = primary school; 2 = Junior high school and above
	<i>Enabling factors</i>	
	Living status	0 = Living alone; 1 = Living with spouse; 2 = Living with spouse and children; 3 = Living with children
	Child support situation	0 = Non-child financial support; 1 = Child financial support
	<i>Need factors</i>	
	Self-care ability	0 = Mild disability; 1 = Moderate disability; 2 = Severe disability; 3 = Normal

RESULT AND DISCUSSION

Descriptive Statistics

Firstly, this study provides statistics on the types of demands for elderly care services. The results show that the demands of elderly people for elderly care services are mainly focused on physiological demand and environmental demand, each accounting for 42.5% and 43.9%, while physiological demand account for only 13.7%. The results of the descriptive statistical analysis of the influencing factors are shown in Table 4. 48.5% of the services in the elderly care information system were provided to male older people, slightly less than the 51.5% provided to female older people, which was balanced overall. In terms of age structure, the majority of elderly people aged 60 to 69 used the services, accounting for 43.3%. 80 years old and above used the services the least, accounting for 20.7%. The overall age distribution is relatively reasonable. In addition, only 2.8% of the services were provided to elderly people with junior secondary education and above, which may be related to the generally low literacy level of elderly people in the region due to the overall low level of education in the 1950s or 1960s. In terms of living status, the largest proportion of elderly people living with their children used the services, at 38.8%. Older people living alone accounted for the least amount of service use, at 20.2%. In terms of child support situation, only 18% of older people who rely on their children for support use the service, indicating that those with more stable financial resources use the service more. In terms of self-care ability, 67.5% of older people with varying degrees of physical incapacity use services.

Table 4: Descriptive statistics of the basic characteristics of the sample

Variable	Classification	Number of people	Percentage(%)	Average value	Standard deviation	
Predisposing factors	Gender	Male	63556	51.5	0.49	0.500
		Female	59876	48.5		
	Age	60–69 years	53420	43.3	0.82	0.867
		70–79 years	44391	36.0		
		80–89 years	19765	16.0		
		Above 90 years old	5856	4.7		
		Uneducated	45894	37.2		
Educational level	Primary school	74092	60.0	0.66	0.531	
	Junior school and above	3446	2.8			
Enabling factors	Living status	Living alone	24926	20.2	1.78	1.163
		Living with spouse	25523	20.7		
		Living with spouse and children	25042	20.3		
		Living with children	47941	38.8		
	Child support situation	Non-child financial support	101167	82.0	0.18	0.385
		Child financial support	22265	18.0		
Need factors	Self-care ability	Mild disability	24595	19.9	1.67	1.126
		Moderate disability	31129	25.2		
		Severe disability	27542	22.3		
		Normal	40166	32.5		

One-way Analysis of Elderly People's Demand for Elderly Care Services

This paper begins with a one-way analysis of variance using the χ^2 test to initially explore which factors influence the demand for elderly services. The results show that the six factors of gender, age, education level, living status, child support situation and self-care ability are statistically significant ($P < 0.05$) in terms of differences in the demand for elderly care services, meaning that they are related to the demand for elderly care services. Therefore they can be included in the subsequent logistic regression analysis model to further verify the relationship.

Logistic Regression Analysis of the Influencing Factors of Elderly People's Demand for Elderly Care Services

Since the explanatory variable "type of demand for elderly care services" is a three categorical variables variable, this paper chooses the multiple logistic regression analysis. The final five variables that entered the regression model were age, living status, self-care ability, education level and child support situation, all of which have a significance level P of less than 0.05. Furthermore, the order in which the variables are entered into the model shows that age is the most significant influencing factor on the demand for elderly care services. Gender does not pass the significance test here, which indicates that although gender difference has an effect on the demand for elderly care services, this effect is not significant. Therefore the hypothesis 1 doesn't hold.

In this paper, 'physiological demand' is chosen as a control item to compare with other options and the model measures the odds ratio (OR). The odds ratio represents how many times more likely the reported choice item is to occur than the control

group, and in this paper is a direct reflection of the older person's propensity to demand. $OR > 1$ means that older people have a greater need for this type of service than the control group (physiological demand), i.e. there is a 'positive' association between the influencing factors and the need for this type of service. $OR < 1$ means that older people have more physiological demand and that there is a negative association between the influencing factor and demand for that type of service. Table 5 shows the results of the multiple logistic regression analysis.

Table 5: Results of multiple logistic regression analysis for types of demand for elderly care services

Variable	Psychological demand (Control item = Physiological demand)			Environmental demand (Control item = Physiological demand)		
	<i>B</i>	<i>P</i>	<i>OR</i>	<i>B</i>	<i>P</i>	<i>OR</i>
<i>C</i>	-1.316	0.000*		-0.016	0.739	
Predisposing factors						
Age(Control item = Above 90 years old)						
60–69 years(<i>Age</i> ₀)	0.319	0.000*	1.376	0.350	0.000*	1.418
70–79 years(<i>Age</i> ₁)	0.211	0.000*	1.235	0.187	0.000*	1.206
80–89 years(<i>Age</i> ₂)	0.109	0.023*	1.115	0.019	0.550	1.020
Educational level(Control item = Junior school and above)						
Uneducated(<i>Educational level</i> ₀)	-0.108	0.055	0.898	-0.219	0.000*	0.804
Primary school(<i>Educational level</i> ₁)	-0.064	0.246	0.938	-0.163	0.000*	0.850
Enabling factors						
Living status(Control item = Living with children)						
Living alone(<i>Living status</i> ₀)	0.061	0.016*	1.063	-0.002	0.917	0.998
Living with spouse(<i>Living status</i> ₁)	-0.068	0.006*	0.934	-0.147	0.000*	0.863
Living with spouse and children(<i>Living status</i> ₂)	0.036	0.150	1.037	-0.008	0.632	0.992
Child support situation(Control item = Child financial support)						
Non-child financial support(<i>Child support situation</i> ₀)	0.044	0.063	1.045	0.038	0.020*	1.039
Need factors						
Self-care ability(Control item = Normal)						
Mild disability(<i>Self-care ability</i> ₀)	-0.114	0.000*	0.892	-0.073	0.000*	0.930
Moderate disability(<i>Self-care ability</i> ₁)	-0.090	0.000*	0.914	-0.081	0.000*	0.922
Severe disability(<i>Self-care ability</i> ₂)	0.012	0.640	1.012	-0.101	0.000*	0.904

* $p < .05$

Results and analysis related to psychological needs

Using physiological demand as a control, the significant factors influencing the psychological needs of older people are age, living status and self-care ability, all of which have significance at the 5% level. Gender, educational level and child support situation did not pass the significance test and there is reason to believe that the differences in these three variables by themselves do not have a significant impact on the psychological needs of older people for elderly care services.

Firstly, the predisposing factors. In terms of age, the regression coefficients for *Age*₀、*Age*₁、*Age*₂ are all positive, indicating that the psychological needs of older people for elderly care services are positively influenced by age relative to physiological demand, with older people having more psychological needs. This is mainly because older people have more psychological needs as they get older and become less involved in outside activities, which in turn leads to them closing themselves off and becoming internally bored. According to the *OR*, the psychological needs of older people in the age group 60-69 are 1.376 times greater than their physiological demand. Based on the above analysis, the hypothesis 2 holds.

Secondly, the enabling factors. In terms of residence status, the regression coefficient for *Living status*₀ is positive, indicating that living alone has a positive impact on the psychological needs of older people. While the regression coefficient of *Living status*₁ is negative, indicating that living with a spouse has a negative effect on the psychological needs of older people in terms of elderly services. According to the *OR*, older people who live alone are more likely to have psychological needs as opposed to physiological demand. This possibility is approximately 1.063 times more likely than the tendency to have physiological demand. This result confirms the important role of family members in the later years of life of older people. Family members are not only a source of help and material support for the elderly, but also a source of spiritual support and comfort. Older people who live with their spouse tend to have more physiological demand than those who live with their children, about 1.07 times more than their psychological needs. This further reflects the different roles played by spouses and children in the later years of life, as children are not able to be with the elderly as often as they would like due to work, and the companionship of the spouse can alleviate the feeling of emptiness and loneliness. However, as spouses are also part of the elderly population and have a limited caring role, these older people often have more physiological demand. This may also be the reason why the presence of a spouse leads to overlapping of needs. Based on the above analysis, the hypothesis 4 holds.

Thirdly, the need factors. In terms of self-care, the regression coefficients for both *Self-care ability*₀ and *Self-care ability*₂ are negative relative to physiological demand, suggesting that self-care ability inhibits the psychological needs of older people. This may be because older people with mild and moderate physical disabilities will focus more of their energy and financial resources on resolving their physiological demand as opposed to those with normal self-care abilities. Thus the hypothesis 6 holds.

Looking at the other two factors, the *OR* for both educational level and child support situation are close to 1, indicating that these two factors do not make much difference to older people in terms of their psychological and physiological demand for elderly care services.

Results and analysis related to environmental demand

Using physiological demand as a control, the significant factors influencing the environmental demand of older people are age and educational level in the category of predisposing factors, living status and child support situation in the category of enabling factors, and self-care ability in the category of need factors, all significant at the 5% level.

Firstly, the predisposing factors. In terms of age, the regression coefficients of *Age*₀ and *Age*₁ are both positive, indicating that age has a positive influence on the environmental demand of elderly people for elderly services compared to physiological demand. The *OR* values show that compared to physiological demand, those under 80 years of age tend to have more environmental demand than physiological demand. The reason for this is that as the elderly grow older they are less able to cope with the household chores of daily life, and the home-based nature of elderly services can solve this difficulty for the elderly. However, for more elderly people, their children or other family members usually prefer to have a dedicated person to take care of them. Therefore, there is less demand for elderly care services provided by the elderly care system. The age group of 80-89 did not pass the significance test and did not differ significantly. This may be because this group shares the characteristics of older people aged 90 and above, so there is little difference in the type of demand. In terms of educational level, both *Educational level*₀ and *Educational level*₁ regression coefficients are negative, indicating that the educational level of Uneducated and primary school have a negative impact on the environmental demand of elderly people for elderly services compared to the group of elderly people with educational level of junior school and above. This may be because environmental demand are not limited by the educational level of older people. So there is relatively less needs in the environment. On this basis, the hypothesis 3 holds.

Secondly, the enabling factors. In terms of living status, the regression coefficient for *Living status*₁ is negative, indicating that living with a spouse negatively affects the environmental demand of older people. In terms of *OR* values, older people living with a spouse have a tendency to have 1.158 times more physiological demand than environmental demand. This is mainly due to the fact that older people live with their spouses. The spouse is usually the primary caregiver for the older person, but both have reduced physical mobility and limited caregiving capacity, making it difficult to fully meet basic physiological demand. There is therefore a demand for elderly care services in this area. In terms of child support situation, the positive regression coefficient for *Child support situation*₀ indicates that older people who are not dependent on their children will have more environmental demand relative to those who are dependent on their children. The *OR* value shows that this is 1.039 times more likely than physiological demand. This validates hypothesis 5. Older people with relatively generous incomes are more likely to enjoy the various services offered by the information system for elderly services, thus showing more environmental demand. In contrast, older people who are supported by their children give priority to services that meet their physiological demand due to their limited financial resources. This also shows that affordability is the basis for the demand for elderly care services.

Thirdly, the need factors. For self-care ability, the regression coefficients for *Self-care ability*₀ and *Self-care ability*₁ are all negative, indicating that self-care ability relative to physiological demand has a negative impact on the environmental demand of elderly people for elderly care services. As can be seen from the results, the *OR* values for mild disability, moderate disability and severe disability are all less than one, indicating that older people with physical disability have a tendency to have more physiological demand compared to environmental demand. According to Maslow's Hierarchy of Needs, environmental demand are based on the condition that lower-level physiological demand are largely met, so older people with disabilities tend to have more physiological demand than environmental demand.

Logistic Regression Model Improvements

In some cases, the two variables combined create a new effect, namely the interaction effect. In order to make the model more accurate, this paper considers adding the interaction term to the main effects model to improve the model and observe how the interaction effect affects the demand for elderly care services. It should be noted that this study focuses on the interaction between different categories of characteristic factors, i.e. the interaction terms of predisposing factor*need factor, enabling factor*need factor and predisposing factor*enabling factor are added to the main effects model to construct an improved multiple logistic regression model. Using SPSS 19.0 to do regression analysis, the final variables entered into the regression model were age, living status, age*living status, self-care ability, age*self-care ability, educational level, educational level*self-care ability, living status*self-care ability, educational level*living status, a total of nine variables. The significant *P* for these nine variables is less than 0.05. This indicates that the interaction effect of the two variables does have a significant effect on the demand for elderly services. Therefore, hypothesis 7 holds. The most significant factor influencing the demand for elderly care services is still age, in keeping with the results of the main effects model. It is worth noting that in addition to

the 'gender' factor, which was not significant in the main effects model, the 'child support situation' factor, which was the last factor to enter the model in the main effects model, also became insignificant when the interaction term was added to the model. In the improved model, physiological demand was again selected as the control group.

The results of the regression analysis showed that there were significant interaction effects between predisposing factor and need factor, enabling factor and need factor, and predisposing factor and enabling factor. The 'gender' factor in the predisposing factor and the 'child support situation' factor in the enabling factor did not have significant interactions with the other categories of factors.

In terms of psychological needs, with the addition of the interaction term to the model, there is not much change in the influence of age and educational level in the older people's predisposing factors on the demand for elderly care services. However, the effect of self-care ability in the need factor on the demand for elderly care services changes from negative to positive, which is a significant change compared to earlier. In terms of environmental demand, with the addition of interactive variables to the model, the influence of the age factor on the demand for elderly care services does not change significantly. However, four factors of educational level, living status, child support and self-care ability significantly change the influence level on the demand for elderly care services. Among these factors, the three factors of educational level, child support situation and self-care ability changed from significant to insignificant ($P > 0.05$). The effect of the living status factor on the demand for elderly care services also changed from negative to positive. It is still significant but to a lesser extent, dropping from 1% to 5% significant.

In terms of interactions, firstly, the impact of self-care ability on the demand for elderly care services is influenced by age, with increasing age being accompanied by decreasing self-care ability which in turn affects demand. Secondly, among older people with the same level of self-care ability, their educational level plays a decisive role in the way they meet their needs, mainly in terms of accessibility to knowledge and openness to ideas among older people with disabilities. Older people with low levels of education are likely to have more information barriers and limited access to care services. Due to their frugality and traditional attitudes, their basic physiological demand are the first to be met when using an information system for elderly care services. Thirdly, the impact of self-care ability on the demand for elderly care services can also be influenced by living status. The regression results show that older people living alone with severe disability have higher psychological needs. For severely disabled older people, restricted mobility and loss of life coping skills often lead to emotional sensitivity and vulnerability. The lack of social roles also leads to low self-esteem. Therefore they need more psychological support. Fourthly, older people living alone or with their spouse have more physiological demand than those living with their children, for the same age group (especially for the 60-89 age group). Those living alone or with a spouse have a tendency to have more physiological demand due to the lack of physical care by their children. Fifthly, the impact of educational level on the needs of elderly people for elderly care services can be influenced by their living conditions. The essence of this is that the needs of elderly people for elderly care services are usually not met due to their own limited educational level, in which family members play a compensating role. Poorly educated older people have difficulty accessing information due to illiteracy or poor comprehension. They have to rely on the help of others to meet their needs, such as access to medical care.

CONCLUSION

Research Summary

This paper takes the elderly in a certain area as the research object, builds a research model based on Anderson's Behavioral Model, and uses the elderly service data in an elderly service information system to empirically analyze the influencing factors of elderly service demand. Based on the four questions raised above, this paper draws the following conclusions.

First, in terms of demand characteristics. In terms of service volume, male elderly people use services slightly less than female elderly people, but they are basically balanced. Elderly people aged 60-79 and those with physical disabilities have become the main group of people who use elderly care services. From the perspective of demand types, physiological demand and environmental demand are the main needs of the elderly at the current stage, and psychological needs are less, which is in line with Maslow's Hierarchy of Needs Theory.

Second, the factors that affect the demand for elderly care services. It can be found that different types of elderly care service demands have different factors that affect them. This study uses physiological demand as a reference to find that age, living status and self-care ability will significantly affect the psychological needs of the elderly; age, educational level, living status, child support situation, and self-care ability significantly affect environmental demand; while gender has no significant impact on the demand for both types of elderly care services.

Third, in terms of the specific impact of various factors on the demand for elderly care services, the research verifies the specific effects of predisposing, enabling factors and need factors on the demand for elderly care services.

In the dimension of predisposing factors: (1) There is no statistical difference between gender in terms of psychological and environmental demand for elderly care services, and it will not have a significant impact on it. This is consistent with most previous research results (Fernández-Olano et al., 2006), but also contradicts some research results (Zhang, 2021). This may be related to the differences in the level of development, pension policies and specific pension service items provided in the

sample regions. (2) Age has a significant positive impact on both psychological needs and environmental demand, indicating that older people tend to have more psychological and environmental demand than physiological demand, which is mutually confirmed with most research results (Lengenfelder et al., 2019; Hahn & Oishi, 2006). (3) Educational level only has a significant negative impact on environmental demand. The elderly with low education have a large demand for medical care and physical examination services due to their limited knowledge of reading and comprehension, but they have a lower demand for the environment that is not limited by educational level. This confirms the previous conclusions on the relationship between educational level, health literacy and the demand for elderly care services (Fernández-Olano et al., 2006; Shi et al., 2021; Eronen et al., 2021).

In the dimension of enabling factors: (1) Living status has a significant impact on psychological needs, but there are both positive and negative effects: the elderly who live alone have more psychological needs than the elderly who live with their children. This is consistent with previous research results (White & Casey, 2017; Teerawichitchainan et al., 2015). The elderly living alone are prone to other negative emotions such as depression, anxiety and loneliness due to the lack of family support and care in life and spirit. Compared with the elderly who live with their children, the elderly who live with their spouses have a greater tendency to have physiological demand. After all, spouses are also elderly and have limited physical mutual care, which is similar to the results of other studies (Pinquart & Sörensen, 2011). (2) The child support situation only has a positive and significant impact on the environmental demand, and the elderly care service demand is supported by a certain economic level. This is consistent with most research conclusions (Herr et al., 2014; Ahn et al., 2004), the better the economic situation, the greater the needs of the elderly, and the higher the level of needs.

In the dimension of need factors: self-care ability has a significant negative impact on both psychological needs and environmental demand, that is, self-care ability will inhibit the psychological needs of the elderly to some extent. For physically disabled older adults, physiological care needs are prioritized, while environmental and psychological needs are less urgent, which is similar to other studies (Canjuga et al., 2018).

Fourth, from the perspective of interaction, this study verifies that there is a significant interaction effect between predisposing factors and need factors, enabling factors and need factors, and predisposing factors and enabling factors, and preliminarily explores the specific interaction. Among them, the severely disabled elderly people living alone in this area have higher psychological needs and deserve special attention.

To sum up, the hypotheses established in this paper are summarized in Table 6.

Table 6: Summary of hypotheses

Factors	Demand Type			Hypotheses
	Environmental demand	Psychological demand		
Predisposing factors	Gender	not significantly	not significantly	Hypothesis 1 does not hold
	Age	Positive impact	Positive impact	Hypothesis 2 holds
	Educational level	negative impact	not significantly	Hypothesis 3 holds
Enabling factors	Living status	negative impact	both positive and negative impact	Hypothesis 4 holds
	Child support situation	Positive impact	not significantly	Hypothesis 5 holds
Need factors	Self-care ability	negative impact	negative impact	Hypothesis 6 holds
Interaction effects	There is a significant interaction effect between predisposing factors and need factors, enabling factors and need factors, and predisposing factors and enabling factors.			Hypothesis 7 holds

Contributions

Compared with previous studies, the contributions of this study can be summarized as follows:

(1) This study uses the service data in the elderly information system to quantitatively verify the influencing factors of elderly service demand. Most of the existing studies obtain research data through questionnaires or interviews, and the research results are vulnerable to external influences. This study selects service data that directly reflects the real needs of the elderly, which supplements and verifies the existing research results to a certain extent.

(2) This study investigated the interaction of factors influencing the demand for elderly care services. Existing studies have focused on the effects of different dimensions of influencing factors alone on the elderly's elderly care service needs. Specific to the application research of Anderson's Behavioral Model, the existing research only focuses on the independent influence of the three factors of predisposing, enabling and need, and rarely pays attention to the interaction between the factors. In this study, while focusing on the main effect, the research on the interaction effect between factors has been added, and the effect of improving the model has been achieved, which supplements and expands the existing research to a certain extent.

(3) In practical application, this research is of great significance to service providers, elderly groups and the elderly care service information system. The elderly group can obtain better services and improve the quality of their elderly care. Service providers can further understand the current situation of demand and improve the supply of services. The elderly care service system can improve its own system design and operation mechanism to achieve precision and personalization of elderly care services.

Suggestions

Based on the conclusions of this paper, the following countermeasures and suggestions are put forward for the provision of elderly care services and the construction of elderly care service information systems.

(1) Provide personalized elderly care services based on needs. From the results of this paper, it can be seen that the factors of the elderly, such as age, self-care ability, living status, child support situation, and educational level, are not the same. The free combination of different factors creates diverse individuals whose needs are different and constantly changing. Therefore, providing differentiated and personalized elderly care services based on demand can improve the utilization rate of elderly care services, and the elderly care service information system plays an auxiliary role in this process.

(2) Pay attention to the psychological needs of the elderly living alone at very high ages. The results of this study show that the elderly of high ages and living alone in this area have more psychological needs for elderly care services. In today's society, most of the elderly care for the elderly only pays attention to meeting the physical demand of the elderly and ignores their psychological needs. In fact, with the reduction of communication with the outside world and the lack of social roles, the elderly will feel empty, lonely and helpless, and are prone to have a negative attitude towards life, especially the elderly living alone. Relevant departments should also increase publicity efforts, calling on young children to give emotional support to their parents and elders, so as to alleviate the psychological needs of the elderly and realize the warmth of old age.

(3) Accelerate the intelligent transformation of the elderly care information system, and manage the elderly care service data in a classified and dynamic manner. The elderly's demand for elderly care services is affected by their own characteristics. The underlying raw data is usually multi-source and multi-dimensional. The data management situation determines the data utilization, so the elderly care service information system should firstly classify and manage the data related to the elderly. Build the personal files of the elderly, and on this basis, form the comprehensive ability assessment grade files of the elderly. In addition, since various data of the elderly are constantly changing, the elderly care information system should update the data regularly to ensure that the system is always as close to the current physical characteristics as possible when recommending personalized services to the elderly.

Deficiency and Prospect

Based on the data of an old-age service information system and guided by Anderson's Behavioral Model and Maslow's Hierarchy of Needs Theory, this paper studies the effects of three factors, namely, predisposing, enabling factors, and need factors of the elderly on their needs for elderly care services. The interaction between the three types of factors is also studied. However, due to limited time and data samples, this study still has some shortcomings. The practice of the elderly care service information system in China is still in the stage of development and improvement, and the data connection between the system itself and other institutions needs to be improved and enhanced. Therefore, the data fields that can be provided by the elderly care service information system at this stage are limited, which leads to certain limitations in the selection of explanatory variables in this study. With the opening of the data interfaces of all parties, more indicators can be selected as explanatory variables for research in the future, making the research results more comprehensive.

Based on the above research deficiencies and combined with the actual situation, there are several directions to expand our research in the future. First, in terms of sample data acquisition, a combination of field investigation and information system data can be adopted to make up for the shortcomings of a single research method, and sample data can be obtained from more regions to improve the representativeness and comprehensiveness of the research results. Secondly, the current research mainly starts from the primary characteristics of the elderly, but according to the analysis framework based on the Anderson's Behavioral Model, it can be seen that environmental factors such as the construction of the elderly care service system and elderly care policies will also affect the needs of elderly care services. In the future, environmental factors can also be incorporated into the model for analysis. Finally, when studying the interaction of influencing factors, considering that the number of interaction items added to the model should not be too many, the second-order interaction is mainly studied. However, the interaction of more types of variables is also worth studying. In the future, we can consider adjusting the variables included in the model to study the third-order interaction of influencing factors.

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