The Rehabilitation Consumption Decision Analysis of Disabled Elderly People in Chengdu Based on the Analytic Hierarchy Process

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Abstract: The rehabilitation of the disabled elderly is a challenging area in China, as it accounts for a large proportion of the deeply aging population, and the development of rehabilitation for the elderly is lagging, to analyze the factors affecting the rehabilitation of the elderly and find the optimal solution. Using Analytic Hierarchy Process, mathematical statistics and logical analysis, and other related research methods to analyze the 13 factors influencing the consumption demand for rehabilitation consumption of the elderly in Chengdu, the mathematical model was established by using the arithmetic mean method for judgment matrices of small order and the eigenvector method for larger ones when performing the weight calculation. There are four main factors affecting the rehabilitation consumption decisions of the elderly in Chengdu: economic factors, environmental factors, time factors, and their factors. Among them, the factors that play a decisive role in the rehabilitation needs of the elderly in Chengdu are: economic factors, environmental factors, and their factors, and the relevant influence factors constitute the greatest weight. Through the mathematical model construction, the final calculation simulation i.e. the score of scenario D_1 (consumption) is 0.5841 and the score of scenario D_2 (no consumption) is 0.4159. Finally, the CR<0.1 for all the single and total sorting according to the relevant steps shows that the consistency of this judgment matrix is acceptable and logical.

1 INTRODUCTION

Consumption is an important behavior and process of human socio-economic activities. As China's economy enters a new normal and the material living standard of residents continues to improve, residents' sports culture is also showing vigorous development. The proportion of residents' sports consumption in consumption is becoming larger and larger, and consumption is gradually becoming a new consumption growth point in China's economy. The current concept of consumption is gradually gaining popularity, which has greatly stimulated people's awareness of consumption (Zhang, 1955). Needs cannot be substituted for one another (for example, a lack of water and shelter cannot be offset by more education or healthcare) They are essential parts of the same package. And–crucially for the development of sustainable consumption corridors– they are intrinsically satiable: there are limits beyond which more food, more work, or more security are no longer helpful and could even do one harm. There comes a point where sufficiency is reached in the process of meeting needs: this helps constrain the tendency toward escalating consumption associated with satisfying consumer wants, threatening to breach planetary boundaries. The focus on needs and sufficiency aligns UBS with sustainable development, aiming to meet current needs without compromising the ability of future generations to meet their own need (Coote, 2021). The average monthly consumption of the surveyed elderly in Chengdu was 2231.11 RMB, of which 969.39 RMB was spent on food, accounting for 43.45%c of the total expenditure, i.e. The Engel coefficient was 0.4345. According to the United Nations Engel coefficient, the standard of living of the surveyed older adults is moderate. By the end of 2018, China's elderly population aged 60 or older reached 249 million, accounting for 17.9% of the total population (Jiang, 2019). Studies show that more than 95% of the disabled elderly in countries such as the UK, the US, and Japan choose to age in place in the

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community, and more than 80% in the Philippines, Vietnam, and Malaysia. The majority of disabled elderly people in China also want to choose to age at home or in the community. Therefore, it is important to identify and meet the long-term care needs of the elderly with disabilities to promote the construction of a community-based elderly care service system and improve the quality of long-term care for the elderly (Zhang, 1955) with disabilities. The study found that there were differences in the ability levels of disabled elderly people by age, gender, education level, marital status, and residential status. The (Activities of daily living) ADL is an important indicator commonly used in academia to measure the ability of older adults to care for themselves in daily life and consists of the Somatic Self-Care Scale and the Instrumental Activities of Daily Living Scale. interviews, participants were assessed for disability in 4 key ADL tasks—bathing, dressing, walking, and transferring (Hardy, 2004). The elderly with disabilities were classified into three levels according to the six indicators in the Self-Care of Somatic Life Scale (eating, dressing, getting in and out of bed by themselves, going to the toilet, walking around indoors, and bathing): Mild disability (1~2 items cannot be completed), moderate disability (3~4 items cannot be completed) and severe disability (5~6 items cannot be completed) (Liu, 2019). According to the design of the questionnaire, the 6 indicators of ADL were replaced by the control of urination and defecation in the bed. If the respondent answered "don't need any help" for all 6 items, he/she is fully self-care; if he/she answered "need help for one item", he/she is partially self-care; if he/she answered "need help for two or more items", he/she is unable to take care of himself/herself.

The main innovations of this paper are as follows:

(1) Rehabilitation of the disabled elderly s lagging in the current development path in China, and this paper finds the main factors influencing the consumption of elderly rehabilitation through rehabilitation demand analysis.

(2) To investigate the rehabilitation needs of the elderly with disabilities and to construct a rehabilitation needs decision model by applying the hierarchical analysis process.

2 OVERVIEW OF THE HIERARCHICAL ANALYSIS CONCEPTION

The Analytic Hierarchy Process (AHP for short) was proposed by Professor T.L. Saaty, an American operations researcher, and applied in 1971 in the study of contingency planning for the U.S. Department of Defense, as a comprehensive approach to system evaluation and decision-making that integrates qualitative and quantitative analysis. AHP has been widely used in many research areas such as security, risk assessment, and related decision problems.

2.1 Basic Characteristics

Complex decision problems are easy by identifying complex problems as general objectives and then setting them as minor ones based on several factors that affect the general objective.

It combines quantitative and qualitative analysis, expresses human subjective judgment scientifically in a mathematical way, gives the weight of each decision option reasonably, finds out the score of each option, ranks the advantages and disadvantages of each option, makes the optimal decision, and thus solves complex practical problems.

2.2 Basic Principle

When studying a complex practical problem, the problem to be studied is identified as the top goal, then it is identified as a small goal based on several factors affecting the total goal, and finally, a progressive hierarchy is constructed based on the hierarchical relationship between these related several small goals, and these small goals are ranked in order of merit, which is ultimately used as the basis for problem decision making.

2.3 Calculation Steps

(1) Construct a structural model diagram. Construct a hierarchical structure based on the indicators affecting the event, while specifying the relationships between the hierarchical factors.

(2) Constructing judgment matrix. Based on the hierarchical model diagram, the relative importance of the factors at (Zhang, 1955) each level needs to be judged and presented in a numerical form.

(3) Hierarchical single ranking. The indicators between the same level are ranked in importance in terms of the magnitude of their influence on the previous level.

(4) Overall ranking of levels. Combine the results of the ranking between each level and calculate the impact of the weight values on the overall index.

(5) Consistency check. Based on the constructed judgment matrix, the eigenvectors, and the maximum eigenvalues are calculated to see if they meet the specified requirements.

2.4 Hierarchical Analysis Example Analysis Process, Establishing a Recursive Hierarchy

The key to determining the success of the Analytic Hierarchy Process (AHP) is the construction of a reasonable, comprehensive, and easy-to-judge recursive hierarchy model. This is also the first step in applying the hierarchical method. In this paper, the system is constructed with no more than nine elements dominated by each element in each level of the structure. Ultimately, the paper divides these layers into four categories: purpose layer, criterion layer, sub-criterion layer, and scheme layer (Zhang, 1955). **(Table 1)**, There are four options for calculating the weights of the Analytic Hierarchy Process: geometric mean, arithmetic mean, eigenvector, and least squares, which are close to each other in terms of values and usually do not need to be studied separately in advance but can be determined in the process of the actual calculation. In this paper, when performing the calculation of weights, the arithmetic average method is used for judgment matrices of small order, and the larger one uses the eigenvector method.

Table 1: A progressive hierarchy of consumption decisions for rehabilitation of the elderly with mild.

Target layer A	Guideline layer B	Sub-criterion layer C	Program level
Rehabilitation consumer demand A	Economic Factors B_1	Retirement pay C_1	Consumption D_1 Or no consumption D_2
		Annual household income C_2	
		Rehabilitation Prices C_3	
		Distance to the rehabilitation site C_4	
	Environmental Factors B_2	Rehabilitation Effect C_5	
		Rehabilitation service attitude C_6	
		Security Risk Factors C_7	
	Time Factor B_3	Leisure time for the elderly C_8	
		Round trip travel time C_9	
		Rehabilitation treatment time C_{10}	
	Self-needs B_4	Assisted Rehabilitation C_{11}	
		Life necessity rehabilitation C_{12}	
		Exercise rehabilitation C_{13}	

2.4.1 Analysis from the Perspective of Economic Factors

Literature projections indicate that the total cost of care for the mildly disabled is currently the highest in China ($3,040 billion in 2050), followed by the severely disabled ($1,682 billion in 2050) and the moderately disabled ($744.9 billion in 2050). Our mildly disabled elderly have to bear the greatest financial pressure, which is very testing for their retirement benefits and their family's financial situation. According to the literature, Only 16.74% of the disabled elderly are entitled to a pension 79.4% of the disabled elderly in rural areas are supported by their children, compared to 55% in urban areas. Therefore, the economic factors considered in this paper should include retirement salary C_1 and annual household income C_2. In addition, the price of rehabilitation C_3 is the most important factor.

2.4.2 Analysis from the Perspective of Environmental Factors

This paper identifies distance from the rehabilitation site, rehabilitation outcomes, service attitudes, and safety risk factors as the four main factors to consider.

In terms of the time factor, the elderly's own leisure time is the main factor. In addition, it also includes the travel time to and from the home and the time spent on rehabilitation treatment. Finally, their own needs determine whether the elderly are willing to take rehabilitation treatment. In this paper, we believe that there are three main categories of mildly disabled elderly people, namely, assisted rehabilitation, rehabilitation of life necessities, and rehabilitation of exercise. The willingness to rehabilitate is different among these three categories of elderly with mild disabilities.

2.4.3 Construction of Judgment Matrix

The second step of hierarchical analysis is to construct the judgment matrix. It is the basis for measuring the importance of things and the source for performing weight value calculations. Ask the expert repeatedly for the criteria of the judgment matrix, where two elements are compared two by two (with each other) which is important, and how much and assign a value to the degree of importance by 1-9 **(Table 2).**

Table 2: Importance scale of judgment matrix.

Importance Scale	Meaning
1 indicates that two elements are of equal importance compared to each other	1 indicates that two elements are of equal importance compared to each other
3 indicates that the former is slightly more important than the latter when compared to the two elements	3 indicates that the former is slightly more important than the latter when compared to the two elements
5 Indicates that the former is significantly more important than the latter when compared to the two elements	5 Indicates that the former is significantly more important than the latter when compared to the two elements
7 Indicates that the former is strongly more important than the latter when compared to the two elements	7 Indicates that the former is strongly more important than the latter when compared to the two elements
9 indicates that the former is more extremely important than the latter when compared to the two elements	9 indicates that the former is more extremely important than the latter when compared to the two elements
2,4,6,8	denotes the intermediate value of the above judgment
Countdown	If the ratio of the importance of element I to element j is a_{ij}, then the ratio of the importance of element j to element i is $a_{ji}=1/a_{ij}$3 (no 3)

The judgment matrix corresponding to each layer (**Table 3**):

Table 3: Judgment matrix corresponding to each layer.

C_1	C_2	C_3	C_4	C_5	C_6
$D_1\begin{bmatrix}1 & 3\\ 1/3 & 1\end{bmatrix}$ D_2	$D_1\begin{bmatrix}1 & 1/3\\ 3 & 1\end{bmatrix}$ D_2	$D_1\begin{bmatrix}1 & 2\\ 1/2 & 1\end{bmatrix}$ D_2	$D_1\begin{bmatrix}1 & 1/5\\ 5 & 1\end{bmatrix}$ D_2	$D_1\begin{bmatrix}1 & 2\\ 1/2 & 1\end{bmatrix}$ D_2	$D_1\begin{bmatrix}1 & 3\\ 1/3 & 1\end{bmatrix}$ D_2
C_7	C_8	C_9	C_{10}	C_{11}	C_{12}
$D_1\begin{bmatrix}1 & 5\\ 1/5 & 1\end{bmatrix}$ D_2	$D_1\begin{bmatrix}1 & 1/3\\ 3 & 1\end{bmatrix}$ D_2	$D_1\begin{bmatrix}1 & 2\\ 1/2 & 1\end{bmatrix}$ D_2	$D_1\begin{bmatrix}1 & 1/2\\ 2 & 1\end{bmatrix}$ D_2	$D_1\begin{bmatrix}1 & 3\\ 1/3 & 1\end{bmatrix}$ D_2	$D_1\begin{bmatrix}1 & 1/5\\ 5 & 1\end{bmatrix}$ D_2
C_{13}	B_1	B_2	B_3	B_4	A
$D_1\begin{bmatrix}1 & 2\\ 1/2 & 1\end{bmatrix}$ D_2	$C_1\begin{bmatrix}1 & 4 & 3\\ 1/4 & 1 & 1/3\\ 1/3 & 3 & 1\end{bmatrix}$ C_2 C_3	$C_4\begin{bmatrix}1 & 1/2 & 3 & 2\\ 2 & 1 & 3 & 2\\ 1/3 & 1/2 & 1 & 1/2\\ 1/2 & 1/2 & 2 & 1\end{bmatrix}$ C_5 C_6 C_7	$C_8\begin{bmatrix}1 & 2 & 3\\ 1/2 & 1 & 3\\ 1/3 & 1/3 & 1\end{bmatrix}$ C_9 C_{10}	$C_{11}\begin{bmatrix}1 & 2\\ 1/2 & 1 & 5\\ 1/5 & 1\end{bmatrix}$ C_{12} C_{13}	$B_1\begin{bmatrix}1 & 2 & 3\\ 1/2 & 1 & 3 & 1/2\\ 1/3 & 1/3 & 2 & 1/2\\ 1/3 & 2 & 1\end{bmatrix}$ B_2 B_3 B_4

In the next step, the: weight values corresponding to each layer are calculated. As mentioned before, the simple judgment matrix can be solved directly using the arithmetic mean method. Firstly, for the sub-

criterion layer, its judgment matrix is simple, and the weight values of the scheme layer relative to the sub-criterion layer can be calculated **(Table 4).**

Table 4: Target layer weight values.

Target layer	B_1	B_2	B_3	B_4
Weight	0.4496	0.2054	0.1052	0.2398

For the target and criterion layers, the matrix dimensionality is high, and this paper uses the eigenvector method to determine their weights, as shown in (**Table 5),** respectively. Take B_1 as an example, its normalized feature vector: and this feature vector is used as the weight value.

Table 5: Criterion layer weight values.

Weights	B_1	B_2	B_3	B_4
C_1	0.6144	0	0	0
C_2	0.1172	0	0	0
C_3	0.2684	0	0	0
C_4	0	0.4182	0	0
C_5	0	0.2707	0	0
C_6	0	0.1205	0	0
C_7	0	0.1906	0	0
C_8	0	0	0.5278	0
C_9	0	0	0.3325	0
C_{10}	0	0	0.1396	0
C_{11}	0	0	0	0.5954
C_{12}	0	0	0	0.2764
C_{13}	0	0	0	0.1283

The next step is to consider the weighting relationships between the layers as a whole. First, the weights between the criterion and solution layers are determined. According to **(Table 4)** target layer weight values. And, the weight matrix between the criterion and solution layers is:

$$\begin{matrix} D_1 \\ D_2 \end{matrix}\begin{pmatrix} B_1 & B_2 & B_3 & B_4 \\ 0.6690 & 0.4994 & 0.4002 & 0.5781 \\ 0.3310 & 0.5006 & 0.5998 & 0.4219 \end{pmatrix}$$

Further, in combination with Table 6, the linkage between the target and program layers can be established. Their weights are determined as follows:

$$\begin{pmatrix} 0.6690 & 0.4494 & 0.4002 & 0.5781 \\ 0.3310 & 0.5998 & 0.5998 & 0.4219 \end{pmatrix} \times \begin{pmatrix} 0.4496 \\ 0.2054 \\ 0.1052 \\ 0.2398 \end{pmatrix} = \begin{pmatrix} 0.5841 \\ 0.4159 \end{pmatrix}$$

According to the formula: Among them is the maximum eigenvalue, which n is the matrix order. Calculate consistency ratio *CR=CI/RI*, If the value is less than 0.1, then the consistency of the judgment matrix is considered to be an acceptable *RI* Value.

The first is the hierarchical single ranking and test. The hierarchical single ranking is obtained for each level. (Table 8). Take the guideline layer B_1 as an example. Perform consistency checks. The maximum eigenvalue is *Max*=3.0735, Consistency indicators of the judgment matrix: According to (**Figure 5**), Find out *RI*=0.58, Thus the consistency ratio: Therefore, the guideline level B_1 The consistency of the judgment matrix is acceptable. Next, the hierarchical total ranking and test are performed. The total ranking is shown in Table 3. The consistency test is performed below.

$$\text{get} \begin{cases} D_1 = 0.5841 \\ D_2 = 0.4159 \end{cases}$$

According to the formula： Among them is the maximum eigenvalue， which n is the matrix order. Calculate the consistency ratio *CR=CI/RI*, If the value is less than 0.1, then the consistency of the judgment matrix is considered to be an acceptable *RI* Value.

3 CONCLUSION

China has a serious aging problem, and the prevalence of chronic diseases brought about by changes in population age structure tends to aggravate the inherent loss of structural and functional aging (Thibaut, 2020). Through the above example analysis process, it can be found that various factors influence the rehabilitation consumption decisions made by the disabled elderly in Chengdu. Mainly includes: 4 major aspects of the economy, environment, time, and own needs. Meanwhile. The indicators that evaluate and influence these 4 major factors, in turn, include: retirement salary, annual household income, annual household income, rehabilitation price, rehabilitation location, distance, rehabilitation effect, attitude toward rehabilitation, leisure time of the elderly, travel time to and from the home, rehabilitation treatment time, assisted rehabilitation, life necessity rehabilitation, and exercise rehabilitation 13 influence factors. The main influencing factors listed above are sufficient to reflect the overall situation affecting the rehabilitation consumption decisions of the elderly in Chengdu. Among the environmental factors, the

rehabilitation distance, rehabilitation effect, service attitude, safety risk factors, service attitude, and rehabilitation effect are the most important factors influencing elderly people's rehabilitation consumption.

Regarding the "own needs" of rehabilitation consumption of the elderly in Chengdu, "exercise rehabilitation", "life necessity rehabilitation" and "supplementary group rehabilitation" are the main factors influencing the consumption of rehabilitation of the elderly in Chengdu. Of the three, "life necessity rehabilitation" is the most important factor affecting the rehabilitation of the elderly (Zhou, 2019), That is, the score of scheme D_1 (consumption) is 0.5841, and Scenario D_2 (no consumption) scored 0.4159. Finally, according to the relevant steps to prove that all single sort and total CR<0.1 for sorting, It means that the consistency of this judgment matrix is acceptable, it means that the judgment matrix is logical. In summary, older adults in Chengdu will choose to spend money on rehabilitation if their retirement income is objective, the price of rehabilitation is appropriate, the rehabilitation effect is good, and they are satisfied with the service; Conversely, if these conditions do not meet the expectations of the disabled elderly in Chengdu, they will influence the elderly's decision to make rehabilitation consumption.

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