Postprint: Analysis of Factors Influencing Information Needs of Older Adults Based on Interpretive Structural Model

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Abstract

[Purpose/Significance] To establish an interpretive structural model of the factors influencing elderly information needs, and to analyze the hierarchical relationships among these factors and their impact on elderly information needs. [Method/Process] Building upon existing research findings regarding factors influencing elderly information needs, a first-round expert survey was conducted to identify and categorize 20 factors affecting elderly information needs. Based on this, a second-round expert survey was performed to determine the interrelationships among these factors, thereby constructing an adjacency matrix; through operations on the adjacency matrix, a reachability matrix was obtained; by decomposing the reachability matrix, the factors influencing elderly information needs were stratified into five levels, establishing an interpretive structural model of these factors, and analyzing their hierarchical relationships and impact on elderly information needs. [Results/Conclusion] The factors influencing elderly information needs can be classified into surface-level factors, middle-level factors, and deep-level factors. Surface-level factors represent the most direct influences on elderly information needs; middle-level factors constitute relatively direct influences; deep-level factors are the fundamental determinants of elderly information needs.

Full Text

Analysis of Factors Influencing Elderly Information Needs Based on Interpretive Structural Modeling

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Abstract

[**Purpose/Significance**] This study establishes an interpretive structural model of the factors influencing elderly information needs and analyzes the hierarchical relationships among these factors and their effects on elderly information needs. [**Method/Process**] Drawing upon existing research findings on factors influencing elderly information needs, a first-round expert survey identified 20 factors affecting elderly information needs, which were then categorized. Building on this, a second-round expert survey determined the interrelationships among these factors and established an adjacency matrix. Through matrix operations, a reachability matrix was obtained. By decomposing the reachability matrix, the factors were divided into five hierarchical levels, establishing an interpretive structural model of factors influencing elderly information needs. [**Result/Conclusion**] The influencing factors can be categorized into surface-level, middle-level, and deep-level factors. Surface-level factors are those that most directly affect elderly information needs; middle-level factors are relatively direct influences; and deep-level factors are the fundamental drivers of elderly information needs.

Keywords: elderly information needs; information needs influencing factors; interpretive structural model
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Introduction

While developed Western countries typically define elderly as individuals aged 65 and above, China has traditionally referred to 60 years as the "huajia" milestone and established this as the retirement age. The Law of the People' s Republic of China on the Protection of the Rights and Interests of the Elderly defines elderly as citizens aged 60 and above. This study adopts the 60-year threshold. Elderly information needs encompass both the need for information and information-seeking behavior, including requirements regarding information content, quantity, quality, and format, as well as preferences for information channels and retrieval methods. Research on factors influencing elderly information needs facilitates understanding of the mechanisms and patterns underlying these needs, expands the scope of information user research, and enables better information services for the elderly.

This study identifies factors influencing elderly information needs and subsequently categorizes them into hierarchical levels to build an interpretive structural model. Existing research provides an important foundation for this work. International scholars such as J. Sharit and M. A. Hernández et al. [**?**] found that verbal expression ability, memory span, cognitive speed, and reasoning capacity significantly impact information retrieval behavior. E. B. Kristina and B. K. Stefan et al. [**?**] identified education level, interest, health status, information-seeking ability, and personal health as important factors affecting elderly health

information needs. M. K. Kbayesi and H. W. J. Meyer et al. [?] surveyed home-based elderly individuals in Nakuru, Kenya, finding that personal factors such as literacy, language ability, memory limitations, and physical disabilities, along with environmental factors like healthcare services, financial resources, cultural traditions, and education, influence elderly information needs. K. V. Wild and N. Matteck et al. [?] noted that computer and internet usage positively impacts elderly daily life and information utilization while also creating difficulties and barriers. A. Palsdottir [?] argued that physical decline and privacy concerns primarily limit elderly use of social network information sources.

Chinese scholars have also contributed valuable insights. Wang Lina [?] found that rural elderly information needs are influenced by rural population structure, elderly group cultural quality, regional geographic differences, and regional traditional cultural differences. Chang Qing [?] identified gender, age, education level, economic status, and health condition as primary factors, along with external factors such as living conditions, economic income, social networks, and living environment. Qiang Wei [?] noted that physical factors, information needs, information-seeking ability, information equipment, education level, public information sources, and economic status affect urban family-based elderly daily information-seeking behavior. Fan Liangying et al. [?] observed significant regional differences in elderly attention to various information types, with central region elderly showing greater interest in social welfare than entertainment information, while western region elderly prioritized news. Li Xiaoping et al. [?] found that elderly daily information-seeking behavior correlates with economic status, education level, and geographic location. Li Fei [?] identified internal factors including gender, age, education, health status, subjective well-being, and work attributes, and external factors including living conditions and work status. Guo Chengfang [?] discovered through questionnaires that gender, age, education, and previous occupation influence elderly use of public libraries.

1. Determination of Factors Influencing Elderly Information Needs

Based on literature review and analysis of existing research, preliminary factor types and specific elements were identified, then finalized through expert surveys.

1.1 Drawing on Existing Research to Preliminarily Identify Factors

International and domestic scholars have achieved considerable research results on factors influencing elderly information needs, providing an important basis for this study. Integrating these perspectives, influencing factors involve three levels: (1) elderly personal factors (gender, age, education, cognitive level, information capability, economic status, health condition, previous occupation, interests); (2) regional environmental factors (financial resources, culture, education, geographic location, population structure, public information resources); and (3) community factors (rural population structure, living conditions, living environment). However, existing research rarely explores family influences.

The author contends that beyond regional, community, and personal factors, the family constitutes the elderly' s primary activity setting, with family members and relatives being their main social contacts. Therefore, family and relatives significantly influence elderly information needs. Accordingly, four categories with 20 specific factors were preliminarily identified: regional environmental factors, community environmental factors, family and relatives factors, and personal factors, as shown in Table 1 .

1.2 Finalizing Factors Through Expert Survey Methods for determining these factors include expert surveys and elderly surveys. Given the numerous and abstract nature of these factors, which require sociological and information management expertise to evaluate properly, and considering that ordinary elderly individuals typically lack the information literacy to accurately recognize and articulate factors influencing their own information needs, this study employs the expert survey method. Twenty middle-aged and elderly experts were selected (one-third aged 60+), including scholars from information management and sociology fields. Experts rated each factor's influence on elderly information needs across five levels: very strong, strong, moderate, weak, and no influence. The survey questionnaire based on Table 1 was distributed to these 20 experts.

As shown in Table 2 , except for a few experts who considered regional natural conditions, community size, and relatives/friends situation as having no influence, and a very small minority who viewed some factors as having weak influence, the vast majority rated all factors as at least moderate influence. Therefore, all 20 factors in Table 1 were confirmed as influencing elderly information needs.

2. Interpretive Structural Model of Factors Influencing Elderly Information Needs

The Interpretive Structural Model (ISM) utilizes practical experience and knowledge, based on directed graphs and matrix structures, to decompose complex systems and analyze direct and indirect relationships among constituent elements, ultimately organizing them into a clearly hierarchical multi-level structure [**?**]. ISM can differentiate surface-level, middle-level, and deep-level factors influencing elderly information needs while visually representing interconnections, thereby clarifying relationships among factors and providing a foundation for analyzing their mechanisms and interaction patterns.

2.1 Determining Factor Interrelationships and Establishing the Adjacency Matrix The interrelationships among the 20 factors from Table 1 were assessed using a matrix questionnaire distributed to the same 20 experts. If the row element directly influenced the column element, it was marked as 1; if not, 0. Synthesizing expert opinions, if at least 4/5 of experts agreed that a row element directly influenced a column element, the result was coded as 1,

otherwise 0. This process yielded the adjacency matrix N for factors influencing elderly information needs, shown in Figure 1 [Figure 1: see original paper].

2.2 Calculating the Reachability Matrix from the Adjacency Matrix The reachability matrix describes relationships where elements can influence other elements through certain paths (or intermediate elements). It is obtained through Boolean operations (logical AND for multiplication, logical OR for addition) on the adjacency matrix N plus the identity matrix I. When (N+I)^(k-1) ≠ (N+I)^k = (N+I)^(k+1), the reachability matrix M = (N+I)^k is obtained.

Through calculation, the reachability matrix for factors influencing elderly information needs is M = (N+I)^5, shown in Figure 2 [Figure 2: see original paper].

In the reachability matrix shown in Figure 2, rows and columns for A1, A2, A3, A4, and A5 are identical and can be replaced by A. Similarly, rows and columns for C1, C2, C3, C4, D2, D3, D4, D5, D6, and D7 are identical and can be replaced by C. This yields the simplified reachability matrix M' , shown in Figure 3 [Figure 3: see original paper].

2.3 Decomposing the Reachability Matrix to Build the ISM The decomposition method involves: (1) deriving each factor' s reachability set R(ni) (all factors reachable from ni, i.e., columns with 1 in ni' s row) and antecedent set A(nj) (all factors reaching nj, i.e., rows with 1 in nj' s column); (2) calculating R(ni) A(nj) to identify bottom-level factors where A(nj) = R(ni) A(nj); (3) identifying top-level factors where R(ni) = R(ni) A(nj). After identifying top-level factors, their corresponding rows and columns are removed, and the process repeats to find the next level' s top factors, continuing iteratively.

Based on the simplified reachability matrix, the first-level partition yields the reachability and antecedent sets shown in Table 3 .

From Table 3, the bottom-level factor is A, and the top-level factors are C and D1. After removing C and D1 from M' , the second-level partition yields Table 4 .

From Table 4, the second-level factors are B3, B4, and D1. After removing these from M' , the third-level partition yields Table 5 .

From Table 5, the third-level factor is B2. After removing B2, the fourth-level partition yields Table 6 .

From Table 6, the fourth-level factor is B1. The complete hierarchical decomposition is shown in Table 7 .

Rearranging the simplified reachability matrix according to Table 7' s levels yields the reordered matrix M" , shown in Figure 4 [Figure 4: see original paper].

After removing reflexive relationships (self-influence) and transitive relationships from Figure 4, and restoring merged factors, the interpretive structural

model of factors influencing elderly information needs is constructed, shown in Figure 5 [Figure 5: see original paper].

3. Hierarchical Relationships Among Factors Influencing Elderly Information Needs

As shown in Figure 5, the five hierarchical levels can be grouped into three layers: surface-level, middle-level, and deep-level factors.

3.1 Surface-Level Factors Surface-level factors represent the highest level and most direct influences on elderly information needs, comprising family/relatives factors and personal factors. These directly affect elderly information needs, with mutual influence among factors within each category.

Family/relatives factors substantially and directly influence elderly information needs. Family member structure primarily affects information content needs: elderly with grandchildren typically focus on child-rearing, education, and healthcare information; those with children pay attention to their children' s work, healthcare, and personal information; those with elderly parents emphasize pension, health preservation, medical care, and nursing information. Co-residence with children mainly influences information acquisition channels and methods —elderly living with children often obtain information through them. Family economic status affects both the quantity of information needs and acquisition channels: affluent elderly, after material needs are satisfied, have greater information demands and can afford televisions, computers, and smartphones for internet-based information access anytime, anywhere; economically disadvantaged elderly have fewer information needs and rely more on free channels like word-of-mouth or outdoor bulletin boards. Relatives/friends situation primarily influences information content needs—elderly with siblings and close relatives typically pay more attention to relatives' personal information and evaluations.

Personal factors significantly and directly affect information needs. Age notably impacts reading text-based information—as vision deteriorates with age, those over 80 read significantly less textual information than younger elderly. Health condition influences information content needs, information-seeking motivation, and acquisition channels. Healthier elderly pay less attention to medical/disease information; severely ill elderly often experience extreme discomfort, leading to slowed thinking and reduced information-seeking capacity; mobility-impaired elderly primarily rely on family or healthcare providers for information. Current work tasks affect information content needs and acquisition methods —non-retired elderly mainly need work-related information obtained through their organization' s information services, while retired elderly typically obtain hobby-related information through themselves or friends. Previous occupation and education level influence information cognition and acquisition methods—elderly who were teachers or technicians generally have higher education, information literacy, and search skills, enabling them to clearly recognize and express their information needs and efficiently retrieve information through appropriate

channels. Interests and hobbies affect information content needs and acquisition channels—elderly who enjoy reading and writing obtain information from traditional print media, while those interested in painting, calligraphy, music, dance, or crafts obtain information from print media, radio, television, internet, and also significantly from other people and community groups.

Family/relatives factors and personal factors mutually influence each other. Family member structure affects family economic status and co-residence with children; elderly age influences health condition, work tasks, and interests; family economic status also affects elderly health condition, work status, and interests.

3.2 Middle-Level Factors Middle-level factors are relatively direct influences, comprising second-, third-, and fourth-level factors: community environmental factors and elderly gender. These are influenced by deep-level factors while directly or indirectly influencing surface-level factors.

Community environmental factors include community living environment and community cultural environment at the second level, community size at the third level, and community geographic location at the fourth level. Community living environment primarily affects elderly health condition—for example, communities near chemical plants have residents more prone to specific diseases. Community cultural environment directly influences elderly interests and hobbies. Since elderly health condition and interests affect age and current work tasks, community living and cultural environments indirectly influence other personal factors. Because elderly age, health condition, current work tasks, and interests affect family/relatives situation, community environments also indirectly influence family/relatives circumstances. Gender is the only middle-level personal factor, influencing many aspects of personal factors: statistically, women' s average lifespan exceeds men' s by 5-10 years; certain occupations (preschool teachers, nurses) are predominantly female, while physical labor or technical positions are predominantly male; child-care tasks fall more to female elderly; gender differences in interests are evident (e.g., square dancing favored by women, chess games by men). Since personal factors affect family/relatives situation, gender also indirectly influences family/relatives circumstances.

Community size at the third level primarily influences second-level community living environment and cultural environment. Generally, larger communities have more complex demographic compositions, better facilities, and more diverse cultures.

Community geographic location at the fourth level mainly affects community size: larger, more populous cities tend to have large or super-large residential communities, while small towns rarely do. Lower suburban land costs and more available space lead developers to build large communities, whereas expensive, scarce downtown land makes large community construction difficult. Community geographic location also substantially influences community living

environment—urban residential communities differ markedly from rural villages in living conditions.

3.3 Deep-Level Factors Deep-level factors are the fundamental influences with broad impact, primarily affecting middle-level factors directly or indirectly. These are regional environmental factors, including regional political environment, economic development, science and technology education, cultural traditions, and natural conditions, which directly or interactively influence middle- and surface-level factors.

Regional environmental factors directly influence community factors while indirectly influencing family/relatives and personal factors. Regional political environment policies on land use planning and real estate development affect community geographic location and size. Regional economic development influences community living environment—more developed regions tend to have better community facilities. Regional science and technology education levels and cultural traditions affect community cultural environment—areas with higher science and education levels have residents with higher cultural quality, while regional cultural traditions directly influence community cultural atmosphere and ethical standards. Regional natural conditions affect community geographic location, size, and living environment—for example, terrain can restrict community site selection and building scale, while natural resources and climate influence community living environment.

Some regional environmental factors directly influence personal and family/relatives factors. Regional cultural traditions significantly and directly affect elderly gender—data show enormous regional gender ratio differences, with some "son-preference" traditions resulting in far more males than females. Regional cultural traditions also directly influence family member structure, co-residence with children, and relatives/friends situation. Regional economic development level directly affects family economic status.

Regional environmental factors also interact with each other. Differences in natural conditions lead to targeted policies; coastal regions have significantly higher economic development than mountainous western regions due to geographic advantages; poor natural conditions and transportation difficulties hinder access to science and technology education resources. Differences in regional political environments also affect economic and science/education development levels.

Conclusion

This study employs ISM methodology to categorize four types of factors influencing elderly information needs—regional environment, community environment, family/relatives, and personal factors—into five hierarchical levels, which are then consolidated into three layers: surface-level, middle-level, and deep-level factors. The hierarchical relationships were analyzed, yielding conclusions with good rationality and novelty. The factor stratification and hierarchical rela-

tionship revelation enable holistic understanding of the influence mechanisms and interaction patterns among factors, distinguishing the directness of different factors' impacts on elderly information needs. This provides guidance for understanding common patterns and characteristics of information needs across different elderly groups. Elderly information service institutions (including public libraries, community libraries, senior centers, and elderly information websites) can use these findings to conduct specific investigations of their service populations' information needs, grasp their characteristics, and provide targeted information services.

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Author Contributions:

Lou Dong: Responsible for research design, questionnaire design and distribution, data collection, and paper writing and revision.

Lou Cequn: Proposed the research topic, participated in research framework and questionnaire design, and contributed to paper writing and revision.

Note: Figure translations are in progress. See original paper for figures.