A study on pseudo-health information screening ability of middle-aged and elderly people based on the AISM-MICMAC method

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Abstract: The advent of Internet+ policy and the era of self-media has provided more convenient channels and platforms for information dissemination and led to the proliferation of pseudo-health information to a certain extent. As "digital immigrants," middle-aged and elderly people may be misled by pseudo-health information, and their health decisions and behaviors may be at greater risk, even leading to serious health consequences. This paper collects data on the search and use behavior of pseudo-health information from the perspective of middle-aged and elderly users through in-depth interviews and constructs a model based on the AISM-MICMAC method for influencing factors of pseudo-health information screening ability of middle-aged and older adults, visualizing the influencing factors and their paths of action, and analyzing the interactions and logical relationships among the factors in the system, in order to provide an effective way and reference basis for improving the pseudo-health information screening ability of middle-aged and elderly people.

1. Introduction

As China's population ages and diseases are getting younger, seeking health information h as become an urgent need for people [1]. At the same time, the promotion of "Internet Plus " makes digital life flourish, and Internet information resources become an important source of information for users because of their convenience, operability, openness, and freedom [2]. The advent of the "self-media" era makes it possible to become information disseminators a nd publishers. While this way of information dissemination brings convenience to people, it also makes the quality of information vary, which is full of "pseudo-health information" (suc h as rumors, superstitions, and other pseudo-scientific information), which has become a sign ificant obstacle for Chinese Internet users to obtain health information. With the uncontrolled spread of pseudo-health information on social media and the lack of adequate supervision, m iddle-aged and elderly people, as "digital immigrants," may be at greater risk of health decis ions and behaviors due to misleading pseudo-health information, which may even lead to ser ious health consequences. Therefore, how to improve the ability of middle-aged and old-aged people to detect pseudo-health information is crucial to promote the construction of the "He alth China Strategy" and enhance the health information literacy of all people.

From the perspective of the transmission mechanism of pseudo-health information, the tran smission of pseudo-health information is influenced by both psychological reactions and socia l context [3]. Some scholars have further studied the psychology of pseudo-health communica tors and found that people mainly deliver messages that elicit emotional responses [4], and e motional arousal usually increases people's willingness to deliver messages [5]. In contrast, fr om the perspective of the corrective type of health information (e.g., disinformation), users' p erceived information quality, perceived source reliability, and cognitive conflict affect their re ception of pseudo-health information [6]. Scholars have studied the recipients of pseudo-healt h information from multiple perspectives and found that people with characteristics such as o lder age[7], low education level[8], lack of knowledge[9] and weak cognitive beliefs[10] hav

e a lower ability to recognize pseudo-health information. Middle-aged and older adults are th e vulnerable group of pseudo-health information. These people cannot evaluate the quality of health information and lack sensitivity to the credibility clues of information content [11]. M iddle-aged and older people are weak in self-protection awareness in the online environment. They are easily misled by certain exaggerated and misleading behaviors [12], so they cannot judge pseudo-health information and have poor screening ability.

Based on the above research background, this paper collects data on real middle-aged and older adults' pseudo-health information is searching and using behaviors through in-depth int erviews from the perspective of middle-aged and elderly people users, text-codes the intervie w data. It is summarized the influencing factors of middle-aged and older people's pseudo-he alth information screening ability and subsequently analyzes the influencing relationships amo ng the influencing factors based on the Adversarial Interpretative Structural Model (AISM). I t is analyzed the influence relationship among the influencing factors, adopted the principle o f oppositional hierarchical extraction, determined the topological map of adversarial hierarchiz ation, and analyzed the dependency and driving of the factors by using the Fuzzy-MICMAC method in order to provide an effective way and reference basis for the improvement of the pseudo-health information screening ability of middle-aged and older people.

2. Research Methodology and Process

In this paper, we firstly define the influencing factors by rooting theory. Then invite expe rts to score them to form FA (fuzzy adjacency matrix) and calculate FR (fuzzy reachability matrix) by FB (fuzzy multiplication matrix). On the one hand, the MICMAC method is used to analyze FR. On the other hand, we select the intercept λ to convert FR into B (multiplic ative matrix) and obtain R (reachable matrix) and S (general skeleton matrix) by Boolean op eration and use R and S to construct an adversarial hierarchical topology diagram.

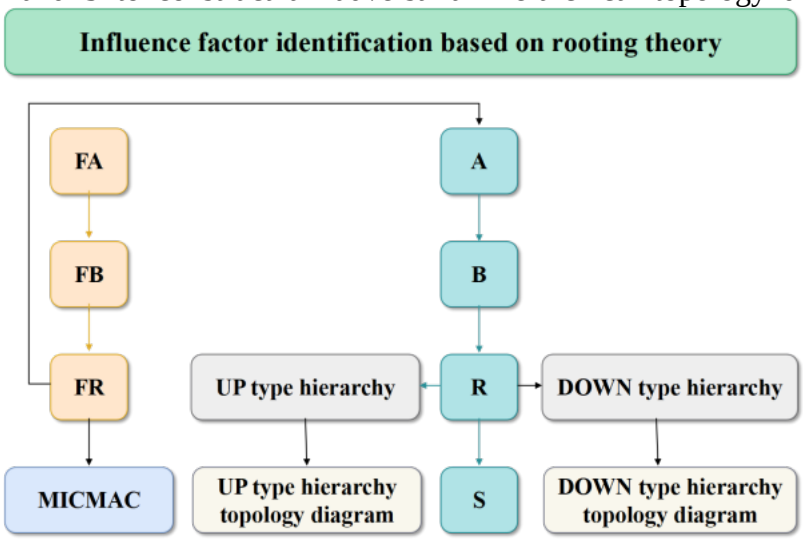

Figure 1. AISM-FUZZY-MICMAC model.

3. AISM construction

3.1 Determination of influencing factors.

In this paper, 30 middle-aged and older adults aged 45 or above who frequently use We Chat were selected as the respondents, and the original data collected by semi-structured inte rviews were converted from 30 audio recordings into documents as the main data for the st udy, and the original data were coded at three levels. The concepts were continuously refine d and integrated into the coding process until the theoretical saturation was reached. The infl uencing factors of health misinformation screening ability were obtained at the end of the th

ree rounds of coding, and the percentage of each influencing factor of health misinformation screening ability of middle-aged and elderly people was clarified by coding and analyzing th e interview data, followed by the explanation of the specific meaning of each influencing fa ctor, as shown in Table 1.

Table 1. Factors influencing the ability to screen health misinformation the middle-aged and elderly population.

Factors Classification	Specific influences	Code	Meaning of specific influencing factors
Personal factors	Personalities	S1	Individual personality issues affecting information screening
	Professional knowledge	S2	The impact of personal expertise on information screening
	Level of education	S3	Impact of individual education level on information screening
	Personal experiences	S4	The influence of personal experience when screening information
Information factors	Article Title	S5	The title of the article on information screening is too exaggerated
	Article View	S6	If the article's view is one-sided, absolute, or contrary to common sense
	Advertising content	S7	The advertising element in the article is obvious
	Article expertise	S8	Whether the expertise in the article is scientifically rigorous
	Information completeness	S9	Whether the information in the article is missing or ambiguous
	Article Tone	S10	Whether the tone of the article is too absolute
	Information source	S11	Whether the information source of the article is reliable
	Content Matching	S12	Whether the content of the article is relevant to health
	Supporting channel	S13	Other sources of corroboration for the information in the article
External factors	Expert recommendation	S14	Experts' attitude towards the relevant information in the article
	Others' opinion	S15	The influence of other people's opinions on one's ability to screen information
	Network Environment	S16	The impact of the quality of the online environment on information screening

3.2 Fuzzy adjacency matrix

Based on identifying influencing factors of false health information screening ability of mi ddle-aged and elderly groups, the fuzzy adjacency relation matrix is first constructed. It is as sumed that the binary fuzzy relation matrix $FA = (a_{ij})_{n\times n}, a_{ij} \in (0,1)$, of project risk factors is u sed to judge the interaction strength of influencing factors. In order to ensure the accuracy a nd rationality of the data, the relational logic judgment questionnaire of influencing factors is distributed to 15 experienced project management experts or related researchers. The averag e arithmetic value of 15 experts' questionnaire opinions indicates the influence degree of infl

uencing factors of false health information screening ability to exist middle-aged and elderly groups, and the fuzzy adjacency matrix is obtained FA.

Table 2. Fuzzy adjacency matrix.

	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16
S1	0.00	0.18	0.29	0.56	0.12	0.33	0.10	0.24	0.34	0.20	0.21	0.35	0.06	0.28	0.87	0.22
S2	0.14	0.00	0.21	0.33	0.10	0.07	0.13	0.92	0.12	0.44	0.17	0.15	0.08	0.77	0.08	0.14
S3	0.37	0.94	0.00	0.42	0.39	0.34	0.17	0.05	0.29	0.21	0.15	0.05	0.39	0.20	0.83	0.41
S4	0.22	0.66	0.78	0.00	0.14	0.10	0.05	0.42	0.40	0.04	0.23	0.95	0.24	0.29	0.41	0.25
S5	0.05	0.45	0.00	0.31	0.00	0.08	0.31	0.20	0.06	0.17	0.02	0.43	0.33	0.21	0.27	0.07
S6	0.45	0.00	0.27	0.36	0.68	0.00	0.02	0.19	0.07	0.11	0.39	0.77	0.27	0.07	0.12	0.09
S7	0.06	0.37	0.02	0.41	0.24	0.22	0.00	0.45	0.22	0.30	0.25	0.11	0.38	0.26	0.31	0.03
S8	0.10	0.38	0.03	0.15	0.26	0.85	0.10	0.00	0.11	0.34	0.11	0.40	0.26	0.35	0.12	0.06
S9	0.33	0.43	0.33	0.26	0.27	0.29	0.71	0.43	0.00	0.34	0.10	0.31	0.22	0.29	0.37	0.06
S10	0.27	0.33	0.11	0.18	0.42	0.21	0.07	0.62	0.44	0.00	0.15	0.13	0.19	0.04	0.10	0.25
S11	0.03	0.32	0.30	0.45	0.35	0.20	0.10	0.03	0.45	0.42	0.00	0.33	0.96	0.26	0.25	0.40
S12	0.21	0.02	0.18	0.36	0.15	0.02	0.22	0.29	0.25	0.19	0.39	0.00	0.01	0.28	0.21	0.01
S13	0.17	0.08	0.17	0.27	0.06	0.17	0.44	0.45	0.07	0.40	0.07	0.04	0.00	0.18	0.24	0.32
S14	0.15	0.10	0.21	0.17	0.41	0.17	0.22	0.37	0.44	0.04	0.23	0.42	0.04	0.00	0.12	0.30
S15	0.19	0.29	0.10	0.16	0.04	0.03	0.11	0.13	0.29	0.03	0.31	0.40	0.18	0.25	0.00	0.35
S16	0.31	0.20	0.32	0.02	0.01	0.11	0.63	0.18	0.29	0.25	0.74	0.12	0.82	0.10	0.14	0.00

3.3 Fuzzy reachability matrix

The fuzzy reachability matrix (FR) can represent the reachability of the interactions of ris k factors, which is calculated by the fuzzy adjacency matrix through the fuzzy operator. The matrix M is a fuzzy reachable matrix when it satisfies $M=(FA+I)^{k+1}=(FA+I)^{k}\neq(FA+I)^{k-1}$.

Table 3. Fuzzy reachability matrix

	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16
S1	1	0.56	0.56	0.56	0.56	0.56	0.44	0.56	0.44	0.44	0.41	0.56	0.41	0.56	0.87	0.41
S2	0.45	1	0.45	0.45	0.68	0.85	0.44	0.92	0.44	0.44	0.41	0.77	0.41	0.77	0.45	0.41

S3	0.45	0.94	1	0.45	0.68	0.85	0.44	0.92	0.44	0.44	0.41	0.77	0.41	0.77	0.83	0.41
S4	0.45	0.78	0.78	1	0.68	0.78	0.44	0.78	0.44	0.44	0.41	0.95	0.41	0.77	0.78	0.41
S5	0.45	0.45	0.45	0.45	1	0.45	0.44	0.45	0.44	0.44	0.41	0.45	0.41	0.45	0.45	0.41
S6	0.45	0.45	0.45	0.45	0.68	1	0.44	0.45	0.44	0.44	0.41	0.77	0.41	0.45	0.45	0.41
S7	0.45	0.45	0.45	0.45	0.45	0.45	1	0.45	0.44	0.44	0.41	0.45	0.41	0.45	0.45	0.41
S8	0.45	0.45	0.45	0.45	0.68	0.85	0.44	1	0.44	0.44	0.41	0.77	0.41	0.45	0.45	0.41
S9	0.45	0.45	0.45	0.45	0.45	0.45	0.71	0.45	1	0.44	0.41	0.45	0.41	0.45	0.45	0.41
S10	0.45	0.45	0.45	0.45	0.62	0.62	0.44	0.62	0.44	1	0.41	0.62	0.41	0.45	0.45	0.41
S11	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.44	1	0.45	0.96	0.45	0.45	0.41
S12	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	1	0.39	0.39	0.39	0.39
S13	0.45	0.45	0.45	0.45	0.45	0.45	0.44	0.45	0.44	0.44	0.41	0.45	1	0.45	0.45	0.41
S14	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.41	0.44	0.41	1	0.44	0.41
S15	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	1	0.39
S16	0.45	0.45	0.45	0.45	0.45	0.45	0.63	0.45	0.45	0.44	0.74	0.45	0.82	0.45	0.45	1

3.4 λ Horizontal intercept matrix division

λ Horizontal intercept matrix is defined as: When there exists a matrix of $R(r_{ij})$, then for any $\lambda \in [0,1]$, when satisfies: $r_{ij}(\lambda) = \begin{cases} 1, r_{ij} \geqslant \lambda \\ 0, r_{ij} < \lambda \end{cases}$ then $R = R(r_{ij}(\lambda))$ is said to be the horizontal intercept matrix of the matrix $R(r_{ij})$. After repeated measurements, it is considered that when $\lambda = 0.65$ it reflects a substantial degree of association, the multiplicative matrix B is obtained, and the reachable matrix R is obtained by Boolean operation.

3.5 General skeleton matrix

Based on the reachable matrix R, the reachable set $R(F_i)$, antecedent set $A(F_i)$, and common set $L(F_i)$ of each factor F_i are established, and the result priority rule(division rule: $L(F_i) = R(F_i)$ and reason priority (division rule: $L(F_i) = A(F_i)$) is used to divide the confrontation hierarchy. The final hierarchy results are shown in Table 4

$$\begin{cases} R(F_i) = \{F_i \mid F_i \epsilon F, k_{ij} = 1\} \\ A(F_i) = \{F_i \mid F_i \epsilon F, k_{ij} = 1\} \\ L(F_i) = \{F_i \epsilon F_i \mid R(F_i) \cap A(F_i) = R(F_i)\} \end{cases} \tag{1}$$

Table 4. Final hierarchical division results.

Layer	Results priority - UP type	Reason priority - DOWN type
Level 0	S5,S7,S12, S13,S14,S15	S5,S12
Level 1	S6,S9,S11	S6
Level 2	S8,S16	S8,S14
Level 3	S2,S10	S2,S15
Level 4	S3	S3,S13
Level 5	S4	S4,S7,S11
Level 6	S1	S1,S9,S10,S16

Scaling up the reachable matrix R and checking strong connection factors at all levels of t he reachable matrix R (F_i and F_j satisfy the relation $k_{ij}=k_{ji}=1$, then F_i and F_j are strong co nnection factors), The shrinking point is treated as a factor to obtain the shrinking point mat rix K; further, the reduced edge matrix is obtained by deleting the overstep binary relationshi p between adjacent binary factors. Finally, the binary relationship of the factors in the shrink ing matrix is eliminated. The main diagonal element "1" of the matrix is changed to "0", an d the skeleton matrix S is obtained.

Table 5. General skeleton matrix.

	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16
S1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
S2	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0
S3	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0
S4	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
S5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S6	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0
S7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S8	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
S9	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
S10	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
S11	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
S12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S16	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0

3.6 adversarial hierarchy topology diagram

According to the final classification results of confrontation hierarchy and skeleton matrix S, the hierarchical structure model diagram of confrontation is drawn by integrating the sorti ng results of centrality and cause degree.

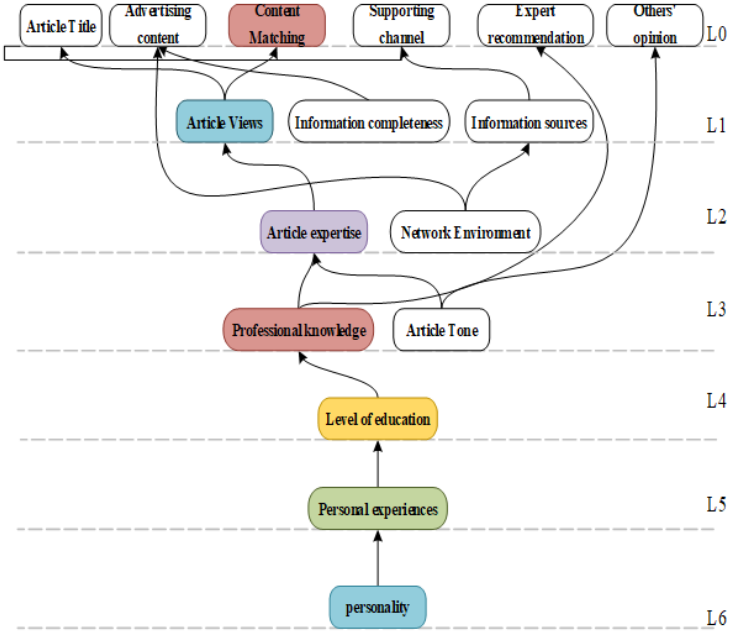

Figure 2. Result-first directed topology hierarchy diagram

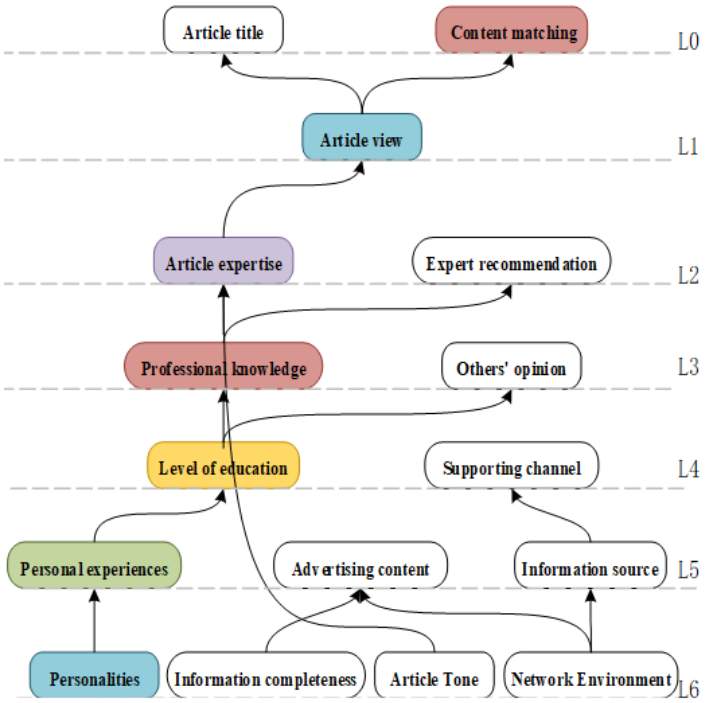

Figure 3. Cause-first directed topology hierarchy diagram

4. Analysis resultS and recommendation

4.1 AISM Influencing Factor Hierarchy Analysis

As shown in Figures 2 and 3, the factors influencing the pseudo-health information screening ability of middle-aged and older people form a top-down hierarchical structure with 6 levels and 3 orders of directed progression. The system is divided into 3 levels: the lower level (L4-L6) factors constitute the fundamental causal level, the middle level (L2-L3) factors constitute the excessive causal level, and the upper level (L1-L2) factors constitute the proximate causal level. The lower level indicates the stronger cause attribute (influence attribute), and the upper level indicates the stronger result attribute (influenced attribute).

The intrinsic causal order is the concatenation of the lower factors in the antagonistic hier archy diagram {S1, S4, S3}. Intrinsic causative order factors are the most fundamental factor s influencing middle-aged and older adults' pseudo-health information screening ability. The p roximate causal order is the concatenation of the upper-level factors in the hierarchical diagr am of grade confrontation {S5, S12, and S6}. The proximate causal order is the most direct factor, so improving the pseudo-health information screening ability of middle-aged and elder ly people can start from the proximate causal order factors. The transitional causal order, i.e. , the concurrent set in the middle of the antagonistic hierarchy after removing the essential c ausal order and the proximate causal order factors {S8, S2}. The proximate causative order f actors take on the role of propagating influence in the system, and they can also be called t he source of influence themselves, affecting other factors. Therefore, it is necessary to contro l the transitional causal order factors.

4.2 Fuzzy-micmac Analysis

This paper synthesized the FUZZY-MICMAC method to analyze the 16 influencing factor s of middle-aged and older people's pseudo-health information screening ability. individual pe rsonality, professional knowledge, education level, personal experience, advertising content, inf ormation completeness, information source, matching degree, supporting channels, and networ k environment had higher driving force and weaker dependence; article title, article opinion, article professional knowledge, expert The article title, article opinion, article expertise, expert s' recommendation, and others' opinions have stronger reliance and lower driving force. Amo ng them, "personal experience" and "education level" are the strongest drivers, and personal knowledge and experience will influence self-judgment and perception of information, which is the key to improving information screening ability.

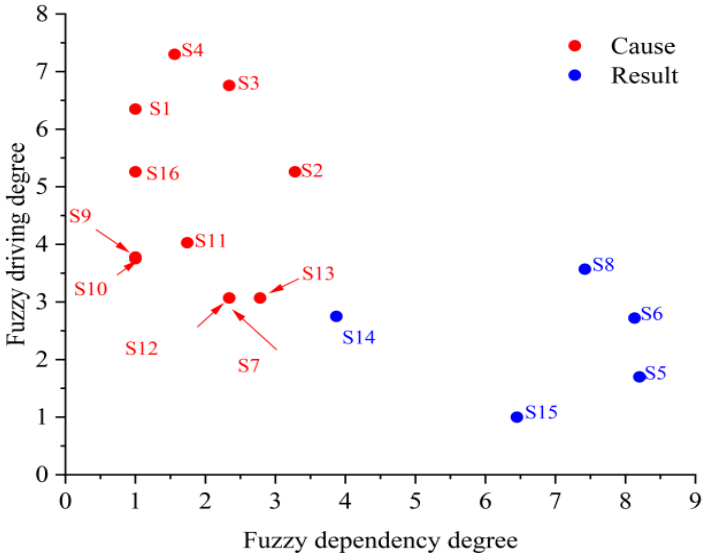

Figure 4. Fuzzy MICMAC diagram.

5. Suggestion

(1) They are cultivating Information Literacy and Improving Discernment Ability. Research results collectively show that middle-aged and older adults' own experiences and literacy lev els are fundamental and key to improving information screening abilities. Middle-aged and ol der adults should be aware of their thinking limitations, overestimate their own knowledge le vel and ability to understand health information and increase their rational judgment when fa cing health information to avoid misleading personal emotions. They should also focus on i mproving their online information literacy and enhancing their skills of retrieving, understandi

ng, and evaluating health information in social media, such as checking information sources and comparing data from different sources to actively understand the real health information.

(2) Authoritative voice and broaden the channels of reliable information sources. Middle-aged and elderly people lack professional knowledge, are confined to inert thinking, and tend to judge information authenticity through information disseminators' reliability. Expert authority can serve as a highly credible information disseminator, which is an essential driving force to improve the information screening ability of middle-aged and older adults. Expert authorities can be producers of health information and correctors of pseudo-health information. Therefore, we should encourage high influencers to speak out on multiple platforms to disseminate beneficial health information and increase the channels for middle-aged and older adults to obtain health information.

(3)Building unsupervised pseudo-health information identification mechanism. As shown in the topology diagram of confrontation hierarchy, article titles and article views are factors that directly affect the ability of middle-aged and older adults to screen pseudo-health information, so public platforms such as WeChat build a filtering mechanism to automatically identify pseudo-health information based on the title and viewpoint characteristics of articles, combined with machine learning and text mining technologies, in order to limit the spread of pseudo-health information and establish a healthy information environment.

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