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Understanding health literacy for cancer prevention and care: A community-based study in rural Southwest China

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Abstract: Cancer remains a leading cause of mortality globally, with rural populations disproportionately affected due to limited access to healthcare services and inadequate health literacy. In China, although urban cancer incidence is higher, rural residents experience significantly higher mortality rates, reflecting disparities in early detection, treatment engagement, and health information access. This study aimed to assess the level of health literacy related to cancer prevention and treatment among rural middle-aged and older adults in northern Guizhou Province, China, and to examine variations in literacy across demographic groups. A quantitative descriptive design was employed involving 200 rural residents aged 40–75 from Zunyi City. Data were collected using a general demographic questionnaire and the validated 37-item Cancer Health Literacy Scale for Chinese Residents. Descriptive statistics were used to determine literacy levels, while Mann-Whitney U and Kruskal-Wallis tests assessed differences across demographic variables. Findings revealed intermediate levels of literacy in cancer awareness (M = 55.7), coping ability (M = 50.8), and healthy behavior beliefs (M = 48.8), with an overall score of 51.8. Treatment-related literacy also scored at intermediate levels for available information and resources, but access to healthcare professionals was low (M = 7.26). Significant differences were found by age, education level, and income ($p < .05$), whereas gender, marital status, family size, and current health status showed no significant variation. The study highlights moderate but uneven health literacy among rural aging populations, with critical gaps in behavioral beliefs and professional healthcare access. Health literacy is shaped by structural factors such as education and income, underscoring the need for equity-driven, community-based interventions. Strengthening culturally responsive health education and healthcare infrastructure is essential to reduce rural cancer disparities in China.

Keywords: *Cancer prevention, Cancer treatment, Early detection, Guizhou province, Health disparities, Health literacy, Health promotion model, Middle-aged and older adults, Patient empowerment, Rural health.*

1. Introduction

Cancer remains one of the leading causes of mortality in the United States and elsewhere around the world [1] with rural populations disproportionately affected due to disparities in access, education, and healthcare utilization [2]. In China, while urban cancer incidence is higher, mortality rates are significantly elevated among rural residents [3] underscoring a critical gap in early detection, prevention, and timely treatment. As national and global cancer burdens escalate, health literacy has emerged as a crucial determinant in promoting health-seeking behaviors, improving treatment adherence, and empowering individuals to make informed decisions regarding their well-being [4].

Health literacy, particularly in the context of cancer, involves individuals' capacity to access, understand, appraise, and apply health-related information to make sound judgments [5]. Not limited to cancer, health literacy discrepancies have been frequently related to even vaccine hesitancy [6] birth

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control [7] and even community health service participation and utilization [8, 9]. While, the growing awareness of cancer risk factors, screening guidelines, early symptom recognition, and coping strategies during illness [10]. Prior studies have demonstrated that low health literacy correlates with decreased participation in preventive practices, such as screenings and lifestyle adjustments, and delayed treatment seeking behavior [11] factors that contribute to the poor prognosis and increased burden in underprivileged communities [12].

In Guizhou Province, one of China's less developed and economically disadvantaged regions, rural middle-aged and older adults face structural barriers to healthcare access and education [13]. Many residents delay seeking medical attention until symptoms become severe, missing opportunities for early intervention. Against this backdrop, the present study examines the current status of health literacy related to cancer prevention and treatment among rural populations in northern Guizhou. It seeks to provide empirical evidence to guide public health strategies and interventions aimed at reducing cancer-related health disparities in rural China.

This study integrates Nola Pender's Health Promotion Model (HPM) [14] and the National Assessment of Adult Literacy (NAAL) Framework [15, 16] to explore health literacy in cancer prevention and treatment. Pender's HPM emphasizes the dynamic interplay between personal beliefs, perceived self-efficacy, and social support in influencing health-promoting behaviors. It highlights how cognitive and emotional factors shape individuals' engagement with health information. Complementing this, the NAAL framework offers a structured view of adult literacy in health contexts, categorizing tasks into clinical, preventive, and navigational domains across home, workplace, and community settings. Together, these models underscore the need to contextualize cancer literacy within individual, cultural, and systemic factors, particularly for aging populations in resource-limited rural settings.

The study addresses a critical gap in understanding health literacy among aging rural populations in China, a demographic that is especially vulnerable to delayed cancer detection and poor treatment outcomes. By identifying specific literacy domains where knowledge and access are limited, such as awareness, coping, and behavioral practices, this research provides actionable insights for designing tailored public health interventions. The findings will not only inform local health education and policy initiatives in Guizhou but also contribute to the global discourse on reducing rural health inequities through culturally and contextually relevant literacy frameworks. Ultimately, it aims to promote early intervention and improve survival outcomes in cancer care for underserved populations.

Specific research objectives (RO) are as follows:

- To describe the demographic profile of rural middle-aged and older adults in northern Guizhou in terms of age, gender, marital status, education, family structure, income, and current health status.
- To assess the level of health literacy related to cancer prevention in the domains of cancer awareness, cancer coping ability, and healthy behavior beliefs.
- To examine the health literacy level in cancer treatment, including the availability and access to information, resources, and healthcare professionals in the community.
- To determine whether significant differences in cancer prevention health literacy exist across demographic subgroups based on age, gender, education, marital status, and family members and income.

2. Literature Review

Global and National Burden of Cancer – As noted earlier, cancer is one of the leading cause of death globally and presents a significant burden to healthcare systems worldwide [1]. According to GLOBOCAN 2020 estimates, there were 19.3 million new cancer cases and approximately 10 million cancer-related deaths globally in that year [17]. Notably, Asia accounted for 49.3% of new cases and 58.3% of deaths, with China contributing 23.7% of global incidence and 30.2% of cancer mortality [18]. In China, cancer has become a leading cause of mortality, with an alarming disparity between

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urban and rural populations [3]. Although incidence rates are higher in urban areas, rural communities suffer significantly higher mortality rates due to delayed diagnoses and limited access to healthcare services.

Age as a Risk Factor and Cancer Incidence among Older Adults - Advancing age is the most critical risk factor for most cancers. Incidence rates escalate with age, reaching over 1,000 per 100,000 individuals among those aged 60 years and above [19]. In China, cancer incidence among individuals aged over 40 is particularly high, with recent statistics indicating standardized incidence rates of 209.61 per 100,000 for men and 197.03 per 100,000 for women [20]. Middle-aged and older adults, thus represent a priority demographic for cancer prevention efforts. Moreover, age-related physiological and cognitive changes can influence health behavior and decision-making [21]. Older adults often face challenges in accessing or processing complex health information, particularly in resource-limited rural settings [22]. This vulnerability is further compounded by socioeconomic factors such as low education levels, limited income, and reduced mobility, which restrict access to preventive health services and screenings. Consequently, many older adults are diagnosed at more advanced stages of cancer, where treatment options are limited, and prognosis is poor [23].

Health Literacy and Its Role in Cancer Prevention and Control - Health literacy, to reiterate is defined as the capacity to obtain, process, and understand basic health information and services for informed health decisions, is a critical determinant of cancer outcomes [5]. Health literacy directly influences awareness of cancer risk factors, early screening participation, treatment adherence, and self-management abilities, making it central to cancer prevention and control efforts [24, 25] . Despite its importance, global levels of health literacy remain suboptimal. Nearly half of the adult populations in Europe demonstrate inadequate health literacy [26]. In China, national surveys highlight substantial improvement, but also persistent challenges for national health literacy. Between 2008 and 2020, the overall proportion of the Chinese population with adequate health literacy rose from 6.48% to 23.15% [27]. Nevertheless, disparities remain stark; urban residents outperform rural counterparts, and eastern regions show significantly higher health literacy levels than central and western areas. Factors such as age, educational attainment, and regional socioeconomic development are closely associated with these disparities.

To address this public health concern, China has begun adopting a comprehensive, multi-level strategy based on the social ecosystem theory, which emphasizes the interplay between individuals and their broader social and institutional environments. National efforts now advocate a "*whole-of-society*" approach to improving health literacy, integrating government initiatives, healthcare providers, community resources, and family support systems [28]. This ecosystem-based model is especially relevant in rural settings, where limited access to healthcare services and educational infrastructure presents unique barriers to improving cancer-related health literacy.

Health Literacy Disparities in Rural China - China's multi-tiered approach to cancer prevention, including vaccination, early screening programs, and health education, has yielded limited benefits for rural populations [29]. Economic constraints, migratory labor patterns, and limited health infrastructure contribute to low awareness and screening rates in rural areas [30]. Consequently, many rural residents are diagnosed at advanced stages, resulting in high mortality [31]. Guizhou Province, located in China's southwest and characterized by economic underdevelopment, exhibits one of the lowest health literacy rates in the country. Studies show that the province lags behind national averages in both general and cancer-specific health literacy [13]. Rural residents in this region are particularly vulnerable due to limited educational attainment, low income, and lack of access to healthcare services [32].

Assessment Tools for Cancer Health Literacy - A variety of tools have been developed to measure health literacy. The most widely recognized include the "*Rapid Estimate of Adult Literacy in Medicine (REALM)*" [33] and the "*Test of Functional Health Literacy in Adults (TOFHLA)*" [34]. More specific instruments for cancer include the Cancer Literacy Score (CLS) [35] Cancer Message Literacy Tests (CMLT-Listening and CMLT-Reading) [36] and scales developed in China such as the "*Survey of*

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Health Literacy for Cancer Prevention and Control of Urban Residents" by Shi, et al. [37]. In addition, Liu, et al. [38] developed a comprehensive "*Resident Cancer Health Literacy Scale*" tailored to the Chinese context. This 37 items scale evaluates three dimensions: cancer awareness, coping ability, and health behavior beliefs. The instrument has demonstrated strong reliability and validity (Cronbach [39] α = .86), and is particularly suitable for assessing the knowledge and practices of rural Chinese residents.

Synthesis and Research Gaps - The reviewed literature highlights a critical gap in the understanding of cancer-related health literacy among rural populations in China, especially in economically disadvantaged regions such as Guizhou. While national and international tools exist to measure general health literacy, there remains a lack of localized, culturally appropriate assessments focused specifically on cancer prevention and treatment. Furthermore, most existing studies concentrate on urban populations or general chronic disease literacy, with limited focus on older adults in rural communities. To address these gaps, the present study is guided by Pender, et al. [14] and the NAAL framework. These models emphasize the dynamic interaction between individual perceptions, sociocultural contexts, and systemic factors influencing health behaviors. In alignment with these theoretical underpinnings, this research aims to explore the health literacy status of rural middle-aged and older adults in northern Guizhou Province; focusing on their knowledge, coping abilities, access to information, and engagement with preventive and treatment behaviors. The study's findings are expected to inform the development of contextually appropriate health interventions and public health policies that promote early cancer detection, diagnosis, and treatment in underserved rural communities.

3. Methods

3.1. Study Design

This study employed a quantitative descriptive research design to assess the level of cancer health literacy among rural middle-aged and older adults. Descriptive research is primarily used to systematically describe characteristics or conditions of a population, relying on data collection and analysis to present an accurate picture of current trends or behaviors [40]. In this context, it was used to document the demographic profile and health literacy levels of the target population. A structured survey method was adopted, which allowed the researchers to collect data using standardized questionnaires [41]. This method is particularly effective for obtaining large volumes of data efficiently and systematically, especially in community settings. While surveys are susceptible to self-report bias, they remain one of the most practical tools for assessing knowledge, attitudes, and behaviors in public health research [42].

3.2. Participants

The study targeted middle-aged and older adults aged 40 to 75 residing in rural areas of Zunyi City, Guizhou Province, China. Inclusion criteria were as follows: (1) aged 40–75 years; (2) permanent residents of rural areas; (3) physically and mentally healthy enough to respond to the questionnaire; (4) at least primary school education; (5) able to hear and comprehend the questions; and (6) provided signed informed consent. Individuals under 40 or over 75, not residing in rural areas, or with significant hearing or cognitive impairments were excluded. Dawo Village in Shenxi Town, one of the eight major villages in Zunyi City, was selected for convenience sampling. According to the statistics, the average population of each village is approximately 100,000. Using G*Power [43] 3.1.9.7, the required sample size was calculated as 200 participants (medium effect size, 80% power, α = .05), which was achieved during the data collection phase from October to November 2024.

Table 1 presents the demographic characteristics of the 200 rural middle-aged and older adults who participated in the study. The majority of respondents (72.0%) were between 40 and 64 years old, while 28.0% were aged 65 and above. In terms of gender, 55.5% were female and 44.5% were male. Most participants were married (68.5%), followed by divorced (16.5%), widowed (12.5%), cohabitating (2.0%), and single (0.5%). Regarding educational attainment, 45.0% had completed primary school, 36.0% had

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attended primary high school, 13.0% had reached junior high school or technical school level, and only 6.0% had completed junior college or university. Household size varied, with 41.5% of participants living in five-person households, 26.5% in households with six or more members, 12.5% with four members, 10.0% with three, and 9.5% with two. Annual family income showed wide variation: 28.5% reported earning between 40,001 and 60,000 RMB, followed by 24.0% earning 60,001 to 80,000 RMB, 17.5% with income between 80,001 and 100,000 RMB, 16.5% earning between 20,001 and 40,000 RMB, 8.5% earning 20,000 RMB or less, and 5.0% earning 100,000 RMB or more. Finally, 85.5% of participants had never been diagnosed with cancer, while 9.0% had a past history of cancer, and 5.5% were currently suffering from the disease.

Table 1.
Demographic Background of Participants ($N = 200$).

Demographic	**Category**	***n***	***%***
Age Group	40 to 64 years old	144	72.0
	65 years old and above	56	28.0
Gender	Female	111	55.5
	Male	89	44.5
Marital Status	Single	1	0.5
	Cohabitation	4	2.0
	Married	137	68.5
	Divorced	33	16.5
	Widow	25	12.5
Education Level	Primary School	90	45.0
	Primary High School	72	36.0
	Junior High School/Technical School	26	13.0
	Junior College/University	12	6.0
Family Members	2 persons	19	9.5
	3 persons	20	10.0
	4 persons	25	12.5
	5 persons	83	41.5
	≥6 persons	53	26.5
Annual Family Income	Less than or Equal to 20,000 RMB	17	8.5
	20,001 to 40,000 RMB	33	16.5
	40,001 to 60,000 RMB	57	28.5
	60,001 to 80,000 RMB	48	24.0
	80,001 to 100,000 RMB	35	17.5
	More than or equal to 100,000 RMB	10	5.0
Current Health Status	Never been diagnosed with cancer	171	85.5
	Ever had cancer	18	9.0
	Current suffering from cancer	11	5.5

Note: 1 RMB is approximately around 0.14 US Dollar.

3.3. Instruments

Two instruments were used in the study:

- General Information Questionnaire – Developed by the research team, this tool gathered demographic data, including gender, age, marital status, education level, number of family members, annual household income, and current health status.
- Cancer Health Literacy Scale for Chinese Residents – Developed and validated by Liu, et al. [38] this scale comprises 37 items across three dimensions:
- Cancer Awareness (17 items across 4 factors)
- Cancer Coping Ability (13 items across 4 factors)
- Health Behavior Beliefs (7 items across 2 factors)

Each item uses a 5-point Likert [44] scale ranging from 1 ("strongly disagree") to 5 ("strongly agree"). Scores were converted to a standardized 100-point scale using the formula: Standardized Score

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= ((Raw Score − 1) / 4) × 100. The scoring interpretation for the Cancer Health Literacy Scale followed the standardized system developed by Liu, et al. [38]. For the cancer awareness dimension, a score below 50 was considered low, scores between 50 and 85 were categorized as intermediate, and scores above 85 indicated high literacy. In the cancer coping ability dimension, scores below 50 were classified as low, 50 to 80 as intermediate, and above 80 as high. For the health behavior belief dimension, a score below 45 was considered low, 45 to 80 as intermediate, and above 80 as high. Lastly, for overall cancer health literacy, a score below 55 reflected low literacy, between 55 and 80 was intermediate, and above 80 was categorized as high. These score ranges were used to interpret participants' literacy levels across individual domains and overall. Lastly, the instrument demonstrated strong reliability: total scale Cronbach [39] $\alpha = .86$, with subscale α values ranging from .72 to .86.

3.4. Data Collection Procedure

Prior to data collection, ethical approval was obtained from the University of St. La Salle Research Ethics Review Office and the Affiliated Hospital of Zunyi Medical University. All field researchers were trained uniformly to ensure consistent administration of the survey. With the consent of local leaders, data were collected using convenience sampling at village markets and participants' homes. The research team traveled to the site using daily commuter transport. Questionnaires were administered face-to-face, with researchers assisting participants as needed, especially important given the relatively low education level of some respondents. Researchers explained unfamiliar terms to ensure accurate understanding. Appropriate health and safety protocols were followed, including mask-wearing, physical distancing, and hand hygiene. Completed paper questionnaires were securely stored in waterproof boxes, coded anonymously, and digitized using a spreadsheet software for analysis. A total of 200 valid questionnaires were collected over two visits. Each participant received a small token of appreciation for their time.

3.5. Data Analysis

Data were cleaned, coded, and analyzed using SPSS version 29.0. Descriptive statistics (frequencies, percentages, means, standard deviations; SD) were used to summarize demographic characteristics and health literacy levels (ROs 1–3). While, inferential statistics were used to examine group differences based on demographic variables (RO4). Since normality assumptions were not met, Mann-Whitney U tests and Kruskal-Wallis tests were applied [41]. All tests were two-tailed, and p-values $< .05$ were considered statistically significant.

3.6. Ethical Considerations

The study followed ethical guidelines based on principles of autonomy, confidentiality, justice, and informed consent. Participants were given clear, written information about the study in Chinese and provided signed consent prior to participation. Data were collected anonymously, no names, contact information, or addresses were recorded. Informed consent forms and survey responses were securely stored in the principal researcher's locked cabinet and encrypted files. All data will be destroyed two years after study completion. To ensure safety, researchers underwent training in fieldwork protocols and traveled via official routes. Participants could withdraw at any time without consequence.

4. Results and Discussions

For RO1, which sought to describe the demographic profile of rural middle-aged and older adults in northern Guizhou, has already been addressed in the Methodology Section and Table 1. To reiterate, the results established that the majority of participants were aged 40 to 64, predominantly female, married, with low-to-moderate educational attainment and income. These baseline characteristics provide essential context for interpreting participants' cancer health literacy levels.

RO2, which is to assess the level of health literacy related to cancer prevention in the domains of cancer awareness, cancer coping ability, and healthy behavior beliefs. Table 2 presents the mean scores and interpretations of participants' cancer-related health literacy across three domains. The mean score

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for cancer awareness was 55.7 (*SD* = 9.66), falling within the intermediate level. Cancer coping ability also registered at an intermediate level with a mean of 50.8 (*SD* = 12.2). The domain of healthy behavior beliefs yielded the lowest mean score among the three, at 48.8 (*SD* = 12.72), still interpreted as intermediate. The overall health literacy score was 51.8 (*SD* = 9.74), confirming that rural middle-aged and older adults in this region possess a moderate understanding of cancer prevention-related knowledge, self-regulation, and health behavior.

Table 2.
Literacy Level in terms of Cancer Awareness, Coping Ability, and Healthy Behavior Beliefs.

Variables	Mean	SD	Interpretation
Cancer Awareness	55.7	9.66	Intermediate
Cancer Coping Ability	50.8	12.2	Intermediate
Healthy Behavior Belief	48.8	12.72	Intermediate
Overall Health Literacy	51.8	9.74	Intermediate

Note: N = 200.

The findings for RO2 indicate that rural middle-aged and older adults in northern Guizhou possess intermediate levels of health literacy regarding cancer prevention, with healthy behavior beliefs being the weakest of the three domains. This pattern reflects a modest foundation of awareness and coping ability, but a limited integration of preventive behaviors into daily life. These results are consistent with national survey findings in China, which report overall low to moderate health literacy levels, particularly in rural areas [24, 27].

The intermediate awareness score suggests that public education campaigns may have some reach but are insufficiently deep or frequent to promote high-level understanding. Similarly, coping ability; critical for emotional regulation, communication, and navigating healthcare, is also only moderately developed, possibly due to limited exposure to health education and social support systems in rural communities. The relatively lower score in healthy behavior beliefs raises concerns. It reflects barriers in translating knowledge into practice, such as adopting healthy diets, physical activity, and screening behavior, which may be hindered by economic constraints, cultural attitudes, or lack of supportive infrastructure [28, 29].

From a theoretical standpoint, these findings align with Pender, et al. [14] which posits that personal beliefs and environmental factors shape health behaviors. In this study, moderate scores suggest a gap in self-efficacy and external support. Similarly, the NAAL framework [16] which underscores the importance of both preventive knowledge and the capacity to act; areas where participants remain vulnerable. In sum, while the population demonstrates foundational cancer literacy, there is a pressing need for community-based interventions that reinforce cancer risk reduction behaviors, empower individuals to take preventive actions, and enhance self-efficacy. Health educators and rural healthcare providers should consider incorporating behavior-change strategies that go beyond awareness, targeting motivation, confidence, and culturally adapted health practices.

For RO3, which is to examine the health literacy level in cancer treatment, including the availability and access to information, resources, and healthcare professionals in the community. Table 3 summarizes the participants' health literacy related to cancer treatment, focusing on their perceived access to information, resources, and professional support. The mean score for available information was 12.54 (*SD* = 2.45), and for available resources, 19.52 (*SD* = 2.87). Both fall within the intermediate level. However, the mean score for available healthcare professionals was notably lower at 7.26 (*SD* = 1.37), which corresponds to a low literacy level in this domain. These results suggest that while participants have moderate awareness of cancer-related information and physical or material resources, they face significant limitations in access to professional healthcare support in their rural communities.

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Table 3.
Literacy Level in terms of Available Information, Resources, and Health Care Professionals.

Variables	Mean	SD	Interpretation
Available Information	12.54	2.45	Intermediate
Available Resources	19.52	2.87	Intermediate
Available Healthcare Professional	7.26	1.37	Low

Note: N = 200.

The findings reveal a concerning gap in rural residents' access to cancer treatment-related healthcare support, particularly regarding the availability of professional guidance. While participants demonstrate intermediate awareness of cancer-related information and resources, potentially reflecting exposure to public campaigns or community materials, their low literacy score concerning healthcare professionals suggests systemic challenges in accessing medical personnel for cancer care. This lack of access may be attributed to understaffed rural clinics, long distances to healthcare facilities, or an overreliance on informal sources of information. In regions like northern Guizhou, where infrastructure is limited and economic development is relatively low, the availability of oncologists or even general practitioners trained in cancer-related care may be scarce [32]. This aligns with national reports that rural Chinese residents experience not only logistical but also financial and informational barriers to professional healthcare [30].

These findings echo the principles of the NAAL framework [16] particularly the navigational aspect of health literacy, which requires individuals to know where and how to seek care. Low scores in this area reflect not only limited patient empowerment but also system-level shortcomings in healthcare delivery. Furthermore, Pender, et al. [14] suggests that without adequate interpersonal and systemic support, like encouragement from healthcare professionals, individual motivation to act on health knowledge may wane. The lack of accessible professionals can thus demotivate residents from pursuing early screening or treatment, reinforcing a cycle of late diagnoses and poor outcomes. Improving this domain of literacy will require multi-level intervention. Local governments and healthcare systems must prioritize the equitable distribution of trained personnel and invest in mobile clinics or telehealth systems tailored to rural populations. In parallel, community health workers can serve as vital intermediaries, providing face-to-face support and building trust between residents and the formal healthcare system. In summary, while rural adults in northern Guizhou possess moderate cancer treatment knowledge and resource awareness, their limited access to healthcare professionals represents a critical gap that may undermine prevention and treatment efforts. Addressing this issue is essential to improving cancer outcomes and reducing rural-urban disparities in China's healthcare system.

Lastly, for RO5, which is to determine whether significant differences in cancer prevention health literacy exist across demographic subgroups based on age, education, and family income. To assess differences in cancer prevention health literacy across demographic variables, Mann-Whitney U and Kruskal-Wallis H tests were employed due to the non-normal distribution of the data. **Table 4** examined gender differences and found **no** statistically significant variation across prevention awareness (p = .496), early screening awareness (p = .474), and early treatment awareness (p = .414), indicating similar literacy levels between males and females.

Table 4.
Gender Differences in terms of Prevention, Early Screening, and Early Treatment Awareness.

Variables	Statistics	*p*-value	Interpretation
Prevention Awareness	4713	0.58	Not significant
Early Screening Awareness	4861	0.85	Not significant
Early Treatment Awareness	4763	0.66	Not significant

Note: N = 200.

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Table 5 revealed significant age-related differences. Participants aged 65 and older scored significantly higher in prevention awareness (U = 2210.5, $p < .001$), early screening awareness (U = 2053.5, $p < .001$), and early treatment awareness (U = 2764.5, $p = .014$) compared to their younger counterparts.

Table 5.
Age Group Differences in terms of Prevention, Early Screening, and Early Treatment Awareness.

Variables	Statistics	*p*-value	Interpretation
Prevention Awareness	2779	< 0.001	Highly significant
Early Screening Awareness	2741	<0.001	Highly significant
Early Treatment Awareness	3145	0.014	Significant

Note: N = 200.

Table 6 explored differences by marital status and found no significant differences across all three awareness domains (p-values > .05), suggesting marital status does not strongly influence cancer prevention literacy.

Table 6.
Marital Differences in terms of Prevention, Early Screening, and Early Treatment Awareness.

Variables	χ^2	*df*	*p*-value	Interpretation
Prevention Awareness	4.202	4	0.379	Not significant
Early Screening Awareness	0.896	4	0.925	Not significant
Early Treatment Awareness	5.414	4	0.247	Not significant

Note: N = 200.

Table 7 showed that different education levels significantly affected all three literacy domains: prevention awareness ($\chi^2 = 32.44$, $p < .001$), early screening awareness ($\chi^2 = 28.28$, $p < .001$), and early treatment awareness ($\chi^2 = 9.71$, $p = .021$), with higher education levels associated with greater awareness.

Table 7.
Educational Differences in terms of Prevention, Early Screening, and Early Treatment Awareness.

Variables	χ^2	*df*	*p*-value	Interpretation
Prevention Awareness	32.44	3	< 0.001	Highly significant
Early Screening Awareness	28.28	3	<0.001	Highly significant
Early Treatment Awareness	9.71	3	0.021	Significant

Note: N = 200.

Table 8 indicated that family size did not significantly influence prevention ($\chi^2 = 3.18$, $p = .528$), early screening ($\chi^2 = 6.18$, $p = .186$), or early treatment awareness ($\chi^2 = 2.63$, $p = .621$).

Table 8.
Family Size Differences in terms of Prevention, Early Screening, and Early Treatment Awareness.

Variables	χ^2	*df*	*p*-value	Interpretation
Prevention Awareness	3.06	4	0.548	Not significant
Early Screening Awareness	8.86	4	0.065	Not significant
Early Treatment Awareness	3.77	4	0.438	Not significant

Note: N = 200.

Table 9 revealed a significant effect of family income across all three domains: prevention awareness ($\chi^2 = 48.91$, $p < .001$), early screening awareness ($\chi^2 = 34.10$, $p < .001$), and early treatment awareness ($\chi^2 = 37.94$, $p < .001$). Participants with higher incomes demonstrated significantly better literacy in all areas.

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Table 9.
Income Differences in terms of Prevention, Early Screening, and Early Treatment Awareness.

Variables	χ^2	*df*	*p*-value	Interpretation
Prevention Awareness	35.0	5	< 0.001	Highly significant
Early Screening Awareness	28.3	5	< 0.001	Highly significant
Early Treatment Awareness	28.2	5	< 0.001	Highly significant

Note: N = 200.

Finally, Table 10 assessed current health status and found no significant differences across the awareness domains (*p*-values > .05), suggesting prior or current cancer diagnosis did not significantly impact literacy levels.

Table 10.
Health Differences in terms of Prevention, Early Screening, and Early Treatment Awareness.

Variables	χ^2	*df*	*p*-value	Interpretation
Prevention Awareness	1.245	2	0.537	Not significant
Early Screening Awareness	1.809	2	0.405	Not significant
Early Treatment Awareness	0.177	2	0.915	Not significant

Note: N = 200.

The findings for RO4 confirm that age, education level, and family income significantly influence cancer prevention-related health literacy among rural middle-aged and older adults in northern Guizhou. Specifically, older participants, those with higher educational attainment, and those from higher-income households demonstrated significantly higher levels of awareness in the domains of cancer prevention, early screening, and early treatment. These results are consistent with prior research emphasizing the strong link between socioeconomic status and health literacy [24, 25]. While, the positive correlation between age and awareness may reflect greater health consciousness among older adults, who are at higher risk for chronic illnesses, including cancer. Alternatively, it may indicate that individuals develop greater health awareness through cumulative life experiences or contact with health systems over time. However, it also highlights the need to engage younger middle-aged adults (40 to 59 years) earlier with targeted prevention strategies, as their lower scores suggest they may not yet be fully responsive to cancer education efforts.

Furthermore, the strong influence of education level supports existing evidence that formal schooling enhances one's ability to access, understand, and apply health information. Education cultivates essential skills such as reading comprehension, critical thinking, and self-directed learning; abilities that directly contribute to navigating complex medical information and systems. Similarly, higher family income was associated with better health literacy, likely due to increased access to resources such as internet connectivity, private health services, transportation to clinics, and time for proactive health behaviors. These structural advantages reinforce health equity concerns and signal the need for resource-sensitive education programs for low-income populations.

In contrast, no significant differences were found across gender, marital status, number of family members, or current health status. This suggests that in the studied rural context, social determinants such as income and education may exert more influence on health literacy than personal or household characteristics. These findings reinforce Pender, et al. [14] which emphasizes the role of prior learning and situational influences in shaping health-promoting behaviors, as well as the NAAL framework [16] which highlights the interaction between individual capacity and system-level accessibility. In summary, RO4 illustrates that demographic disparities in cancer health literacy are not random, but strongly shaped by structural inequalities. Interventions must be differentiated by age, education, and income, ensuring that vulnerable subgroups are not left behind in health promotion initiatives.

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5. Conclusions and Recommendations

This study investigated the status of cancer-related health literacy among rural middle-aged and older adults in northern Guizhou Province, China, using a validated literacy scale and a robust theoretical framework grounded in Nola Pender's Health Promotion Model and the NAAL framework. The findings revealed that participants demonstrated intermediate levels of health literacy across the domains of cancer awareness, coping ability, and healthy behavior beliefs. Similarly, treatment-related health literacy was moderate in terms of information and resource access but notably low in access to healthcare professionals. Importantly, statistically significant differences in health literacy were observed across age, education, and income levels, while no significant differences were found based on gender, marital status, family size, or current health condition. These results highlight both the strengths and vulnerabilities in the cancer literacy landscape of rural aging populations and underscore the critical need for equitable, targeted interventions that address underlying socioeconomic disparities.

Based on the findings, several recommendations are proposed to strengthen cancer prevention and treatment literacy in rural communities. First, tailored health education programs should be developed that not only raise awareness but also foster behavior change, especially in translating knowledge into daily health practices. These programs must be culturally appropriate, accessible regardless of literacy level, and delivered in local dialects when necessary. Second, community health initiatives should prioritize improving access to healthcare professionals through the expansion of rural medical teams, mobile clinics, and telehealth services. Third, policymakers and public health agencies should focus on socioeconomically disadvantaged groups; those with lower income and education, by providing subsidies, incentives, or community-based workshops that empower these individuals to participate in preventive screening and treatment. Lastly, integrating health literacy content into adult education and agricultural outreach programs may prove effective in reaching those who are traditionally underserved by the formal health system.

While the study offers valuable insights, several limitations must be acknowledged. First, the use of convenience sampling in one rural village limits the generalizability of the findings to other regions in Guizhou or rural China more broadly. Future studies should consider multi-site sampling across diverse rural communities to enhance representativeness. Second, the cross-sectional design restricts causal inference, as the relationships between demographic factors and health literacy cannot be conclusively established over time. Longitudinal research is recommended to assess how literacy evolves and responds to interventions. Third, self-reported data may be influenced by social desirability bias or misunderstanding of survey items despite researcher support during administration. Finally, the study focused exclusively on middle-aged and older adults; extending the investigation to include younger rural populations could offer a more comprehensive view of the intergenerational dynamics in cancer health literacy.

Institutional Review Board Statement:

The study was conducted in accordance with the Declaration of Helsinki. Study protocols were evaluated and approved by the panel of evaluators of the University of St. La Salle Graduate Program.

Transparency:

The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

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Conceptualization, M.Z., T.-A.B.L., and S.M.T.; methodology, M.Z., T.-A.B.L., and S.M.T.; software, G.S.C.; validation, M.Z., T.-A.B.L., S.M.T., and G.S.C.; formal analysis, M.Z.; investigation, M.Z., T.-A.B.L., S.M.T., and G.S.C.; resources, M.Z., T.-A.B.L., S.M.T., and G.S.C.; data curation, M.Z.; writing—original draft preparation, M.Z.; writing—review and editing, M.Z., T.-A.B.L., S.M.T., and G.S.C.; visualization, G.S.C.; supervision, T.-A.B.L. and S.M.T.; project administration, M.Z., T.-A.B.L., and S.M.T.; funding acquisition, M.Z., T.-A.B.L., S.M.T., and G.S.C. All authors have read and agreed to the published version of the manuscript.

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