Research Progress on Health Literacy in Lung Cancer Patients

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Abstract This article systematically reviews the research progress on health literacy in lung cancer patients, covering the core definition and multidimensional assessment system of health literacy, epidemiological characteristics, mechanisms of its impact on clinical outcomes and quality of life, as well as targeted intervention strategies. Research indicates that health literacy significantly improves patient prognosis through pathways such as enhancing treatment adherence, optimizing doctor-patient communication, and strengthening self-management capabilities. This review also points out that future research needs to focus on developing cross-cultural assessment tools, exploring neurocognitive mechanisms, integrating digital technologies, and promoting policy translation to address the new challenges in the era of chronic disease management for lung cancer.

Key words Lung cancer, Health literacy, Research progress

1 Introduction

Health literacy, defined as an individual's ability to obtain, understand, and apply health information to make reasonable health decisions, holds a core position in the field of cancer prevention and treatment[1]. Lung cancer, as the leading cause of cancer death in China, has approximately 820 000 new cases annually and causes up to 710 000 deaths, accounting for 23.8% of total cancer deaths[5-7]. With the transformation of lung cancer diagnosis and treatment models, especially breakthroughs in targeted therapy and immunotherapy, the five-year survival rate for advanced lung cancer patients has increased from 4.2% during 2004 - 2008 to 7.9% during 2015 - 2019. Furthermore, 60% of anaplastic lymphoma kinase (ALK)-positive patients achieve five-year progression-free survival after treatment with third-generation inhibitors, signifying that lung cancer is gradually entering an "era of chronic disease management"[2]. This trend increasingly highlights the importance of health literacy—it is not only crucial for the rationality of treatment decisions but also involves long-term symptom management, coping with adverse reactions, and maintaining quality of life. However, the current status of health literacy among lung cancer patients is not rosy. According to multiple studies[3], approximately 30% - 40% of patients have insufficient health literacy, making it difficult for them to understand treatment plans or medication instructions; this proportion is even higher among the elderly, those with low education levels, and rural populations. Deficiencies in health literacy not only lead to decreased treatment adherence but also exacerbate patients' psychological burden and financial toxicity[4]. Therefore, this review aims to systematically organize the research progress on health literacy in the field of lung cancer, providing evidence support for clinical interventions and policy formulation.

Received: April 13, 2025 Accepted: June 24, 2025
Supported by National Natural Science Foundation of China (71774049).
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2 Assessment tools and epidemiological characteristics of health literacy

2.1 Development of assessment tools The assessment tools for health literacy in lung cancer patients have evolved from early generic scales to lung cancer-specific modular tools. The most widely used currently include the following three categories (Table 1).

2.1.1 Functional assessment tool. The Brief Health Literacy Screen (BRIEF) focuses on measuring basic reading and numeracy skills, for example, understanding prescription dosages ("twice daily, 25 mg each time") or calculating chemotherapy cycles. This tool is time-efficient (< 5 min), suitable for rapid screening in outpatient settings, but cannot assess higher-order abilities[5].

2.1.2 Interactive assessment tool. The Cancer Health Literacy Test (CHLT) covers dimensions such as information acquisition, doctor-patient communication, and decision-making participation. Its advantage lies in capturing the patient's performance in dynamic healthcare interactions, for example, assessing whether the patient can accurately describe symptom changes to the doctor or understand the key content of informed consent documents[6].

2.1.3 Critical assessment tools. Emerging tools like the Health Insurance Literacy Measure (HILM) focus on complex skills such as cost management, interpretation of insurance terms, and healthcare rights advocacy. Studies have found that only 12% of patients can independently calculate the out-of-pocket costs for targeted drugs, while 42% have misunderstandings about the scope of medical insurance reimbursement[7].

2.2 Epidemiological characteristics The health literacy of lung cancer patients exhibits significant demographic differences and group distribution characteristics. A study of 376 lung cancer patients showed[12] that the total health literacy score (96.34 ± 19.57) points was positively correlated with social support (41.06 ± 9.28) points and self-efficacy (85.55 ± 19.36) points. However, scores were significantly below average among elderly patients (> 70 years old), those with low education levels (primary school or below), and rural patients. It is noteworthy that the health literacy

Table 1 Comparison of mainstream assessment tools for health literacy in lung cancer patients

Tool name	Core dimensions	Applicable scenarios	Sensitivity	Limitations
BRIEF[8]	Reading ability, numeracy (calculation ability)	Outpatient initial screening	0.82	Neglect communication and decision-making abilities
CHLT-30[9]	Information acquisition, doctor-patient communication, treatment decision-making	Inpatient assessment	0.91	Time (20 min)
HILM[10]	Cost understanding, insurance utilization, advocacy skills	Financial assistance counseling	0.79	Dependent on insurance system context
LLI[11]	Online health information appraisal, information authenticity judgment	Digital health education	0.75	Require network device support

of family caregivers is also crucial. A study in Ohio, USA found[13] that approximately 32.7% of 236 caregivers had limited health literacy (7.2% "inadequate", 25.5% "marginal"), which was significantly associated with low income (annual household income <30 000 yuan) ($\beta = 0.20$, $p = 0.009$). Such caregivers are more likely to misunderstand principles of analgesic use, leading to poor symptom control in patients. Group differences in health literacy directly impact clinical decision-making. For example, patients with low health literacy have a 27% lower rate of accepting genetic testing due to difficulties in understanding the value of targeted therapy; their willingness to participate in clinical trials decreases by 34%, mostly stemming from fear of randomization and placebo controls[14].

3 Impact mechanisms of health literacy on lung cancer patients

3.1 Impact on clinical outcomes Health literacy influences the quality of survival and disease progression in lung cancer patients through multiple mediating pathways. Structural equation modeling reveals[15] that health literacy not only has a direct effect on quality of life (effect size 0.347) but also an indirect effect mediated through social support and self-efficacy (effect size 0.135), with the total effect ranking highest among all factors.

Specific pathways of action include:

(i) Treatment Adherence Pathway: Patients with high health literacy have a more accurate understanding of treatment plans; adherence to oral targeted drugs reaches 92% in this group, compared to only 76% in the low-literacy group; the error rate in dosage adjustment (5%) is significantly lower in the former than in the latter (28%). (ii) Symptom Management Pathway: Patients who can correctly use Patient-Reported Outcome (PRO) tools have a 40% higher rate of timely symptom reporting, enabling earlier intervention windows for adverse reactions such as nausea and dyspnea. (iii) Survival Benefit Pathway: Among ALK-positive patients, the 5-year progression-free survival rate (68%) in the high-health-literacy group is higher than in the low-literacy group (52%), due to earlier recognition of signs of brain metastasis and subsequent medication adjustments.

3.2 Psychological and social adaptation Insufficient health literacy is prone to inducing "information overload anxiety", particularly in the newly diagnosed stage. Research shows[16] that social support partially mediates the buffering effect of health literacy on psychological stress: when the health literacy score is >100, the risk of depression in patients decreases by 40%, but this effect weakens in those who live alone or have low social support. The digital divide exacerbates the gap in psychological adaptation. "Drifting elderly" (elderly migrants following their children) have a 65% failure rate in online follow-up appointment bookings due to insufficient digital skills, leading to strong feelings of incompetence; moreover, children's "over-support" (*e.g.*, making appointments for them) further undermines their autonomy, reducing self-efficacy by 19%.

3.3 Moderating role of economic burden Health insurance literacy (HIL), as a sub-dimension of health literacy, directly determines patients' ability to effectively utilize insurance resources. Studies have found[17]:

(i) The out-of-pocket cost proportion for patients with low HIL is as high as 42%, approximately 1.8 times that of the high HIL group (23%), due to underutilization of medical assistance or charitable drug donation programs. (ii) The virtual navigation intervention (HINT program), through five insurance education sessions, increased patients' correct understanding of deductibles and out-of-pocket maximums by 55% and reduced financial toxicity scores by 30%.

4 Intervention research and application practices for health literacy

4.1 Interventions at the individual and family level

4.1.1 Health coach program. Shanghai Chest Hospital implemented a "Doctor-Patient Partnership" model, training nurses to serve as health coaches who use the "teach-back" method to verify patient understanding (Table 2). For example, when teaching EGFR-mutant patients to recognize symptoms of interstitial pneumonia, they are asked to restate key warning signs, reducing the misunderstanding rate from 35% to 12%[18].

4.1.2 Family caregiver empowerment. Structured educational courses for caregivers (covering medication management, symptom recording, and psychological support skills) led to a 25% reduction in their anxiety scores ($p = 0.001$), alleviated caregiving burden, and simultaneously improved patients' quality of life scores by 18%.

4.2 Integration at the community and hospital level

4.2.1 Digital health ecosystem. Hangzhou communities built an "online-offline mutual assistance network", with offline smart terminal learning points staffed by volunteers guiding the elderly in operating appointment systems; a dialect-based medication reminder mini-program was developed online, increasing the follow-up rate of elderly rural patients to 85%[19].

4.2.2 Peer patient navigator system. Beijing Cancer Hospital recruited patients in recovery to serve as navigators, sharing "cancer journey diaries" and cost management experiences. After matching newly diagnosed patients with navigators, their confidence scores in treatment decision-making increased from 54 to 78 points ($p<0.01$)[20].

4.3 Policy and social support innovation

4.3.1 Health insurance navigation project. The HINT II study enhanced health insurance literacy through two modes: synchronous courses (HINT-S) and asynchronous videos (HINT-A). Preliminary data showed a 40% decrease in medical insurance complaint rates and a 33% reduction in overdue medical debts in the intervention group[21].

4.3.2 Lung Cancer Chronic Disease Management Kit. It incorporates the Agency for Healthcare Research and Quality Toolkit (AHRQ Toolkit), requiring drug package inserts to be written at or below a 6th-grade reading level and includes QR codes linked to video explanations[22].

Table 2 Evidence level and effectiveness of health literacy intervention strategies for lung cancer patients

Intervention type	Representative project	Target population	Core measures	Evidence level	Effectiveness indicators
Individualized education[23]	Doctor-patient partnership	Newly diagnosed patients	Teach-back method, decision aids	1A	Adherence ↑28%
Family empowerment[23]	Caregiver skills training	Family caregivers	Symptom recognition, psychological support skills	2B	Caregiver burden ↓25%
Digital inclusion[24]	Cross-generational digital mentoring (youth assisting elderly)	Elderly patients	One-on-one coaching by child volunteers	3C	Appointment booking success rate ↑65%
Policy support[25]	Health insurance navigation services	Economically disadvantaged individuals	Insurance policy interpretation, financial assistance application	1B	Out-of-pocket costs ↓30%

5 Challenges and future directions

5.1 Existing challenges

5.1.1 Methodological limitations. Existing studies predominantly rely on cross-sectional designs, making it difficult to establish a causal chain between health literacy and survival rates. For instance, whether health literacy improves survival rates by prolonging the duration of targeted drug use still requires verification through prospective cohort studies.

5.1.2 Digital health inequality. The advancement of smart healthcare may exacerbate health disparities. Only 32% of elderly patients can independently use health apps, and children's "digital substitution" (doing it for them) actually accelerates the decline of their abilities[26].

5.1.3 Insufficient translational research. The coverage of community intervention programs (*e. g.*, intergenerational learning stations) is insufficient and lacking in rural areas, primarily due to a lack of supportive medical insurance payment policies.

5.2 Cutting-edge development directions

5.2.1 Exploration of neurocognitive mechanisms. The fMRI technology is employed to analyze the neural basis of health literacy. Preliminary research found that individuals with high health literacy exhibit stronger activation in the prefrontal cortex when comprehending medical information, suggesting the involvement of executive functions in decision-making.

5.2.2 Integration of intelligent technologies. AI health assistant is adapted to different literacy levels. For example, a ChatGPT plugin converts chemotherapy precautions into dialect speech and dynamically adjusts information density based on cognitive load.

5.2.3 Whole-cycle health literacy management. The literacy assessment is integrated into the entire lung cancer diagnosis and treatment process: screening literacy levels at initial diagnosis, matching education programs during treatment, and reinforcing self-management during rehabilitation. There is a need to develop dynamic monitoring systems and early warning feedback mechanisms.

6 Conclusions

Health literacy in lung cancer patients has evolved from a simple "ability to understand information" into a comprehensive construct encompassing medical decision-making, financial planning, and digital adaptability. Research demonstrates that health literacy significantly improves quality of life and survival prognosis through multiple pathways, including enhancing treatment adherence, optimizing doctor-patient communication, and strengthening self-management capabilities. Especially as lung cancer enters a new era of chronic disease management, health literacy has become a core skill for achieving the goal of "living with cancer".

Future research needs to focus on resolving three major contradictions: balancing technological empowerment with humanistic care (avoiding digitalization exacerbating the marginalization of the elderly), coordinating individual responsibility with social support (*e. g.*, subsidy policies for low-income family caregivers), and translating evidence-based interventions into real-world implementation (sustainability of community programs).

The following action strategies are recommended:

(i) Implementing Tiered Interventions: It is necessary to classify patients into "self-management type", "support-dependent type", and "full-assistance type" based on baseline assessments, and match them with differentiated education programs. (ii) Building a "Doctor – Patient Community": It is necessary to incorporate health literacy into indicators for shared decision-making between doctors and patients, encouraging patient participation in developing treatment plans. (iii) Ensuring Policy Implementation: It is necessary to integrate health literacy interventions into DRG-

based payment reforms and reward hospitals that meet standards with medical insurance surplus incentives.

Only through the synergistic interaction of individual empowerment, technological innovation, and institutional safeguards (a trifecta approach) can the ultimate vision of "health literacy equity" be realized in the era of lung cancer as a chronic disease.

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