



MIND THE GAP: LUNG CANCER KNOWLEDGE, PERCEIVED RISK, AND SYMPTOM LITERACY AMONG SUBURBAN RESIDENTS IN YOGYAKARTA, INDONESIA

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Abstract

Lung cancer is a major contributor to mortality worldwide, yet late-stage diagnoses remain frequent due to inadequate public knowledge. This study aimed to assess lung cancer awareness, perceived risks, and symptom recognition among suburban residents in Yogyakarta, Indonesia, to provide data for public health initiatives. The research utilized a cross-sectional design, enrolling 100 individuals aged 18 to 80 from the Kasihan 1 Community Health Center area through consecutive sampling. Participants were given a validated questionnaire regarding their knowledge of lung cancer, its risk factors, and associated symptoms. Descriptive statistical analysis revealed that 63% had moderate knowledge, 22% exhibited good knowledge, and 15% showed poor knowledge. While 76% recognized lung cancer, 55% incorrectly considered it rare, and only 35% were informed about early screening opportunities. Participants demonstrated a strong awareness of active smoking (85%) and passive smoke exposure (82%), yet displayed limited knowledge of environmental carcinogens such as asbestos (35%) and genetic risks (49%). Most could identify key symptoms like shortness of breath (77%), chronic cough (76%), and chest pain (70%). The results highlight significant gaps in understanding non-tobacco-related risks and preventive measures, influenced by socioeconomic factors and local lifestyle habits. Overall, suburban residents show critical blind spots regarding non-behavioral risks for lung cancer, underscoring the need for enhanced primary care education and subsidized screening programs to promote early detection.

Keywords: Early Detection, Health Literacy, Lung Cancer, Risk Perception, Suburban Population; Symptom Recognition



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INTRODUCTION

Cancer drives global mortality, accounting for an estimated 9.6 million deaths annually (Siegel et al., 2025). Lung cancer is the most commonly diagnosed cancer and the leading cause of cancer-related death worldwide. Asia accounts for approximately 60% of newly diagnosed lung cancer cases and 62% of lung cancer deaths worldwide, highlighting the substantial burden of lung cancer in the region (Filho., 2025; GLOBOCAN., 2022). Despite advances in diagnosis and treatment, survival remains poor because most patients are diagnosed at advanced stages when curative treatment is no longer feasible (Gorría et al., 2026; Hall et al., 2022). Although tobacco smoking remains the predominant global risk factor, emerging epidemiological evidence reveals a rising incidence among never-smokers, particularly Asian women (Ko et al., 2020; Siegel et al., 2025). Studies across East Asia indicate that nearly one-third of patients have never smoked, underscoring the contribution of genetic susceptibility and environmental or occupational exposures, including biomass smoke, pesticides, and asbestos, to lung carcinogenesis (Ko et al., 2020; Lam et al., 2023).

Recent national and regional health data indicate that the Special Region of Yogyakarta continues to experience a substantial cancer burden, underscoring the need for strengthened cancer prevention, early detection, and treatment services (Ministry of Health of the Republic of Indonesia., 2024). At the local level, only 50% of households in the Kasihan 1 Community Health Center catchment area meet the Clean and Healthy Living Behavior (CHLB) indicators (Bantul Regency Health Office, 2022). These findings suggest behavioral and environmental vulnerabilities that may increase exposure to modifiable lung cancer risk factors. Although many lung cancer risk factors are preventable, public awareness remains limited. Poor recognition of warning symptoms, misconceptions about personal susceptibility, and low awareness of screening frequently delay healthcare-seeking behavior and contribute to advanced-stage diagnosis (Alsuhim et al., 2025; Feng et al., 2024; Ko et al., 2020; Ma et al., 2023; Rehman et al., 2025; Ryan et al., 2025; Shachar et al., 2024). Effective lung cancer awareness includes recognition of warning symptoms, understanding of modifiable and non-modifiable risk factors, and awareness of early detection opportunities, all of which influence timely healthcare utilization and participation in screening programs (Bardaweel et al., 2026; Carter-Bawa et al., 2025; Ryan et al., 2025; Yousef et al., 2026).

Previous studies have investigated lung cancer awareness, risk perception, and barriers to lung cancer screening in broader regional populations or among high-risk groups in Malaysia, Jordan, Saudi Arabia, and other Asian countries (Alsuhim et al., 2025; Bardaweel et al., 2026; C. Li et al., 2023; Nyanti et al., 2023; Yousef et al., 2026; Yusof et al., 2022), evidence describing these dimensions simultaneously within suburban Indonesian communities remains scarce. Few studies have comprehensively evaluated general lung cancer knowledge, perceptions of tobacco- and non-tobacco-related risk factors, recognition of warning symptoms, and awareness of early detection opportunities within a primary healthcare setting. Addressing this gap is important because community knowledge and perceptions influence help-seeking behavior, screening acceptance, and participation in preventive health programs. Therefore, locally relevant evidence is essential for designing culturally appropriate educational strategies and strengthening early detection initiatives in primary healthcare (Gorría et al., 2026; Rehman et al., 2025).

Accordingly, this study evaluated lung cancer knowledge, perceptions of tobacco- and non-tobacco-related risks, symptom recognition, and awareness of early detection among residents in the Kasihan 1 Community Health Center catchment area, Yogyakarta, Indonesia. This study provides an integrated assessment of these dimensions within a suburban Indonesian primary healthcare setting, generating locally relevant baseline evidence to inform targeted lung cancer education and early detection strategies. By examining misconceptions related to environmental carcinogens, genetic susceptibility, symptom recognition, and screening awareness, this study provides context-specific evidence that may inform targeted community

education, strengthen early detection initiatives, and support implementation of the Indonesian National Cancer Plan 2024–2034 (Ministry of Health of the Republic of Indonesia., 2024).

RESEARCH METHOD

Research Design

This study employed a descriptive, cross-sectional observational design to evaluate community knowledge, perceived risk, and symptom awareness regarding lung cancer within the working area of the Kasihan 1 Community Health Center, Bantul Regency, Yogyakarta. The cross-sectional approach captured a snapshot of population awareness and perceptions at a single point in time (Sastroasmoro & Ismael, 2014). The Research Ethics Committee of the Faculty of Medicine and Health Sciences, Universitas Muhammadiyah Yogyakarta, officially approved the study protocol (No: 166/KEP-FKIK-UMY/V/2024). Investigators obtained written informed consent from all participants before enrollment, ensuring that participation remained completely voluntary, confidential, and anonymous.

Research Target/Subject

The target population comprised residents living within the administrative jurisdiction of the Kasihan 1 Community Health Center. Eligible participants included health center visitors aged 18–80 years who provided informed consent. The study excluded individuals residing outside the health center's service area or those who declined to participate. To determine the minimum required sample size, investigators applied Slovin's formula with a 10% margin of error based on an accessible population of 1,700 individuals, yielding a target sample of 94 respondents. Ultimately, the study enrolled 100 participants using a consecutive sampling method, recruiting all eligible individuals encountered during the study period until the target sample was achieved.

Research Procedure

The research team administered the questionnaire digitally via Google Forms using electronic tablets available at the health center's waiting area. Prospective respondents received a concise brief outlining the study's scope, objectives, and ethical safeguards. Participants provided electronic informed consent before accessing the questionnaire items. Participation remained entirely voluntary and anonymous, generating primary data obtained directly from the target population.

Instruments, and Data Collection Techniques

Data collection utilized a structured questionnaire developed to measure three primary domains: (1) general knowledge regarding lung cancer, (2) knowledge of lung cancer risk factors, and (3) knowledge of clinical symptoms or signs. The items utilized a dichotomous (Yes/No) response format based on the Guttman scale to ensure clear categorization. Public health experts and oncology specialists validated the instrument content, confirming its reliability and validity. To ensure analytical accuracy, researchers reverse-scored negative items during data processing. Table 1 outlines the complete item formulation across the three domains.

Data Analysis Technique

Data were analyzed using descriptive statistics. Frequencies and percentages were calculated to summarize respondents' sociodemographic characteristics and their knowledge of lung cancer, risk factors, symptoms, and early detection. Knowledge levels were also descriptively stratified by age, sex, educational attainment, and monthly household income and presented in tables and figures. No inferential statistical tests were performed; therefore,

subgroup differences were interpreted as descriptive patterns only, without claims of statistical significance or association.

Table 1. Questionnaire Items for Evaluating Lung Cancer Awareness

Domain	Item Formulations
General Knowledge	1. Have you ever heard about lung cancer?
	2. Do you think lung cancer is a rare disease in the community?
	3. Do you know the common signs and symptoms of lung cancer?
	4. Have you ever heard about a screening or early detection program for lung cancer?
Risk Factors	5. Smoking increases the risk of developing lung cancer.
	6. Inhaling cigarette smoke at the workplace or at home increases the likelihood of lung cancer.
	7. Having a family member with a history of lung cancer increases one's risk.
	8. Consuming more fruits and vegetables can prevent lung cancer.
	9. Regular exercise cannot reduce the likelihood of developing lung cancer. (<i>Reverse-scored</i>)
	10. Kitchen smoke or factory emissions are not related to lung cancer incidence. (<i>Reverse-scored</i>)
	11. Using asbestos as a ceiling material does not increase lung cancer risk. (<i>Reverse-scored</i>)
	12. Anxiety and stress are not associated with the occurrence of lung cancer. (<i>Reverse-scored</i>)
	13. Coffee consumption is not related to the incidence of lung cancer. (<i>Reverse-scored</i>)
	14. A history of asthma or chronic lung disease is not related to lung cancer. (<i>Reverse-scored</i>)
Symptoms & Signs	15. In your opinion, is coughing a symptom/sign of lung cancer?
	16. In your opinion, is chest pain a symptom/sign of lung cancer?
	17. In your opinion, is shortness of breath a symptom/sign of lung cancer?

RESULTS AND DISCUSSION

Study Area Description

This study took place within the administrative boundaries of the Kasihan 1 Community Health Center, which oversees Bangunjiwo and Tamantirto Villages in the Kasihan Subdistrict, Bantul Regency, Special Region of Yogyakarta. The Kasihan subdistrict encompasses approximately 3,238 hectares and features a mixed topography of lowlands and hills, blending agricultural zones with expanding suburban residential developments, and is geographically situated between 110°20'40" East Longitude and 7°48'42" South Latitude. The subdistrict has an estimated population of 122,323, predominantly in the young, productive age bracket (20–29 years). Socioeconomically, the community is low- to middle-income; most residents work as farmers or small-scale traders, reflecting modest living conditions and constrained access to specialized healthcare services.

Sociodemographic Characteristics

The sociodemographic characteristics of respondents provide essential context for interpreting their knowledge, perceptions, and awareness of lung cancer. Table 2 summarizes the demographic and socioeconomic profiles of the cohort (N = 100), displaying variables such as gender, age, education, household income, and Body Mass Index (BMI). Therefore, it

provides a foundation for understanding variations in health literacy and preventive behavior related to lung cancer.

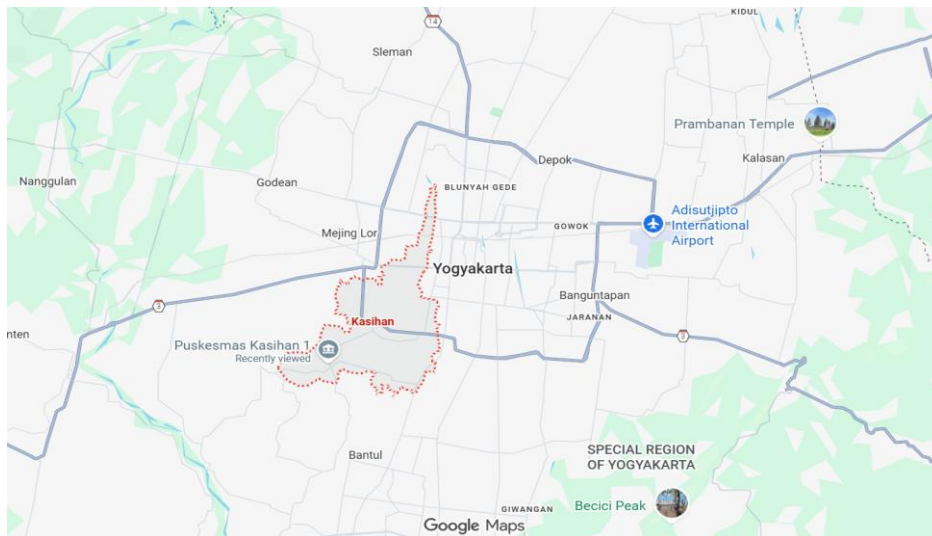


Figure 1. Geographical Mapping of the Kasihan Subdistrict, Illustrating its Administrative Boundaries and Proximity to Major Landmarks in the Yogyakarta Special Region

Table 2. Description of Respondents' Characteristics

Characteristics	Frequency (n)	Percentage (%)
Gender		
Male	41	41%
Female	59	59%
Age Group (years)		
<40	67	67%
40–60	24	24%
>60	9	9%
Educational Level		
No formal education	2	2%
Kindergarten–Elementary–Junior High School	21	21%
Senior High School	24	24%
Higher Education (University/College)	53	53%
Monthly Income (IDR)		
< 2,000,000	45	45%
2,000,000 – 5,000,000	39	39%
> 5,000,000	16	16%
Body Mass Index (BMI)		
< 18.5 (Underweight)	26	26%
18.5 – 22.9 (Normal)	25	25%
23 – 24.9 (Overweight)	14	14%
25 – 29.9 (Obese I)	24	24%
≥ 30 (Obese II)	11	11%

The sample predominantly comprised females (59%) and individuals within the core productive age group of 20–40 years (65%). Regarding educational background, 53% of

respondents had completed higher education. Financially, 45% of households earned less than IDR 2,000,000 per month, reflecting a low-income distribution. In terms of nutritional status, 49% of the respondents fell into the above-normal BMI category. The study population consists of productive-age females with moderate-to-high education and low-to-middle income levels. These characteristics are likely to influence the community's health literacy, perceived risk, and awareness regarding lung cancer prevention.

Knowledge of Lung Cancer

Respondents' knowledge regarding lung cancer was categorized into three domains: general knowledge, knowledge of risk factors, and knowledge of symptoms. Descriptive analysis of overall lung cancer literacy revealed that 63% of respondents had moderate knowledge, 22% had good knowledge, and 15% had poor knowledge.

3.1. General Knowledge about Lung Cancer

Although a clear majority of respondents (76%) had heard of lung cancer, significant misconceptions emerged regarding its epidemiological impact; 55% of the cohort erroneously perceived lung cancer as a rare disease within the community. Furthermore, only 49% could correctly identify its primary symptoms, and a mere 35% expressed familiarity with existing lung cancer screening or early detection programs.

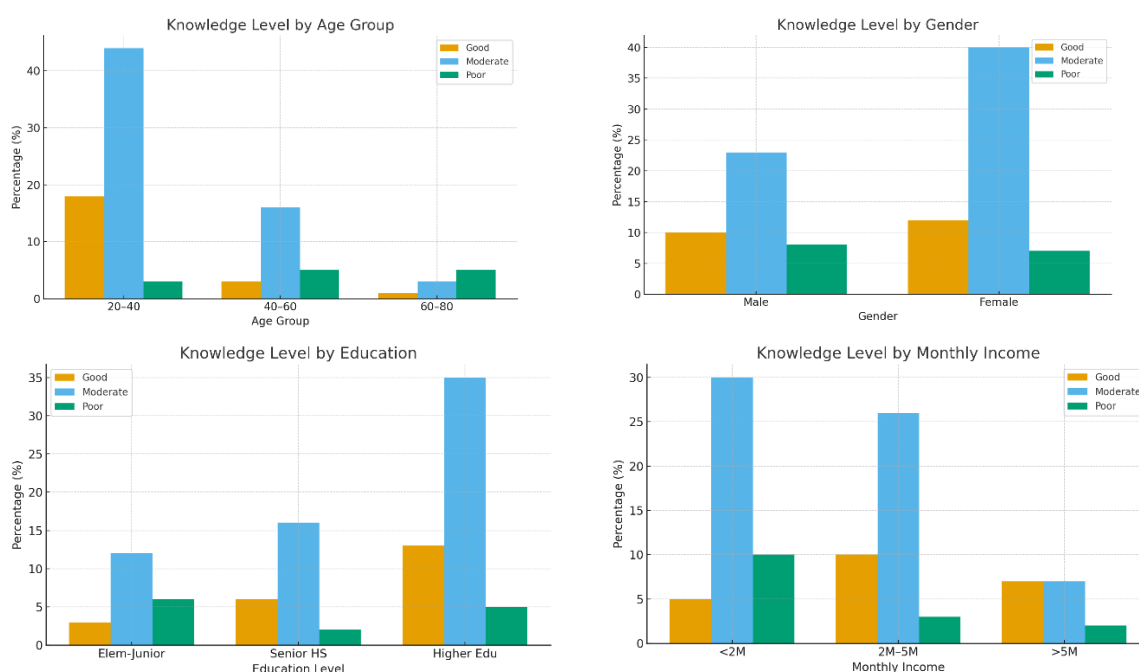


Figure 2. Descriptive Distribution of Lung Cancer Knowledge Levels Within Sociodemographic Subgroups According to: (1) Age Group, (2) Gender, (3) Educational Attainment, and (4) Monthly Household Income. Bars Represent Within-Subgroup Percentages, and No Inferential Comparisons Were Performed

Knowledge about Lung Cancer Risk Factors

The cohort demonstrated robust awareness regarding conventional behavioral risks; 85% correctly identified active smoking, and 82% identified passive smoke exposure as a major risk factor. In contrast, awareness regarding non-tobacco environmental and biological risks was substantially lower: only 49% recognized genetic predisposition, 49% recognized ambient air pollution, and merely 35% identified occupational asbestos exposure as carcinogenic. Additionally, distinct misconceptions persisted; many respondents incorrectly viewed psychological stress (38%), coffee consumption (40%), and a clinical history of asthma or chronic lung disease (41%) as direct causal factors for lung cancer.

Knowledge about Symptoms or Signs of Lung Cancer

Respondents displayed relatively high literacy regarding classical clinical manifestations. Chronic cough was correctly identified by 76%, chest pain by 70%, and shortness of breath by 77% of the sample. Nevertheless, approximately one-fifth of the respondents remained uncertain about these cardinal red-flag signs, highlighting critical gaps in symptom recognition.

Figure 2 presents the descriptive distribution of lung cancer knowledge levels across age, gender, educational attainment, and monthly household income groups. Moderate knowledge was the most frequently observed category in most subgroups. Descriptively, poor knowledge appeared more common among older and lower-income respondents, whereas good knowledge appeared relatively more frequent among respondents in the highest-income category. These variations were not evaluated using inferential statistical tests and should therefore not be interpreted as statistically significant differences.

This study evaluated community knowledge, perceived risk, and symptom recognition, and awareness of early detection for lung cancer among residents of a suburban population in Yogyakarta. Although most respondents demonstrated a moderate level of general knowledge, substantial gaps remained in their understanding of lung cancer epidemiology, environmental occupational risk factors, and opportunities for early detection. These findings are consistent with community-based studies conducted across Southeast Asia and the Middle East, which have similarly reported that while adults generally possess basic awareness of lung cancer, important deficiencies persist in their understanding of risk factors, warning symptoms, and preventive practices (Jaferian et al., 2025; Mohammed et al., 2026; Ryan et al., 2025; Yousef et al., 2026); Yusof et al., 2022).

Participants demonstrated high awareness of tobacco smoking as the principal driver of lung cancer, aligning with extensive global and Asian epidemiological data (Ma et al., 2023; Yang, 2024). However, the data expose severe deficits regarding non-smoking etiologies, particularly occupational exposures, indoor air pollution, biomass smoke, asbestos, and hereditary factors (Bujang et al., 2024; Ko et al., 2020; Urrutia-Pereira1 et al., 2023). These findings support growing evidence that the burden of lung cancer among never-smokers, particularly Asian women, is increasingly driven by environmental and genetic determinants that remain underrepresented in public health messaging (Bray et al., 2021; Ko et al., 2020; Lam et al., 2023). Similar misconceptions have been reported among high-risk populations in Malaysia, where awareness of environmental carcinogens and eligibility for lung cancer screening remained limited despite adequate recognition of smoking-related risks (Nyanti et al., 2023). Comparable deficiencies in recognizing environmental and occupational carcinogens have also been observed in Canadian community populations, suggesting that public understanding continues to focus predominantly on tobacco while underestimating other established lung cancer risk factors (Walker et al., 2010). This pattern is further supported by evidence indicating that individuals generally perceive tobacco-related risks more readily than other determinants of lung cancer, which may influence preventive behaviours and screening intentions (Lei, 2025).

The present study also identified descriptive differences in knowledge across sociodemographic groups. Younger respondents appeared to demonstrate greater familiarity with several classical symptoms, whereas older adults and lower household incomes showed greater uncertainty regarding lung cancer prevention, screening, and several knowledge domains. Similar patterns have been described in previous studies, which suggest that educational attainment, socioeconomic status, and access to health information influence cancer-related knowledge and preventive behaviours (Alsuheim et al., 2025; Bardaweel et al., 2026; Yusof et al., 2022). Health Belief Theory likewise proposes that perceived susceptibility and perceived benefits play important roles in determining willingness to participate in lung cancer screening (Lei et al., 2022). However, because the present study was limited to descriptive statistics and did not include inferential analyses, these subgroup differences should

not be interpreted as statistically significant associations or independent sociodemographic effects. Rather, they represent descriptive patterns that require confirmation through future studies employing appropriate inferential analyses, including chi-square tests and multivariable regression models.

The observed knowledge gaps are likely influenced not only by individual sociodemographic characteristics but also by broader community health behaviours. Within the Kasihan 1 Community Health Center catchment area, only half of households meet the Clean and Healthy Living Behaviour (CHLB) standards established by local health authorities (Bantul Regency Health Office, 2022). This relatively low level of compliance reflects broader behavioural and environmental vulnerabilities, including inadequate health-seeking behaviour, continued exposure to domestic biomass smoke, and limited engagement with preventive healthcare (Bantul Regency Health Office, 2022; Asmara et al., 2023). These findings are consistent with evidence demonstrating that modifiable lifestyle behaviours substantially influence respiratory health and chronic disease prevention (Agienko et al., 2024). Furthermore, inadequate physical activity may contribute to reduced respiratory function by limiting improvements in forced vital capacity (FVC) and forced expiratory volume (FEV1), thereby increasing susceptibility to chronic respiratory disease (Daswara et al., 2024). Accordingly, international recommendations emphasize integrating behavioural interventions with environmental risk reduction and early detection strategies to strengthen lung cancer prevention (Gorría et al., 2026).

Consistent with these observations, respondents demonstrated limited recognition of several environmental and occupational carcinogens, including industrial emissions, kitchen smoke, and asbestos-containing building materials. Similar deficiencies have been documented in community-based studies from Malaysia, Jordan, and multiethnic populations, indicating that public education continues to emphasize tobacco smoking while giving comparatively little attention to environmental carcinogens (Bujang et al., 2024; Nyanti et al., 2023; Yousef et al., 2026). Comparable misconceptions have also been reported across West Asian and North African countries, suggesting that inadequate awareness of environmental risk factors represents a broader international public health challenge rather than a problem unique to Southeast Asia (Mohammed et al., 2026; Yang, 2024). In Indonesia, these knowledge gaps may be further compounded by the country's high tuberculosis burden, where persistent cough and other respiratory symptoms are frequently attributed to infectious diseases rather than suspected malignancy, thereby delaying appropriate oncological evaluation and referral (Simanjuntak et al., 2025).

Awareness of lung cancer screening was also limited, with only a minority of respondents recognizing the availability of early detection services. Similar findings have been reported in community-based studies from the United States, Jordan, Malaysia, and China, Hong Kong, where limited knowledge of low-dose computed tomography (LDCT), uncertainty regarding screening eligibility, and misconceptions about the benefits of screening reduced both willingness to undergo screening and overall screening acceptance (Bardaweel et al., 2026; R. Li et al., 2022; Nyanti et al., 2023; Pitrou et al., 2025; Rogova et al., 2025; Ryan et al., 2025; Zhong et al., 2026). This interpretation is further supported by a recent systematic review demonstrating that interventions aimed at improving lung cancer awareness, encouraging timely help-seeking, and promoting early detection can substantially improve public engagement with lung cancer prevention and screening programmes (Saab et al., 2021). Collectively, these barriers create a double burden by reducing participation in preventive services while simultaneously delaying diagnosis. Taken together, these findings indicate that improving knowledge alone is insufficient; increasing perceived benefits, reducing misconceptions, and strengthening perceived susceptibility are equally important for promoting screening participation. This interpretation is supported by the Health Belief Model, which identifies perceived susceptibility and perceived benefits as key determinants of preventive

health behaviours, including lung cancer screening (Li et al., 2023). Accordingly, community-based educational interventions integrated with smoking cessation programmes have been recommended as effective strategies for improving lung cancer screening uptake, particularly among underserved populations (Li et al., 2023).

Overall, these findings highlight the need for comprehensive community-based interventions that integrate health education, environmental risk reduction, and promotion of healthy lifestyles. Improving compliance with Clean and Healthy Living Behaviour (CHLB) programmes may simultaneously enhance lung cancer literacy and reduce exposure to preventable carcinogenic factors (Kemenkes RI, 2019). Nevertheless, improving public awareness alone is unlikely to be sufficient. Effective implementation of lung cancer screening also depends on healthcare professionals who possess adequate knowledge, confidence, and communication skills to educate communities and appropriately recommend screening (Carter-Bawa et al., 2023). Similar integrated public health approaches combining smoking cessation, community education, and healthcare provider engagement have demonstrated encouraging improvements in community participation in lung cancer screening programmes (Hillyer et al., 2020).

Study Limitations

This study has certain limitations that merit acknowledgment. First, the sample size is relatively small and drawn from a single suburban health center, which limits the immediate generalizability of the findings to broader populations. Second, the cross-sectional design captures data at only one point in time, preventing any causal inferences regarding changes in health literacy. Finally, the reliance on self-reported questionnaire data introduces potential risks of recall or social desirability bias.

Despite these limitations, this study provides valuable, localized baseline evidence regarding community-level lung cancer awareness in suburban Indonesia. Strengthening primary care-based education and expanding access to subsidized screening initiatives could bridge these critical knowledge gaps and ultimately improve lung cancer clinical outcomes in similar suburban communities.

CONCLUSION

Residents of the Kasihan 1 Community Health Center area demonstrated a moderate level of knowledge about lung cancer. Although awareness of tobacco-related risks was relatively high, important gaps remained regarding environmental carcinogens, genetic susceptibility, warning symptoms, and early detection opportunities. These findings indicate the need for culturally appropriate, primary care-based education that emphasizes both tobacco- and non-tobacco-related risks, promotes timely recognition of persistent respiratory symptoms, and provides clear information on available referral and early detection services. In practice, the Kasihan 1 Community Health Center may incorporate these topics into routine counseling, community outreach, and health-promotion activities involving community health workers and locally relevant educational materials. Such interventions may help improve risk awareness, reduce misconceptions, and encourage earlier health-seeking behavior among suburban residents.

DECLARATION OF AI AND AI ASSISTED TECHNOLOGIES IN THE WRITING PROCESS

During the preparation of this work the authors used Google Gemini (OpenAI) exclusively for language editing, translation, and improving the clarity and readability of the text. PubMed was used to support the literature search and identification of relevant studies.

After using this tool/service, the author(s) reviewed and edited the content as needed and take(s) full responsibility for the content of the publication.

AUTHOR CONTRIBUTIONS

Author 1: Conceptualisation; Project administration; Validation; Writing - review and editing.

Author 2: Formal analysis; Methodology; Data curation; Investigation.

Author 3: Supervision; Validation.

DECLARATION OF COMPETING INTEREST

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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