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Original article

Association between Traditional and Electronic Cigarette Smoking Behaviors and Lung Cancer among Men: A Cross-Sectional Comparative Study

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ABSTRACT

Tobacco smoking is the principal modifiable cause of lung cancer, with risk rising in proportion to the duration and intensity of exposure, yet comparative data on smoking behaviors and their clinical correlates remain limited in many regional settings. A questionnaire-based cross-sectional study was conducted in Benghazi, Libya, enrolling 197 men in three groups: 30 patients with diagnosed lung cancer, 122 traditional cigarette smokers, and 45 electronic cigarette users; the sample was restricted to men because tobacco use among women in this setting is very low. Two self-administered structured questionnaires captured demographic characteristics, smoking behavior, respiratory symptoms, diagnostic history, and attitudes toward smoking, and categorical associations were assessed using the chi-square test, with significance set at $P < 0.05$. Among lung cancer patients, 93.3% reported a smoking history before diagnosis, and 23.3% reported a family history of the disease. Among the 122 traditional cigarette smokers, the most common smoking duration was 5–10 years (30.3%), and 80.3% smoked at least ten cigarettes per day, comprising 49.2% in the 10–20 per day band and 31.1% smoking more than 20 per day. Electronic cigarette users were younger, with 66.7% aged 20 to 29 years, a mean use duration of 2.23 years, and 82.2% using the device more than ten times daily; concurrent use of other tobacco products, mainly waterpipe, was reported by 71.1% of them. Reported respiratory symptoms were most frequent among patients and least frequent among electronic cigarette users, with shortness of breath reported by 43.3% of patients, 18.9% of traditional smokers, and 15.6% of electronic cigarette users. Age was significantly associated with smoking duration among both traditional cigarette and electronic cigarette users ($P < 0.001$). The high prevalence of prior smoking among diagnosed patients is consistent with tobacco as the dominant correlate of lung cancer in this male sample, and the frequent, poly-tobacco electronic cigarette use concentrated among young adults, accompanied by a measurable respiratory symptom burden, does not support the perception of these products as harmless. Age-specific prevention and earlier diagnostic engagement are warranted; the cross-sectional design precludes causal or quantitative risk inference.

Introduction

Lung cancer is the most frequently diagnosed cancer and the leading cause of cancer death worldwide, accounting for an estimated 2.5 million new cases (12.4% of all cancers) and 1.8 million deaths in 2022 [1]. Tobacco smoking accounts for the large majority of cases. Cigarette smoke contains more than 60 established carcinogens, including tobacco-specific nitrosamines and polycyclic aromatic hydrocarbons, which form DNA adducts and induce the mutations that drive malignant transformation in bronchial epithelium [2]. The relationship is dose dependent, and cohort data indicate no threshold below which smoking carries no excess risk: even consistent consumption of fewer than one cigarette per day is associated with markedly elevated lung cancer mortality relative to never-smoking [3]. These features make smoking behavior the single most informative exposure to characterize in any lung cancer population.

Over the past decade, electronic cigarettes have entered the market as a purportedly lower-risk substitute and have been adopted rapidly, particularly by adolescents and young adults [4,5]. Users frequently cite reduced harm, flavor, and the ability to use the product in smoke-free settings as reasons for uptake [6]. The supporting evidence is still developing. Reports of respiratory symptoms among users, together with a tendency toward concurrent use of conventional cigarettes and waterpipe, raise the possibility that the perceived safety of these devices is not matched by their physiological effects [7,8].

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The causal role of tobacco in lung carcinogenesis is among the most firmly established relationships in epidemiology. Hecht described the mechanistic basis: cigarette smoke delivers more than 60 carcinogens, of which tobacco-specific nitrosamines, polycyclic aromatic hydrocarbons, and aromatic amines are metabolically activated to form DNA adducts, producing the somatic mutations that initiate and sustain tumor growth [2], and combustible tobacco is estimated to account for the large majority of lung cancer cases [9]. The exposure-response gradient is steep and continuous: in the National Institutes of Health-AARP cohort of approximately 290,000 adults, lifelong smokers of fewer than one cigarette per day had about nine times the risk of lung cancer death of never-smokers, and those smoking one to ten per day had nearly twelve times the risk [3].

Electronic cigarettes generate an inhalable aerosol from a nicotine-containing liquid and have been promoted as a reduced-harm alternative to combustible tobacco, yet the evidence on their pulmonary effects is more equivocal than that framing implies [10]. The aerosol is not inert: it contains volatile carbonyls, reactive oxygen species, and metals such as nickel, lead, and chromium, several of which are toxic to lung tissue [11]. The 2019 outbreak of e-cigarette or vaping use-associated lung injury demonstrated an acute hazard, and current knowledge is insufficient to establish that the respiratory effects of these products are smaller than those of conventional cigarettes [10]. Proponents argue that, for established smokers who switch completely, these products are substantially less harmful and may aid cessation [7,12]. In contrast, rapid uptake among adolescents and young adults, many of whom are never-smokers, has prompted a precautionary stance [4,5,13].

Exposure to tobacco smoke is not confined to the smoker. In a meta-analysis of 97 epidemiological studies, second-hand smoke was estimated to raise lung cancer risk among never-smokers by approximately 24% overall (pooled relative risk 1.24), with higher estimates for workplace exposure (relative risk 1.38), and a risk that increased with the duration and intensity of exposure [14]. Globally, second-hand smoke has been estimated to cause more than 600,000 deaths each year [15]. Waterpipe smoking, common across North Africa and the Middle East, is associated with lung cancer and respiratory disease and exposes the user to the same classes of toxicants as cigarettes, so concurrent or poly-tobacco use may add exposure rather than replace it [16].

Most of this evidence originates in high-income Western populations. Comparatively little has been reported on how traditional and electronic smoking behaviors differ within a single regional sample, how their respiratory symptom profiles compare, or how attitudes and diagnostic engagement vary across diagnosed patients, traditional smokers, and electronic cigarette users; patterns of poly-tobacco use and the demographic concentration of electronic cigarette use in such settings are likewise not well documented. This study addresses that gap by examining these dimensions in a single setting, describing the distribution of smoking intensity and duration, the prevalence of reported respiratory symptoms, and the associations between age and educational level and smoking patterns.

Materials and Methods

Study Design and Setting

This descriptive cross-sectional comparative study was conducted in Benghazi, Libya, between February and June 2025. Lung cancer patients were recruited from the oncology department of Benghazi Medical Center, while traditional cigarette smokers and electronic cigarette users were recruited from outpatient clinics and public settings in the city. The study compared three predefined groups: patients with a confirmed diagnosis of lung cancer, current traditional cigarette smokers, and current electronic cigarette users.

Participants and Sampling

A total of 197 men were enrolled: 30 lung cancer patients, 122 traditional cigarette smokers, and 45 electronic cigarette users. The sample was restricted to men because tobacco use among women in Libya is very low, so a male sampling frame reflects the population of tobacco users in this setting [17]. Traditional cigarette smokers and electronic cigarette users were enrolled by convenience sampling from outpatient clinics and public settings, whereas lung cancer patients were recruited consecutively from the oncology department of Benghazi Medical Center after a confirmed diagnosis.

For the two smoker groups, eligibility required male sex, residence in Benghazi, age 18 years or older, current tobacco use, and willingness to complete the questionnaire; participants with incomplete responses were excluded. Eligibility for the patient group was based on a confirmed lung cancer diagnosis rather than tobacco use, which is why a small number of patients reported no smoking history. Because some participants used more than one product, group membership was assigned according to each participant's predominant tobacco-use behavior during the preceding year. No formal sample size or power calculation was performed; the sample size reflects the number of eligible participants available during the study period.

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Data Collection Instrument

Data were collected using two structured, self-administered questionnaires in Arabic: one for traditional cigarette smokers and lung cancer patients, and one for electronic cigarette users. Both instruments shared four sections, covering general demographic information (age, marital status, educational level); smoking behavior (status, duration, daily quantity, location, and concurrent use of other tobacco products); health and lung-cancer-related items (physical activity, diagnosis, family history, respiratory symptoms, and diagnostic tests undergone); and awareness of and attitudes toward smoking and lung cancer. The electronic cigarette version additionally asked about reasons for choosing the device. The demographic, health, symptom, and awareness items were common to both instruments, allowing comparison across groups; respiratory-symptom and contributing-factor items permitted multiple responses.

The questionnaires were adapted from previously published studies and modified to suit the aim of this research. Content validity was assessed by three subject-matter experts, and the instruments were pilot-tested with 15 participants. The first page stated the study aim and the voluntary, anonymous nature of participation, and no personal identifiers were recorded. Completion required approximately 10 to 15 minutes. Data were collected by four trained students from the Faculty of Biomedical Sciences under supervision; they were instructed on the study aims, ethical considerations, participant selection, and questionnaire handling, and did not influence responses. All participants provided informed consent before completing the questionnaire.

Statistical Analysis

Categorical variables were summarized as frequencies and percentages, and means with standard deviations were derived for smoking duration and daily quantity. Associations between categorical variables were tested using the Pearson chi-square test, with statistical significance set at $P < 0.05$. Data were entered in Microsoft Excel 2019 and analyzed using IBM SPSS Statistics version 26.0. Where the assumptions of the chi-square test were not met because expected cell counts were below five, the corresponding results should be interpreted with caution and confirmed using the Fisher's exact test.

Ethical Considerations

Ethical approval was obtained from the Research Ethics Committee of the Faculty of Biomedical Sciences, University of Benghazi (approval reference NBC:008. H.25.05, dated 29 January 2025). Informed consent was obtained from all participants, and responses were anonymized and used solely for research purposes.

Results

Participant Characteristics

The 197 men comprised 30 lung cancer patients, 122 traditional cigarette smokers, and 45 electronic cigarette users. The three groups differed markedly in age. Lung cancer patients were concentrated in the 50-years-and-above category (66.7%), whereas electronic cigarette users were predominantly aged 20 to 29 years (66.7%) and were absent from the 40-and-above categories. Traditional smokers were most common in the 20-to-29 group (42.6%) but were distributed across all age bands. All lung cancer patients were married, while single individuals predominated among electronic cigarette users (82.2%). University education was most prevalent among electronic cigarette users (57.8%); no electronic cigarette user was illiterate or held a postgraduate qualification (Table 1; Figure 1).

Table 1. Demographic characteristics by group, n (%) (N = 197)

Characteristic	Patients (n=30)	Traditional (n=122)	E-cigarette (n=45)	Total (n=197)
Age, < 20 y	0 (0.0)	14 (11.5)	8 (17.8)	22 (11.2)
20–29 y	0 (0.0)	52 (42.6)	30 (66.7)	82 (41.6)
30–39 y	5 (16.7)	21 (17.2)	7 (15.6)	33 (16.8)
40–49 y	5 (16.7)	13 (10.7)	0 (0.0)	18 (9.1)
≥ 50 y	20 (66.7)	22 (18.0)	0 (0.0)	42 (21.3)
Marital, Single	0 (0.0)	64 (52.5)	37 (82.2)	101 (51.3)
Married	30 (100.0)	55 (45.1)	7 (15.6)	92 (46.7)
Divorced	0 (0.0)	1 (0.8)	1 (2.2)	2 (1.0)
Widowed	0 (0.0)	2 (1.6)	0 (0.0)	2 (1.0)

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Characteristic	Patients (n=30)	Traditional (n=122)	E-cigarette (n=45)	Total (n=197)
Education, Illiterate	2 (6.7)	6 (4.9)	0 (0.0)	8 (4.1)
Intermediate	9 (30.0)	27 (22.1)	5 (11.1)	41 (20.8)
High school	8 (26.7)	35 (28.7)	14 (31.1)	57 (28.9)
University	9 (30.0)	46 (37.7)	26 (57.8)	81 (41.1)
Postgraduate	2 (6.7)	8 (6.6)	0 (0.0)	10 (5.1)

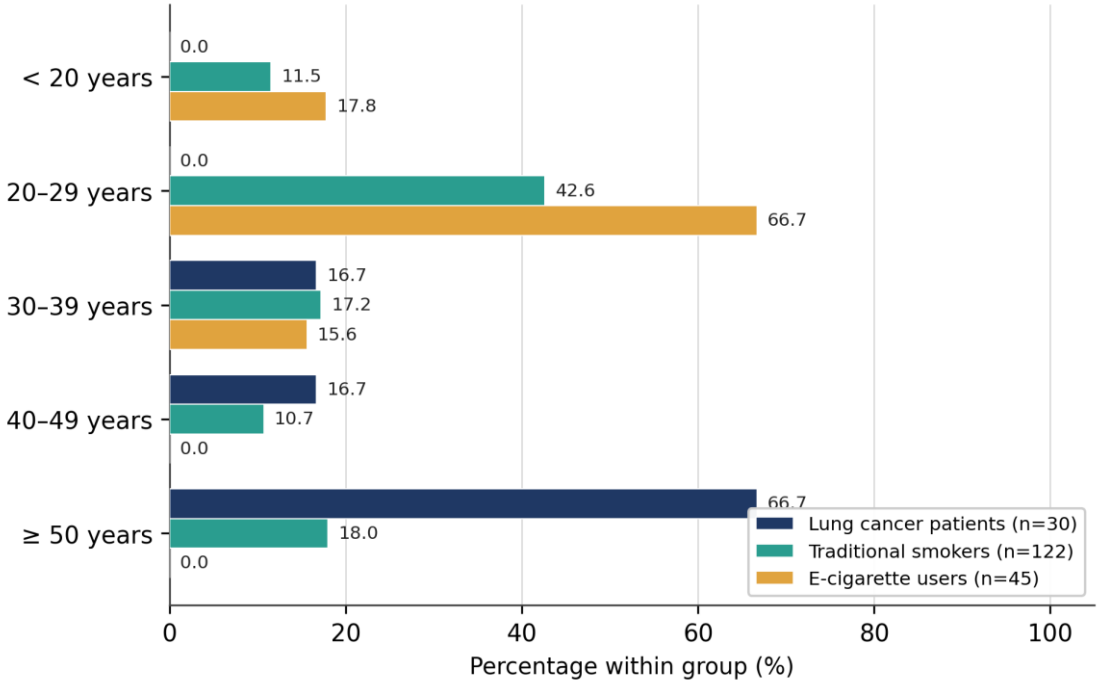

Figure 1. Age distribution by group (% within group).

Smoking Behavior

Of the lung cancer patients, 25 (83.3%) were current smokers at the time of survey, and 28 (93.3%) reported having smoked before diagnosis; all traditional and electronic cigarette users were, by definition, current users. Among the 122 traditional cigarette smokers, the most commonly reported smoking duration was 5–10 years (30.3%, n = 37), followed by 11–20 years (28.7%, n = 35), less than 5 years (19.7%, n = 24), 21–30 years (14.8%, n = 18), and more than 40 years (6.6%, n = 8). With regard to daily cigarette consumption, 80.3% (n = 98) smoked at least ten cigarettes per day, comprising 49.2% (n = 60) who smoked 10–20 cigarettes per day and 31.1% (n = 38) who smoked more than 20 per day; an additional 13.1% (n = 16) smoked 5–10 per day, and 5.7% (n = 7) smoked fewer than 5 per day. Electronic cigarette users reported a shorter mean use duration of 2.23 years (SD 1.52), and 82.2% used the device more than ten times per day (mean 11.28, SD 2.85). Smoking in both open and closed environments was the most common pattern in every group, reported by 83.3% of patients, 69.7% of traditional smokers, and 88.9% of electronic cigarette users. Concurrent use of other tobacco products, principally waterpipe, was reported by 71.1% of electronic cigarette users, compared with 24.6% of traditional smokers and 6.7% of patients (Table 2; Figure 2).

Table 2. Smoking behavior by group, n (%)

Variable	Patients (n=30)	Traditional (n=122)	E-cigarette (n=45)	Total (n=197)
Current smoker	25 (83.3)	122 (100.0)	45 (100.0)	192 (97.5)
Smoking site: open only	2 (6.7)	33 (27.0)	4 (8.9)	39 (19.8)
Closed only	0 (0.0)	4 (3.3)	1 (2.2)	5 (2.5)
Open and closed	25 (83.3)	85 (69.7)	40 (88.9)	150 (76.1)
Uses other tobacco products	2 (6.7)	30 (24.6)	32 (71.1)	64 (32.5)

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Variable	Patients (n=30)	Traditional (n=122)	E-cigarette (n=45)	Total (n=197)
Exercises regularly	13 (43.3)	53 (43.4)	27 (60.0)	93 (47.2)
Family history of lung cancer	7 (23.3)	15 (12.3)	8 (17.8)	30 (15.2)

Smoking duration and daily cigarette consumption are reported for traditional smokers only (n = 122). All percentages use n = 122 as the denominator.

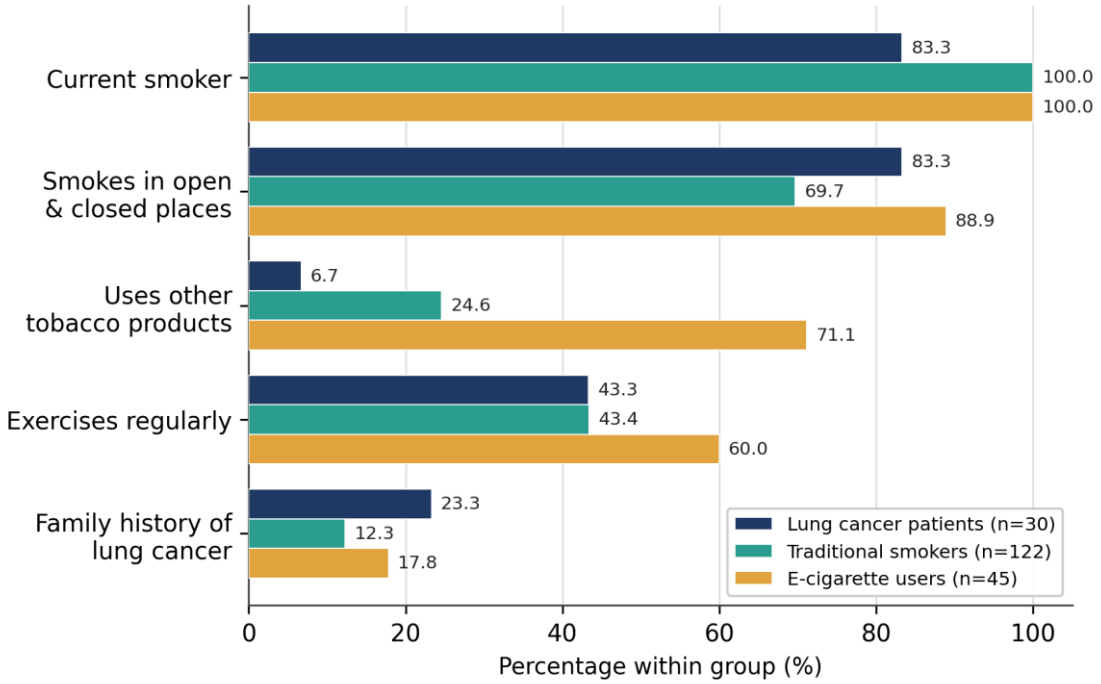

Figure 2. Key smoking-behavior indicators by group (% within group).

Respiratory Symptoms and Diagnostic History

Reported respiratory symptoms were consistently the most frequent among lung cancer patients and least frequent among electronic cigarette users. Shortness of breath and unexplained weight loss were the most reported symptoms among patients (each 43.3%), followed by chronic cough (40.0%). Among traditional smokers, chronic cough (20.5%) and chest pain (19.7%) were most frequent. Electronic cigarette users reported lower symptom frequencies overall, with chronic cough, shortness of breath, and chest pain each reported by 15.6% (Figure 3). Diagnostic testing was concentrated among patients: 83.3% had undergone lung biopsy, 80.0% chest radiography, and 70.0% computed tomography, whereas most traditional smokers (83.6%) and electronic cigarette users (88.9%) reported no prior testing (Figure 4).

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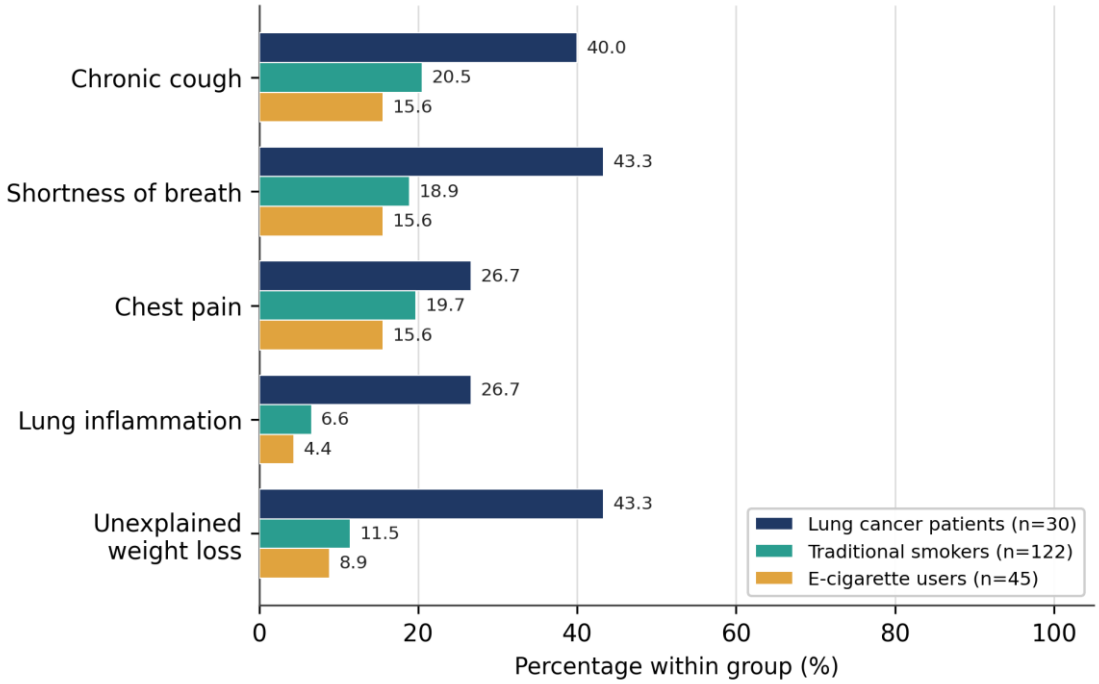

Figure 3. Reported respiratory symptoms by group (% within group; multiple responses permitted).

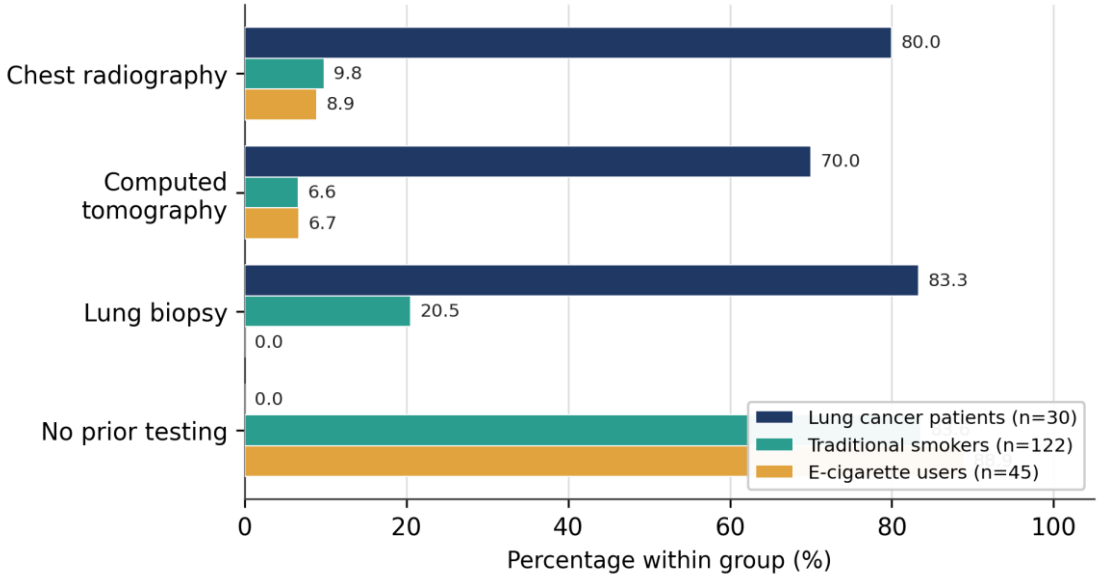

Figure 4. Diagnostic tests undergone by group (% within group).

Awareness and Attitudes

Electronic cigarette users were the most likely to regard awareness campaigns as effective (88.9%), compared with 30.0% of patients and 27.0% of traditional smokers. Most patients (76.7%) and electronic cigarette users (80.0%) believed that smoking cessation reduces lung cancer risk, against 54.9% of traditional smokers. When asked about other contributing factors, exposure to harmful chemicals was the most endorsed across all groups, and genetic causes were most frequently cited by electronic cigarette users (71.1%) (Figure 5).

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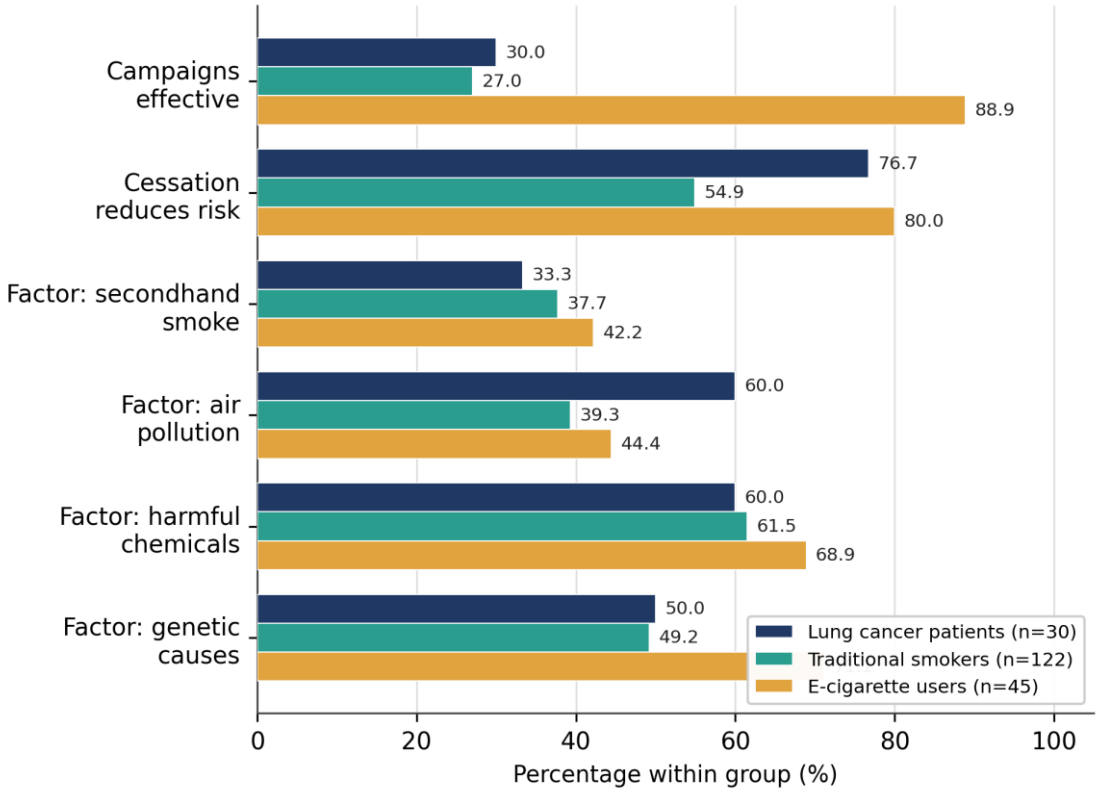

Figure 5. Awareness and perceived contributing factors by group (% within group; factor items multiple-response).

Associations of Age and Education with Smoking Patterns

Age was significantly associated with smoking duration in both the electronic cigarette group ($P < 0.001$) and the traditional cigarette group ($P < 0.001$); longer durations occurred in older participants among traditional smokers, while electronic cigarette use was concentrated among those aged 20 to 29 years. Educational level was significantly associated with traditional smoking duration ($P = 0.006$) but not with electronic cigarette duration ($P = 0.077$). Neither age nor education was significantly associated with the number of electronic cigarettes used per day, and education was not associated with daily traditional cigarette count; age was associated with daily traditional cigarette count ($P = 0.003$) (Table 3).

Table 3. Chi-square associations between participant characteristics and smoking patterns

Association tested	P value	Significance (P < 0.05)
Age × e-cigarette use duration	< 0.001	Significant
Age × traditional smoking duration	< 0.001	Significant
Age × e-cigarette daily use	0.586	Not significant
Age × traditional daily cigarettes	0.003	Significant
Education × e-cigarette use duration	0.077	Not significant
Education × traditional smoking duration	0.006	Significant
Education × e-cigarette daily use	0.528	Not significant
Education × traditional daily cigarettes	0.247	Not significant

P values reported as 0.000 in the source are presented here as P < 0.001 in accordance with standard convention.

Discussion

In this sample, the overwhelming majority of lung cancer patients (93.3%) had a smoking history before diagnosis, which is consistent with the established role of tobacco as the principal cause of the disease and with its position as the leading malignancy worldwide in both incidence and mortality [1]. The dose-response relationship is well characterized: risk rises with both the number of cigarettes smoked daily and the number of years of exposure, with no safe lower bound [3]. The traditional smokers in the present study reported

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substantial cumulative exposure: the most common duration was 5–10 years (30.3%), followed by 11–20 years (28.7%), and 80.3% smoked at least ten cigarettes per day, placing the majority in exposure ranges associated with elevated risk in the wider literature.

The electronic cigarette users formed a distinct demographic profile: younger, more often single, and more highly educated than the other groups. This concentration among young adults is consistent with international reports of rapid uptake in this age band [4,5]. The high rate of concurrent tobacco use observed here (71.1%) indicates that, in this sample, electronic cigarettes were rarely used as a standalone product, a pattern also described elsewhere [8]. Such poly-tobacco use complicates any interpretation of electronic cigarettes as a harm-reduction tool, because exposure is not substituted but added to; waterpipe, the most common additional product reported, is itself associated with lung cancer and respiratory disease [16]. Whatever benefit complete substitution may offer established smokers [12], it does not extend to users who continue to use combustible products alongside the device.

Reported respiratory symptoms followed the expected gradient, being most frequent among diagnosed patients and least frequent among electronic cigarette users. This pattern differs from the claim, sometimes advanced, that electronic cigarette users experience a symptom burden indistinguishable from that of conventional smokers; in the present data, electronic cigarette users reported lower symptom frequencies than traditional smokers for every symptom assessed. Nevertheless, the presence of cough, breathlessness, and chest discomfort in a group with a mean exposure of only 2.23 years is notable and warrants longitudinal follow-up, given that the respiratory effects of these products continue to be documented [10]. The low rate of prior diagnostic testing among both smoker groups is also notable, because long-term smokers are precisely the group for whom annual low-dose computed tomography screening is recommended [18].

Environmental and behavioral factors are relevant to interpretation but were not measured as risk quantities in this study. The wider literature provides quantified estimates: a meta-analysis of 97 studies found that second-hand smoke exposure increases lung cancer risk in never-smokers by about 24% overall, by roughly 38% for workplace exposure, and in proportion to the duration and intensity of exposure [14]. The high proportion of participants who smoked in both open and closed environments in the present sample is consistent with the relevance of such exposure, but these external estimates cannot be reproduced from the present cross-sectional data, which lack a disease-free comparison group and exposure measurement preceding outcome.

The associations between age and smoking duration in both smoking groups are unsurprising and largely reflect the accumulation of exposure time with age. The significant association between educational level and traditional smoking duration runs counter to the inverse education-smoking gradient commonly reported internationally [19,20], and may reflect features of the sampled population or the way participants were recruited rather than a population-level effect. Given the convenience sampling and the absence of multivariable adjustment, these associations should be regarded as descriptive.

Limitations

This study has several limitations. Its cross-sectional design, based on prevalent, already-diagnosed cases, precludes any estimate of risk and is open to recall bias and reverse causation. The groups were recruited by non-probability sampling and were small and unequal, particularly the 30 patients, which limits subgroup stability and generalizability, and the sample comprised men only. Finally, the data were self-reported and not verified against medical records, and several sparse cross-tabulations should be confirmed with Fisher's exact test.

Conclusion

Within the limits of a cross-sectional design, this study found a high prevalence of prior smoking among lung cancer patients, consistent with tobacco as the dominant correlate of the disease. Electronic cigarette use was concentrated among young, frequently poly-tobacco-using adults and was accompanied by a measurable, though comparatively lower, respiratory symptom burden, which argues against treating these products as harmless. The findings support age-targeted prevention focused on younger users, stronger discouragement of concurrent tobacco use, and earlier diagnostic engagement among smokers. Prospective studies with a disease-free comparison group and verified exposure data are needed to quantify risk.

Conflict of Interest

The authors declare no conflict of interest.

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Authors' Contributions

Abusneina interpreted the data and drafted the manuscript. Alhursh, Abdullah, Al-Sahli, Osman, and Al-Mahdawi performed the study design, data collection, and original analysis, with Alhursh also critically reviewing the manuscript. All authors approved the final version.

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References

1. Bray F, Laversanne M, Sung H, Ferlay J, Siegel RL, Soerjomataram I, et al. Global cancer statistics 2022: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. CA Cancer J Clin. 2024;74(3):229-263. doi: 10.3322/caac.21834.
2. Hecht SS. Tobacco carcinogens, their biomarkers and tobacco-induced cancer. Nat Rev Cancer. 2003;3(10):733-744. doi: 10.1038/nrc1190.
3. Inoue-Choi M, Liao LM, Reyes-Guzman C, Hartge P, Caporaso N, Freedman ND. Association of long-term, low-intensity smoking with all-cause and cause-specific mortality in the National Institutes of Health-AARP Diet and Health Study. JAMA Intern Med. 2017;177(1):87-95. doi: 10.1001/jamainternmed.2016.7511.
4. Cullen KA, Gentzke AS, Sawdey MD, Chang JT, Anic GM, Wang TW, et al. e-Cigarette use among youth in the United States, 2019. JAMA. 2019;322(21):2095-2103. doi: 10.1001/jama.2019.18387.
5. Wang TW, Neff LJ, Park-Lee E, Ren C, Cullen KA, King BA. E-cigarette use among middle and high school students - United States, 2020. MMWR Morb Mortal Wkly Rep. 2020;69(37):1310-1312. doi: 10.15585/mmwr.mm6937e1.
6. Pepper JK, Ribisl KM, Emery SL, Brewer NT. Reasons for starting and stopping electronic cigarette use. Int J Environ Res Public Health. 2014;11(10):10345-10361. doi: 10.3390/ijerph111010345.
7. Farsalinos KE, Polosa R. Safety evaluation and risk assessment of electronic cigarettes as tobacco cigarette substitutes: a systematic review. Ther Adv Drug Saf. 2014;5(2):67-86. doi: 10.1177/2042098614524430.
8. Czoli CD, Hammond D, White CM. Electronic cigarettes in Canada: prevalence of use and perceptions among youth and young adults. Can J Public Health. 2014;105(2):e97-e102. doi: 10.17269/cjph.105.4119.
9. US Department of Health and Human Services. The Health Consequences of Smoking-50 Years of Progress: A Report of the Surgeon General. Atlanta (GA): Centers for Disease Control and Prevention; 2014. Available from: https://www.ncbi.nlm.nih.gov/books/NBK179276/.
10. Gotts JE, Jordt SE, McConnell R, Tarran R. What are the respiratory effects of e-cigarettes? BMJ. 2019;366:l5275. doi: 10.1136/bmj.l5275.
11. Goniewicz ML, Knysak J, Gawron M, Kosmider L, Sobczak A, Kurek J, et al. Levels of selected carcinogens and toxicants in vapour from electronic cigarettes. Tob Control. 2014;23(2):133-139. doi: 10.1136/tobaccocontrol-2012-050859.
12. Hartmann-Boyce J, Lindson N, Butler AR, McRobbie H, Bullen C, Begh R, et al. Electronic cigarettes for smoking cessation. Cochrane Database Syst Rev. 2022;11(11):CD010216. doi: 10.1002/14651858.CD010216.pub7.
13. National Academies of Sciences, Engineering, and Medicine. Public Health Consequences of E-Cigarettes. Washington (DC): National Academies Press; 2018. doi: 10.17226/24952.
14. Possenti I, Romelli M, Carreras G, Biffi A, Bagnardi V, Specchia C, et al. Association between second-hand smoke exposure and lung cancer risk in never-smokers: a systematic review and meta-analysis. Eur Respir Rev. 2024;33(174):240077. doi: 10.1183/16000617.0077-2024.
15. Öberg M, Jaakkola MS, Woodward A, Peruga A, Prüss-Ustün A. Worldwide burden of disease from exposure to second-hand smoke: a retrospective analysis of data from 192 countries. Lancet. 2011;377(9760):139-146. doi: 10.1016/S0140-6736(10)61388-8.
16. Akl EA, Gaddam S, Gunukula SK, Honeine R, Jaoude PA, Irani J. The effects of waterpipe tobacco smoking on health outcomes: a systematic review. Int J Epidemiol. 2010;39(3):834-857. doi: 10.1093/ije/dyq002.
17. World Health Organization. WHO Global Report on Trends in Prevalence of Tobacco Use 2000-2024 and Projections 2025-2030. 6th ed. Geneva: World Health Organization; 2025.
18. US Preventive Services Task Force. Screening for lung cancer: US Preventive Services Task Force recommendation statement. JAMA. 2021;325(10):962-970. doi: 10.1001/jama.2021.1117.
19. Cutler DM, Lleras-Muney A. Understanding differences in health behaviors by education. J Health Econ. 2010;29(1):1-28. doi: 10.1016/j.jhealeco.2009.10.003.
20. Hiscock R, Bauld L, Amos A, Fidler JA, Munafò M. Socioeconomic status and smoking: a review. Ann N Y Acad Sci. 2012;1248:107-123. doi: 10.1111/j.1749-6632.2011.06202.x.

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