

SS-003 — Impact of Adverse Childhood Experiences on Lung Cancer Risk and the Role of Mediating Factors: A Case-Control Study

Çocukluk Çağı Travmaları ile Akciğer Kanseri ve Aracı Faktörler Arasındaki İlişki: Bir Klinik Vaka-Kontrol Çalışması

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IMPACT OF ADVERSE CHILDHOOD EXPERIENCES ON LUNG CANCER RISK AND THE ROLE OF MEDIATING FACTORS: A CASE-CONTROL STUDY

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ABSTRACT

Objective: Adverse childhood experiences (ACEs) are increasingly recognized as important life-course determinants of adult physical health, including cancer. This study aimed to investigate the association between ACEs and lung cancer using the Childhood Trauma Scale-33 (CTS-33) and its subscales, and to examine potential intermediary factors.

Methods: This observational case-control study included 60 patients with lung cancer and 60 healthy controls recruited from pulmonology outpatient clinics at a tertiary hospital. Childhood trauma exposure was assessed using the Turkish version of the CTS-33. Demographic, smoking, and histological cancer type data were collected via a face-to-face questionnaire. Group comparisons were performed using the Chi-square and Mann-Whitney U tests.

Results: Patients with lung cancer had significantly higher total CTS-33 scores compared with healthy controls ($p = 0.01$). Emotional abuse, physical abuse, physical neglect, and emotional neglect scores were also significantly higher in the patient group ($p = 0.01$, $p = 0.01$, $p = 0.01$, $p = 0.00$, respectively). Ever-smoker patients exhibited higher childhood trauma, emotional abuse, physical neglect, and emotional neglect scores than ever-smoker healthy individuals ($p < 0.0001$, $p = 0.01$, $p < 0.0001$, $p < 0.0001$, respectively). Smoking prevalence, smoking duration, and lower educational attainment were significantly more common among patients with lung cancer ($p = 0.00$ for all).

Conclusion: ACEs, particularly emotional and physical abuse and neglect, are significantly associated with lung cancer risk. Integrating trauma-informed care, educational interventions, and targeted tobacco-prevention strategies into cancer control programs offers a novel pathway to reduce the population burden of lung cancer.

Keywords: Childhood trauma, emotional abuse, lung cancer, CTS-33, smoking

INTRODUCTION

Adverse childhood experiences (ACEs) are traumatic and distressing events that occur before the age of 18 (1). Exposure to toxic stress during early life disrupts the immune, endocrine, and nervous systems, thereby increasing the risk of mental and physical health issues, substance use disorders, and adverse socioeconomic outcomes over the lifespan (2-4). Accumulating evidence indicates that a wide range of physical health conditions, including cancer, chronic obstructive pulmonary disease, asthma, coronary artery disease, stroke, diabetes, dyslipidemia, arthritis, liver, digestive, and kidney diseases, are associated with ACEs (5,6).

The first study demonstrating the link between ACEs and cancer was performed in animal models, revealing that early-life stressors increased susceptibility to tumor development (7). In humans, alterations in stress response and regulatory systems, chronic inflammation, immune dysregulation, and epigenetic modifications induced by early adverse experiences have been implicated in ACE-related carcinogenesis (8).

Lung cancer remains the leading cause of cancer-related morbidity and mortality worldwide (9). While tobacco consumption is the principal risk factor, genetic susceptibility, poor diet, occupational exposures, and air pollution contribute significantly to lung cancer risk (10). Given the rising global incidence of lung cancer, identifying modifiable and preventable risk factors is of paramount importance (11). ACEs represent one such potentially preventable factor. A large population-based study demonstrated a graded association between cumulative ACE exposure and lung cancer risk (12).

The primary aim of this study was to investigate the association between childhood trauma and its subtypes—emotional abuse, physical abuse, physical neglect, emotional neglect, sexual abuse, overprotection-control, and denial—and the development of lung cancer in adults using the Turkish version of CTS-33.13 The secondary aim was to evaluate the factors that may contribute to the observed relationship between ACEs and lung cancer.

MATERIAL AND METHOD

This observational case-control study was conducted in the pulmonology outpatient clinics of Yedikule Pulmonology Center and included 60 patients with lung cancer and 60 healthy individuals. Comparative analyses were performed between patients with lung cancer and healthy controls. Within the patient group, CTS-33 total and subscale scores were analyzed according to age, gender, smoking status, duration of smoking, marital status, educational level, and histological type of cancer. In addition, CTS-33 total and subscale scores were compared between ever-smoker patients with lung cancer and ever-smoker healthy individuals.

Participant Recruitment

Among individuals admitted to outpatient clinics between 30.06.2023 and 30.10.2024, healthy individuals aged 25-85, with no chronic diseases (e.g., cancer, cardiovascular diseases, diabetes, chronic obstructive pulmonary disease, asthma, liver, kidney, or digestive diseases), who consented to answer the questionnaire, participated in the study. Among patients with lung cancer admitted to outpatient clinics between 30.06.2023 and 30.10.2024, those aged 25-85 years without chronic diseases, cognitively able to cooperate, and who consented to complete the questionnaire were included in the study (**Figure 1**).

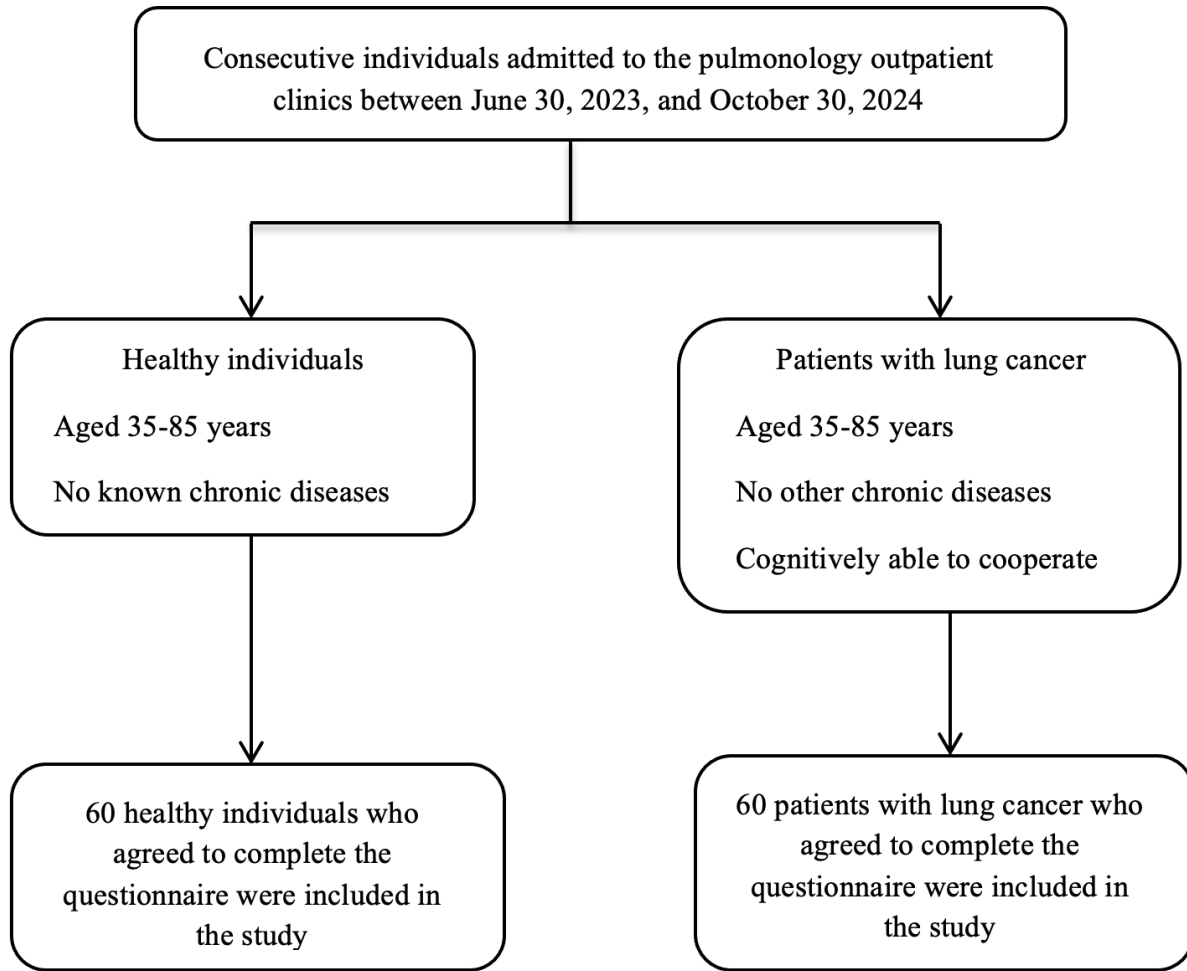


Figure 1. Flowchart of the study participants

Data Collection

Data on demographics; smoking status (current, non-, and former smokers); smoking duration (years); marital status (married, single, divorced, widow); educational attainment (illiterate, primary school, secondary/high school, university graduate); total CTS-33 scores; and scores for childhood trauma subscales (emotional abuse, physical abuse, physical neglect, emotional neglect, sexual abuse, overprotection/overcontrol, and denial) were collected via a questionnaire. The questionnaires were completed by the participants during face-to-face interviews.

Childhood Trauma Scale-33

CTS-33 is a retrospective assessment of individuals' ACEs. The 33-item scale assessed ACEs in seven categories: physical abuse, emotional abuse, physical neglect, emotional neglect, sexual abuse, overprotection-overcontrol, and denial (minimizing). The Cronbach's alpha for the total CTS-33 score was 0.87, while the Gutman split-half coefficient was 0.69 (13).

The Cronbach's alpha values obtained in this study were found to be 0.898 for the total CTS-33 score, 0.803 for emotional abuse, 0.822 for physical abuse, 0.722 for physical neglect, 0.833 for emotional neglect, 0.717 for sexual abuse, 0.785 for overprotection/control, and 0.633 for denial (minimizing).

Statistical Analysis

Statistical analyses were performed using IBM SPSS Statistics for Windows, version 25.0 (IBM Corp., Armonk, NY, USA). Categorical variables were summarized as frequencies and percentages and compared between groups using the Chi-square test of independence.

Because most CTS-33 total and subscale scores did not follow a normal distribution, comparisons between the lung cancer and healthy control groups were primarily conducted using the Mann–Whitney U test. Results were reported as mean $\pm$ standard deviation and mean rank values, where appropriate.

Within the patient group, the Mann–Whitney U test was used to compare total childhood trauma scores and the subscale scores of emotional abuse, physical abuse, physical neglect, sexual abuse, and denial (minimizing) according to age, gender, marital status,

and educational level. An independent-samples t-test was used to compare emotional neglect and overprotection/overcontrol scores across the same variables. Comparisons of total childhood trauma scores and the subscale scores of emotional abuse, physical abuse, physical neglect, sexual abuse, and denial (minimizing) according to smoking status and duration of smoking were performed using the Kruskal–Wallis H test, while One-Way Analysis of Variance (ANOVA) was used to compare emotional neglect and overprotection/overcontrol scores.

All statistical tests were two-tailed, and a *p*-value of < 0.05 was considered statistically significant.

RESULTS

The average age of patients was 61.25 years, whereas that of healthy individuals was 52.55 years. The proportion of men was nonsignificantly higher in the patient group than in the healthy group (66.7% vs. 50%). Among histological types of lung cancer, adenocarcinoma was the most common (41.7%) (**Table 1**).

Chi-square test results revealed statistically significant differences between the groups regarding smoking status, smoking duration, and educational attainment (*p* = 0.001 for all). Ever-smokers were more prevalent among patients than among healthy individuals. Smoking duration was longer in the patient group compared to the healthy group. Additionally, the patient group had a lower educational attainment than the healthy group.

Table 1. Demographics, smoking and histological cancer type (author-supplied original table).

Table 1. Demographics and smoking characteristics of participants and histological types of lung cancer

	Patients N = 60		Healthy individuals N = 60		Total participants N = 120		<i>p</i>
	N	%	N	%	N	%	
Age (years)							
< 65	37	61.7	42	70.0	79	65.8	0.44
≥ 65	23	38.3	18	30.0	41	34.2	
Gender							
Women	20	33.3	30	50.0	50	41.7	0.10
Men	40	66.7	30	50.0	70	58.3	
Smoking status							
Never-smoker	7	11.7	25	41.7	32	26.7	< 0.0001*
Ever-smoker	53	88.3	35	58.3	88	73.3	
Smoking duration (years)							
< 20	12	20.0	20	33.3	32	26.7	< 0.0001*
21-40	27	45.0	8	13.3	35	29.2	
> 40	14	23.3	7	11.7	21	17.5	
Marital status							
Married	48	80.0	50	83.3	98	81.7	0.81
Single/divorced/widow	12	20.0	10	16.7	22	18.3	
Educational attainment							
Primary education or less	34	56.7	11	18.3	45	37.5	< 0.0001*
Secondary education or higher	26	43.3	49	81.7	75	62.5	
Histological types of lung cancer							
Adenocarcinoma	25	41.7	0	0.0	25	20.8	-
Small cell carcinoma	12	20.0	0	0.0	12	10.0	
Large cell carcinoma	2	3.3	0	0.0	2	1.7	
Squamous cell carcinoma	21	35.0	0	0.0	21	17.5	

N, number of participants; *p*, Chi-Square Test of Independence; **p* < 0.05, significant value

Compared with the healthy group, the patient group had significantly higher mean scores for overall childhood trauma, emotional abuse, physical abuse, physical neglect, and emotional neglect. The differences were statistically significant for all these variables (*p* = 0.01), except for emotional neglect, which was even more significant (*p* < 0.0001). However, the patient group did not show significant differences in sexual abuse, overprotection-overcontrol, or denial (minimizing) scores on the CTS-33 and its subscales (shown in **Table 2**, **Figure 1**).

Table 2. Childhood trauma scores by group (author-supplied original table).

Table 2. Comparison of Childhood Trauma Scale-33 and subscale scores between the patient and healthy groups

Participants N = 120	Lung cancer patients N = 60			Healthy individuals N = 60			Z	p
	Mean	SD	Rank Avg.	Mean	SD	Rank Avg.		
Total childhood trauma	59.75	14.91	69.41	52.92	15.98	51.59	-2.807	0.01*
Emotional abuse	8.63	2.73	68.43	7.98	4.00	52.57	-2.531	0.01*
Physical abuse	7.60	3.31	68.21	6.27	2.43	52.79	-2.620	0.01*
Physical neglect	11.28	3.38	68.83	9.65	3.52	52.18	-2.636	0.01*
Emotional neglect	14.50	4.93	69.77	12.00	4.65	51.23	-2.926	< 0.0001*
Sexual abuse	6.08	2.29	60.76	5.80	1.96	60.24	-0.103	0.92
Overprotection-control	11.65	4.17	63.34	11.22	4.39	57.66	-0.898	0.37
Denial (minimizing)	0.63	0.88	57.07	0.87	1.03	63.93	-1.191	0.23

N, number of participants; SD, standard deviation; Avg, average; Z, Mann-Whitney U Test; T, Independent Sample T Test; * $p < 0.05$ indicates significant value

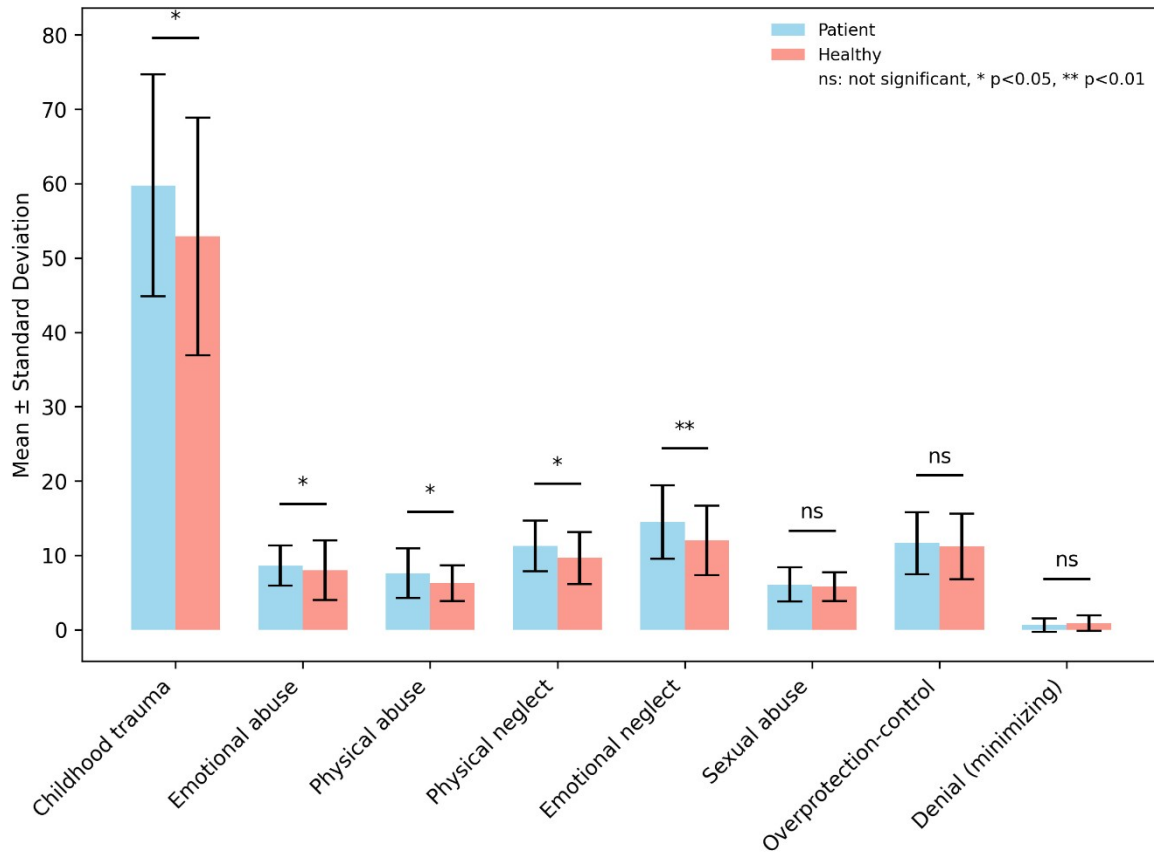


Figure 2. Comparison of Childhood Trauma Scale-33 and subscale scores between the patient and healthy groups

CTS-33 and subscale scores were compared between ever-smoker patients and ever-smoker healthy individuals. Ever-smoker patients had higher average scores for childhood trauma, emotional abuse, physical neglect, and emotional neglect compared to the ever-smoker healthy individuals ($p = 0.00$, $p = 0.01$, $p = 0.00$, and $p = 0.00$, respectively) (Table 3).

Table 3. Scores among ever-smoker participants (author-supplied original table).

Table 3. Comparison of Childhood Trauma Scale-33 and subscale scores between ever-smoker patients with lung cancer and ever-smoker healthy individuals

Ever-smoker participants N = 88	Lung cancer patients N = 53			Healthy individuals N = 35			Z/T	Z/T	p
	Mean	SD	Rank Avg.	Mean	SD	Rank Avg.			
Childhood trauma	60.55	14.56	51.94	50.20	13.68	33.23	Z	-3.365	0.00*
Emotional abuse	8.83	2.81	50.53	7.29	2.71	35.37	Z	-2.754	0.01*
Physical abuse	7.79	3.44	48.08	6.51	2.58	39.07	Z	-1.700	0.09
Physical neglect	11.47	3.36	51.54	9.17	3.72	33.84	Z	-3.195	< 0.0001*
Emotional neglect	14.58	4.82	51.48	11.31	4.30	33.93	Z	-3.162	< 0.0001*
Sexual abuse	6.04	2.08	46.31	5.46	1.09	41.76	Z	-1.077	0.28
Overprotection-control	11.83	4.08	48.55	10.46	4.38	38.37	Z	-1.835	0.07
Denial (minimizing)	0.60	0.88	41.79	0.91	1.07	48.60	Z	-1.358	0.17

N, number of participants; SD, standard deviation; Avg, average; Z, Mann-Whitney U Test; T, Independent Sample T Test; * $p < 0.05$ indicates significant value

CTS-33 and its subscale scores of the patients were compared by age, gender, smoking status, smoking duration, marital status, educational attainment, and histological type of cancer. When comparing patient groups < 65 and ≥ 65 years old in terms of CTS-33 and its subscale scores, a significant difference was found only in the sexual abuse score. The mean sexual abuse score was higher in the patients < 65 years old than in those ≥ 65 years old ($p = 0.04$) (shown in **Table 4, Figure 3**). No significant differences in CTS-33 or subscale scores were observed across gender, smoking status, smoking duration, marital status, educational attainment, and histological type of cancer ($p > 0.05$).

Table 4. Scores in lung cancer patients by age (author-supplied original table).

Table 4. Comparison of Childhood Trauma Scale-33 and subscale scores of the patients with lung cancer by age

Lung cancer patients N = 60	Age						Z/T	p	
	< 65 years N = 37			≥ 65 years N = 23					
	Mean	SD	Rank Avg.	Mean	SD	Rank Avg.			
Total childhood trauma	62.38	15.02	33.59	55.52	14.02	25.52	Z	-1.742	0.08
Emotional abuse	9.03	2.80	32.96	8.00	2.54	26.54	Z	-1.395	0.16
Physical abuse	7.86	3.13	32.73	7.17	3.60	26.91	Z	-1.305	0.19
Physical neglect	12.03	3.51	33.93	10.09	2.83	24.98	Z	-1.944	0.06
Emotional neglect	15.32	4.72	33.69	13.17	5.07	25.37	T	1.668	0.10
Sexual abuse	6.59	2.76	33.28	5.26	0.69	26.02	Z	-2.013	0.04*
Overprotection-control	11.54	4.13	29.70	11.83	4.30	31.78	T	-0.256	0.80
Denial (minimizing)	0.62	0.92	29.81	0.65	0.83	31.61	Z	-0.438	0.66

N, number of participants; SD, standard deviation; Avg, average; Z, Mann-Whitney U Test; T, Independent Sample T Test; * $p < 0.05$ indicates significant value

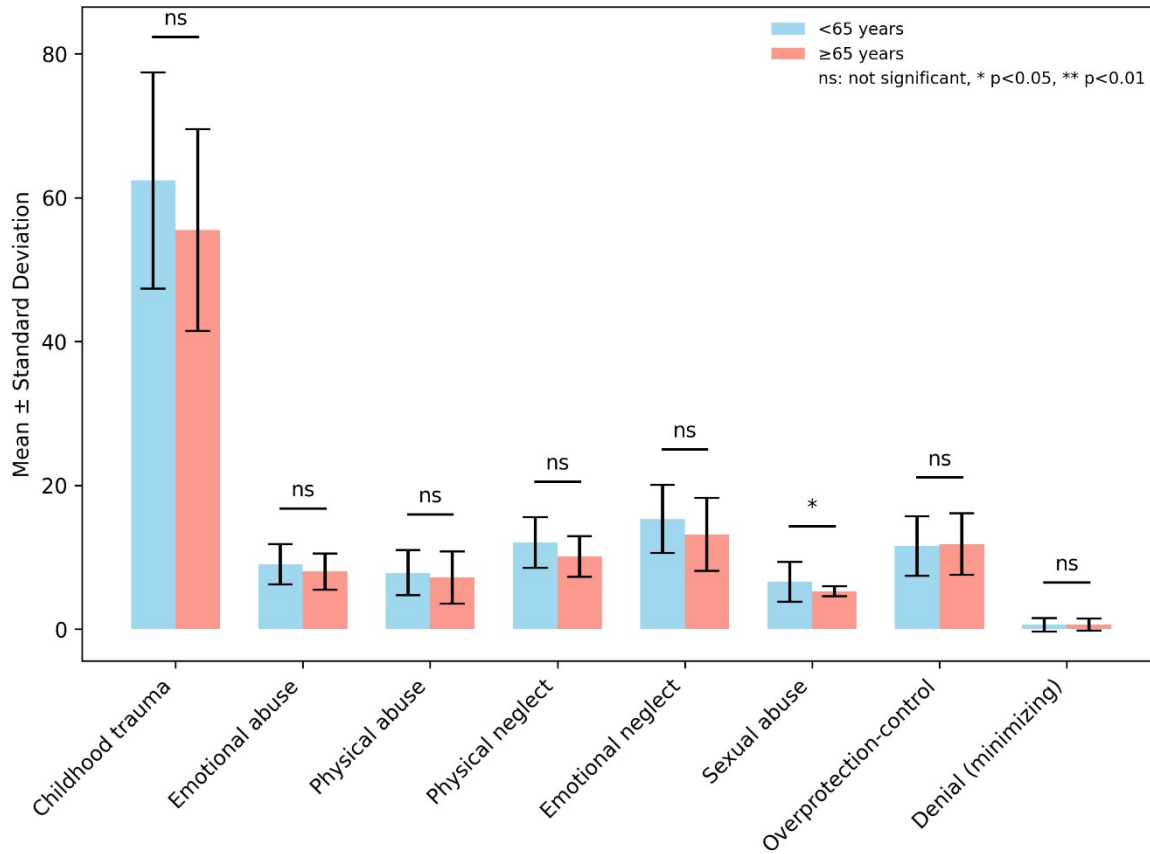


Figure 3. Comparison of the Childhood Trauma Scale-33 and subscale scores of patients with lung cancer by age

DISCUSSION

Numerous epidemiological studies have reported associations between ACEs and overall cancer incidence, as well as specific malignancies such as lung, cervical, and breast cancers (14). This case-control study expands on existing literature by evaluating the relationship between ACEs and lung cancer using the CTS-33 and its subscale scores, and by exploring potential mediating factors. Our primary findings indicate that patients with lung cancer reported significantly higher levels of total childhood trauma, emotional abuse, physical abuse, physical neglect, and emotional neglect compared with healthy controls. Consistent with our results, the only comparable study reported that individuals with six or more ACEs had an approximately threefold increased risk of lung cancer and developed the disease nearly 13 years earlier than those without ACEs (12). These findings support the hypothesis that early-life adversity contributes to lung carcinogenesis.

Individuals exposed to higher levels of childhood adversity are more likely to adopt health-risk behaviors, particularly smoking, which is the strongest established risk factor for lung cancer (15). In the present study, smoking prevalence and smoking duration were significantly higher among patients with lung cancer. Moreover, among ever-smokers, patients with lung cancer reported greater exposure to childhood trauma and its subscales, such as emotional abuse, physical neglect, and emotional neglect, than healthy individuals, suggesting that ACEs may influence both smoking initiation and prolonged tobacco exposure.

Beyond smoking behavior, ACEs may increase lung cancer risk through independent pathways, including reduced participation in cancer screening programs and biological mechanisms such as epigenetic alterations and chronic inflammation (16-18). Supporting this notion, Brown et al. demonstrated that the association between childhood adversity and lung cancer persisted even after adjustment for individual and parental smoking behaviors (12). Similarly, in our study, comparisons restricted to ever-smokers revealed a higher ACE burden among patients with lung cancer, indicating an effect beyond smoking alone.

Higher ACE scores are also associated with poorer academic achievement and lower educational attainment (19,20). Consistent with prior research, patients had higher ACE scores and lower educational levels than healthy individuals. Educational attainment, a core component of socioeconomic status, strongly influences health behaviors, access to healthcare, and occupational exposures (21). Lower educational attainment may indirectly increase lung cancer risk by limiting access to preventive services and smoking cessation resources while increasing smoking prevalence and exposure to environmental and occupational carcinogens (22,23). We hypothesize that reduced educational attainment among patients contributed to higher smoking rates and longer smoking duration, thereby facilitating lung cancer development.

When CTS-33 total and subscale scores were examined across demographic and clinical variables, age was the only factor associated with significant differences. Exposure to sexual abuse was reported more frequently by patients under 65 years of age.

This finding may reflect a cohort effect, whereby younger generations have grown up in different social environments and demonstrate greater awareness and willingness to disclose childhood sexual trauma, rather than indicating a true difference in exposure. In contrast, older individuals may be less likely to report such experiences due to stronger social stigma, limited awareness, or recall bias.

The study has several limitations. The major limitation is its case–control design, which precludes causal inference. Although significant associations were observed between ACEs, smoking behavior, educational attainment, and lung cancer, the temporal and causal directions of these relationships could not be definitively established. Prospective longitudinal studies are required to confirm the proposed pathways linking ACEs to lung cancer risk. The sample size was relatively small, and the study was conducted at a single tertiary care center, which may limit the generalizability of the findings. Childhood trauma was evaluated retrospectively using a self-administered questionnaire. This method might be prone to recall bias, especially among individuals diagnosed with cancer, who might be more likely to remember or disclose adverse experiences. However, the CTS-33 has demonstrated strong reliability and validity, and internal consistency was high across most subscales in the present study, supporting the robustness of the measurements.

CONCLUSION

This case–control study demonstrates that ACEs, particularly emotional abuse, physical abuse, physical neglect, and emotional neglect, are significantly more prevalent among patients with lung cancer than among healthy controls. These associations persist even after accounting for smoking behavior, suggesting that ACEs may contribute to lung cancer risk both indirectly through increased smoking exposure and directly via psychosocial and biological pathways.

Our findings highlight the potential role of early-life adversity as an upstream determinant of lung cancer risk, mediated by higher smoking prevalence, longer smoking duration, and lower educational attainment. Recognizing ACEs as a modifiable and preventable risk factor may provide new opportunities for cancer prevention through early psychosocial interventions, improved educational support, and targeted smoking prevention strategies in vulnerable populations.

Future large-scale, prospective studies are needed to clarify causal pathways and to determine whether early identification and mitigation of childhood adversity can reduce lung cancer incidence and improve long-term cancer outcomes.

ETHICS AND RESEARCH DECLARATIONS

Ethics Committee Approval: This study was approved by the hospital's local Ethics Committee under reference number 147 (date: 02.06.2023). It was conducted in the pulmonology outpatient clinics of the study hospital in accordance with the Declaration of Helsinki.

Consent to Participate: All participants provided written informed consent.

Conflicts of Interest: The authors declared no conflicts of interest with respect to the research, authorship, and/or publication of this article.

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References

1. Merrill EC, Thomas AJ. Adverse childhood experiences and risk of late-life dementia: a systematic review and meta-analysis. *Psychol Med*. 2020;50(8):1314–1325.
2. Pechtel P, Pizzagalli DA. Effects of early life stress on cognitive and affective function: an integrated review of human literature. *Psychopharmacol (Berl)*. 2011;214(1):55–70.
3. Danese A, McEwen BS. Adverse childhood experiences, allostasis, allostatic load, and age-related disease. *Physiol Behav*. 2012;106(1):29–39.
4. Garner AS, Shonkoff JP, on behalf of the Committee on Psychosocial Aspects of Child and Family Health; Committee on Early Childhood, Adoption, and Dependent Care; Section on Developmental and Behavioral Pediatrics. Early childhood adversity, toxic stressMcG and the role of the pediatrician: translating developmental science into lifelong health. *Pediatrics*. 2012;129(1):e224–e231.
5. Lin L, Wang Y, Chen X et al. Adverse Childhood Experiences and Subsequent Chronic Diseases Among Middle-aged or Older Adults in China and Associations With Demographic and Socioeconomic Characteristics. *JAMA Netw Open*. 2021;4(10):e2130950.
6. Jemiyo C, McGregor BA, Rehana H, et al. Adverse childhood experiences and chronic health outcomes: evidence from 33 US states in the Behavioral Risk Factor Surveillance System, 2019-2023. *BMC Public Health*. 2025;25:1650.
7. Lanconi E, Giannerini F, Colasanti A, et al. Early exposure to restraint stress enhances chemical carcinogenesis in rat liver. *Cancer Lett*. 2000;157(2):187–193.

8. Taylor SE. Mechanisms linking early life stress to adult health outcomes. *Proc Natl Acad Sci U S A*. 2010;107(19):8507–8512.
9. Zhou J, Xu Y, Liu J et al. (2024) Global burden of lung cancer in 2022 and projections to 2050: incidence and mortality estimates from GLOBOCAN. *Cancer Epidemiology* 93:102693.
10. Malhotra J, Malvezzi M, Negri E, et al. Risk factors for lung cancer worldwide. *Eur Respir J*. 2016;47(1):125–137.
11. Jakobsen E, Høgdall C, Aldrin M, et al. Forecasting lung cancer incidence, mortality, and prevalence to year 2030. *BMC Cancer*. 2021;21:985.
12. Brown DW, Anda RF, Felitti VJ, et al. Adverse childhood experiences are associated with the risk of lung cancer: a prospective cohort study. *BMC Public Health*. 2010;10:20.
13. Şar V, Necef I, Mutluer T, et al. A revised and expanded version of the Turkish Childhood Trauma Questionnaire (CTQ-33): overprotection-overcontrol as additional factor. *J Trauma Dissociation*. 2021;22(1):35-51.
14. Holman DM, Ports KA, Buchanan ND, et al. The association between adverse childhood experiences and risk of cancer in adulthood: A systematic review of the literature. *Pediatrics*. 2016;138(Suppl 1):S81–S91.
15. Felitti VJ, Anda RF, Nordenberg D, et al. Reprint of: Relationship of childhood abuse and household dysfunction to many of the leading causes of death in adults: The Adverse Childhood Experiences (ACE) Study. *Am J Prev Med*. 2019;56(6):774–786.
16. Mouton CP, Hargreaves MK, Liu J, et al. Adult cancer risk behaviors associated with adverse childhood experiences in a low income population in the Southeastern United States. *J Health Care Poor Underserved*. 2016;27(1):68–83.
17. Argentieri MA, Nagarajan S, Seddighzadeh B, et al. Epigenetic pathways in human disease: The impact of DNA methylation on stress-related pathogenesis and current challenges in biomarker development. *EBioMedicine*. 2017;18:327–350.
18. Baumeister D, Akhtar R, Ciufolini S, et al. Childhood trauma and adulthood inflammation: a meta-analysis of peripheral C-reactive protein, interleukin-6 and tumour necrosis factor- α . *Mol Psychiatry*. 2015;21(5):642–649.
19. Li M, D’Arcy C, Meng X. Association between adverse childhood experiences and academic performance among children and adolescents: A global meta-analysis. *Child Abuse Negl*. 2020;103:104493.
20. Fisher C, Stillerman A, Feinglass J. The association of adverse childhood experiences with household income, educational attainment and partnered status among adults aged 30–39. *Child Protection and Practice*. 2024;5:Article 100097.
21. Marmot M. Social determinants of health inequalities. *Lancet*. 2005;365(9464):1099–1104.
22. Hodge JM, Patel AV, Islami F, et al. Educational Attainment and Cancer Incidence in a Large Nationwide Prospective Cohort. *Cancer Epidemiol Biomarkers Prev*. 2023;32(12):1747–1755.
23. Borg M, Løkke A, Henriksen M, et al. Educational attainment and employment status in lung cancer patients: a nationwide study. *Clin Transl Oncol*. 2026;28(1):176–183.

AUTHOR'S STATEMENT

I declare that this is the final version of the complete text, that its content and ethical/consent/conflict-of-interest/funding statements are accurate, and that there is no identifiable patient data in the text.

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