

INFLUENCE OF ACTIVE CIGARETTE SMOKING ON POSTOPERATIVE OUTCOMES AFTER ELECTIVE GENERAL SURGERY: A PROSPECTIVE COHORT STUDY

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ABSTRACT **OBJECTIVES**

This study aimed to assess the association between active cigarette smoking and postoperative morbidity and hospital stay among adults undergoing elective non-cardiac general surgery at a tertiary-care hospital in Pakistan.

METHODOLOGY

This prospective observational cohort study enrolled 280 adults aged 18–60 years undergoing elective general surgical procedures at Services Institute of Medical Sciences/Services Hospital, Lahore, from November 2024 to December 2025. Participants comprised 180 active smokers and 100 non-active smokers. Smoking exposure was quantified in pack-years. Patients received standard perioperative care and were followed through 30 days after discharge. Outcomes included pulmonary complications, surgical-site or wound-related complications, postoperative fever, cardiovascular events, and total hospital stay. Associations were assessed using chi-square testing, logistic regression for overall complications, and independent-samples testing for length of stay.

RESULTS

Overall postoperative complications occurred in 67/180 smokers (37.2%) and 13/100 non-smokers (13.0%), corresponding to an odds ratio of 3.96 (95% CI 2.0–7.7; $p < 0.001$). Pulmonary complications were the most frequently reported adverse event among smokers. Among smokers with more than 11 pack-years, 55/121 (45.5%) developed at least one complication. Mean total hospital stay was 14.90 days in smokers and 7.58 days in non-smokers (reported $p < 0.001$).

CONCLUSION

Active smoking was associated with substantially greater postoperative morbidity and longer hospitalisation after elective general surgery. Routine preoperative tobacco assessment, pack-year documentation, and structured cessation support should be incorporated into elective surgical pathways.

KEYWORDS: Smoking; Tobacco Use, Elective Surgery, Postoperative Complications, Surgical-Site Infection, Pulmonary Complications, Hospital Stay, Smoking Cessation

INTRODUCTION

Tobacco smoking remains a major preventable cause of morbidity and mortality and is highly relevant to surgical care. Pakistan continues to carry a substantial burden of tobacco use, particularly among adult men, and cigarette smoking is common among working-age patients who present for elective operation.^{1,2} For surgeons and anaesthetists, smoking status is not simply a lifestyle characteristic; it is a modifiable perioperative exposure that can influence pulmonary function, tissue oxygenation, wound healing, infection risk, and recovery after surgery. The mechanisms linking smoking with adverse postoperative outcomes are biologically plausible and well described. Nicotine produces sympathetic stimulation and vasoconstriction, while carbon monoxide reduces oxygen-carrying capacity and shifts the oxyhemoglobin dissociation

curve. Tobacco smoke impairs mucociliary clearance, increases airway reactivity, promotes mucus production, and alters innate and adaptive immune responses. Smoking also affects platelet function, endothelial physiology, collagen synthesis, and microvascular perfusion. Together, these effects can increase susceptibility to pulmonary complications, surgical-site infection, delayed wound healing, and cardiovascular stress.³ Large contemporary surgical datasets show that current smoking is associated with increased postoperative complications across a wide range of specialities.^{4,5,6,7,8} International prospective evidence from elective surgical systems likewise demonstrates worse outcomes among current smokers and supports systematic identification of smoking status before surgery.⁹ Earlier intervention studies and systematic reviews have shown that preoperative smoking cessation can reduce postoperative

complications, particularly when abstinence begins several weeks before surgery.^{7,10,11} The perioperative period therefore represents a clinically important teachable moment in which patients may be more receptive to cessation advice. The importance of smoking-related complications may be amplified in resource-constrained hospitals. Additional pulmonary infection, wound morbidity, or prolonged inpatient stay increases antibiotic use, nursing workload, bed occupancy, and overall cost. Pakistan's surgical system already faces pressure related to access, timeliness, workforce, and resource distribution.⁴ Local studies have documented surgical-site infection as an important postoperative problem, but smoking-specific evidence in general surgical populations remains limited.⁵ A further methodological issue is that smoking exposure should not be treated only as a binary variable. Pack-years provide a simple measure of cumulative cigarette exposure and may help identify patients with heavier lifetime tobacco burden. Although pack-years cannot capture all dimensions of smoking intensity or recent cessation, documenting them can improve risk communication and provide a more informative baseline for perioperative counselling. The present study was therefore undertaken to assess the association between active cigarette smoking and postoperative complications among adults undergoing elective non-cardiac general surgery at Services Hospital Lahore. Secondary objectives were to describe cumulative tobacco exposure among active smokers and to compare hospital stay between smokers and non-active smokers. The study was intended to generate locally relevant evidence that could support routine tobacco screening and structured preoperative cessation pathways.

METHODOLOGY

A prospective observational cohort study was conducted at the Department of General Surgery, Surgical Unit, Services Institute of Medical Sciences/Services Hospital, Lahore, Pakistan. The duration of the study was 12 months, from November 2024 to December 2025. The study was approved by the hospital's Institutional Ethics (Ref No. IRB/2022/709/SIMS, Dated: 15-11-2022) Committee prior to commencement, and procedures were conducted in accordance with the principles of the Declaration of Helsinki. Adults aged 18-60 years listed for elective non-cardiac general surgical procedures were screened consecutively. Patients were excluded if they had established chronic pulmonary disease or cardiac disease, were immunocompromised because of illness or medication, or were undergoing cardiac surgery. A total of 280 participants were analysed: 180 active smokers and 100 non-active smokers. The sample

was calculated using the OpenEpi web-based sample size calculator, using the recent prevalence of smoking in Pakistan to be 13.4%.⁶ A total of 180 patients were enrolled in the study. In order to make a comparison between smokers and non-smokers, 100 patients with no smoking history were also enrolled in the study. A structured tobacco use history was taken from every participant at the time of the preoperative consultation. The enrollment was focused on cigarette smokers, as this was the predominant form of tobacco use in our society. Participants were classified as active smokers if they reported current cigarette use at the time of surgical listing. Those who had completely abstained from all tobacco products for a minimum of four consecutive weeks before their surgical date, or who had never used tobacco, were classified as non-active smokers. Cumulative tobacco burden was quantified using the pack-year index, calculated by multiplying the number of cigarette packs consumed daily by the total years of active smoking.⁷ All participants received uniform perioperative care in line with the hospital's standard surgical protocols, including antibiotic prophylaxis, infection control practices, and standardised anaesthetic management. No modifications to the standard of care were made on the basis of smoking status. Each active smoker received brief verbal counselling at the preoperative visit regarding the additional risks that continued smoking posed to their surgical recovery, with abstinence strongly recommended. No formal pharmacological cessation support program was in place at the study institution during the study period. A reality that itself reflects the broader gap in cessation services within Pakistan's public surgical sector. Participants were followed from the day of admission through to 30 days post-discharge. Wound assessment was conducted using the Southampton Wound Assessment Scale, and surgical site infections were identified using the National Nosocomial Infections Surveillance (NNIS) system criteria of the United States Centres for Disease Control and Prevention. Respiratory complications were defined as new pulmonary consolidation on chest imaging or the initiation of antibiotic therapy for clinically suspected postoperative lower respiratory tract infection. Postoperative fever was defined as temperature exceeding 38°C on at least two separate occasions, each at least 24 hours apart. Cardiovascular complications were defined as new electrocardiographic changes or a confirmed acute cardiac event during admission. Total hospital stay was measured in days and disaggregated into preoperative and postoperative components. Data were recorded on a standardised proforma and entered into Microsoft Excel 2021. Analysis was performed using IBM SPSS Statistics version 26.0. Continuous variables were

reported as means; categorical variables as frequencies and percentages. The chi-squared test was used to assess associations between categorical variables. Odds ratios with 95% confidence intervals were estimated by binary logistic regression. Length of stay was compared using the independent samples t-test. A two-tailed p-value below 0.05 was considered statistically significant throughout.

RESULTS

Two hundred eighty participants met the eligibility criteria and were included, comprising 180 active smokers and 100 non-active smokers.

Table 1: Baseline Characteristics of the Study Population

Characteristic	Active Smokers (n=180)	Non-Active Smokers (n=100)
Mean age, years	42.8	38.5
Male, n (%)	177 (98.3)	84 (84.0)
Mean BMI, kg/m ²	22.8	24.3
Married, n (%)	166 (92.2)	79 (79.0)
Urban residence, n (%)	107 (59.4)	71 (71.0)

Table 2: Cumulative Cigarette Exposure Among Active Smokers

Pack-Year Category	n (%)
1–5 pack-years	39 (21.7)
6–10 pack-years	20 (11.1)
>11 pack-years	121 (67.2)

Table 3: Association Between Smoking Status and Overall Postoperative Complications

Group	Complication	No Complication	Odds ratio (95% CI)	p-value
	n (%)			
Active smokers	67 (37.2)	113 (62.8)	3.96 (2.0-7.7)	<0.001
Non-active smokers	13 (13.0)	87 (87.0)		

Table 4: Specific Postoperative Complications Reported by Smoking Group

Complication type	Active smokers, n	Non-active smokers, n
Pulmonary complication	20	3
Wound-related / surgical-site complication	11	4
Postoperative fever	12	5
Cardiovascular event	4	1

Table 5: Hospital Stay by Smoking Status

Admission Phase	Active Smokers, Mean Days	Non-Active Smokers, Mean Days	Mean Difference, Days	p-value
Preoperative stay	5.38	3.11	2.27	
Postoperative stay	9.52	4.47	5.05	
Total hospital stay	14.90	7.58	7.32	<0.001

DISCUSSION

Our prospective study has shown that active tobacco smoking is an important and independent predictor of postoperative morbidity among male patients undergoing elective general surgical procedures at a tertiary care hospital in Pakistan. According to our results, smokers experienced complications at more than three times the rate of non-smokers (OR 3.96; 95% CI: 2.0–7.7; $p \leq 0.0007$), with hospital stay nearly doubled. These findings align with a growing international body of evidence. Gräsbeck et al., in a machine learning-based analysis of more than 300,000 surgical patients in Finland, reported that active smoking was a consistent and significant predictor of complications across all surgical specialities.⁸ Similarly, a multinational secondary analysis by Glaszby et al. conducted across 442 hospitals in 29 countries confirmed that current smokers undergoing elective surgery had significantly elevated complication rates and longer hospital stays compared to non-smokers.⁹ Our findings provide locally grounded Pakistani data that have, until now, been largely absent from the perioperative literature. The near-exclusive male composition of the smoker cohort (98.0%) directly reflects the deeply entrenched gender asymmetry of tobacco use in Pakistan. As Zahra et al. have reported in a national study examining tobacco exposure patterns in Pakistan, active tobacco use remains overwhelmingly concentrated among men, with important implications for household and occupational exposure as well as direct health risk.¹⁰ This demographic pattern has a direct consequence for preoperative surgical risk assessment: male patients of working age presenting for elective surgery in Pakistan should be systematically screened for tobacco use using structured histories including pack-year quantification, as this group constitutes the predominant smoking population within Pakistan's surgical caseload. Respiratory complications were the most frequently observed adverse outcome in the smoker group, occurring in 20 smokers (13.3%) compared with only 3 non-smokers (2.7%). This finding is mechanistically consistent with the well-documented effects of chronic tobacco exposure on airway physiology. This has been reported by Vágvölgyi et al., who showed that smoking disturbs normal physiology and substantially increases the risk of postoperative atelectasis and pneumonia in patients undergoing surgical procedures.¹¹ In Pakistani public hospitals, where access to high-dependency respiratory care and intensive monitoring is constrained, the prevention of pulmonary complications carries particular operational importance. Each avoidable case of postoperative pneumonia occupies a surgical bed for additional days and displaces capacity for other elective

admissions. Wound-related complications and surgical site infections (SSIs) represented the second most prevalent complication category in this study, with 11 smokers affected compared to 4 non-smokers. Existing evidence consistently confirms the SSI-promoting effects of tobacco in diverse surgical settings. A similar result reported by Ahmad et al., in a recent Pakistani study examining SSI risk following orthopaedic surgery, found that active smoking was among the most significant modifiable predictors of surgical site infection, corroborating the relevance of tobacco-attributable wound risk in the Pakistani surgical population specifically.¹² In an elderly surgical cohort, Ma et al. similarly identified current smoking as a leading modifiable factor increasing SSI risk following hip fracture surgery, with an independent contribution to wound-related morbidity that persisted after adjustment for comorbidities.^{13,16} These findings, taken together with the high baseline SSI rates documented at Pakistani public hospitals, underscore the compounding nature of tobacco-attributable wound risk in resource-constrained settings. A clear dose-response gradient was observed between cumulative pack-year exposure and complication risk. Patients with more than 11 pack-years of tobacco exposure carried a complication odds ratio of 3.9 (95% CI: 1.88-8.24; $p \leq 0.0002$) relative to non-smokers, compared with lower odds in those with 1-5 and 6-10 pack-years. This graded relationship is consistent with findings reported by Quan et al., who demonstrated in a retrospective study of 2,469 patients undergoing radical gastrectomy for gastric cancer that increasing smoking dose was independently associated with escalating rates of postoperative complications, and that preoperative cessation attenuated this risk in a dose-dependent fashion.¹⁴ The majority of our smoker cohort (67.3%) had accumulated more than 11 pack-years, reflecting the long-duration, high-volume smoking patterns prevalent among working-age Pakistani men. Pakistani surgeons must therefore anticipate that most smokers they encounter will fall into the highest-risk exposure category, and should quantify pack-year burden routinely rather than treating smoking as a binary variable. The near-doubling of total hospital stay in active smokers (14.90 versus 7.58 days; $p \leq 0.0001$) has direct and substantial implications for bed management and resource utilisation in Pakistan's overburdened public surgical sector. The multinational data of Glaszbe et al. similarly reported significantly prolonged inpatient stays among current smokers across 442 hospitals, confirming that smoking-attributable bed-day extension is not a local phenomenon but a reproducible and quantifiable operational burden on surgical systems worldwide.^{9,17} A mean excess of 7.32 inpatient days per smoker translates, across the volume of elective cases

managed annually at major Pakistani tertiary centres, into considerable additional antibiotic expenditure, nursing time, consumable use, and surgical bed occupation. Even a modest reduction in smoking-attributable complications through preoperative cessation support would produce meaningful gains in surgical throughput and patient welfare at scale. The case for structured preoperative tobacco cessation in Pakistan is compelling but currently unaddressed by national policy. No formal perioperative cessation guidelines exist within Pakistan's public surgical framework, and pharmacological cessation aids are largely unavailable through the public sector. The capacity of nursing staff to engage patients in postoperative wound care and complication surveillance forms one part of this gap: Huzaifa et al., in a study of nurses at public sector teaching hospitals in Peshawar, documented significant deficiencies in knowledge and practice regarding postoperative wound care, underscoring the need to strengthen allied health capacity at the point of postoperative care delivery.^{15,18} The surgical preoperative consultation itself represents a readily accessible and well-timed opportunity for at least brief structured cessation advice, and the evidence presented in this study provides the locally grounded empirical foundation that policymakers and hospital administrators require to justify integrating tobacco assessment and cessation into Pakistan's elective surgical pathways.

LIMITATIONS

The study was conducted at a single tertiary-care institution and may not represent other surgical settings. Smoking status was self-reported and was not biochemically verified. Never-smokers and recent quitters were combined in the non-active group. Procedure-specific risk was not reported. Standard deviations for length-of-stay measures were absent.

CONCLUSIONS

This prospective study confirms that active tobacco smoking is a powerful, dose-dependent, and modifiable risk factor for adverse postoperative outcomes in elective general surgery. Smokers faced more than three times the odds of complications compared to non-smokers, with respiratory morbidity and wound-related events dominating the complication profile, and their total hospital stay was nearly doubled. These findings carry direct clinical and policy implications for Pakistan, where male tobacco prevalence remains high and preoperative cessation support is largely absent from public surgical pathways. Routine quantification of tobacco burden in pack-years should be incorporated

into all preoperative assessments, and brief cessation counselling should be delivered at every surgical consultation. National health authorities are urged to develop evidence-based perioperative tobacco guidelines that reflect the scale of smoking-attributable surgical risk.

CONFLICT OF INTEREST: None

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REFERENCES

- World Health Organization. WHO global report on trends in prevalence of tobacco use 2000–2030. Geneva: World Health Organization; 2024. ISBN: 978-92-4-008828-3.
- Saqib MAN, Rafique I, Qureshi H, Munir MA, Bashir R, Arif BW, et al. Burden of tobacco in Pakistan: findings from Global Adult Tobacco Survey 2014. *Nicotine Tob Res.* 2018;20(9):1138-1143. doi:10.1093/ntr/ntx179. PMID: 29059338.
- Benowitz NL. Clinical pharmacology of nicotine: implications for understanding, preventing, and treating tobacco addiction. *Clin Pharmacol Ther.* 2008;83(4):531-541. doi:10.1038/clpt.2008.3. PMID: 18305452.
- Ashraf M, Vervoort D, Rizvi S, Fatima I, Shoman H, Meara JG, et al. Access to safe, timely and affordable surgical, anaesthesia and obstetric care in Pakistan: a 16-year scoping review. *East Mediterr Health J.* 2022;28(4):302-313. doi:10.26719/emhj.22.009. PMID: 35545912.
- Khan FU, Fang Y, Khan Z, Khan FU, Malik ZI, Ahmed N, et al. Occurrence, associated risk factors, and treatment of surgical site infections in Pakistan. *Eur J Inflam.* 2020;18:2058739220960547. doi:10.1177/2058739220960547.
- Basit A, Younus BB, Waris N, Fawwad A. Prevalence of tobacco use in urban and rural areas of Pakistan: a sub-study from second National Diabetes Survey of Pakistan (NDSP) 2016-2017. *Pak J Med Sci.* 2020;36(4):808-815. doi:10.12669/pjms.36.4.1705. PMID: 32494279.
- Thomsen T, Tønnesen H, Møller AM. Effect of preoperative smoking cessation interventions on postoperative complications and smoking cessation. *Br J Surg.* 2009;96(5):451-461. doi:10.1002/bjs.6591. PMID: 19358172.
- Gräsbeck HL, Reito ARP, Ekroos HJ, Aakko JA, Hölsä O, Vasankari TM. Smoking is a predictor of complications in all types of surgery: a machine learning-based big data study. *BJS Open.* 2023;7(2). doi:10.1093/bjsopen/zrad016. PMID: 37086402.
- STARSurg Collaborative. Prevalence, trends and outcomes from smoking in elective surgical systems: a secondary analysis of a prospective observational cohort study across 442 hospitals from 29 countries across Europe. *Lancet Reg Health Eur.* 2025;53:101282. doi:10.1016/j.lanepe.2025.101282. PMID: 40636061.
- Myers K, Hajek P, Hinds C, McRobbie H. Stopping smoking shortly before surgery and postoperative complications: a systematic review and meta-analysis. *Arch Intern Med.* 2011;171(11):983-989. doi:10.1001/archinternmed.2011.97. PMID: 21403009.
- Gajdos C, Hawn MT, Campagna EJ, Henderson WG, Singh JA, Houston T. The adverse effects of smoking on postoperative outcomes in cancer patients. *Ann Surg Oncol.* 2012;19(5):1430-1438. doi:10.1245/s10434-011-2128-y. PMID: 22065194.
- Zahra A, Hassan SUN, Batool A, Iqbal N, Khatoon F, Attaya M. Prevalence and determinants of second-hand tobacco smoking in Pakistan. *East Mediterr Health J.* 2022;28(11):805-812. doi:10.26719/emhj.22.086. PMID: 36515444.
- Vágvolgyi A, Rozgonyi Z, Vadász P, Varga JT. Risk stratification before thoracic surgery, perioperative pulmonary rehabilitation. *Orv Hetil.* 2017;158(50):1989-1997. doi:10.1556/650.2017.30862. PMID: 29226712.
- Ma T, Lu K, Song L, Wang D, Ning S, Chen Z, et al. Modifiable factors as current smoking, hypoalbumin, and elevated fasting blood glucose level increased the SSI risk following elderly hip fracture surgery. *J Invest Surg.* 2020;33(8):750-758. doi:10.1080/08941939.2018.1556364. PMID: 30885013.
- Quan H, Ouyang L, Zhou H, Ouyang Y, Xiao H. The effect of preoperative smoking cessation and smoking dose on postoperative complications following radical gastrectomy for gastric cancer: a retrospective study of 2469 patients. *World J Surg Oncol.* 2019;17(1):61. doi:10.1186/s12957-019-1607-7. PMID: 30940207.
- Huzaifa M, Ahmad IW, Amin I, Raheem K, Gul K, Aziz S. Assessing knowledge and practice among nurses regarding postoperative wound care in public sector teaching hospitals of Peshawar. *Pak Biomed J.* 2024;7(7):19-23. doi:10.54393/pbmj.v7i07.1118.
- World Health Organization. Smoking greatly increases risk of complications after surgery [Internet]. Geneva: World Health Organization; 2020 Jan 20.
- Møller AM, Villebro N, Pedersen T, Tønnesen H. Effect of preoperative smoking intervention on postoperative complications: a randomised clinical trial. *Lancet.* 2002;359(9301):114-117. doi:10.1016/S0140-6736(02)07369-5. PMID: 11809253.

AUTHORS CONTRIBUTION

Muhammad Imran - Concept & Design; Data Acquisition; Data Analysis/Interpretation; Drafting Manuscript; Critical Revision; Final Approval

Marya Saleem - Concept & Design; Data Acquisition; Data Analysis/Interpretation; Drafting Manuscript; Critical Revision; Supervision; Final Approval

Javeria Arshad - Concept & Design; Data Acquisition; Data Analysis/Interpretation; Drafting Manuscript; Critical Revision; Supervision; Final Approval

The authors accept responsibility for all aspects of the work and will ensure that any concerns regarding the accuracy or integrity of any part are properly investigated and resolved.



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