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ORIGINAL ARTICLE

Comparison of in-Hospital Outcomes of Smoker Versus Non-Smoker Patients Presenting with Acute Coronary Syndrome

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ABSTRACT

Background: Cigarette smoking is a well-established modifiable risk factor for the development of acute coronary syndrome (ACS). However, its impact on short-term, in-hospital outcomes among patients presenting with ACS remains controversial, with conflicting evidence and the ongoing debate surrounding the so-called "smoker's paradox." This study aimed to compare in-hospital clinical outcomes between smoker and non-smoker patients presenting with acute coronary syndrome.

Methods: This prospective, hospital-based observational comparative study was conducted in the Department of Cardiology, Khyber Teaching Hospital, Peshawar, Pakistan, over a six-month period. Adult patients (≥18 years) presenting with confirmed ACS, including ST-segment elevation myocardial infarction, non–ST-segment elevation myocardial infarction, or unstable angina, were consecutively enrolled. Patients were categorized as smokers or non-smokers based on predefined criteria at admission. Baseline demographic characteristics, cardiovascular risk factors, clinical presentation, and in-hospital management were recorded. In-hospital outcomes, including acute heart failure, cardiogenic shock, arrhythmias, stroke, in-hospital mortality, and length of hospital stay, were compared between the two groups using appropriate statistical tests.

Results: A total of 157 patients were included, comprising 85 smokers (54.1%) and 72 non-smokers (45.9%). Baseline characteristics, including age, body mass index, cardiovascular risk factors, ACS type, Killip class, and in-hospital management strategies, were comparable between the two groups. No statistically significant differences were observed between smokers and non-smokers with respect to acute heart failure, cardiogenic shock, arrhythmias, stroke, in-hospital mortality, or length of hospital stay.

Conclusion: In this cohort of patients presenting with acute coronary syndrome, smoking status was not associated with differences in short-term, in-hospital clinical outcomes or duration of hospitalization. These findings underscore the importance of distinguishing short-term hospital outcomes from the well-established long-term cardiovascular risks associated with smoking. Despite comparable in-hospital prognosis, smoking cessation remains a critical component of secondary prevention in patients with acute coronary syndrome.

Keywords: Acute Coronary Syndrome, Smoking, Cigarette Smoking, In-Hospital Outcomes, Cardiovascular Risk Factors, Myocardial Infarction, Observational Study, Mortality, Length of Stay, Pakistan

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Introduction

Acute coronary syndrome (ACS), comprising ST-segment elevation myocardial infarction (STEMI), non-ST-segment elevation myocardial infarction (NSTEMI), and unstable angina, remains a leading cause of cardiovascular morbidity and mortality worldwide despite substantial advances in prevention and treatment strategies (1).

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The burden of ACS is particularly high in low- and middle-income countries, where increasing cardiovascular risk factors, delayed presentation, and limited healthcare resources contribute to poor clinical outcomes (2). South Asian populations experience ACS at a younger age and often present with more severe disease, highlighting the need for locally generated evidence to guide clinical practice (3).

Cigarette smoking is one of the most important modifiable risk factors for coronary artery disease and ACS (4). Smoking promotes endothelial dysfunction, oxidative stress, inflammation, platelet activation, and thrombosis, thereby accelerating atherosclerosis and increasing the risk of acute coronary events (5). Consequently, smokers frequently present with ACS at a younger age than non-smokers and constitute a substantial proportion of patients admitted with acute myocardial infarction.

Although smoking is an established cause of cardiovascular disease, its influence on short-term outcomes after ACS remains controversial. Several studies have described the so-called "smoker's paradox," whereby smokers appear to experience lower in-hospital mortality or more favorable short-term outcomes following ACS than non-smokers (6). Proposed explanations include younger age, fewer chronic comorbidities, and greater responsiveness to reperfusion therapy among smokers. However, more recent investigations suggest that these apparent benefits largely disappear after adjustment for baseline clinical characteristics, indicating that the smoker's paradox may primarily reflect residual confounding rather than a true protective effect of smoking (7). Furthermore, long-term follow-up consistently demonstrates poorer cardiovascular outcomes among smokers, emphasizing the detrimental effects of continued tobacco exposure (8).

In-hospital outcomes, including acute heart failure, cardiogenic shock, arrhythmias, stroke, mortality, and duration of hospitalization, are important indicators of disease severity and quality of care in patients with ACS (9). However, evidence regarding the relationship between smoking status and these short-term outcomes remains inconsistent, particularly in low- and middle-income countries where patient characteristics and treatment patterns may differ substantially from those reported in Western populations (10). In Pakistan, data comparing in-hospital outcomes between smokers and non-smokers presenting with ACS are limited. Therefore, this prospective observational study was conducted to compare in-hospital clinical outcomes between smoker and non-smoker patients presenting with acute coronary syndrome at a tertiary care hospital in Pakistan. The findings may contribute to a better understanding of the clinical impact of smoking on short-term ACS outcomes and provide evidence to support risk stratification and secondary prevention strategies in similar healthcare settings.

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Methods

This prospective hospital-based observational comparative study was conducted in the Department of Cardiology, Khyber Teaching Hospital, Peshawar, Pakistan, over a six-month period to compare in-hospital outcomes between smoker and non-smoker patients presenting with acute coronary syndrome (ACS). Khyber Teaching Hospital is a tertiary care referral center serving patients from both urban and rural areas of Khyber Pakhtunkhwa. The study was conducted in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines. Ethical approval was obtained from the Institutional Ethical Review Board of Khyber Teaching Hospital, Peshawar (Approval No. 108/DME/KMC; dated 30 January 2025). Written informed consent was obtained from all participants or their legally authorized representatives.

The sample size was calculated using the World Health Organization (WHO) sample size calculator assuming a 95% confidence level, a 4% margin of error, and the expected prevalence of smoking among patients with ACS reported in previous regional studies. A minimum sample size of 157 participants was obtained. Consecutive non-probability sampling was used, and all eligible patients presenting during the study period were enrolled until the required sample size was achieved.

Adult patients (≥18 years) with a confirmed diagnosis of ACS, including ST-segment elevation myocardial infarction (STEMI), non-ST-segment elevation myocardial infarction (NSTEMI), or unstable angina, based on clinical presentation, electrocardiographic findings, and cardiac biomarkers, were included. Only patients presenting within 48 hours of symptom onset were enrolled. Patients with previous coronary artery bypass grafting or percutaneous coronary intervention, chronic kidney disease requiring dialysis, advanced chronic liver disease, active malignancy, significant valvular heart disease, pre-existing neurological disorders, incomplete medical records, or passive smoking exposure alone were excluded.

Smoking status was determined through direct patient interviews at admission. A current smoker was defined as an individual who smoked at least one cigarette daily during the preceding six months and continued smoking until hospital admission. A former smoker was defined as an individual who had abstained from smoking for at least six months before admission, while a non-smoker was defined as an individual who had never smoked or had smoked fewer than 100 cigarettes during their lifetime. Smoking duration, average daily cigarette consumption, and cumulative smoking exposure (pack-years) were recorded whenever available. For the primary analysis, patients were categorized as current smokers or non-smokers (including never-smokers and former smokers).

Demographic, clinical, laboratory, and treatment-related data were collected using a structured proforma through patient interviews and review of medical records. Variables included age, sex, body mass index, diabetes mellitus, hypertension, dyslipidemia, smoking status, type of ACS, symptom duration, laboratory investigations, electrocardiographic findings, thrombolytic therapy, primary percutaneous coronary intervention, and relevant imaging findings. Patients were prospectively followed throughout hospitalization to assess pre-defined clinical outcomes.

The primary outcome was the comparison of in-hospital clinical outcomes between

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smokers and non-smokers. Length of hospital stay was defined as the number of days from hospital admission until discharge or in-hospital death. In-hospital mortality was defined as death from any cause during the index hospitalization. Cardiogenic shock was defined as persistent systolic blood pressure <90 mmHg for at least 30 minutes or the need for vasopressor support with evidence of end-organ hypoperfusion. Acute heart failure was defined as new or worsening heart failure requiring intravenous diuretics, vasodilators, or inotropic therapy. Stroke was defined as a new focal neurological deficit lasting more than 24 hours with radiological confirmation. Clinically significant arrhythmia was defined as any documented atrial or ventricular arrhythmia requiring pharmacological or electrical treatment during hospitalization.

Data were analyzed using SPSS version 25.0 (IBM Corp., Armonk, NY, USA). Continuous variables were presented as mean ± standard deviation or median (interquartile range), while categorical variables were expressed as frequencies and percentages. Comparisons between smokers and non-smokers were performed using the independent-samples t-test or Mann–Whitney U test for continuous variables and the Chi-square test or Fisher's exact test for categorical variables. Cases with missing data were analyzed using a complete-case approach. A two-sided p-value ≤0.05 was considered statistically significant.

Results

A total of 157 patients with acute coronary syndrome were included, comprising 85 smokers (54.1%) and 72 non-smokers (45.9%). The mean age and body mass index were comparable between smokers and non-smokers (55.41 ± 10.50 vs. 53.03 ± 7.66 years, $p = 0.114$; and 26.59 ± 4.07 vs. 26.56 ± 3.48 kg/m², $p = 0.959$, respectively).

Baseline demographic characteristics, cardiovascular risk factors, clinical presentation, and in-hospital management strategies were similar between smokers and non-smokers, as detailed in Table 1.

Table 1. Baseline characteristics of smokers and non-smokers with acute coronary syndrome

Variable	Smokers (n = 85)	Non-smokers (n = 72)	*p*-value
Gender			
Male	62 (72.9%)	54 (75.0%)	>0.05
Female	23 (27.1%)	18 (25.0%)	
Diabetes mellitus			
Yes	33 (38.8%)	30 (41.7%)	>0.05
No	52 (61.2%)	42 (58.3%)	
Hypertension			
Yes	43 (50.6%)	40 (55.6%)	>0.05
No	42 (49.4%)	32 (44.4%)	
Dyslipidemia			
Yes	35 (41.2%)	21 (29.2%)	>0.05
No	50 (58.8%)	51 (70.8%)	
Type of ACS			
STEMI	47 (55.3%)	38 (52.8%)	>0.05
NSTEMI	28 (32.9%)	27 (37.5%)	
Unstable angina	10 (11.8%)	7 (9.7%)	
Killip class			
Class I	44 (51.8%)	42 (58.3%)	>0.05
Class II	20 (23.5%)	19 (26.4%)	
Class III	15 (17.6%)	9 (12.5%)	
Class IV	6 (7.1%)	2 (2.8%)	
Thrombolysis			
Yes	41 (48.2%)	31 (43.1%)	>0.05
No	44 (51.8%)	41 (56.9%)	
Primary PCI			
Yes	26 (30.6%)	23 (31.9%)	>0.05
No	59 (69.4%)	49 (68.1%)	

Values are presented as a number (percentage) unless otherwise stated.

The comparison of in-hospital outcomes between smokers and non-smokers is shown in Table 2. The incidence of acute heart failure, cardiogenic shock, arrhythmias, stroke, and in-hospital mortality did not differ significantly between the two groups.

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In-hospital mortality occurred in 18 patients (11.5%) overall, including 11 smokers (12.9%) and 7 non-smokers (9.7%), with no statistically significant difference between the groups ($p > 0.05$).

Table 2. Comparison of in-hospital outcomes between smokers and non-smokers

Outcome	Smokers (n = 85)	Non-smokers (n = 72)	*p*-value
Acute heart failure			
Yes	19 (22.4%)	17 (23.6%)	>0.05
No	66 (77.6%)	55 (76.4%)	
Cardiogenic shock			
Yes	7 (8.2%)	7 (9.7%)	>0.05
No	78 (91.8%)	65 (90.3%)	
Arrhythmia			
Yes	14 (16.5%)	11 (15.3%)	>0.05
No	71 (83.5%)	61 (84.7%)	
Stroke			
Yes	3 (3.5%)	3 (4.2%)	>0.05
No	82 (96.5%)	69 (95.8%)	
In-hospital mortality			
Yes	11 (12.9%)	7 (9.7%)	>0.05
No	74 (87.1%)	65 (90.3%)	

The length of hospital stay was not normally distributed; therefore, a Mann–Whitney U test was used. The median duration of hospitalization was similar between smokers and non-smokers, with no statistically significant difference observed (Mann–Whitney U = 3025, $p = 0.943$). These findings suggest that smoking status was not associated with short-term, in-hospital clinical outcomes among patients admitted with acute coronary syndrome.

Discussion

In this hospital-based observational study, patients presenting with acute coronary syndrome who were smokers and non-smokers demonstrated comparable baseline demographic and clinical characteristics, including cardiovascular risk factors, type of ACS, Killip class at presentation, and in-hospital management strategies. Importantly, no statistically significant differences were observed between smokers and non-smokers in terms of acute heart failure, cardiogenic shock, arrhythmias, stroke, in-hospital mortality, or length of hospital stay.

The association between smoking status and outcomes following acute coronary syndrome has been widely studied, with heterogeneous and sometimes conflicting results. Several contemporary studies have reported neutral short-term outcomes between smokers and non-smokers, particularly in settings where early reperfusion and guideline-directed medical therapy are consistently applied(11,12,13). Our findings are in agreement with these reports, supporting the notion that advances in acute cardiovascular care may attenuate early outcome differences related to smoking status.

In contrast, other investigations have shown worse outcomes among smokers, including higher rates of complications and mortality, often attributed to a higher burden of ongoing inflammation, prothrombotic states, and poorer adherence to secondary prevention strategies(14,15). Conversely, the so-called "smoker's paradox" where smokers appear to experience more favorable short-term outcomes after ACS has been described in several studies(16,17). However, this paradox has increasingly been challenged and is now largely considered an artifact of confounding, particularly related to younger age, fewer

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comorbidities, and differences in baseline risk profiles among smokers (11).

In the present study, the absence of a smoker's paradox may be explained by the similarity in baseline characteristics between smokers and non-smokers, as well as comparable in-hospital management across groups. Additionally, our focus on in-hospital outcomes only may have limited the detection of longer-term differences that have been reported in some studies evaluating post-discharge outcomes. These factors collectively provide a plausible explanation for the neutral findings observed.

Cigarette smoking is a well-established contributor to atherogenesis and acute coronary events through mechanisms such as endothelial dysfunction, oxidative stress, systemic inflammation, enhanced platelet activation, and plaque instability(18,19). Despite these harmful pathophysiological effects, our findings suggest that smoking-related vascular injury does not necessarily translate into worse short-term in-hospital outcomes once ACS has occurred.

The observation of comparable in-hospital outcomes between smokers and non-smokers should not be interpreted as evidence that smoking is benign. Smoking remains one of the most important modifiable risk factors for cardiovascular disease and is strongly associated with recurrent myocardial infarction, heart failure, and long-term mortality (20–22). Hospitalization for ACS represents a critical "teachable moment" for initiating smoking cessation interventions.

From a clinical standpoint, structured smoking cessation counseling, pharmacotherapy, and referral to cessation programs should be integral components of ACS management. From a public health perspective, these findings reinforce the need to distinguish short-term hospital outcomes from long-term cardiovascular risk, emphasizing sustained tobacco control and secondary prevention strategies.

Strength of the Study

The strengths of our study included the direct comparison of smokers and non-smokers presenting with ACS within the hospital setup, and the confounding is reduced by comparison of the baseline characteristics between the groups, thus enhancing internal validity.

Study Limitations

Our study has certain limitations, such as a single-center design, which limits the generalizability, and the observational nature of the study reduces the causal inference. In addition to this data regarding the smoking intensity, duration, and cessation of smoking were not available, which can influence risk stratification; all these limitations primarily affect the external validity without affecting the internal consistency of the findings.

Future studies should focus on large multicenter prospective studies with longer follow-up.

Conclusion

Our findings highlight the importance of distinguishing short-term in-hospital prognosis from long-term cardiovascular risk. While immediate outcomes may be similar under contemporary care, smoking cessation remains essential for reducing recurrent events and improving long-term survival.

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All the authors agree to take responsibility for every facet of the work, making sure that any concerns about its integrity or veracity are thoroughly examined and addressed.	