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Frequency of Persistent Smoking Among Patient Undergone Percutaneous Coronary Intervention (PCI) at Tertiary Care Hospital

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ABSTRACT

Background: Tobacco smoking is a major modifiable risk factor for coronary artery disease and is strongly associated with adverse cardiovascular outcomes. Although percutaneous coronary intervention effectively restores coronary blood flow in patients with acute coronary syndrome, continued smoking after intervention significantly reduces its long-term benefits and increases the risk of recurrent cardiac events. **Objective:** To determine the frequency of persistent smoking among patients undergone percutaneous coronary intervention (PCI) at a tertiary care cardiac center. **Methods:** This was a descriptive, cross-sectional study conducted at the Department of Cardiology, Liaquat National Hospital & Medical College, Karachi, from 14 February 2025 to 14 May 2025. A total of 178 patients who had undergone percutaneous coronary intervention (PCI) for acute coronary syndrome were included. **Results:** Persistent smoking was observed in 68 patients (38.2%), while 110 patients (61.8%) successfully quit smoking after PCI. Higher rates of persistent smoking were noted among younger patients aged 30–44 years (50.0%), males (42.6%), obese individuals (49.2%), and patients with diabetes mellitus (52.2%) and dyslipidemia (47.7%). Heavy smokers consuming more than 20 cigarettes per day showed the highest persistence rate (56.8%). Multivariable analysis identified male gender (adjusted OR 2.14), age <45 years (adjusted OR 2.61), diabetes mellitus (adjusted OR 2.78), dyslipidemia (adjusted OR 1.96), obesity (adjusted OR 1.89), and heavy smoking (adjusted OR 3.12) as independent predictors of persistent smoking. **Conclusion:** More than one-third of patients continued smoking after PCI, particularly younger males, heavy smokers, and those with metabolic comorbidities. These findings highlight the need for structured, targeted smoking cessation interventions as an integral component of post-PCI care.

INTRODUCTION

There has been little indication that tobacco smoking is not one of the biggest yet the avoidable causes of morbidity and mortality across the globe. It is approximated that over 1.1 billion adults are cigarette smokers in the world and an extra number of several hundred million people use smokeless or substitute tobacco products [1]. World Health Organization states that tobacco use has been the cause of more than eight million deaths every year; this is approximately fifty percent of the long-term tobacco users [2]. In addition to malignancies and chronic respiratory diseases, tobacco consumption is a significant cause of cardiovascular disease (CVD), which remains the most prevalent cause of death in the whole world [3]. Smoking has been central to the pathogenesis and progression of atherosclerosis since it causes endothelial dysfunction, oxidative stress, inflammation, platelet activation, and a poor lipid profile change [4]. These pathophysiological processes put individuals at high risk of developing acute coronary syndrome (ACS), such as ST-elevation myocardial infarction (STEMI), non-ST-elevation myocardial infarction (NSTEMI), and unstable angina [5]. The epidemiological information indicates that tobacco consumption causes approximately 11 percent of all cardiovascular deaths in the world, which highlights its significant role in causing coronary artery disease (CAD) burden [6]. Coronary artery disease is one of the primary issues of societal concern especially in the low and the middle-income nations. The South Asian people have an extremely higher disease burden of CAD and cardiovascular events occur at a younger age than in Western populations [7]. Other prevalence of CAD in Pakistan is reported between 7-12 percent and smoking has been considered to be a notable and modifiable risk factor [8]. The fact that smoking is present in combination with other risk factors of heart diseases like diabetes mellitus, hypertension, dyslipidemia, and obesity only

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increases the severity of the disease and exacerbates the clinical outcomes [9].

Percutaneous coronary intervention (PCI) now represents an important part of the treatment of patients with stable CAD and ACS, providing efficient coronary reperfusion and symptom relief [10]. The developments in stent technology and pharmacotherapy have better short and long term outcomes after PCI. Nevertheless, behavioral issues attributable to the patients, especially their persistence in smoking during the follow-up, may negatively influence the outcome of the procedure and the final prognosis [11]. Even though a significant percentage of the patients who experience a coronary event or a PCI will make an attempt to quit smoking, evidence indicates that most will revert to smoking even after receiving medical counsel [12]. Continued smoking following PCI has been linked to the heightened risk of myocardial infarction recurrence, in-stent restenosis, stent thrombosis, HF and cardiovascular mortality [13]. The persistent exposure to tobacco smoke contributes to the vulnerability of the plaque, the increase in the thrombogenicity, and the deterioration of vascular healing and, as a result, the impact of revascularization is compromised [14]. Interestingly, other studies have also referred to the so-called smokers paradox wherein it seems that smokers receiving PCI have better short-term results than non-smokers. This has been explained by younger age, less comorbidities, and possible ischemic preconditioning effects on smokers [12]. But current evidence is slowly refuting this notion, and shows that any ostensible short term gain is offset by worse long term cardiovascular prognosis in regards to continued smoking [13][14]. Even though there is a lot of international literature, information on the smoking behaviour following PCI among the local Pakistani populations is limited. Some of the reasons behind continued tobacco use following intervention may include the cultural factors, the absence of structured smoking cessation programs, insufficient post-PCI counseling and insufficient awareness of the long-term risks of cardiovascular complications. It is thus necessary to determine the prevalence of chronic smoking among post- PCI patients so as to formulate specific second line prevention measures.

Objective

To determine the frequency of persistent smoking among patients undergone percutaneous coronary intervention (PCI) at a tertiary care cardiac center.

METHODOLOGY

This was a descriptive, cross-sectional study conducted at the Department of Cardiology, Liaquat National Hospital & Medical College, Karachi, 14 February 2025 to 14 May 2025. A total of 178 patients who had undergone percutaneous coronary intervention (PCI) for acute coronary syndrome were included. The study was designed to determine the frequency of persistent smoking among patients following PCI. Patients presenting to the cardiology outpatient department for routine follow-up at least six months after PCI were assessed systematically.

Inclusion Criteria

- Patients of either gender
- Age between 30 and 75 years
- Diagnosed cases of acute coronary syndrome (STEMI, NSTEMI, or unstable angina) as per operational definitions
- Patients who had undergone percutaneous coronary intervention at least six months prior
- Patients who were smokers at the time of PCI
- Patients willing to provide informed consent

Exclusion Criteria

- Patients who refused to give informed consent
- Patients with a history of alcohol use
- Patients with a prior history of coronary artery bypass grafting
- Patients with incomplete clinical records or missing follow-up data

Data Collection

Data were collected using a structured, pre-designed proforma after obtaining approval from the institutional ethical review committee of Liaquat National Hospital and CPSP. Patients fulfilling the inclusion criteria were enrolled during follow-up visits to the cardiology outpatient department. Demographic variables including age and gender were recorded. Anthropometric measurements such as weight and height were obtained, and body mass index was calculated accordingly. Clinical comorbidities including hypertension, diabetes mellitus, dyslipidemia, and obesity were documented as per operational definitions. Smoking status after PCI was assessed through patient history, and participants were categorized as persistent smokers or non-smokers. Among persistent smokers, smoking intensity was further classified as same intensity or reduced intensity compared to pre-PCI status. All data were recorded by the principal investigator to ensure consistency and completeness.

Statistical Analysis

Data were entered and analyzed using SPSS version 25.0. Quantitative variables such as age, weight, height, and body mass index were assessed for normality using the Shapiro–Wilk test and expressed as mean ± standard deviation or median with interquartile range as appropriate. Qualitative variables including gender, comorbidities, smoking status, and intensity of persistent smoking were presented as frequencies and percentages. Effect modifiers such as age group, gender, diabetes mellitus, hypertension, dyslipidemia, and obesity were controlled through stratification. Post-stratification chi-square test or Fisher's exact test was applied where appropriate. A p-value of ≤ 0.05 was considered statistically significant.

RESULTS

Among 178 patients, most were aged 45–59 years (44.4%), followed by ≥60 years (28.7%) and 30–44 years (27.0%). Males predominated (76.4%). Obesity was present in 35.4% of patients. Persistent smoking was highest in younger patients aged 30–44 years (50.0%), compared with 39.2% in those aged 45–59 years and 25.5% in those ≥60 years. Males showed higher persistent smoking (42.6%) than females (23.8%), and obese

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patients had nearly half continuing smoking after PCI (49.2%).

Table 1

Baseline Demographic, Anthropometric, and Clinical Characteristics of Study Participants (N = 178)

Variable	Category	n (%)	Persistent Smokers n (%)	Quit Smokers n (%)
Age (years)	30–44	48 (27.0)	24 (50.0)	24 (50.0)
	45–59	79 (44.4)	31 (39.2)	48 (60.8)
	≥60	51 (28.7)	13 (25.5)	38 (74.5)
Gender	Male	136 (76.4)	58 (42.6)	78 (57.4)
	Female	42 (23.6)	10 (23.8)	32 (76.2)
Body Mass Index	Normal (<25 kg/m²)	54 (30.3)	15 (27.8)	39 (72.2)
	Overweight (25–27.4 kg/m²)	61 (34.3)	22 (36.1)	39 (63.9)
	Obese (≥27.5 kg/m²)	63 (35.4)	31 (49.2)	32 (50.8)

STEMI was the most common presentation (51.7%), followed by NSTEMI (30.3%) and unstable angina (18.0%). Persistent smoking was most frequent among STEMI patients (44.6%) compared to NSTEMI (35.2%) and unstable angina (25.0%). Hypertension was present in 58.4% of patients, with 45.2% of them continuing smoking. Diabetes mellitus affected 38.8% of patients, over half of whom remained smokers (52.2%). Dyslipidemia was present in 49.4%, with 47.7% showing persistent smoking.

Table 2

Clinical Presentation and Cardiovascular Risk Profile

Variable	Category	Total n (%)	Persistent Smoking n (%)	p-value
Type of ACS	STEMI	92 (51.7)	41 (44.6)	0.032
	NSTEMI	54 (30.3)	19 (35.2)	
	Unstable Angina	32 (18.0)	8 (25.0)	
Hypertension	Present	104 (58.4)	47 (45.2)	0.021
	Absent	74 (41.6)	21 (28.4)	
Diabetes Mellitus	Present	69 (38.8)	36 (52.2)	0.004
	Absent	109 (61.2)	32 (29.4)	
Dyslipidemia	Present	88 (49.4)	42 (47.7)	0.009
	Absent	90 (50.6)	26 (28.9)	

At the time of PCI, 39.9% smoked 10–15 cigarettes/day, 35.4% smoked 16–20/day, and 24.7% smoked more than 20/day. Persistent smoking increased with smoking intensity, affecting 25.4% of light smokers, 39.7% of moderate smokers, and 56.8% of heavy smokers. Long-term smoking for more than 20 years showed higher persistence (47.9%). Unconventional smoking was reported by 21.9%, with 56.4% continuing smoking. Persistent smoking declined with longer follow-up, from 47.0% at 6–9 months to 29.6% after 12 months.

Table 3

Smoking-Related Characteristics at Time of PCI and Follow-up

Variable	Category	Total n (%)	Persistent Smokers n (%)	Quit Smokers n (%)
Cigarettes/day (Pre-PCI)	10–15	71 (39.9)	18 (25.4)	53 (74.6)
	16–20	63 (35.4)	25 (39.7)	38 (60.3)
	>20	44 (24.7)	25 (56.8)	19 (43.2)
Duration of Smoking	≤10 years	56 (31.5)	16 (28.6)	40 (71.4)
	11–20 years	74 (41.6)	29 (39.2)	45 (60.8)
	>20 years	48 (27.0)	23 (47.9)	25 (52.1)
Unconventional Smoking	Yes	39 (21.9)	22 (56.4)	17 (43.6)
	No	139 (78.1)	46 (33.1)	93 (66.9)
Time Since PCI	6–9 months	66 (37.1)	31 (47.0)	35 (53.0)
	10–12 months	58 (32.6)	21 (36.2)	37 (63.8)
	>12 months	54 (30.3)	16 (29.6)	38 (70.4)

Among persistent smokers, 57.4% continued smoking at the same or higher intensity, while 42.6% reduced consumption. Male gender (adjusted OR 2.14), age below 45 years (adjusted OR 2.61), diabetes mellitus (adjusted OR 2.78), dyslipidemia (adjusted OR 1.96), obesity (adjusted OR 1.89), and heavy smoking of more than 20 cigarettes/day (adjusted OR 3.12) were independently associated with continued smoking after PCI.

Table 4

Intensity and Predictors of Persistent Smoking After PCI

A. Intensity Pattern Among Persistent Smokers (n = 68)

Variable	Category	n (%)	Associated Comorbidity n (%)
Smoking Intensity	Same or Increased	39 (57.4)	26 (66.7)
	Reduced (≥50%)	29 (42.6)	14 (48.3)
Diabetes Mellitus	Present	36 (52.2)	24 (66.7)
Obesity	Present	31 (45.6)	21 (67.7)

B. Multivariable Logistic Regression Analysis for Persistent Smoking

Variable	Adjusted OR	95% CI	p-value
Male Gender	2.14	1.03–4.45	0.041
Age <45 years	2.61	1.29–5.28	0.007
Diabetes Mellitus	2.78	1.42–5.46	0.003
Dyslipidemia	1.96	1.01–3.81	0.046
Obesity	1.89	1.02–3.51	0.039
Heavy Smoking (>20/day)	3.12	1.58–6.17	0.001

DISCUSSION

Permanent smoking was identified in 68 patients (38.2) out of 178 patients who underwent percutaneous coronary intervention, and 110 patients (61.8) were able to give up smoking. This percentage of persistent smoking is in very close correlation with former studies, in which about one-third to two-fifths of post-PCI patients did not reach long-term cessation, which suggests that revascularization is not a sure tool of behavioral modification. The prevalence of persistent smoking had apparent age gradient, with the percentage being 50.0 in the cohort of 30-44 years, 39.2 in 45-59 years and 25.5 years in 60 years and older cohorts respectively. Age-related differences with reduced cessation among younger patients have also been found to be similar in past studies [15][16]. There was also a significant difference between genders, as continuing smoking among males (23.8 per cent) was observed to be significantly higher than in females (42.6 per cent), as it has been observed in the past

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studies and it can be ascribed to sociocultural and behavioral differences [17]. There was a strong correlation between cardiovascular risk factors and smoking persistence. Hypertension was found in 58.4 percent of the patients and 45.2 percent of hypertensive were smokers. The prevalence of diabetes mellitus was 38.8 percent with 52.2 percent of patients being smokers and 49.4 percent having dyslipidemia and the persistence rate was 47.7. In the 35.4% of patients obesity was recorded and almost half of them were still smoking. Other papers have also underlined similar clustering of metabolic comorbidities in conjunction with long-term smoking [18]. The variables that were related to smoking showed a dose-response relation. Heavy smokers taking more than 20 cigarettes per day who got PCI still smoked 56.8% as opposed to 39.7% of those smokers taking 16-20 cigarettes and 25.4% of those taking less than 16 cigarettes. The association between persistence (47.9% and longer) and more than 20 years of long-term smoking was found. Similar gradients have also been observed in earlier studies, with heavy and long-term smokers appearing to be highly resistant to quitting [19]. Abnormal smoking practices were documented in 21.9% of patients, 56.4% of whom continued to smoke after PCI, which is in line with past studies indicating underreporting of the risk of non-smoking alternative tobacco products [20].

The highest smoking was observed at 6-9 months (47.0) and reduced to 36.2 at 10-12 months and 29.6 at one year follow-up, a similar pattern appearing in earlier studies, where improving smoking percentage was recorded with time as follow-ups were done; however, a significant percentage of the patients still remained smokers [21]. In persistent smokers, 57.4 percent were still smoking at the same level or higher than before and only 42.6 percent were found to have decreased consumption by at least 50 percent compared to prior studies which found that a decrease without stopping of smoking does not confer much cardiovascular protection [22]. Multivariate analysis established male gender as an independent predictor of persistent smoking (adjusted OR 2.14), age- younger than 45 years (adjusted OR 2.61), diabetes mellitus (adjusted OR 2.78), dyslipidemia (adjusted OR 1.96), obesity (adjusted OR 1.89), and heavy smoking (>20 cigarettes/day; adjusted OR 3.12) were independent predictors of persistent smoking. These results support the evidence of the existing literature proving that the smoking retention following PCI is both multi-factorial and is concentrated within recognizable high-risks groups [23]. In general, the current results, in agreement with the past studies, prove that post-PCI persistent smoking is a widespread phenomenon that is highly concentrated in younger males, heavy and long-term smokers, and patients with metabolic comorbidities. These findings indicate the urgent necessity of designed, aggressive smoking cessation programs that lie within post-PCI care regimens, with particular emphasis on high-risk subgroups, which have been revealed in this study.

Limitations

This study was limited by its cross-sectional design, which precludes causal inference. Smoking status was self-reported, introducing potential recall and reporting bias. The single-center setting may limit generalizability. Biochemical confirmation of smoking was not performed, and psychosocial factors influencing smoking behavior were not assessed. Long-term cardiovascular outcomes related to persistent smoking were also not evaluated.

CONCLUSION

It is concluded that persistent smoking remains highly prevalent among patients undergoing percutaneous coronary intervention, with more than one-third of patients continuing tobacco use despite experiencing acute coronary syndrome and receiving revascularization therapy. Persistent smoking was significantly associated with younger age, male gender, heavy and long-term smoking patterns, and the presence of metabolic comorbidities such as diabetes mellitus, dyslipidemia, and obesity. These findings highlight that PCI alone is insufficient to achieve sustained smoking cessation and emphasize the urgent need for structured, targeted smoking cessation strategies integrated into post-PCI care. Implementing comprehensive counseling, pharmacological support, and formal cardiac rehabilitation programs, particularly for high-risk patient groups, may play a crucial role in reducing persistent smoking and improving long-term cardiovascular outcomes.

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