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Original Article

Smokers Paradox Phenomenon and Impact of Pharmacists' Smoking Cessation Counselling in Acute Myocardial Infarction Patients

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ABSTRACT

Background: The "smoker's paradox" suggests that smokers may have better outcomes following Acute Myocardial Infarction (AMI) than non-smokers. However, this paradox remains controversial. This study aimed to evaluate the paradox by comparing clinical outcomes between chronic smokers, former smokers and non-smokers with AMI and to assess the impact of pharmacists' smoking cessation counselling. **Materials and Methods:** A prospective interventional study was conducted at Sudha Institute of Medical Sciences, Erode, involving 218 AMI patients. Data were collected on rehospitalization, recurrent Myocardial Infarction (MI), mortality, and comorbidities. The study population was divided into chronic smokers, former smokers and non-smokers. Statistical analyses, including the chi-square test and Mann-Whitney U test, were used to evaluate the differences in patient outcomes and the effectiveness of smoking cessation counselling. The follow-up period assessed smoking cessation at day 90. **Results:** Chronic smokers had significantly worse outcomes compared to non-smokers, including higher mortality (37.6% vs. 23.5%, $p<0.05$), recurrent MI (47.7% vs. 28.2%, $p<0.05$), and rehospitalization rates. When female patients were excluded, these differences became more pronounced, with higher mortality (37.6% vs. 20%, $p<0.05$) and recurrent MI (47.7% vs. 25%, $p<0.05$). Former smokers had better outcomes than chronic smokers but fared worse than non-smokers. Smoking cessation counselling showed positive effects, with 30.8% of patients quitting smoking by day 90 ($p=0.008$). **Conclusion:** Contrary to the smoker's paradox, chronic smokers experienced poorer short- and long-term outcomes post-AMI. Smoking cessation interventions, especially pharmacist-led counselling, improved patient outcomes, highlighting the need for continued efforts to reduce smoking in AMI patients.

Keywords: Acute Myocardial Infarction (AMI), Smokers Paradox, Smoking Cessation, Pharmacist Intervention, Rehospitalisation, Mortality Rate, Recurrent Myocardial Infarction (MI).

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INTRODUCTION

Globally, cardiovascular disease is the primary cause of death for adults aged 35 to 70, with the aging population contributing to an increase in CVD-related fatalities, making it a major health concern.[1,2] Acute Myocardial Infarction (AMI) has a significant 30-day mortality rate of 3% to 14% among the major cardiovascular diseases.[3] The most severe form of Coronary Artery Disease (CAD) is acute Myocardial Infarction (MI), a potentially lethal event frequently associated with Sudden Cardiac Death (SCD).[4,5] This condition manifests as either ST-Elevation Myocardial Infarction (STEMI) or non-ST-Elevation Myocardial Infarction (NSTEMI).[6]

Cigarette smoking significantly increases the risk of STEMI, making smokers five times more likely to experience this severe condition.[7,8] Despite the known risks, some studies suggest that current smokers recover more favourably from AMI compared to non-smokers,[9] a phenomenon termed the "Smoker's Paradox." This paradox, first identified in 1995,[10] also appears in conditions like COVID-19, lung cancer, and ischemic stroke. The paradox has been partly attributed to factors such as cardiomyocyte preconditioning and altered cellular responses.[11]

Tobacco use remains a major global health challenge, being the second most prevalent psychoactive substance with over one billion users worldwide.[12] It is a leading contributor to Cardiovascular Disease (CVD), accounting for approximately one-quarter of CVD-related deaths.[13] Both active smoking

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and exposure to second-hand smoke are responsible for over 8 million deaths annually.[14] Addressing this issue, pharmacists play a crucial role in smoking cessation by employing the 5 A's method-Ask, Advise, Assess, Assist, and Arrange-to support smokers in their journey to quit, thereby significantly reducing the risk of conditions such as Coronary Artery Disease (CAD) and improving overall health outcomes.[15,16,17]

This study aims to explore the "Smoker's Paradox" in post-myocardial infarction patients by examining their rates of rehospitalization, recurrent myocardial infarction, and mortality. Additionally, it assesses the effectiveness of smoking cessation counselling provided between day 15 and day 90 in supporting patients to quit smoking. The research seeks to clarify the paradox and evaluate the counselling's success in promoting smoking cessation.

MATERIALS AND METHODS

Study Design, Participants, and Study Setting

This prospective interventional study was conducted at the Sudha Institute of Medical Science, Erode, between January 2024 and June 2024, with retrospective data collected from January 2020. Ethical approval was obtained from the Hospital's Ethical Committee (Approval number: ECR/948/Inst/TN/2018/RR-22). Informed consent was secured from all participants, ensuring compliance with ethical standards for human research.

The study included patients diagnosed with Acute Myocardial Infarction (AMI) who had undergone Percutaneous Coronary Intervention (PCI). Eligible participants were between the ages of 31 and 80 years and could have minor comorbidities such as hypertension and diabetes mellitus. Patients who had undergone thrombolysis or those with severe comorbidities that could interfere with study outcomes were excluded. Smoking status was assessed either from case reports or through follow-up phone interviews. All participants were required to provide informed consent and be willing to participate in follow-up assessments.

Sampling Method

For this study, a purposive sampling method was employed. This non-probability sampling technique was chosen to specifically select participants who met the inclusion criteria, ensuring that only patients diagnosed with Acute Myocardial Infarction (AMI) who had undergone Percutaneous Coronary Intervention (PCI) were included. The sampling focused on individuals between the ages of 31 and 80 years with minor comorbidities such as hypertension and diabetes mellitus, while excluding those with severe comorbidities. This method was suitable for targeting a specific subset of the population relevant to the study's objectives.

Sample Size

The prevalence of AMI was estimated at 2.4%, and the sample size was calculated using the following formula:

[N=frac{t2\times P\times (1-P)}{M2}]

Where:

- (t=1.96) (standard normal value at 95% confidence interval),
- (P=0.038) (prevalence of AMI),
- (M=0.05) (margin of error).

[N=frac{(1.96)2\times 0.038\times (1-0.038)}{(0.05)2}=94]

After accounting for an attrition rate, the final sample size was set at 109 participants.

Data Collection Tool

Data was collected using a structured form designed to capture essential patient information, including smoking status, rehospitalization, recurrent myocardial infarction rates, and mortality outcomes. This information was extracted from patient case notes, hospital records, and follow-up interviews.

Ethical Considerations

The study received ethical clearance from the Sudha Institute of Medical Science's Ethical Committee (Approval number: ECR/948/Inst/TN/2018/RR-22). Informed consent was obtained from all participants, and their privacy and confidentiality were maintained throughout the research process.

Statistical Analysis

The chi-square test was used to assess the association between smoking status (Non-Smokers, Former Smokers, and Chronic Smokers) and key outcomes, including re-hospitalization, recurrent MI rates, and death occurrence, with a significance threshold set at $p<0.05$. Additionally, the Mann-Whitney U test was used to evaluate the effectiveness of smoking cessation counselling by comparing the smoking status of patients on day 15 and day 90 post-counselling.

RESULTS

Table 1 shows the baseline characteristics of patients categorized as Non-Smokers, Former Smokers, and Chronic Smokers, indicating significant variations in age and gender distribution. Non-Smokers have the highest mean age (62±7 years) compared to Former Smokers (55±8.1 years) and Chronic Smokers (56± 9.8 years), with this difference being statistically significant ($p < 0.001$). Gender distribution also differs notably, with 52.9% of Non-Smokers being female, while both the Former Smokers and Chronic Smokers groups consist entirely of male patients, resulting in a highly significant p-value ($p < 0.0001$). These results reflect an older average age and a balanced gender representation in the Non-Smoker group, contrasting with the exclusively male composition of the smoking groups. Chronic smoking was most prevalent among younger males aged 31-50 years (Figure

1), consistent with the findings of Bouabdallaoui *et al.*,[18] where younger individuals showed higher smoking rates.

CARDIOVASCULAR RISK PROFILES

Table 2 reveals that former smokers have a more favorable cardiovascular risk profile than both non-smokers and chronic smokers in both groups: the total group (men and women) and men only. Former smokers show lower rates of hypertension (33.3% vs. 40% and 38.5%) and combined hypertension and diabetes (12.5% vs. 24.7% and 21.1%) compared to non-smokers and chronic smokers. Interestingly, chronic smokers exhibit a slightly better profile than non-smokers regarding these conditions. However, the differences are not statistically significant in either group (total or men only).

Table 3 reveals significant differences in rehospitalization rates among non-smokers, former smokers, and chronic smokers,

Table 1: Baseline Characteristics.

Patient demographics		Non-Smokers (*n*=85)	Former-Smokers (*n*=24)	Chronic-Smokers (*n*=109)	*p*-Value
Age in years (Mean±Std)		62±7	55±8.1	56±9.8	<0.001
Gender	Female	45(52.9%)	0(0%)	0(0%)	<0.0001
	Male	40(47%)	24(100%)	109(100%)	

Table 2: Co-morbidities profile in MI patients.

Co-morbidities profile		Non-Smokers *n* (%)	Former-Smokers *n* (%)	Chronic-Smokers *n* (%)	*p*-Value (Non-Smokers vs Former Smokers)	*p*-Value (Former Smokers vs Chronic Smokers)	*p*-Value (Non-Smokers vs Chronic Smokers)
In total group (Men+ Women) *n*=218	None	30(35.2%)	13(54.1%)	43(39.4%)	0.365	0.548	0.729
	Hypertension	34(40%)	8(33.3%)	42(38.5%)			
	Hypertension+Diabetes Mellitus	21(24.7%)	3(12.5%)	23(21.1%)			
	Hypertension+Diabetes mellitus +Peptic ulcer	0(0%)	0(0%)	1(0.9%)			
Only men n=173	None	17(20%)	13(54.1%)	43(39.4%)	0.471	0.548	0.887
	Hypertension	16(18.8%)	8(33.3%)	42(38.5%)			
	Hypertension +Diabetes Mellitus	7(8.2%)	3(12.5%)	23(21.1%)			
	Hypertension +Diabetes mellitus +Peptic ulcer	0(0%)	0(0%)	1(0.9%)			

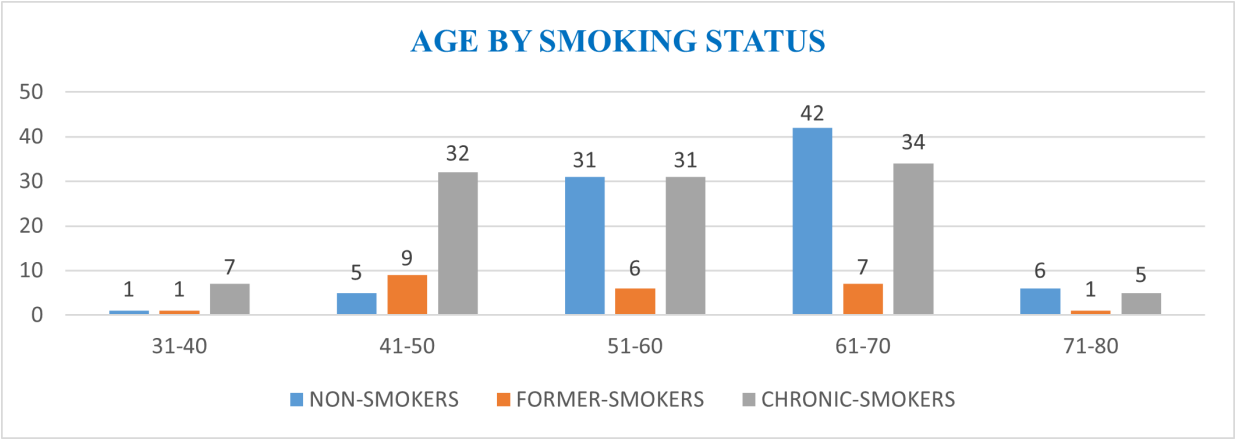

Figure 1: Age in years by smoking status.

Table 3: Re-hospitalization among MI patients.

Re-hospitalization rate		Non-Smokers *n* (%)	Former-Smokers *n* (%)	Chronic-Smokers *n* (%)	*p*-Value (Non-Smokers vs Former Smokers)	*p*-Value (Former Smokers vs Chronic Smokers)	*p*-Value (Non-Smokers vs Chronic Smokers)
In total group (Men+Women) *n*=218	None	23(27%)	1(4.1%)	8(7.3%)	0.006	0.052	<0.01
	1time	27(31.7%)	6(25%)	11(10%)			
	2 times	28(32.9%)	13(54.1%)	40(36.6%)			
	3 times	5(5.8%)	0(0%)	24(22%)			
	4 times	2(2.3%)	3(12.5%)	19(17.4%)			
	5 times	0(0%)	1(4.1%)	7(6.4%)			
Only men *n*=173	None	12(14.1%)	1(4.1%)	8(7.3%)	0.041	0.052	0.0006
	1time	8(9.4%)	6(25%)	11(10%)			
	2 times	14(16.4%)	13(54.1%)	40(36.6%)			
	3 times	4(4.7%)	0(0%)	24(22%)			
	4 times	2(2.3%)	3(12.5%)	19(17.4%)			
	5 times	0(0%)	1(4.1%)	7(6.4%)			

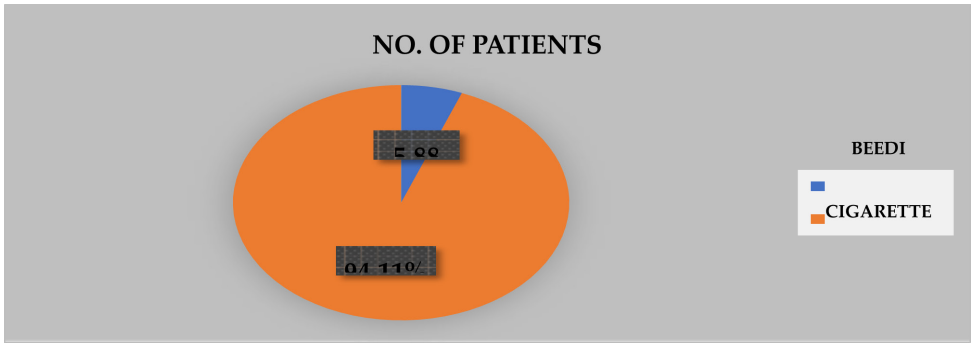

Figure 2: Smoking Habits Variation.

with distinct patterns observed in both the total group (men and women) and men-only group. Non-smokers had the lowest rehospitalization rates in both groups, with a statistically significant difference compared to former smokers (p=0.006 in the total group, p=0.041 in the men-only group) and chronic smokers (p<0.01 in the total group, p=0.0006 in the men-only group). Chronic smokers had the highest rates of multiple rehospitalizations, particularly with two or more admissions, while former smokers showed a mixed pattern, having fewer overall rehospitalizations but notable instances of multiple admissions.

Recurrent MI Rates

Table 4 highlights significant differences in recurrent MI rates among non-smokers, former smokers, and chronic smokers in both groups: those including females and those excluding females. Non-smokers had the lowest recurrent MI rates in both groups (28.2% in the total group {Men+Women} and 17.6% in the men-only group), followed by former smokers (33.3%), while chronic smokers exhibited the highest rates (47.7%). The difference between non-smokers and chronic smokers was statistically significant in the total group (p=0.005) but not in the men-only group.

Mortality Rates

As shown in Table 4, non-smokers had a mortality rate of 23.5% (12.9% in the men-only group), former smokers had the lowest mortality rate at 12.5%, and chronic smokers had the highest rate at 37.6%. A significant difference was observed between non-smokers and chronic smokers (p<0.01 in the total group {Men+Women}, p=0.251 in the men-only group), as well as between former smokers and chronic smokers (p=0.017 in both groups).

Smoking Habits and Cessation

Figures 2 and 3 showed that 94.11% of smokers used cigarettes, with only 5.88% using beedis. Most patients smoked fewer than 10 cigarettes daily (58.82%). Figure 4 demonstrated that

Table 4: Recurrent Myocardial Infarction (MI) and Death Occurrence among MI Patients.

Event		Non-Smokers *n* (%)	Former-Smokers *n* (%)	Chronic-Smokers *n* (%)	*p*-Value (Non-Smokers vs Former Smokers)	*p*-Value (Former Smokers vs Chronic Smokers)	*p*-Value (Non-Smokers vs Chronic Smokers)
Recurrent MI							
In total group (Men+Women) *n*=218	None	61(71.7%)	16(66.6%)	57(52.2%)	0.628	0.200	0.005
	2nd Attack	24(28.2%)	8(33.3%)	52(47.7%)			
Only men *n*=173	None	25((29.4%)	16(66.6%)	57(52.2%)	0.736	0.200	0.267
	2nd Attack	15(17.6%)	8(33.3%)	52(47.7%)			
Death Occurrence							
In total group (Men+Women) *n*=218	None	65(76.4%)	21(87.5%)	68(62.3%)	0.242	0.017	<0.01
	Death	20(23.5%)	3(12.5%)	41(37.6%)			
Only men *n*=173	None	29(34.1%)	21(87.5%)	68(62.3%)	0.0159	0.017	0.251
	Death	11(12.9%)	3(12.5%)	41(37.6%)			

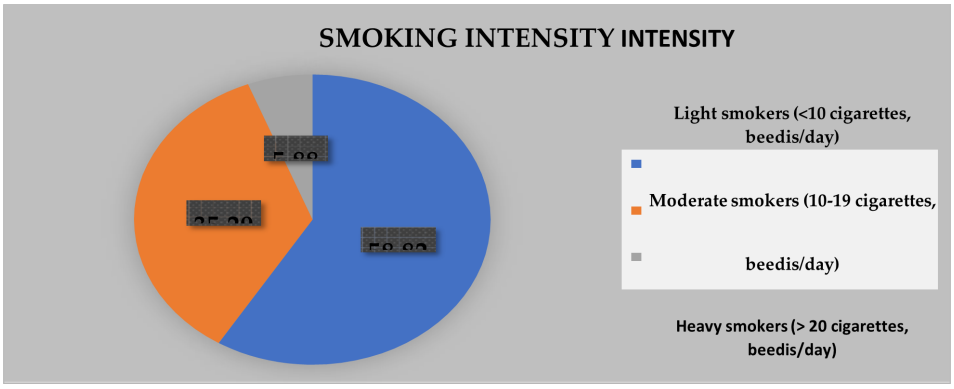

Figure 3: Smoking Intensity.

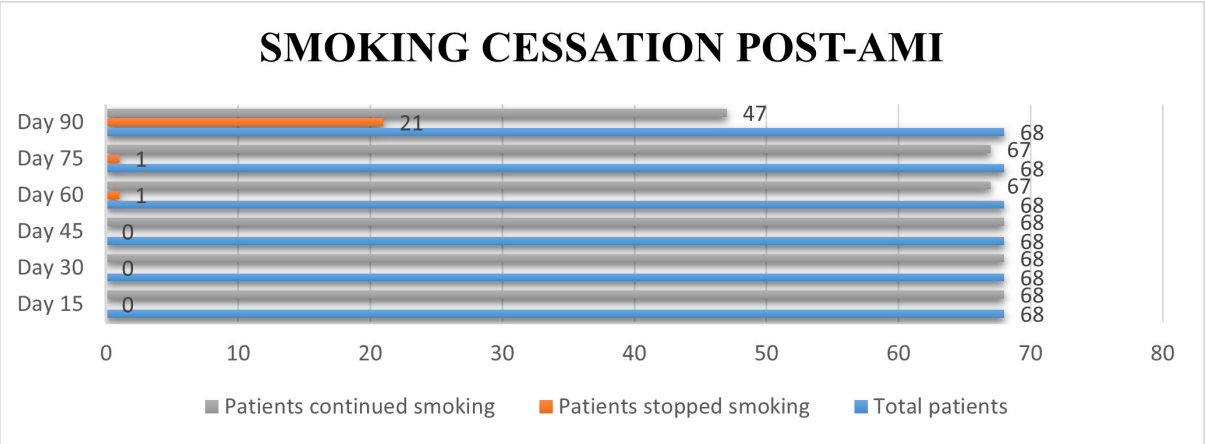

Figure 4: Smoking Cessation in MI patients.

69.1% of patients continued smoking after 90 days, while 30.8% successfully quit, with a significant *p*-value of 0.008.

DISCUSSION

This study provides key insights into the effects of smoking on cardiovascular outcomes in patients with Myocardial Infarction (MI). The higher prevalence of chronic smoking among younger males aged 31-50 aligns with the findings of Bouabdallaoui *et al*.,[18] highlighting the importance of early smoking cessation interventions for younger populations.

Our analysis of cardiovascular risk profiles showed that former smokers had a more favorable risk profile compared to non-smokers, particularly in hypertension and combined disease rates. This suggests that smoking cessation leads to improvement in cardiovascular health, though risks persist compared to non-smokers. Chronic smokers, despite exhibiting slightly better profiles in some aspects, were more prone to worse outcomes.

Rehospitalization and recurrent MI rates were highest among chronic smokers, with non-smokers faring the best in both categories. The significant *p*-values for these outcomes ($p<0.001$ for rehospitalization and $p=0.005$ for recurrent MI) confirm the strong association between continued smoking and adverse cardiovascular events. These findings align with studies by Sia *et al*. and Kagabo *et al*.,[19,20] which underscore the detrimental effects of smoking on cardiovascular health.

Our study challenges the concept of the "smoker's paradox," as chronic smokers exhibited worse mortality outcomes compared to non-smokers. This contradicts the findings of Venkatason *et al*.,[21] which suggested better short-term outcomes for smokers post-MI. However, our results are consistent with Bouabdallaoui *et al*.,[18] reinforcing the conclusion that chronic smoking contributes to higher mortality.

Cigarette smoking's dominance over beedi smoking (Figure 2) reflects regional socio-economic factors, emphasizing the need for targeted public health initiatives. The high percentage of patients continuing to smoke after 90 days (Figure 4) stresses the importance of sustained counselling, consistent with findings from Schlyter *et al*.,[22] demonstrating the effectiveness of long-term follow-up for smoking cessation.

Our study has several limitations. Being a single-centre study, it lacks diversity in genetic backgrounds. The short duration of the study may affect the generalizability of the results compared to longer-term studies. Furthermore, the absence of specific clinical endpoints limits the study's scope. Reliance on phone interviews to verify smoking cessation among chronic smokers may impact the accuracy of the data, and there was limited cooperation from participants during smoking cessation counselling.

Our study recommends expanding the research to multiple centres to include diverse genetic populations. A longitudinal study spanning 4 to 5 years with a cohort design would be beneficial. Incorporating additional clinical endpoints could offer a more thorough analysis. Furthermore, implementing robust methods or techniques to verify smoking cessation is advised.

CONCLUSION

In our study, the smoker's paradox does not apply, as chronic smokers exhibited higher rates of re-hospitalization, increased risk of recurrent myocardial infarction, and elevated mortality compared to non-smokers. Additionally, our clinical data demonstrate that short-term smoking cessation counselling effectively improves smoking cessation rates in patients with acute myocardial infarction.

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ETHICS APPROVAL AND CONSENT TO PARTICIPATE

The research obtained ethical approval from the Ethical Committee of Sudha Institute of Medical Science (Approval number: ECR/948/Inst/TN/2018/RR-22). All participants provided informed consent, and their privacy and confidentiality were safeguarded throughout the study.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

ABBREVIATIONS

AMI: Acute Myocardial Infarction; **MI:** Myocardial Infarction; **CAD:** Coronary artery disease; **CVD:** Cardiovascular Disease; **SCD:** Sudden Cardiac Death; **STEMI:** ST-Elevation Myocardial Infarction; **NSTEMI:** Non-ST-Elevation Myocardial Infarction; **PCI:** Percutaneous Coronary Intervention; **CVD:** Cardiovascular Disease.

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