ORIGINAL RESEARCH ARTICLE

Impact of Smoking on All-Cause Mortality in Patients Undergoing Cardiovascular and Thoracic Procedures: A Prospective Observational Study

Hadiya Jan[1], Chetan Ram[2], Mohammad Ashraf Bhat[3], Farooq Ahmad Ganie[4], Manmohan Singhal[5], Periyasami Seenivasan[6], Mandeep Kumar Arora[7*]

[1,2,5,7]School of Pharmaceutical and Population Health Informatics, DIT University, Dehradun, India
[3,4]Sher-i-Kashmir Institute of Medical Sciences, Soura, Kashmir, India
[6]ICAR - Central Institute of Fisheries Education, Mumbai, India

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ABSTRACT

Introduction: Tobacco smoke is the primary cause of illness and death in today's society, and cigarette smoking (CS) remains a substantial health risk. The primary goal of this study was to assess the extent of smoking among adult Kashmiri patients who had undergone cardiovascular procedures and to identify the sociodemographic factors associated with smoking in this population.

Methods: A prospective evaluation was conducted on 143 patients who underwent various thoracic and cardio-vascular procedures. With the use of a common, validated questionnaire, data was collected. The investigation utilized Cox proportional hazards regression to explore the associations between smoking and overall mortality, incorporating adjustments for non-communicable diseases, sociodemographic factors, and lifestyle variables.

Results: In total, 36.92% (95% CI: 1.54%–1.71%) of people were smokers, with men having a considerably greater prevalence than women (85.42%, 95% CI: 0.75–0.95 vs. 14.58%, 95% CI: 0.08–0.4). The age group of 33–63 years old had the highest rate of smoking prevalence (77.08%). Additionally, the multivariate logistic regression showed that men were substantially more likely than women to smoke (aOR 0.39, 95%CI: 0.28-0.21). A higher odds ratio indicates high cause of smoking.

Conclusions: The chance of mortality from daily smoking increased as the intensity of smoking increased. Consequently, persistent tobacco use is linked to a notably increased likelihood of mortality from any cause. Tobacco smoking necessitates a long-term plan of care. It should be treated with the same rigor as other health risks.

Keywords: Tobacco smoke; cardiac surgery; Kashmiri population; Sociodemographic

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***Correspondence:** Dr. Mandeep Kumar Arora (Email: mmmarora2@gmail.com)

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INTRODUCTION

Smoking tobacco is the biggest cause of premature mortality globally[1] taking the lives of more than 8 million people annually. Of these deaths, about 7 million are directly attributable to tobacco use.[2] It serves as a notable risk factor for fatalities among men, constituting 20.2% of male fatalities,[3] even in the context of substantial reductions in tobacco usage.[4] Furthermore, tobacco use has been linked to cancer[5,6] as well as an increased risk of chronic respiratory and cardiovascular disorders. As smoking rates rise, so does the prevalence of diseases such as oral cavity, larynx, lung malignancies, ischemic heart disease, and chronic obstructive airway disease (20-40 years later).[5,6]

Smoking is associated with an elevated risk of mortality from all causes and plays a significant role in the development of cardiovascular disease (CVD). Both active smoking and exposure to second-hand smoke contribute to over 30% of deaths related to coronary heart disease (CHD). Smoking adversely affects platelet function, inflammation, fibrinolysis, vasomotor function, and induces oxidative processes, collectively doubling the 10-year risk of fatal events in smokers compared to non-smokers. Female smokers exhibit a 25% increased risk of coronary heart disease (CHD) compared to their male counterparts at equivalent smoking levels, resulting in a higher mortality rate from CVDs. Quitting smoking at a young age, specifically at 40 years, is shown to reduce additional risk of death by an impressive 90%.[7]

Jammu and Kashmir is the country's sixth most tobacco-dependent state/UT, with more than 20% of the population using tobacco. J&K has the sixth highest smoking prevalence in the country, at 20.8%. The overall rate of tobacco prevalence is 56% in Kashmir, 44% in Pulwama, 49% in Anantnag and Bandipora, 52% in Shopian, 48% in Budgam, 41% in Baramulla and Kulgam, 42% in Ganderbal, and 38% in Srinagar, according to the National Health Survey. Based on GATS 2 data, 5.1% of women, 35.2% of men, and 20.8% of all adults in Jammu and Kashmir currently use tobacco.[8]

There are tactics that can be used to enhance and expand the provision of help for quitting smoking (for example, by training providers), as well as to expand the scope and volume of support provided to smokers (for example, by offering more counselling or customized printed materials).[9]

The objective of this study is to bridge the awareness gap on mortality caused due to smoking in Kashmir by evaluating the chances of cardiovascular disease and mortality from all causes among adult Kashmiri population.

METHODOLOGY

This prospective observational study was carried out in the ICU at Department of Cardiovascular and Thoracic Surgery. Following ethical approval from the Ethical Committee, a prospective study of 143 patients who underwent various cardio-vascular and thoracic procedures between June 1, 2022 and June 30, 2023 was conducted. The available intensive care unit is a specifically "cardiovascular and thoracic surgery intensive care unit" that accepts patients undergoing various types of cardiovascular and thoracic procedures. All individuals were previously admitted to the medical facility prior to undergoing cardiac surgery, and their progress was monitored until they were discharged or experienced mortality. The demographic and clinical information of the patients was obtained and documented in a prospective manner. Patients below 18 years of age mentally unfit, severely ill, pregnant women, and institutionalized individuals were excluded from the study.

The foundational data collected encompassed various aspects, including participants' lifestyle factors such as smoking status, alcohol consumption, and physical activity. Additionally, it comprised socio-demographic characteristics, encompassing age, gender, and ethnicity, as well as biochemical indicators such as glucose and lipid profile. Blood pressure measurements and anthropometric data, including weight, height, and waist circumference, were also part of the baseline information extracted.

Two categories based on smoking status were identified: smokers and non-smokers. Individuals, who engaged in the consumption of tobacco products on a daily basis (referred to as daily smokers) or those who smoked intermittently, but not on a daily basis, were classified as smokers. Those who never smoked or abandoned the habit at least six months ago were considered non-smokers.

Individuals were categorized as having hypertension if their mean systolic blood pressure was equal to or exceeded 140 mmHg and/or their diastolic blood pressure was equal to or exceeded 90 mmHg, if they possessed a documented history of hypertension,[10] or if a healthcare professional, such as a physician or medical assistant, had communicated to them the presence of hypertension. The two-hour postprandial glucose tolerance test was used to examine diabetes mellitus in respondents who indicated that they had been informed they had the disease by a physician or medical assistant, as well as in those who did not know they had the disease. Individuals classified as diabetics had a fasting plasma glucose level of 7.0 mmol/L,[10] or had a documented diagnosis of diabetes mellitus. Moreover, participants were categorized as having hypercholesterolemia if their total cholesterol level surpassed 5.2 mmol/L or if they had received a prior diagnosis of dyslipidemia or hypercholesterolemia. Daily follow-up forms were used to collect data on survival and mortality for both survivors and non-survivors.

Statistical analysis: The statistical analysis was con-

ducted using the complex samples add-on module for IBM SPSS version 25.0 (IBM Corp., Armonk, New York, USA). The intricate survey design and uneven selection probabilities were considered in every analysis. By survival status (dead/alive), sociodemographic, lifestyle risk factors and the prevalence of smoking are displayed as percentages, frequencies, and 95% (CI) confidence intervals. To contrast the survival rates of non-smokers and smokers, the Kaplan-Meier analysis was conducted. Subsequently, the log-rank test was employed to identify statistically significant differences in survival rates between these two groups. The association between drinking, smoking, and all-cause mortality was investigated through Cox regression multivariable analysis. The correlation between smoking and all-cause mortality was explored using three Cox proportional-hazards regression models: Model 1 adjusted for age and drinking status; Model 2 adjusted for age and gender; and Model 3 adjusted for all independent variables, including selected sociodemographic traits and health risk behaviors. Every model underwent the proportional hazards test, and every model satisfied the assumption ($p>0.05$). Every independent variable in every model was examined for two-way interactions; $p>0.05$ meant that no significant two-way interactions were found. Furthermore, PS Power software was utilized to compute the study's post hoc power. With an alpha of 0.05, a one-year accrual interval, and frequencies of 27 and 82 smokers and non-smokers, respectively, the study's power was greater than 90%.

We have 130 participant pairs scheduled for the study. Previous research shows that the response difference between matched pairs has a standard deviation of 0.48 and is regularly distributed. If a genuine disparity in the mean responses of matched pairs, amounting to 1.68, exists, we have the capability to reject the null hypothesis, positing that the difference in responses is zero, with a power of 1.00. The probability of committing a Type I error in this test of the null hypothesis is 0.05.

RESULTS

The investigation comprised a total of 130 participants, with 68 individuals (52.3%) identified as male and 62 individuals (47.6%) identified as female, all meeting the specified inclusion and exclusion criteria. The majority of the respondents were of Kashmiri origin (n=117; 90%). Also (n=118; 90.76%) belonged to Rural area.

Table 1: Social demographic characteristic of respondents (N=130)

Characteristics	Participants (%)	95%CI
Smoking Status		
Smoker	27 (20.76)	20.66 - 20.86
Non-smoker	82 (63.07)	62.97 - 63.17
EX	21 (16.15)	16.05 - 16.25
Gender		
Male	68 (52.3)	52.21 - 52.39
Female	62 (47.69)	47.6 - 47.78
Ethnicity		
Urban	12 (9.23)	9.18 - 9.28
Rural	118 (90.76)	90.71 - 90.81
Region		
Kashmiri	117 (90)	89.95 - 90.05
Other	13 (10)	9.95 - 10.05
Age (years)		
19-32	20 (15.38)	13.71 - 17.06
33- 63	90 (69.23)	67.26 - 71.2
64-85	20 (15.38)	13.02 - 17.75
High fasting blood glucose or DM type 2		
Yes	9 (6.92)	6.88 - 6.96
No	121 (93.07)	93.03 - 93.11
High blood pressure or hypertension		
Yes	24 (18.46)	18.39 - 18.53
No	106 (81.53)	81.46 - 81.6
Hypertriglyceridemia		
Yes	12 (9.23)	9.18 - 9.28
No	118 (90.7)	90.65 - 90.75
Physical active		
Active	115 (88.46)	88.41 - 88.51
Inactive	15 (11.53)	11.48 - 11.58
Alcohol drinker		
Yes	1 (0.76)	0.74 - 0.78
No	129 (99.23)	99.21 - 99.25

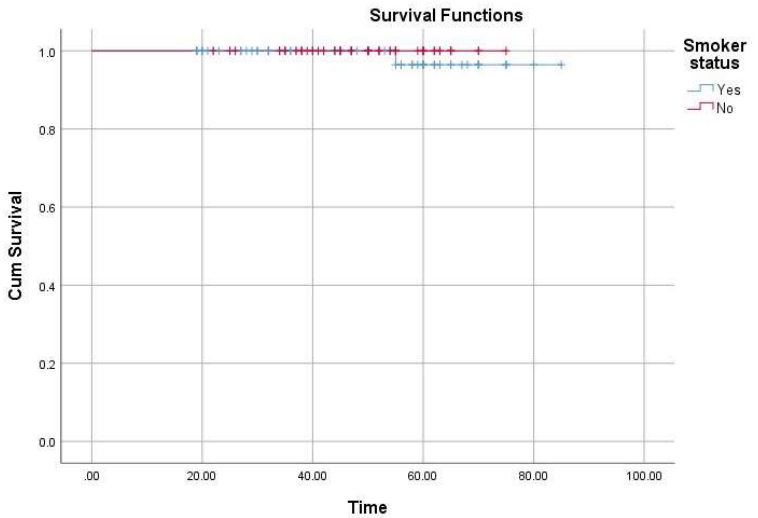

Figure 1: Kaplan Meier survival curve for smokers and non-smokers. (Log rank test (Chi-square=129, df=1, p<0.001)

More than one-third of the respondents fell in 33–63 age range. Additionally, 18.46 % (n=24) and 6.92 % (n=9) participants had hypertension and diabetes respectively (either known or found through biochemical testing). About 9.23 % (n=12) of the respondents had hypertriglyceridemia.

The baseline smoking prevalence was 20.76%, substantially higher among males (18.46%) in comparison to females (2.3%). Respondents taking alcohol were almost negligible i.e., n=1; 0.76% (p<0.001). Table 1 shows the participants' comprehensive sociodemographic information, as well as the prevalence of smoking and health risk behaviours. The survival function (Figure 1) demonstrates that non-smokers had a greater cumulative survival rate. Additionally, smoking tends to reduce the survival function (log rank test $\chi 2$ =129, df=1, p<0.001).

The Kaplan-Meier survival curves in the graph represent the cumulative survival probabilities over time for two groups: smokers (blue line) and non-smokers (red line). The y-axis shows the cumulative survival probability and the x-axis represents time. The red line indicates the survival function for non-smokers and the blue line indicates the survival function for smokers. Both curves start at a survival probability of 1, which means that all participants are alive at the beginning of the study. Over time, the survival probabilities for both groups decline, indicating that some participants have died. The graph shows that non-smokers (red line) tend to have a slightly better survival probability compared to smokers (blue line) over time. The separation between the two lines suggests that smokers have a lower cumulative survival probability compared to non-smokers, although the difference is relatively small. This interpretation suggests that smoking is associated with a reduction in survival probability; consistent with the hypothesis that smoking increases the risk of mortality.

After adjusting for age, the multivariable analysis indicates a significant association between smoking and an elevated risk of all-cause mortality. In model 1, adjusted hazard ratio (AHR) was 0.63 (95% CI: 0.62–0.64). This association persists in model 2 with AHR of 0.62; (95% CI: 0.58–0.66) and in the final model adjusting for all independent variables, the AHR remains at 0.62 (95% CI: 0.57–0.69) (Table 2). In accordance to the multivariate logistic regression, men were substantially more likely than women to smoke (aOR 0.39, 95%CI: 0.28-0.21). A higher odds ratio indicates an increased likelihood of smoking. Individuals aged 33-63 years had the highest likelihood of being smokers (aOR 1.76, 95%CI: 0.94-3.25). There was a strong association between diabetes mellitus and smoking (aOR 4.69, 95%CI: 0.60-36.31). However, no significant associations were found between hypertension, cholesterol, ethnicity and smoking (Table 3).

Table 2: The relationship between smoking and all-cause mortality within the study cohort

Variables	Study cohort		Model 1*		Model 2*		Model 3	
	Survivor (n=113) (%)	Non-survivor (n=17) (%)	AHR (95% CI)	P value	AHR (95% CI)	P value	AHR (95% CI)	P value
Smoking status								
Non-smoker	68 (60.18)	14 (82.35)	*Ref*		*Ref*		*Ref*	
Smoker	45 (39.82)	3 (17.65)	0.63(0.62–0.64)	0.217	0.62(0.58–0.66)	0.202	0.62(0.57–0.69)	0.072
Age (years)								
19-32	20 (17.70)	0	*Ref*		*Ref*		*Ref*	
33- 63	77 (68.14)	13 (76.47)	0.43(0.11-1.66)	0.22	0.49(0.13–1.89)	0.298	0.49(0.13–1.89)	0.068
64-85	16 (14.16))	4 (23.53)	1.21(0.54-2.70)	0.648	1.36(0.60–3.03)	0.465	1.36(0.60–3.03)	0.182
Gender								
Male	58 (51.33)	10 (58.82)			5.36(2.40–11.96	0.001	5.64(2.52–12.62)	0.001
Female	55 (48.67)	7 (41.18)			*Ref*		*Ref*	
Physical activity								
Active	101 (89.38)	14 (82.35)					*Ref*	
Not active	12 (10.62)	3 (17.65)					0.99(0.60–1.62)	0.96
Alcohol drinker								
Yes	1 (0.88)	0					0.87(0.61-1.55)	0.969
No	112 (99.12)	17 (100)					*Ref*	
Hypercholesterolemia								
Yes	12 (10.62)	0					1.55(0.51-4.66)	0.437
No	101 (89.38)	17 (100)					*Ref*	
Diabetes mellitus								
Yes	4 (3.54)	5 (29.41)					0.21(0.03-1.55)	0.125
No	109 (96.46)	12 (70.59)					*Ref*	
Hypertension								
Yes	19 (16.81)	5 (29.41)					0.94(0.45-1.95)	0.862
No	94 (83.19)	12 (70.59)					*Ref*	
Cholesterol								
Yes	10 (8.85)	0					0.98(0.26-3.61)	0.97
No	103 (91.15)	17 (100)					*Ref*	
Ethnicity								
Kashmiris	102 (90.27)	16 (94.12)					1.08(0.45-2.58)	0.865
Others	11 (9.73)	1 (5.88)					*Ref*	

*Variables with Gray colour not included in model; AHR – Adjusted Hazard Ratio

Table 3: Correlation between social-demographic characteristics and smoking

Variable	Adjusted Odds Ratio (95 % CI)	P value
Age (years)		
19-32	*Ref*	
33- 63	0.456 (0.199 - 1.045)	0.077
64-85	1.015 (0.407 - 2.990)	0.529
Gender		
Male	0.084 (0.033 - 0.21)	0.001
Female	*Ref*	
Physical activity		
Active	*Ref*	
Not active	0.89 (0.287 - 2.594)	0.783
Alcohol drinker		
Yes	1.012 (0.988 - 1.02)	0.631
No	*Ref*	
Hypercholesterolemia		
Yes	0.59 (0.20 - 1.71)	0.248
No	*Ref*	
Diabetes mellitus		
Yes	5.081 (0.60 - 36.31)	0.091
No	*Ref*	
Hypertension		
Yes	0.82 (0.40 - 1.70)	0.378
No	*Ref*	
Cholesterol		
Yes	0.878 (0.26 - 2.96)	0.541
No	*Ref*	
Ethnicity		
Kashmiris	1.81 (0.549 - 5.964)	0.248
Others	*Ref*	

We employed Cox proportional hazards regression for the analysis. Variables were included in the regression model based on specific criteria: variables with a p-value <0.05 in bivariate analysis were included in the multivariate model. Additionally, we considered variables with a p-value <0.2 in bivariate analysis to account for potential confounders. These details ensure a rigorous statistical approach to identify significant predictors of all-cause mortality.

DISCUSSION

After accounting for various confounders, our study revealed that smokers had a 0.7-fold increased risk of all-cause mortality. This outcome aligns with prior research conducted in Western and Asian cohorts.[11,12] Notably a meta-analysis combining data from 20 prospective cohort studies across six Asia Cohort Consortium,[13] participating nations (mainland Japan, China, India, Korea, Taiwan and Singapore) with 1002258 participants supports our results. Furthermore, the baseline daily smoking prevalence of 20.76% in our study is comparable to the rates observed in a various national survey, including the National Health and Morbidity Survey (NHMS) 2015, the Global Adult Tobacco Survey Malaysia (GATS-M), and the NHMS 2019.[14-16]

According to the findings of a preliminary study, 90% of the male subjects in the J&K population living in South Kashmir were regular smokers. Moreover, 75% of female participants in all age categories were discovered to smoke regularly, which is comparable to our research.[17]

The meta-analysis reported hazard ratios for different cohorts born before 1920 (1.26, 95% CI: 1.17–1.37), in the 1920s (1.47, 95% CI: 1.35–1.61) and born in 1930 or after (1.70, 95% CI: 1.57–1.84). Ye et al. in China [18] conducted a study involving 18237 individuals from 2003 to 2018 revealing 579 fatalities (11.2% current smokers and 7.5% non-smokers) observed over a 15-year period. In their comprehensive multivariable analysis, the authors reported a 60% increased risk of all-cause mortality among current smokers (Adjusted Hazard Ratio [AHR] =1.60; 95% Confidence Interval [CI]: 1.23–2.08). This analysis also encompassed adjustments for hypertension, drinking, and diabetes, mirroring the variables considered in our study. In a similar vein, the research conducted by Halipah et al[19] involving 3353 participants aged 40 years or older in the Indonesian Family Life Survey (IFLS), demonstrated a smoking prevalence of 40.3%. Current smokers exhibited a 48% elevated risk of mortality from all causes compared to non-current smokers (Hazard Ratio [HR] =1.48; 95% Confidence Interval [CI]: 1.11–1.98).

Analogous research has been carried out in Western countries. The Consortium on Health and Ageing Network of Cohorts in Europe and the United States, or CHANCES, reported the highest hazard ratio[20] among twenty-two population-based cohort studies involving senior citizens in the US and Europe. With 489056 participants in the pooled study, 99298 fatalities were noted; smokers exhibited 2-fold increased chance of dying from any cause as opposed to non-smokers. The greater Hazard Ratio (HR) found in CHANCES may be attributed to the advanced age (≥60 years) of the study population, suggesting longer smoking durations. [21] Another extensive Western study, examined data from the US National Health and Nutrition and Examination Survey (NHANES) spanning 1999–2000 to 2013–2014.[22] Over an average follow-up period of 8.3 years involving 30,674 individuals aged 20–79, non-smokers, which includes those who smoked intermittently, exhibited an elevated risk of mortality from all causes (Adjusted Hazard Ratio [AHR]=1.50; 95% Confidence Interval [CI]: 1.08-2.08) after accounting for sociodemographic factors, lifestyle variables, and chronic disorders such as diabetes, dyslipidemia and hypertension. Akter et al.[23] conducted a study in Japan on 79114 Japanese workers aged 20 to 85, observing 252 fatalities during a six-year follow up. The adjusted Hazard Ratio (HR) for overall mortality was 1.49 (95% Confidence Interval [CI]: 1.10–2.01). In conclusion variations in follow-up duration and sociodemographic profiles including age and ethnicity, contributed to slightly different magnitudes in association between smoking and mortality risk across these studies.

The discrepancies or similarities between our study and other research can be interpreted in the context

of several influencing factors. Our study's findings are consistent with similar cohorts in Asia, likely due to comparable smoking prevalence and patterns within these populations. Differences in study design, sample size, population demographics, and follow-up duration can impact the observed associations between smoking and mortality. For example, the higher hazard ratios seen in some Western studies may be due to the inclusion of older populations with longer smoking histories, leading to a greater cumulative risk. In our study, the demographic characteristics and shorter follow-up duration may contribute to different risk estimations. Moreover, variations in socio-economic factors, healthcare access, and cultural attitudes towards smoking can further shape these outcomes. These factors collectively highlight the need to consider contextual and methodological differences when interpreting the impact of smoking on all-cause mortality.

Strengths and Limitations

Our study has certain limitations. Initially, the assessment of smoking status was solely conducted at the baseline, which may introduce imprecision given potential changes in participants' smoking status throughout the follow-up period. The study did not account for second-hand smoke (SHS) exposure, which could have overstated the link between smoking and death. Additionally, the absence of precise causes of death and the relatively short duration and small sample size pose challenges. Nevertheless, the study's strengths include applicability to non-institutionalised populations and control for key confounders like age, gender, race, physical activity, alcohol consumption, and chronic diseases, mitigating potential biases in the link between smoking and death risk.

Conclusion

This study identifies a significant connection between smoking and increased all-cause mortality among adult Kashmiri patients who have undergone cardiovascular procedures, with a higher prevalence among men and individuals aged 33-63 years. Men were found to have a higher likelihood of smoking, and greater smoking intensity was linked to an increased risk of mortality. It is crucial to address smoking as a key factor in patient outcomes in this demographic. We recommend targeted smoking cessation interventions for high-risk groups, comprehensive risk assessments that include detailed smoking histories, a multifactorial approach to managing lifestyle factors and comorbidities, and continuous monitoring and follow-up care to detect and reduce mortality risks.

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