

## ORIGINAL ARTICLE

## Association between Smoking and Alcohol Consumption and the Severity of Coronary Artery Injuries in Patients with AMI

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### Abstract

**Background:** Smoking is the most important risk factor for coronary heart disease (CHD) and ischemic events; alcohol consumption, on the other hand, appears to have a protective role.

**Objective:** Assess the association between smoking and alcohol consumption with the severity of coronary artery injuries in patients with acute myocardial infarction (AMI).

**Methods:** Cross-sectional study, performed in Santa Catarina. Variables were evaluated using the Chi-squared T/Fisher's exact test, Kendall's correlation coefficient, Student's t test or Mann-Whitney U test. Values of  $p < 0.05$  were considered significant.

**Results:** Between August 2016 to June 2017, 226 patients were evaluated with first episode of AMI. There was a difference in sex distribution, showing that 59.7% of men and 85.4% of women were not alcoholic ( $p < 0.001$ ). There was a higher prevalence of non-hypertensive patients who consumed alcohol than hypertensive ones (40.7% vs. 24.4% and  $p = 0.010$ ) and patients without diabetes who had drinking habits than those diabetic (36.4% vs. 12.0% and  $p = 0.001$ ). There was also a higher prevalence of non-diabetic patients who smoked than diabetic ones (38.1% vs. 22.0% and  $p = 0.035$ ). A weak and negative correlation was found between the number of cigarettes per day and the pack-year with the TIMI frame count ( $r = -0.174$  and  $p = 0.041$  and  $r = -0.192$  and  $p = 0.027$ , respectively). The other associations did not show statistical significance.

**Conclusion:** The study showed that the number of cigarettes consumed per day and the pack-year is related to a smaller TIMI frame count, i.e., to a better coronary flow, which may be related to the Smoker's Paradox. There was no correlation between the beverage type and quantity with the SYNTAX score, Ejection fraction and TIMI frame count. (Int J Cardiovasc Sci. 2019; [online].ahead print, PP.0-0)

**Keywords:** Coronary Artery Disease Myocardial Infarction, Alcohol Drinking; Tobacco Use Disorder; Risk Factors.

### Introduction

Coronary artery disease (CAD) is the leading cause of morbidity and mortality worldwide.<sup>1</sup> Every year in Brazil, cardiovascular diseases account for more than one-third of deaths.<sup>2</sup> CAD is a chronic disease that progresses over a period of years or decades<sup>3</sup> and results in major social impact. Acute Myocardial Infarction (AMI) is one of the main and often the first manifestation of CAD.

Protective and risk factors for CAD and AMI are widely known in the literature. Several studies

indicate that mild-to-moderate alcohol consumption is associated with a 40 to 70% decreased risk of CAD, compared to no alcohol consumption or heavy alcohol use.<sup>4</sup> This decreased risk is found in both men and women,<sup>5</sup> and this protective effect has been observed in various groups.<sup>6</sup> Smoking, on the other hand, is the most important isolated risk factor – following advanced age – for coronary artery disease. Coronary ischemic events are the cause of death in more than one-third of these patients.<sup>7</sup> It is undoubtedly the most relevant preventable risk factor of cardiovascular disease.<sup>8</sup>

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Smoking cessation virtually benefits all smokers, regardless of age, duration or tobacco smoking load. A reduction in mortality rate is observed with smoking cessation at any age.<sup>9</sup> However, the sooner smoking cessation occurs, the greater the benefits: those who stop smoking by 40 years of age avoid 90% of the increased risk of death of continuing smoking.<sup>10</sup>

Until this day, tobacco use is clearly present in society, despite numerous efforts of public policies and warnings from the medical community about the harms that smoking causes to a person's health. It is also known that alcohol is toxic for several organs and systems. However, light/moderate and regular alcohol consumption is a protective factor for coronary heart diseases, contributing with reduced AMI risk. In spite of their clear association with cardiovascular morbidity and mortality, there are still gaps concerning the association of these two factors with the severity and complexity of coronary injuries in patients with AMI. Thus, this study aims at assessing the relationship of smoking and alcohol consumption with the severity of coronary injuries in patients with AMI.

## Methods

This was a cross-sectional, observational study carried out in the emergency units of public hospitals in the metropolitan region of Florianopolis, centers of reference in the treatment of patients with AMI, with a population composed by 226 patients seen in the emergency department for AMI, in the period of August 2016 to June 2017. The objectives of this study were to describe the demographic and clinical characteristics of the population; to associate these data with the severity (expressed by the left ventricular ejection fraction - LVEF) and complexity (measured by the SYNTAX score) of coronary injuries and with coronary perfusion after PCI in AMI patients, presenting with ST-segment elevation (assessed by TIMI frame count), and to correlate smoking, alcohol and wine consumption, using the SYNTAX score, LVEF and TFC.

The patients were selected consecutively when admitted to the emergency, diagnosed with first AMI. We included patients over 18 years of age; of both sexes; with precordial pain suggestive of acute myocardial infarction associated with electrocardiogram with new ST segment elevation at the J point in two contiguous leads:  $\geq 0.1$  mV in all leads, except for leads V2 and V3, to which the limits of  $\geq 0.2$  mV in men  $\geq 40$  years,  $\geq 0.25$  mV in men  $< 40$  years and  $\geq 0.15$  mV in women

are applied, or presence of precordial pain suggestive of acute myocardial infarction associated with elevation in troponin I or CK-MB levels above the 99th percentile of the upper reference limit. Patients with previous acute myocardial infarction were excluded.

This study is an integral part of another ongoing study called Catarina Heart Study, a project entitled "Follow-up of patients after first acute MI in the state of Santa Catarina: A study of prospective cohort (Catarina Heart Study)", with the general aim of assessing the mortality and severity of ischemic disease in patients with post-myocardial infarction and their potential protective and risk factors. The instrument of data collection used corresponds to that of Catarina Study.

The Catarina Study was submitted and approved by the Committee of Ethics in Human Researches of ICSC (CEP-ICSC), via the Brazil Platform (Plataforma Brasil), and approved with opinion number 1519838.

## Statistical analysis

We calculated a sample of 192 patients to find a mean difference of 2 points in the SYNTAX score, with a standard deviation of 7.0, power (80%), alpha (0.05), among alcohol consumer patients and non-alcohol consumers based on previous data from our group.

The data were tabulated using the Windows Excel software and analyzed using the Statistical Package for the Social Sciences, version 13.0 (SPSS Inc., Chicago, IL, USA, 2005) for Windows. Qualitative data were presented as simple and relative frequencies and assessed using the Chi-square test. Data normality was assessed through the Kolmogorov-Smirnov test. Quantitative data with normal distribution were expressed as mean and standard deviation and assessed using the t test for independent samples. Non-normal quantitative data were described as median and interquartile amplitude and assessed using the Mann-Whitney U test. Correlations were assessed using Kendall's correlation coefficients, since in all evaluations at least one of the variables presented non-normal distribution. P-values less than 0.05 were considered statistically significant.

## Results

From 2016 to 2017, we analyzed the data of 226 patients who participated of the Catarina Heart Study, admitted to public hospitals of the metropolitan region of Florianopolis, due to AMI.

The mean age of the patients included in the sample was  $59.2 \pm 11.5$  years, 63.7% male. Of the patients, 59.7% had SAH, 22.1% had DM, 35.4% were dyslipidemic, 42.0% had a family history of cardiovascular disease and 45.3% presented with STEMI (Table 1).

With respect to the association between clinical characteristics and alcohol consumption, there was a difference in the distribution by gender: data showed that 59.7% of men and 85.4% of women had no alcohol drinking habit ( $p < 0.001$ ). There was a significantly higher prevalence of patients without hypertension who consumed alcohol (40.7%) than alcoholic hypertensive patients (24.4%) ( $p = 0.010$ ). Similarly, there was a higher prevalence of patients without diabetes (36.4%) than diabetic ones (12.0%) ( $p = 0.001$ ). The other associations did not show any statistical significance (Table 2).

There was a significantly lower prevalence of patients with diabetes who smoked (22.0%) than those without diabetes who smoked (38.1%) ( $p = 0.035$ ). The other associations did not show any statistical significance (Table 3).

None of the associations of alcohol consumption and smoking with coronary perfusion after PCI – assessed by the TIMI frame count method – and the severity of the AMI and the complexity of coronary injuries, measured respectively through the LVEF and the SYNTAX score, showed statistical significance (Tables 4 and 5).

A negative and weak correlation was found between the number of pack-year and cigarettes per day with coronary perfusion after PCI – assessed using the TIMI frame count method ( $r = -0.174$  and  $p = 0.041$  and  $r = -0.192$  and  $p = 0.027$ , respectively). The other correlations did not show any statistical significance (Tables 6 and 7).

## Discussion

This is an unprecedented study, which used data from the Catarina Heart Study – a cohort study that has assessed patients admitted to the emergency department of public hospitals in Santa Catarina after a first episode of AMI – and found a negative correlation between variables related to smoking and the TIMI frame count (TFC), that is, to coronary perfusion after PCI.

In relation to the demographic and clinical characteristics, there was a prevalence of male patients with mean age of 59.97 years, similar to the profile of patients seen in other Brazilian hospitals.<sup>11,12</sup> More

**Table 1 - Demographic and clinical characteristics of patients**

Variables (n = 226)	n	%
Sex		
Male	144	63.7
Female	82	36.3
Age*	$59.2 \pm 11.5$	
Alcohol	70	30.9
Smoking	78	34.5
SAH†		
Yes	135	59.7
No	91	40.3
DM‡		
Yes	50	22.1
No	176	77.9
Dyslipidemia		
Yes	80	35.4
No	146	64.6
Family History		
Yes	95	42.0
No	131	58.0
STEMI§	102	45.3
NSTEMI	123	54.7

\*Mean  $\pm$  standard deviation; †Systemic arterial hypertension; ‡Diabetes mellitus; §ST-segment elevation myocardial infarction; || Non-ST segment elevation myocardial infarction. Source: Author's elaboration, 2017.

than half of the patients claimed to suffer from SAH, whereas only 22.1% of patients had DM and 35.4% had dyslipidemia. Similar data were found by Soares et al.,<sup>13</sup> who showed that the majority of patients had hypertension (60.3%), but only 24% and 35% had diabetes and dyslipidemia, respectively.<sup>13</sup> In the current study, less than half of the sample had a family history of cardiovascular disease (42%), superior to Brazilian literature data, in which prevalence ranges from 26.8 to 35%.<sup>14,15</sup>

The results of this study demonstrated no significant difference between the mean SYNTAX score, LVEF and TFC, comparing alcoholic patients with non-alcoholic

**Table 2 - Association between the demographic and clinical characteristics of patients and alcohol consumption. Assessment using the Chi-square test**

Variables	Alcohol - n (%)		p-value
	Yes	No	
Sex			
Male	58 (40.3)	86 (59.7)	< 0.001
Female	12 (14.6)	70 (85.4)	
SAH*			
Yes	33 (24.4)	102 (75.6)	0.010
No	37 (40.7)	54 (59.3)	
DM†			
Yes	6 (12.0)	44 (88.0)	0.001
No	64 (36.4)	112 (63.6)	
Dislipidemia			
Yes	20 (25.0)	60 (75.0)	0.151
No	50 (34.2)	96 (65.8)	
Family history			
Yes	32 (33.7)	63 (66.3)	0.453
No	38 (29.0)	93 (71.0)	

\*Systemic arterial hypertension; †Diabetes mellitus. Source: Author's elaboration, 2017.

**Table 3 - Association between the demographic and clinical characteristics of patients and smoking. Assessment using the Chi-square test**

Variables	Smoking - n (%)		p-value
	Yes	No	
Sex			
Male	52 (36.1)	92 (63.9)	0.503
Female	26 (31.7)	56 (68.3)	
SAH*			
Yes	40 (29.6)	95 (70.4)	0.060
No	38 (41.8)	53 (58.2)	
DM†			
Yes	11 (22.0)	39 (78.0)	0.035
No	67 (38.1)	109 (61.9)	
Dislipidemia			
Yes	29 (36.3)	51 (63.8)	0.684
No	49 (33.6)	97 (66.4)	
Family history			
Yes	34 (35.8)	61 (64.2)	0.731
No	44 (33.6)	87 (66.4)	

\*Systemic arterial hypertension †Diabetes mellitus. Source: Author's elaboration, 2017.

ones. Furthermore, both alcohol and wine intake did not show any correlation with the complexity of injuries and the severity of the infarction – assessed by the SYNTAX score and the LVEF, as well as with the post-infarction coronary perfusion – assessed by the TIMI frame count method. This may indicate that, although alcohol has a protective effect on CAD risk and prevents development of atherosclerosis,<sup>16</sup> once CAD is established with coronary injuries, alcohol consumption or the amount of alcohol consumed has no effect on the complexity and the severity of injuries in AMI patients. However, the literature lacks studies that determine the correlation of alcohol consumption with the severity and complexity of coronary injuries.

A negative correlation was found between the number of pack-year and the number of cigarettes per day with the TIMI frame count in STEMI patients – that is, with coronary perfusion after PCI. Thus, we can infer that the greater the number of cigarettes smoked or the tobacco

**Table 4 - Association of alcohol consumption (g) with the severity of coronary injuries and with ventricular function. Assessment using the independent sample t-test**

Variables	Alcohol - mean ± standard deviation		p-value
	Yes	No	
SYNTAX score	12.46 ± 7.85	13.26 ± 10.72	0.544
LVEF*	50.41 ± 11.95	50.24 ± 15.14	0.947
TIMI frame count †	25 (14 - 34)	24 (15 - 36)	0.885

\*Left ventricle ejection fraction; †Median (interquartile amplitude). Source: Author's elaboration, 2017.

smoking load, the lower the TFC value and, therefore, the faster the coronary reperfusion after PCI will take place.

**Table 5 - Association of smoking (year-pack) with severity of injuries and with ventricular function. Assessment using the independent sample t-test and the Mann-Whitney test**

Variables	Smoking - mean ± standard deviation		
	Yes	No	p-value
SYNTAX score	13.10 ± 10.02	12.97 ± 9.89	0.924
LVEF*	50.54 ± 13.61	50.16 ± 14.67	0.882
TIMI frame count †	20 (12.5 - 34)	28 (16 - 36)	0.123

\*Left ventricle ejection fraction; †Median (interquartile amplitude). Source: Author's elaboration, 2017.

**Table 7 - Correlation between smoking and severity of coronary injuries and ventricular function. Assessment using Kendall's correlation coefficients**

Variables	SYNTAX score r (p)	LVEF* r (p)	TIMI frame count r (p)
Years of smoking	0.010 (0.855)	-0.015 (0.806)	0.019 (0.823)
Pack-year	-0.025 (0.635)	0.019 (0.763)	-0.174 (0.041)
Cigarettes per day	-0.029 (0.593)	0.017 (0.788)	-0.192 (0.027)

\*Left ventricle ejection fraction. Source: Author's elaboration, 2017.

**Table 6 - Correlation between alcohol consumption and severity of coronary injuries and ventricular function. Assessment using Kendall's correlation coefficients**

Variables	SYNTAX score r (p)	LVEF* r (p)	TIMI frame count r (p)
Amount of alcohol consumed (g)	0.019 (0.728)	-0.026 (0.683)	0.072 (0.404)
Amount of wine consumed (g)	0.056 (0.325)	-0.095 (0.159)	0.030 (0.745)
Amount of alcohol consumed per week (g)	0.007 (0.896)	-0.007 (0.912)	0.049 (0.562)
Amount of wine consumed per week (g)	0.027 (0.632)	-0.097 (0.154)	0.033 (0.725)

\*Left ventricle ejection fraction; †Median (interquartile amplitude). Source: Author's elaboration, 2017.

Several data in the literature have found results compatible with the so-called Smoker's Paradox, according to which there is fewer mortality among smoker patients who suffered AMI, in addition to an apparent better coronary perfusion after the use of the thrombolytic therapy or PCI.<sup>17,18</sup> Such reduction in mortality is attributable to the difference in the profile of patients who suffer an AMI and are smokers: in their vast majority they are younger, since AMI tends to occur up to eleven years earlier among smokers, with fewer associated morbidities – such as DM and SAH – and usually in the inferior wall – associated with lower mortality than anterior wall MI.<sup>19,20</sup> However, even after adjusting these clinical differences, such paradox persisted, which could be explained by differences in the coronary anatomy and flow patterns in smokers and non-smokers.<sup>20-22</sup> Angeja et al.,<sup>19</sup> confirmed that smokers demonstrated better epicardial flow than non-smokers, but when they studied microvascular flow measurements, they could

not note any differences between these two groups.<sup>19</sup> A possible explanation for these better results seem to lie in the physiopathological differences between smokers and non-smokers with AMI – due to increased thrombus in smokers – which would induce a greater effectiveness of thrombolytic therapy and a better response to antiplaquetary therapy.<sup>23-26</sup> However, the literature still lacks studies that quantitatively compare the TFC with the number of cigarettes smoked per day and the number of pack-years of smoking. This finding could thus be explained by the paradoxical effect of smoking on CAD and its association with a better response to post-AMI reperfusion procedures, assuming that smokers may have better myocardial vascularization, in addition to changes at the biochemical physiopathological levels and, therefore, present better TIMI frame count values. We cannot still rule out that this result may also be attributed to chance, given the small proportion of the sample, together with a weak correlation effect. Despite

the correlation between the number of pack-year and the TFC, there was no association of smoking with the mean SYNTAX score, LVEF and TFC.

The results showed a greater number of alcoholic patients among non-hypertensive than among hypertensive ones (40.7% versus 24.4%). Different studies in the literature show that, among hypertensive patients, the majority consumes alcoholic beverages,<sup>27,28</sup> which diverges from these results. It is known that excessive alcohol consumption is associated with hypertension<sup>29</sup> and that light-to-moderate alcohol consumption, on the other hand, does not have a substantial impact on blood pressure.<sup>30</sup> Therefore, we could explain this finding by admitting the possibility that the patients in this study consume less alcohol, which, perhaps, would not be associated with hypertension in the same way as excessive consumption.

The results also show a higher prevalence of non-diabetic patients (36.4%) among alcoholic patients than non-diabetic ones (12.0%), which may indicate that alcohol has a protective effect on diabetes. Skiros et al also showed that, among patients with light consumption of alcohol, 85.2% had no DM.<sup>27</sup> The literature shows that light-to-moderate alcohol consumption is associated with a reduced risk of DM and it seems to play a protective role for its development,<sup>31,32</sup> which might justify this result.

We also found that most patients who smoked had no diabetes (38.1%). On the other hand, studies show that there is an association of smoking with increased DM risk.<sup>33,34</sup> A possible explanation for this result would be the fact that diabetic patients, already aware of the severity and comorbidities associated with their disease, choose to stop smoking. This result may also be attributed to chance.

There was also an association between gender and alcohol consumption, in which 59.7% of men and 85.4% of women had no drinking habits ( $p < 0.001$ ). Such difference between sexes was also noted in the Greek study by Skiros et al.,<sup>27</sup> in which 40.2% of men and 59.8% of women did not consume alcoholic beverages.<sup>27</sup>

In spite of the careful design and performance of this study, it is worth pointing out that there are some limitations to the analysis and interpretation of the results: it has a cross-sectional design within a cohort that follows patients admitted to emergency departments with a first episode of AMI, and, thus, cannot prove cause/effect. In addition, it has a small sample size, which can be influenced by other variables that were

not assessed. Furthermore, the SYNTAX scores found were low, and, therefore, they cannot be extrapolated to a population with higher SYNTAX scores. Certain differences and correlations found can be viewed as the result of mere chance. However, these biases do not invalidate the results found, because it is a study with valuable national data and which raises hypothesis for the development of potential clinical trials and cohorts for the assessment of specific variables, such as smoking and alcohol in AMI. It is worth to highlight that efforts to avoid that patients start smoking or to promote tobacco cessation should be massively employed, and the smoker's paradox should not be mistakenly interpreted and used to encourage cigarette consumption. Moreover, it is necessary to search for a better understanding of the effects of alcohol consumption on the pathogenesis of hypertension and diabetes on a greater number of studies, before encouraging its consumption.

## Conclusion

There was a negative correlation between the number of cigarettes consumed per day and the number of pack-year with the TIMI frame count. There was no correlation between alcohol consumption – be it wine or other types – with the SYNTAX score, the LVEF and the TIMI frame count. The study found an association between alcohol consumption and the prevalence of hypertension, diabetes and patients' sexes. In addition, we found an association of diabetes with smoking. There was no association of the severity and complexity of coronary injuries and ventricular function with smoking and alcohol consumption.

## Author contributions

Conception and design of the research: Albuquerque LG, Moreira DM. Acquisition of data: Albuquerque LG, Silva RL, Fattah T. Analysis and interpretation of the data: Albuquerque LG, Moreira DM. Statistical analysis: Albuquerque LG, Moreira DM. Obtaining financing: Albuquerque LG, Moreira DM. Writing of the manuscript: Albuquerque LG. Critical revision of the manuscript for intellectual content: Albuquerque LG, Moreira DM.

## Potential Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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## Study Association

This article is part of the thesis of course completion submitted by Luis Gustavo Albuquerque, from *Universidade do Sul de Santa Catarina*.

## Ethics approval and consent to participate

This study was approved by the Ethics Committee of the Instituto de Cardiologia de Santa Catarina under the protocol number 1.519.838. All the procedures in this study were in accordance with the 1975 Helsinki Declaration, updated in 2013. Informed consent was obtained from all participants included in the study.

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