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ORIGINAL ARTICLE

The smoking habit negatively influences autonomic heart control in community-dwelling elderly adults

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Abstract *Objective:* The present study aimed to analyze the influence of smoking on heart autonomic control in elderly adults who did and did not smoke.
Methods: In a population-based study, all community-dwelling elderly adults (≥60 years old) from Aiquara, Bahia, Brazil, were invited to participate in the study. Two-hundred-thirty-two (232) elderly adults provided information about their smoking habits and underwent 5-min recordings of successive RR intervals. Analysis of the variability of the RR intervals was performed in time and frequency domains and with nonlinear methods. The HAC parameters were adjusted for the following potential confounders: age, sex, diabetes, beta-blocker use, cardiovascular disease, body mass index and physical activity level. After exclusions, 210 elderly adults were divided into 2 groups, nonsmokers or those who stopped smoking (NSMOK [n = 190]) and current smokers (SMOK [n = 20]). Owing to the absence of a normal distribution, the Mann-Whitney test was used for group comparisons.
Results: For unadjusted HAC parameters, a significant difference was observed ($p < 0.05$) between groups for the following parameters in the time domain: CV_RR; SDNN; RMSSD; pNN50; triangular index TINN; and nonlinear parameters SD1, SD2 and D2. All of the adjusted HAC parameters (including the Mean RR and frequency domain parameters) were significantly different between the groups.

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Conclusion: Together, the HAC parameters indicated a higher variability of successive RR intervals in NSMOK elderly adults. Notwithstanding, adjustment of the HAC parameters was an important step to improve data analysis. These results indicate an impaired sympathovagal balance on the heart of elderly adult smokers.

1. Introduction

Aging is a progressive, dynamic and irreversible process characterized by changes in psychological, social, behavioral and biological aspects, leading to significant organic changes.[1] Owing to these organic changes, the physiology of many systems is impaired as the cardiovascular system is significantly impaired, especially by reductions of cardioprotection from a sympathovagal imbalance.[2–4]

Environmental factors may also accelerate these aging-associated physiological changes. For example, a smoking habit, due to exposure to various substances, particularly heavy metals, nicotine and toxic gases (e.g., carbon monoxide), is one of the major modifiable risk factors for cardiovascular disease.[5–8] Previous studies have demonstrated that nicotine can stimulate sympathetic activity, promoting dysfunction at the cardiac and vascular levels, culminating in a higher risk for cardiac events and elevated blood pressure levels,[9,10] while carbon monoxide (CO), beyond promoting autonomic changes, exerts harmful effects by hypoxia secondary to the formation of carboxyhemoglobin.[11,12]

Despite the cited changes induced by substances contained in cigarettes, it is known that smoking cessation can restore cardiovascular health by reducing sympathetic hyperactivity and reestablishing parasympathetic modulation (i.e., vagal activity).[13,14] Additionally, smoking cessation can improve blood pressure control, decrease the risk of acute coronary disease and increase life expectancy.[15–19]

The autonomic influence on the cardiovascular system can be non-invasively assessed, analyzing fluctuations in successive RR intervals (i.e., Heart Rate Variability (HRV)).[20] Notwithstanding, the HRV has proven to be able to identify cardiac adaptation, either in response to physiological and environmental stimuli or pathological conditions.[21,22]

Therefore, based on the cardiovascular aging-associated changes and harmful influences of smoking on heart autonomic control,[23,24] analysis of fluctuations of successive RR intervals represent a useful, non-invasive and low-cost tool for evaluating heart autonomic control in elderly adults who do and do not smoke.[23,25] Additionally, previous studies have shown that smoking cessation can restore autonomous activities, but this knowledge is restricted to results obtained from young individuals.[26–28] In this context, the present study aimed to analyze the influence of smoking on heart autonomic control in elderly adults with and without a smoking habit.

2. Materials and methods

This is a population-based, cross-sectional, analytical study that was conducted with all community-dwelling elders (i.e., ≥60 years) from the urban area of Aiquara, Bahia, Brazil.

All visits were from trained interviewers to identify subjects who were 60 years of age or older. Therefore, 263 elders were identified who were invited to participate in the study and, after signing the informed consent form, proceeded to undergo an interview through a structured questionnaire, which included sociodemographic data, health status and lifestyle data.

Of the 263 elders, 9 refused to participate in the study, twenty-two did not meet the eligibility criteria (4 were bedridden and 15 presented with neurological disorders and 3 with auditory problems, which could interfere with their understanding of the questions). As a result, 232 individuals from both sexes were initially included in the study. Another 22 elderly individuals with incomplete data from the variables of interest were excluded from the study analysis. Ultimately, 210 elders who met the eligibility criteria comprised the studied population, and they were included in the statistical analysis.

All procedures were conducted in conformity with the Helsinki Declaration, and the study was submitted and approved by the Human Research Ethics Committee from the State University of Southwest Bahia. Additionally, all elderly participants were informed about the procedures and provided informed consent.

2.1. Smoking classification

Information about the smoking habit was obtained from the life habits questionnaire. The population was stratified into two groups, Smokers (SMOK: n = 20; age: 67.0 [64.0–71.5] years old; BMI: 24.1 [20.7–25.2] Kg/m^2), which included elderly who currently smoke, and Non-Smokers (NSMOK: n = 190; age: 72.0 [66.0–78.0] years old; BMI: 25.7 ± 4.9 Kg/m^2), which included elderly who never smoked or stopped smoking for more than 3 years. The cutoff criteria for smoking cessation (i.e., 3 years or more) were based on Rosenberg et al. (1990)[29] and LaCroix et al. (1991),[30] which demonstrated that the mortality rate due to cardiovascular reasons in the elderly who stopped smoking was similar to those who never smoked in the three years after smoking cessation. Thus, 116 ex-smokers were included in the NSMOK group. Table 1 shows the absolute and relative data of sex, diabetes, cardiovascular disease, beta-blocker use, and physical activity level of the studied elderly according to the smoking habit (smokers and non-smokers).

2.2. RR interval recordings and analysis

Successive RR intervals were recorded for five minutes from elderly in the supine position, as recommended by the Task