25TH NATIONAL & 11TH INTERNATIONAL ANNUAL CONGRESS
ON RESEARCH AND TECHNOLOGY OF IRANIAN MEDICAL SCIENCES STUDENTS
URMIA UNIVERSITY OF MEDICAL SCIENCES, URMIA, IRAN

# Association of Hookah and Cigarette Smoking with ECG Abnormalities

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**Citation:**
Islampanah M, Nejad Shahrokh Abadi R, Saffar Soflaei S, Moohebati M, Esmaily H, Ghayour-Mobarhan M. Association of Hookah and Cigarette Smoking with ECG Abnormalities. *Iranian biomedical journal*. Supplementary (12-2024): 119.

## ABSTRACT

**Introduction:** Hookah smoking is popular among youth and young adults due to its smooth smoke, attractive flavors, and perceived lower harm compared to cigarettes. Despite this perception, hookah smoking poses similar health risks and contains enough nicotine to cause dependence. Hookah smoke is also associated with cardiovascular disease (CVD), similar to traditional cigarettes. Electrocardiogram (ECG) is a non-invasive test used to assess cardiac function, and it has been used to evaluate the cardiovascular effects of hookah and cigarette smoking. In this study, we aimed to determine hookah- and cigarette-associated CVD using ECG.

**Methods and Materials:** The study included 9,704 subjects aged 35-65 from the Mashhad stroke and heart atherosclerotic disorder (MASHAD) cohort study (2007-2024). Baseline characteristics and smoking status were recorded using a questionnaire, and body mass index (BMI) was calculated. A standard 12-lead ECG was recorded for each participant and analyzed and categorized according to the Minnesota coding system. Major and minor abnormalities were identified, and participants without abnormalities were considered to have a normal ECG. Statistical analysis was performed using STATA version 17, including chi-squared tests and logistic regression with adjustments for covariates. Penalized logistic regression was used to estimate and select risk factors for binary outcomes with low exposure prevalence.

**Results:** The analysis included 8821 participants. Cigarette smokers had a higher proportion of males (92.3%) compared to non-smokers (35.9%; $p = 0.001$), while hookah smokers had a higher proportion of females (90.2%) compared to non-smokers (64.1%; $p = 0.001$). BMI was lower in cigarette smokers (25.27 kg/m2) and higher in hookah smokers (28.97 kg/m2) compared to non-smokers ($p = 0.001$). Cigarette smokers showed a significantly higher prevalence of minor abnormalities compared to non-smokers ($p = 0.001$; OR: 1.359; 95% CI: 1.139-1.622). Cigarette smokers had a significantly higher prevalence of ST-segment elevation ($p = 0.002$; OR: 1.614; 95% CI: 1.194-2.181), left axis deviation ($p = 0.004$; OR: 1.631; 95% CI: 1.165-2.285), sinus bradycardia ($p = 0.001$; OR: 2.784; 95% CI: 2.004-3.867), and high amplitude P wave ($p = 0.001$; OR: 3.806; 95% CI: 1.777-8.154) and a significantly lower prevalence of significant isolated ST-T abnormalities ($p = 0.002$; OR: 0.507; 95% CI: 0.310-0.830) and left ventricular hypertrophy (LVH) plus ST-T abnormalities ($p = 0.008$; OR: 0.521; 95% CI: 0.331-0.822), compared to non-smokers. Hookah smokers showed a significantly higher prevalence of LVH plus ST-T abnormalities ($p = 0.027$; OR: 1.606; 95% CI: 1.047-2.463) and a significantly lower prevalence of sinus tachycardia ($p = 0.042$; OR: 0.197; 95% CI: 0.027-0.415), compared to non-smokers. In the adjusted regression model, cigarette smoking was significantly associated with sinus bradycardia ($p = 0.009$; OR: 1.600; 95% CI: 1.127-2.271) and high amplitude P wave ($p = 0.002$; OR: 4.775; 95% CI: [1.771-12.880).

**Conclusion and Discussion:** Both hookah and cigarette smoking are associated with CVD and ECG abnormalities. Thus, diagnostic and preventive measures are needed for the general population.

*Keywords:* Cigarette smoking, Cardiovascular diseases, Electrocardiography



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[ DOI: 10.61186/ibj.25th-11th-IACRTIMSS ]