

Measurement of toxic heavy metals lead, cadmium, arsenic, mercury and chromium in the blood of cigarette and hookah smokers using an inductively coupled plasma mass spectrometer (ICP-MS). Case study: selected population of Ardabil city

Abstract

Background: Smoking (cigarettes and hookahs) is an important source of particles in indoor air and due to the presence of dangerous substances in tobacco smoke, rare metals, carbon monoxide and nicotine that can lead to cancer, heart and lung diseases, it can potentially cause Human respiratory diseases.

Aim: This study aimed to investigate the amount of toxic heavy metals lead, cadmium, arsenic, mercury and chromium in the blood of cigarette and hookah smokers using an inductively coupled plasma mass spectrometer.

Materials and methods: This study is a case-control study that included people who used cigarettes and hookah at the same time in Ardabil city. Stratified sampling was done among the people who referred to Ardabil Gastroenterology Research Center to participate in the Persian cohort study who had a history of smoking and hookah. The sample size was 90 samples with the prevalence of 16% of smoking in the study population according to the Persian cohort study and 0.8 power and 0.95 confidence interval, 45 of which were considered as the case group and 45 as the control group. ICP-MS was used to measure heavy metals in the blood of the subjects. Also, a questionnaire containing 20 questions was used to collect information related to demographic characteristics. Finally, the data will be entered into SPSS version 21 software for analysis.

Results: The results showed that among cigarette brands, Winston Blue was the most used brand among cigarette smokers with 26.9%. Al-Fakher hookah brand had the highest consumption rate among the case group with 40.4%. The highest concentration of arsenic in Bahman cigarette was 0.19 ± 0.04 $\mu\text{g/g}$ and the lowest concentration was 0.12 ± 0.03 $\mu\text{g/g}$ in Montana cigarette. The highest concentration of cadmium in Tir brand was 9.5 ± 8.7 $\mu\text{g/g}$ and the lowest concentration in Winston Blue brand was 0.35 ± 0.14 $\mu\text{g/g}$. The highest and lowest lead

concentrations in Bahman and Magna brands were 0.98 ± 0.2 and 0.22 ± 0.14 $\mu\text{g/g}$, respectively. The maximum chromium concentration in Winston Blue cigarette was equal to 8.31 ± 0.51 $\mu\text{g/g}$ and the minimum concentration in Montana cigarette was equal to 4.28 ± 0.76 $\mu\text{g/g}$. The highest concentration of mercury in Ace Black cigarette was equal to 0.86 ± 0.15 $\mu\text{g/g}$ and the lowest in Magna cigarette was 0.34 ± 0.17 $\mu\text{g/g}$. The concentration of arsenic in Ahmad brand hookah was higher than other samples and equal to 0.18 ± 0.1 $\mu\text{g/g}$ and the lowest concentration in Al Jazeera brand was 0.08 ± 0.01 $\mu\text{g/g}$. The highest concentration of cadmium in Al-Nakhl trademark was 0.29 ± 0.08 $\mu\text{g/g}$ and the lowest concentration in Al-Fakhir trademark was 0.16 ± 0.03 $\mu\text{g/g}$. The highest and lowest concentration of lead in Ahmad and Al-Nakhl brands were 0.58 ± 0.15 and 0.31 ± 0.1 $\mu\text{g/g}$, respectively. The maximum chromium concentration in Ahmad brand hookah tobacco was equal to 7.92 ± 0.46 $\mu\text{g/g}$ and the minimum chromium concentration in Al-Fakhir brand hookah tobacco was equal to 0.36 ± 0.07 $\mu\text{g/g}$. The highest concentration of mercury in Amad brand was 0.21 ± 0.06 $\mu\text{g/g}$ and the lowest in Al-Fakhir brand was 0.13 ± 0.02 $\mu\text{g/g}$. According to the chi-square test, significantly, the case group reported higher alcohol consumption. Also, a significant difference was observed between the two groups in terms of drug use (such as opium, heroin, etc.) ($p=0.02$). According to chi-square test and significantly, people in the case group reported higher drug use.

Conclusion: In general, the results showed that the concentration of most of the investigated elements in the case subjects, i.e. cigarette and hookah smokers, was higher than the control group. Most of the investigated elements show a significant difference between the case and control groups in terms of the concentration of that metal and microelement. Also, the results showed that the results of the Pearson test analysis showed that there was no significant relationship between the amount of daily consumption of cigarettes and hookah and the amount of cigarettes and hookah consumed as well as their brands with the concentration of heavy metals in the blood of the subject group.

Keywords: Concentration of heavy metals, tobacco, cigarettes and hookah, health risk, inductively coupled plasma mass spectrometry.