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Studying relationship of drug abuse with concentrations of cadmium, chromium, and lead in smokers and non-smokers under auspices of Behjoo Center, Tehran, 2019

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ABSTRACT

Smoking is responsible for the death of 1 out of 10 adults. Smokers are exposed to gaseous (such as nitrogen and carbon monoxide) and particulate agents (tar and nicotine). Tobacco and drinking water are considered among the human-made resources of exposure to cadmium, group I carcinogen, lead-enhancing delta-amino-levulinic-acid dehydrase in urine, and chromium, pulmonary carcinogen. This descriptive-analytical research aims to examine the relationship of drug abuse with the concentrations of cadmium, lead, and chromium among smokers and non-smokers under the auspices of Behjoo Center, Tehran, in 2019, by sampling.This was a descriptive-analytical study on smokers and non-smokers under the auspices of Behjoo Center, Tehran, on May 2019, via questionnaire and testing. The sample size was 30 (case-control sampling method). The collection tool was a researcher-made questionnaire that was completed in the center. The questionnaire included demographic variables(11 items), history of drug use(17 items), information on the history of high-risk behaviors(5 areas and 21 items), medical and psychiatric background(5 items), screening for psychiatric disorders(2 areas and 10 items), family status(12 items), and previous treatment(5 items) and was completed by the individuals. The collected information was analyzed in SPSS 21. To achieve the research objectives, paired t-test and Chi-square tests with the significance level of 0.05 were used.Mean concentrations of cadmium, chromium, and lead in the control group at Behjoo Center were obtained equal to 4.3±2.2(2.4-4.9), 4.5±2.1(4.9-2.6), and 14.4±3.2(7.9-16.9) (ppb), respectively. Mean urinary concentrations of cadmium, chromium, and lead in the patient group at Behjoo Center were obtained as 36.5±6.3(26.4-49.5), 38.3±6.5 (29.1-52.4), and 46.1±7.2(32.2-56.3), respectively. Mean age of the control and patient groups was equal to 33.4±58.5(21-50) and 31.5±57.5(52-20). The mean urinary concentration of cadmium in the patients was 20 times higher than the global NIOSH standards. Mean concentration of cadmium in the urine of the patients was about 740% higher than that of the control group. Therefore, it is essential to include the dangers of smoking and drug abuse in the educational planning of all educational stages.

Keywords: *Addiction*, *Behjoo Center,Chrumium, Cigarettes*, *Lead*, *Urinary Cadmium,*

1. INTRODUCTION

Risks of exposure to secondhand smoke, as a major environmental pollutant and the most important cause of disease outbreak and premature death, greatly affect the human health in public health studies [1]. Smokers are exposed to gaseous and particulate agents, including organic and inorganic carcinogens. The United States Environmental Protection Agency classifies cigarette smoke as a group A carcinogen [2]. The population of Tehran is 7705036 people and its area is 730 km^2. Heavy metals, such as chromium, nickel, cadmium, and lead in cigarette smoke, are accumulated in tissues and fluids [3]. Exposure to cadmium in cigarette smoking, given its adverse health effects such as exposure to a heavy metal such as cadmium, a toxic element with long biological half-life of 10-20 years, leads to liver and kidney damage as target organs due to biological accumulation of cadmium in the liver and renal cortex [4]. Cigarette smoking is the second leading cause of mortality in the world. According to the available statistics, mortality and disability caused by smoking are the second leading causes of diseases, i.e. 6.1 and 143.5 million people worldwide in 2013, respectively [5]. According to the statistics, the number of smokers and mortality caused by cigarette smoking has been announced as 12-15 million and 73,000 people in 2016 in Iran, respectively. World Health Organization estimates the mortality rate of 10 million people due to cigarette smoking in 2030. A major part of the nicotine linger on the hair, skin, and clothes of smokers, furniture, floors, walls, beds, carpets, and dust

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produces more pollutants indoors due to the re-emission characteristics in the gas phase and reaction with environmental oxidants caused by long-term retention [6]. Pregnant women, infants, and children are considered vulnerable population to cigarette smoking [7]. Premature birth and low birth weight are symptoms of exposure to second-hand smoking during pregnancy [8]. Cigarette smoking has toxic, genotoxic, and carcinogenic effects. Cigarettes and food are the most important resources of cadmium for humans. Tobacco smoking and drinking water are considered among the human-made resources of exposure to cadmium. Cadmium is absorbed in large amounts through water, food, and air [9]. Anemia, kidney, and liver disorders, bone fractures, and group I carcinogens are some of the adverse effects of exposure to cadmium. The effects of embryonic defects and strong mutagenesis are the adverse effects of exposure to cadmium [10]. Cadmium is considered a heavy metal with characteristics such as low melting point and high electrical conductivity. It is used in plating to prevent corrosion in steelmaking [11]. Exposure to cadmium through skin contact with soil and water has also been reported [9]. Soil is one of the natural resources of human contact with cadmium. Urinary cadmium is used as a biomarker to show the amount of chronic exposure to cadmium in general population [12]. Many scholars have conducted studies on cigarette smoking and drugs. For example, Khlifi et al. (2013) concluded that the concentration of a heavy metal such as chromium in blood is increased with exposure to smoking [13]. Alemam et al. (2019) studied the concentrations of cadmium, chromium, and plasma lead in smokers and non-smokers in Tripoli, Libya, and found that the concentrations of cadmium, chromium, and plasma lead in smokers was higher than those in non-smokers [14]. Prokopowicz et al. (2019) studied the exposure of smokers to cadmium and lead and concluded that the geometric mean of blood lead in smokers was higher than that in non-smokers [15]. The extent of cadmium in tobacco leaves was 1-2 µg/g dry weight, which was equivalent to 0.1-5 µg of cadmium in cigarettes [16].

1.1Objective of study

This study's aim is to investigate the relationship of drug abuse with cadmium concentration in smokers and non-smokers under auspices of Behjoo Center, Tehran, 2019.

2. METHODS and MATERIALS

The research method in this descriptive-analytical study was based on case-control census. The statistical population of this research consisted of 30 participants including non-smokers and people without drug abuse (10 people) and smokers and people with drug abuse (20 people) at Behjoo Center, Tehran, 2019.The control group was matched with the previous two groups in terms of age, gender, place of residence, and education. All the participants participated in accordance to ethical principles of Declaration of Helsinki. The collection tool was a researcher-made questionnaire that was completed in the center. The questionnaire included demographic variables (11 items), history of drug use (17 items), information on history of high-risk behaviors (5 areas and 21 items), medical and psychiatric background (5 items), screening for psychiatric disorders (2 areas and 10 items), family status (12 items), and previous treatment (5 items) and was completed by the individuals. Demographic variables, including date of referral to center, education, gender, methods of drug abuse, age, terms of contact with addiction, occupation, place of residence, type of drug, source of referral, and marital status were analyzed. The collected data were analyzed in SPSS 18. In order to correct and improve the questionnaire in this study, the pre-test of the employees participating in the pilot project with the volume of 10 people was used. In this study, to determine the scientific validity and reliability of the instruments, the content validity and retest methods were employed, respectively, and theresults had the statistical reliability of 100% [17].To achieve the research objectives, paired t-test and Chi-square tests with the significance level of 0.05 were used [18]. Figure 1 shows the sampling location. The population of Tehran was 7,705,036 peopleand its area was 730 km^2 located at latitude 35°41′21.11″ north, longitude 51°23′20.31″ east. Behjoo Center was located at latitude 35°76′23″ and longitude 51°33′16.8″with the area of 90 m^2 in District 5,Tehran. Urinary samplingwas performed between 8-10 am in a polyethylene container rinsed with nitric acid. The urine sample was sent to thetrusted laboratory of Department of Environment in accordance to standard conditions of -4°C. Theconcentrations of cadmium, chromium, and lead in urine were measured by an atomic absorption spectrophotometer (Perkin Elmer,made in USA) with the detection range of 0.01 µg/dL [19]. The results were compared with the standard and the contamination level was determined in low, medium, high, very high, and excessive groups. Experiments were repeated 3 times and the mean value was reported. The cadmium map of sampling station was prepared by Geographic Information System (GIS) (Arc GIS, 10.1) [20].

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3. RESULTS

Table 1 shows the mean urinary concentrations of cadmium, chromium, and lead in the control andpatient groups of Behjoo Center. Mean concentrations of cadmium, chromium, and lead in the control group at Behjoo Center were obtained equal to 4.3±2.2 (2.4-4.9), 4.5±2.1 (2.6-4.9), and 14.4±3.2 (7.9-16.9) (ppb), respectively. Mean concentrations of cadmium, chromium, and lead in the urine of the patient group at Behjoo Center were obtained equal to 36.5±6.3 (26.4-49.5), 38.3±6.5 (29.1-52.4), and 46.1±7.2 (32.2-56.3), respectively. Mean age of the control and patient groups was equal to 33.4±58.5 (21-50) and 31.5±57.5 (20-52), respectively. Mean concentrations of cadmium, chromium, and lead in urine of the patients exceeded NIOSH international standards. Statistical comparison of cadmium, chromium, and lead concentration variables in the patient group and the studied variables such as age, gender, education, marriage, occupation, date of referral to center, type of drug, cause of the referral, age at first use, type of use, and source of referral are shown in Table 2. Significant correlation was obtained between the urinary concentrations of the patient's group and variables of age, type of drug, and cause of referral to center (P<0.05). Figure 1 shows a map of the center.

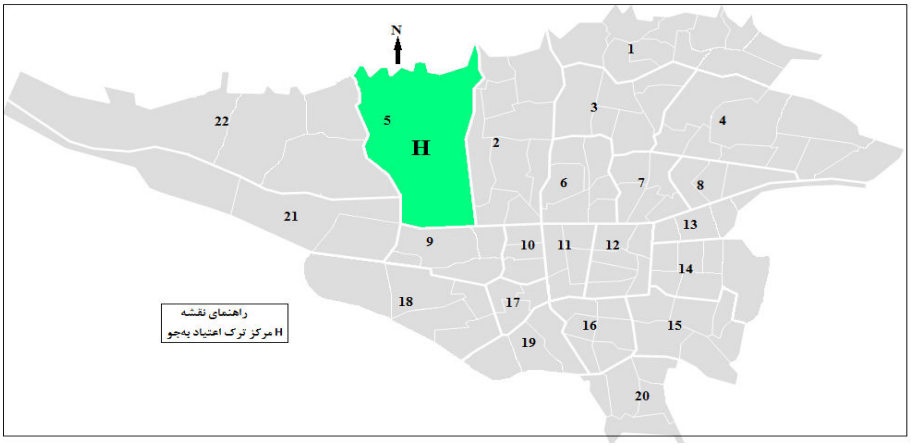

Fig. 1.*Map of Behjoo Drug Rehabilitation Center*

Table 1. Demographic results of the surveyed people

Study group	Demographic variable	Mean	Standard deviation	Minimum	Maximum
Control	Age	33.45	58.56	21	51
	Gender	1 Female			
	Education	Above high-school diploma (100%)			
	Marital status	Single (6 people) and Married (24 people)			
Patient	Age	31.54	57.58	20	52
	Gender	1 Female			
	Education	Below high-school diploma (1 people), high-school diploma (8 people), and above high-school diploma (6 people)			
	Marital status	Divorced (1 people), Single (13 people), and Married (6 people)			
	Date of referral	2019 (12people), 2018 (5people),2017 (2people), 2016 (1 people)			
	Type of drug and cause of referral	Cannabis (2 people), Alcohol (3 people), Opium (3 people), Heroin (1 people), Crack (9 people), Oral Opioid (2 people)			
	Age at first use	22.8	8.39	13	49
	Occupation	Self-employed (16 people), Unemployed (3 people), Employee (1 people)			
	Type of use	Respiratory (16 people), Inhalation (1 people), Smoking (3 people)			
	Source of referral	Family (10 people), Drug Rehabilitation Center (6 people), Addiction Treatment Center in Prison (2 people)			

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Table 2. Concentrations of cadmium, chromium, and lead in urine of the studied people

Study group	Variable	Mean	Standard deviation	Minimum	Maximum	Standard
Control	Cadmium	4.3	2.2	2.4	4.9	5
	Lead	14.4	3.2	7.9	16.9	50
	Chrome	4.5	2.1	2.6	4.9	5
Patient	Cadmium	36.5	6.3	26.4	49.5	5
	Lead	46.1	7.2	32.2	56.3	50
	Chrome	38.3	6.5	29.1	52.4	5

Table 3. Statistical Comparison of Studied Variables

Variable	R2	P value	F
Age	0.436	0.002(S)	13.905
Gender	0.012	0.652(NS)	0.211
Education	0.034	0.436 (NS)	0.636
Marital status	0.044	0.373(NS)	0.835
Date of referral	0.012	0.652(NS)	0.210
Type of drug and cause of referral	0.426	0.001(S)	13.805
Age at first use	0.033	0.444(NS)	0.618
Occupation	0.065	0.278(NS)	1.254
Type of use	0.001	0.930(NS)	0.008
Source of referral	0.014	0.618(NS)	0.258

4. DISSCUTION

Pre-tests showed theurinary concentrations of cadmium, chromium, and lead were considered the biomarker and risk assessment of long-term exposure to cadmium. Theconcentrations of cadmium, chromium, and lead in the urine were also affected by gender and smoking status. This research finding is consistent with the research conducted by Ebert-McNeill[21]. Jha announced that the smoking-related death among women was lower than menin the United States (11430 versus 18040), the United Kingdom (3210 versus 6100), and Canada (919 versus 1640)per 1,000 during 1960-2020 [22]. The highest concentrations of cadmium, chromium, and lead in the urine were obtained in the patient group,the concentrations of whom were 49.5 ppb, 52.4, and 56.3 ppb, and among men at the age of 50. The highest urinary concentrations of cadmium, chromium, and lead can be attributed to old age. This research finding is consistent with the research conducted by Zhang et al., showing the mean concentration of cadmium among non-smokers was 2.25 µg/L[23].The pre-tests showed the maximum concentrations of cadmium, chromium, and lead in the urine and the adverse health effects were among hookah users. Therefore, the urinary concentrations of cadmium, chromium, and lead were affected by smoking status. This research finding was consistent with the research conducted by Shihadeh [24]. Mean concentrations of cadmium in urine among the control and patient groups at Behjoo Center were 4.3±2.2 (2.4-4.9) and 36.5±6.3 (26.4-49.5) (ppb), respectively. The mean age in the control and patient groups was equal to 33.4±58.5 (21-50) and 31.5±57.5 (20-52). The mean concentrations of albumin in the urine in the control and patient groups were obtained equal to 4.8±5.8 (3.4-5.8) and 8.5±4.7 (6.5-9), respectively. Therefore, the first symptoms of exposure to cadmium can be seen on the kidney function (protein in the urine). This research finding is consistent with the research conducted by Sharma [25]. Concentrations of cadmium, chromium, and lead in the urine in the samples studied at Behjoo Center, Tehran, showed a large difference. This research finding is consistent with research conducted by Akerstorm et al. [26], representing that the urinary cadmium-to-kidney ratio was 1 to 60. According to the results, the mean concentration of cadmium in the urine of patients was 20 times higher than the global NIOSH standards. The mean concentration of cadmium in the urine of patients was about 740% higher than that of the control group. Therefore, it is essential to include risks of smoking and drug abuse in the educational planning in all educational stages. Changes in urinary cadmium concentration can be attributed to factors such as absorption, tissue distribution, half-life, and cadmium removal rate. This research finding is consistent with research conducted by Satarug et al. [27], the results of which showed the mean values of blood pressure, creatinine, and albumin in the control group (75, 114.44, 0.911, 0.032) were lower than the patient group (82.5, 119.5, 1.095, 0.048), respectively. The mean blood hemoglobin in the control group, 14.3±2.2. (12.4-14.9), was higher than the patient group, 12.8±3.4 (10.9-12.4). The decreased hemoglobin

level in the patient group can be attributed to the increased chromium of blood plasma in the patient group. This research finding is consistent with the research conducted by Teklay. They showed that chronic exposure to chromium leads to decreased blood hemoglobin [28]. The increased blood pressure in the patient group can be attributed to the increased lead of blood plasma in the patient group. This research finding is consistent with the research conducted by Wani et al. They showed that chronic exposure to lead results in increased blood pressure [29]. Domeneh et al. announced high blood lead level among the oral drug users [30]. Al-Ghabban reported that the blood lead level of smokers was higher than that of the non-smokers [31]. Hassan et al. reported that the blood lead level of smokers was higher than that of non-smokers [32]. Banihani et al. announced high serum levels of cadmium in smokers [33]. Pre-tests showed that the mean number of hypertensive red blood cells, creatinine, and albumin in the control group was higher than that of the patient group. According to the results of this study, the amount of cadmium, chromium, and lead in urine showed a strongly positive correlation with the occurrence of risky behaviors in the patient group. Therefore, the awareness of national health officials of this matter is of particular importance in public health promotion.

5. CONCLUSION

Mean concentration of cadmium in the urine of patients was 20 times higher the global NIOSH standards. Mean concentration of cadmium in the urine of the patients was about 740% higher than that in the control group. Therefore, it is essential to include the risks of smoking and drug abuse in the educational planning in all educational stages. Investigating thebehavior and changes in blood variables, such as hemoglobin, are among the strengths of the research. The small number of studied samplesis considered the weakness of the research. Further research is required on the concentrations of cadmium, chromium, and lead in exposed individuals in Tehran. Cadmium, chromium, and lead can have toxic effects on patients, and public health education and public health promotion via the media are suggested. The health promotion in public places is suggested in such a way to avoid the exposure of a non-smoker to a smoker. Thesmoke-free laws in public places should be followed by a better guarantee. A workshop on lifestyle should be held indrug rehabilitation centers.

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