-%5 -RXUQDO RI ,QWHUGLVFLSOLQDU
0HGLFLQH DQG 'HQWDO 6FLHQFH

%FUFSNJOBUJPO PG 4FMFDUFE)FBWZ .FUBM - 4BNQMFT GSPN %FOUBM -BCPSBUPSZ 5FDIOJD

Mervat A. Al-Awadeen [1], Ahmad S Al-Hiyasat [2]

[3]Department of Medicinal Chemistry and Pharmacognosy, Faculty of Pharmacy, Jordan University of Science and Technology, Irbid, Jordan

Abstract

The aim of this study was to determine selected heavy metal levels including cobalt (Co), Chromium (Cr) nickel (Ni) in scalp KDLU DQG ¿QJHUQDLO VDPSOHV RI GHQWDO WHFKQLFLDQV 7KH VFDOS KDLU DQG ¿QJHUQDL DQG PHGLFDO WHFKQLFLDQV FRQWURO JURXS ,Q WKH VDPSOH WLPH D TXHVWLRQQDLUH FRQFHQWUDWLRQ RI KHDY\ PHWDOV &R &U DQG 1L LQ VFDOS KDLU DQG ¿QJHUQDLO ZHUH WKH &R FRQFHQWUDWLRQ LQ KDLU DQG QDLOV RI GHQWDO WHFKQLFLDQV ZDV —J J – (0.04 µg/g, 0.03 µg/g respectively). Ni concentration in hair and nails of dental technicians was (12.00 µg/g, 17.4 µg/g respectively) compared with medical technicians (6.3 µg/g, 6.00 µg/g respectively). Concentration of Cr in hair and nails of dental technicians was (9.37 µg/g, 10.6 µg/g respectively) compared with medical technicians (0.0 µg/g, 10.3 µg/g respectively), Ni was found to have the KLJKHVW OHYHO LQ WKH KDLU DQG ¿QJHUQDLOV RI GHQWDO WHFKQLFLDQV

Keywords: Heavy metals; Dental technician; Scalp hair; Fingernails

Introduction

Dental laboratory technicians have multiple occupational exposures, which may have adverse e ects on their health. e potential occupational risk factors include chemical, physical, psychological, ergonomic, and other job-related factors [1,2].

e substances to which dental technicians are exposed include heavy metals from the base metal alloys and some other materials that are used in the fabrication of dental prosthesis [3]. Indeed, base metal alloys have become widely used in dental practice as cast materials and especially used for the construction of metal core in metal-ceramic restorations and the construction of Co-Cr metal framework of removable partial denture (RPD) (cobalt-chromium) [4-6]. In general, these alloys consist of 35–65% cobalt (Co), 20–30% chromium (Cr), 0–30% nickel (Ni) and small amounts of molybdenum (Mo), silica, beryllium, boron and carbon [7,8].

Nickel (Ni), chromium (Cr) and cobalt (Co) are essential elements required for the human body in extremely low amounts; whereas at high levels these elements may cause serious problems in the body [9]. Contact with Ni compounds can cause a variety of adverse e ects on human health, such as nickel allergy in the form of contact dermatitis, lung brosis, cardiovascular and kidney diseases and cancer of the respiratory tract [10,11]. Chromium may cause asthma, cough, shortness of breath, and wheezing [12]. Occupational exposure to Co is primarily via inhalation of dusts, fumes, or mists containing Co, targeting the skin and the respiratory tract [13].

e use of scalp hair and ngernails samples in an assessment of environmental and occupational metal exposure has received a great deal of attention in the literature [14-19]. In the past few years human hair and ngernails have been recognised as an invaluable tissue and more attractive diagnostic tool in assessing heavy metals in human body with environmental exposure [20]. Nowadays there is an increasing interest of scalp hair and ngernails in the elds of medical, biological, forensic, and environmental sciences [17,18,21-23], they can be easily sampled collected, stored and prepared for analysis [24,25].

e hypothesis of the present study is that the dental laboratory technicians are at risk of exposure to heavy metals from the alloys that they used in the production of dental prosthesis, the level of heavy metals in their body will be increased than the normal level in the general population, their hair and gure nails are good biological tissues to trace the level of these elements in their body. erefore, In this study, the levels of heavy metals namely: Co, Cr and Ni in scalp hair and ngernails samples collected from dental technicians were determined and compared with the other samples collected from medical laboratory works as a control group.

Materials and Methods

Study population

is study was conducted for determination of selected heavy metal levels in scalp hair and ngernail samples collected from dental technicians in Jordan. e target population was dental technicians who work in the dental laboratories in Jordan. A convenient sample of 21 dental laboratories and 6 medical laboratories were selected from those available in the north and middle region of Jordan.

Samples collection

A total of 80 samples of human hair and 80 samples of ngernails were collected from 55 dental technicians who work in dental laboratories and 25 medical laboratories technicians as a control group. e age range for all of the subjects was 20-50 years old with a mean of 36 years. At the begging all subjects were given a form detailing the aim of the study and all agreed to participants and signed this form.

A questionnaire was also administered in order to collect details

*Corresponding author: Professor Ahmad S. Al-Hiyasat, Department of Conservative Dentistry, Faculty of Dentistry, Jordan University of Science and Technology, Irbid, Jordan, Tel.: +962 7 97066097; Fax: + 962 2 7201080; E-mail: hiyasat@just.edu.jo

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signi cant e ect in the Co, Ni and Cr concentration also were not signi cantly a ected by any of the variables of the subjects investigated (p>0.05).

Correlation between the concentration of heavy metals in hair and nails (Table 7) indicated that all the metals investigated were signi cantly correlated to each other in hair as well as in ngernails. In the other hand the correlation in the concentration of the heavy metals in hair vs. nails was found to be signi cantly only for the Co (p>0.05).

While the other variables have no signi cant e ect in the Ni. Co and Cr concentration have no signi cance at all in their concentrations related to the variables of the subjects investigated.

Figure 2show the mean concentrations of Co, Cr and Ni (µg/g) in ngernails of the dental technician and medical technicians. e statistical analysis by Mann-Whitney revealed that the concentrations of both Ni and Co were signi cantly more in nails of dental technicians compared to their concentration in nails of the medical technicians (p<0.001), while the concentration of Cr was not signi cantly di erence in fact the mean was very closed in both groups (p=0.196). Analysis of multivariable showed no signi ed e ects at all for the variables investigated in the concentrations of heavy metal in the nails of dental technicians (Table 5). For the medical technicians samples analysis (Table 6), Co concentration was the only one that was signi cantly a ected by the smoking habit, while the other variables had no

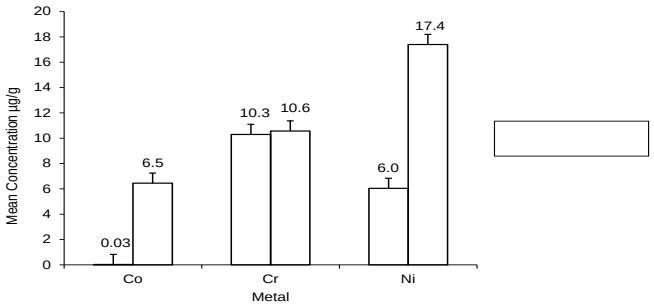

Figure 2: 0 H D Q F R Q F H Q W U D W L R Q V R I & R & U D Q G 1 L — J J L Q ¿ Q J H U Q D L O V R I W K H dental technician and medical technicians.

dental prosthesis such as crown, bridge and the metal framework of removable partial denture, the environment of dental laboratory may have also airborne contamination from dust and metal [3,7,8].

Concentration of Ni in hair of dental technicians was found high than Co and Cr, this could be related to the base metal alloys that are the most frequently used in dental laboratories in Jordan that were found to be; Remanium CS (Ni 61%, Cr 26%, Mo 11%, Si 1.5%, Fe Ce, Al, Co<1%), Heranium NA (Ni 59%, Cr 24%, Mo 10%,Fe, Mn, Ta, Si, No < 2%), Wiron 99 (Ni 65%, Cr 22.5%, Mo 10%,No 1%, Si 1%, Fe 0.5%, Ce 0.5%, C 0.02%), CB So (Ni 72.8%, Cr 4.9%, Cu 12.3%, othe 10%) [28,29]. us, it could be seen that Ni represents approximately 60% or more of the composition of these alloys, whereas, the other elements were less than Ni content.

mean concentration of Co, Cr and Ni (0.74 µg/g, 9.37 µg/g, and 12.0 µg/g respectively) in hair samples compared with medical technicians (0.04 µg/g, 0.0 µg/g, and 6.3 µg/g respectively), the di erence was signi cant for the three heavy metals Co, Cr and Ni ($p<0.001$, $p<0.001$, $p=0.001$ respectively). e explanation of these di erences is due to nature of work and environment of laboratory; dental technicians exposed to heavy metal through inhalation and skin absorption by production of

31-50 years old compared with 20-30 and this related to the number of years of exposure to the Ni during their work, this is also been shown to the association of working time with the concentration of the Ni level on the hair of the subjects.

e results in this study related to Ni levels in smoker (Sheesha) compared with non smoker are in a good agreement with other ndings by Wolfsperger et al. [30], which could be related to the smoke that is inhaled from the Sheesha.

Previous researcher have reported that the concentrations of Cr, Co and Ni in the urine of dental tech ians were signi cantly elevated, con rming the occupational exposure e ect to these metals, Co concentration was higher than the level of Cr and Ni [3], the alloys used in those laboratories that were investigated in (Ankara) were; Wironit (Co 64%, Cr 28%, Mo 5.0%), Remanium CD (Co 65%, Cr 26%, Mo 4.5%), Remanium GM380 (Co 64.5%, Cr 29%, Mo 4.5%), and also Formalloy C (Cr 30%, Ni 60%, Mo 5.0%), Ceraplus S (Cr 23%, Ni 62%, Mo 10%) and Remanium CS (Cr 26%, Ni 61%, Mo 11%). is may explain why the Co level was higher than Cr and Ni, since Co represents approximately more than 60% of the composition of three out of the six alloys that are used in the laboratory investigated.

In this study, there is a signi cant association between a g participates and Ni concentration for dental technicians and medical technicians ($p<0.016$, $p<0.021$ respectively). It is more in the age group

who reported that the mean value of individual sister chromatid exchange (SCE) frequencies and the percentage of high-frequency cells (HFC) were signi cantly higher compared to controls, and both were statistically signi cantly a ected by exposure status and smoking habit. Moreover, Shirakawa and Morimoto [34] reported that the relationship between smoking habits and hard metal exposure in the elevation of speci c immunoglobulin E (IgE) to cobalt remains unideni ed.

In this study, it was found that the heavy metals (Co, Cr and Ni) are correlated to each other in hair and ngernail samples Table 7 whereas, there was no correlation between the concentration of Ni and Cr in hair vs. nails, but signi cant correlation was found for Co as shown in (Table 7). Other researchers reported that there was no correlation between nails vs. hair for the levels of Ni [32], and no correlation for other metals including Co and Cr in hair and nails samples [35].

In this study, it was clearly that there was a variation in number of dental technicians who had high concentrations of Co, Cr and Ni compared to the control group (medical technicians). is variation may be due to the nature of work and laboratory environment as mentioned previously.

A standard reference values for Co, Cr and Ni in human hair were; Co (0.01-0.2), Cr (0.10-1.50) and Ni (<1.40) µg/g [36]. us, Ni was the dominant element that a ected the subjects investigated in this study in both groups dental technicians and medical technicians (87.3% vs. 52%) while Cr was the second having (78.2%) of the dental technicians above the standard reference while non was found for medical technicians, for the Co (65.5%) of the dental technicians had concentration higher than standard compared to (4%) among the medical technicians. is clearly demonstrates that the dental technicians are at risk to have high concentration of heavy metals in their body that is above the standard reference used for the hair.

us, the results of the study support its hypotheses, therefore, a special caution should be taken to protect the personnel of this profession from the toxic e ect of these metals that may harm their body. Future research may investigate any clinical signs or symptoms that could be related to the high level of these metals and their e ect in the body of the dental technicians.

Conclusions

Based in this study the following could be concluded:

i. e level of heavy metals found in hair of dental technicians was signi cantly higher than in the hair of medical technicians for under tested elements (Co, Cr and Ni).

ii. e level of Co and Ni in ngernails was signi cantly higher in dental technicians than in medical technicians, whereas the Cr level was very similar in both groups.

iii. Overall the levels of the heavy metals in the ngernails were relatively higher than those in hair samples.

iv. Ni was the dominant element found with the high level of concentration compared to other element. While the Co was the least.

v. Chromium was signi cantly found in ngernails of the medical technicians but was not found at all in their hair.

vi. Heavy metal levels was found to be a ected by the age of the participants, place of work, working time, use of suction, and smoking of sheesha.

vii. Signi cant correlation was found between of the three metals investigated (Co, Cr and Ni) in hair as well as in ngernails. While signi cant correlation was found between ngernails and hair only for the Co but not for the Ni neither Cr.

viii. More that 65.5% of the dental technicians investigated had level of heavy metals in their hair sample above the standard reference.

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