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BIOLOGICAL MONITORING OF MERCURY EXPOSURE IN DENTISTS OF TEHRAN

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ABSTRACT

In order to assess the risk for mercury poisoning in dentists, urine specimens were collected and analysed from 250 dentists (190 male, 60 female). Subject data and pertinent health symptoms were asked via a questionnaire. The results indicate that the mean and standard deviation of mercury values were 51.3± 38.0 µg/L, while 27.2 percent of dentists had levels within normal limits (0-19 µg/L). The results also showed that values for general practitioners tended to be higher, but was not significant for the specialists. The data demonstrated that there is an association between health symptoms pertinent to mercury poisoning and urine mercury values above 50 µg/L.
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INTRODUCTION

The dental office is a closed area that contains chemical, physical and biological agents as well as stressful conditions. Therefore, dentists and dental health professionals constitute a sizeable occupational group at risk to multiple hazards.[7,13]

The health hazards of mercury to the dental profession have been a topic of debate and research in the United States since the 1830s. Recent surveys have shown that at least 10% of dental offices in the United States have ambient mercury vapor levels in excess of the TLV (TLV=0.025 mg/m^3 (ACGIH, 1993-1994))[1]. Blood and urine analyses of dentists attending professional meetings have shown that anywhere from 50% to 70% of those tested have mercury levels above normal.

Battistone et al.[2] and Buchwald[4] suggested hygienically-significant exposure to mercury in dental offices. The health effects of mercury exposure are well documented.[5] Mercury is a systemic toxin that targets primarily the nervous system and kidneys.[10] Dental personnel are exposed to mercury toxicity through two primary sources: 1) contact or handling of mercury, and 2) inhalation of mercury vapor.

This study was designed to assess the risk of mercury poisoning in dentists by biological monitoring and evaluation of various factors such as sex, specialty, the number of years in practice and work hours per week.

MATERIALS AND METHODS

The investigation was carried out on 250 dentists (190 males, 60 females). The dentists were selected by stratified random sampling method with regard to sex, specialty and the number of years in practice. Each was asked to complete a questionnaire containing a self description and several items pertinent to habits that might influence mercury hygiene in dental practice.

Dentists' mercury absorption was assessed via urine samples. Urinary mercury is considered to be an accurate measure of exposure among dentists.[5] 24-hour collections of urine were collected from 190 male and 60 female subjects for examining the urinary mercury concentration. Urine specimens were preserved by acidifying with HCl(pH1-2)[12] and were stored. Storage

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time was extended by freezing (4°C).[12] Samples for analysis were obtained from frozen specimens and were subsequently brought to room temperature immediately before analysis. Urine specimens were vigorously shaken before aliquoting, as the precipitates formed contain mercury. Mercury in urine was analysed using the cold vapor atomic absorption (CV AAS) technique.[3] Standard aqueous solutions of mercury were prepared on the basis of normal urine and analysis was performed as described above. Determination in urine can therefore be made by reference to a standard curve based on normal urine. The urinary mercury concentration has been expressed in µg/L and corrected for 1.024 specific gravity.[12] Then the mercury determinations and questionnaire data statistical analysis. Calculation of the results was carried out using SPSS program.

Table I. Description of participants (n=250)

		Years of	
Sex	%	employment	%
Male	76	5-9	28.4
Female	24	10-14	27.2
		15-19	16.4
Specialty		20-24	7.6
General Practitioners	73.6	25-29	10.4
Specialists	26.4	30+	10.0
Age (years)		work hours/week	
30	15.2	20	4.0
31-39	40.0	21-29	14.4
40-49	26.0	30-39	23.2
50-59	17.2	40-49	34.0
60 and above	1.6	50 and above	24.4
Total	100		

RESULTS

Description of participants

Demographic characteristics of the selected dentists are shown in Table I. There are 190 males and 60 females. The average age was 39.24 ± 10.4 years old. The majority of the dentists (72%) had less than 20 years of job history while 28.4% of them had less than 10 years of dental practice.

Dentists were classified according to their specialties. The subjects included 183 general practitioners (73.6%) and 67 specialists (26.4%).

Biological monitoring

Table II summarizes the results of urine mercury testing. The values ranged from 0 to 99 µg/L with a mean of 57.2 (SD=36.4). 27.2% (68 dentists) had levels within normal limits (less than 20 µg/L). Of the 182 dentists with elevated levels, 38, 8 and 136 had levels between 20-50 µg/L, 50-80 µg/L and more than 80 µg/L, respectively.

The mean and standard deviation of urinary mercury concentrations were separated according to the type of sex and practice (Table III). The overall results are shown graphically in Fig. 1. The mercury values are

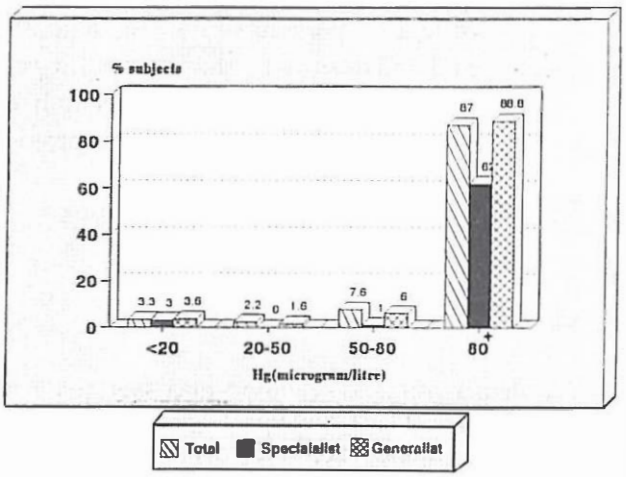


Fig. 1. Percentage distribution of dentists with regard to urine mercury values.

Table II. Concentration of urine mercury testing.

				Urinary Mercury Concentration (µg/L)							
		$\bar{\chi}$	S.D.	< 20		20-50		50-80		> 80	
	No.	(µg/L)	(µg/L)	No.	%	No.	%	No.	%	No.	%
General Practitioner*	183	59.23	36.54	48	26.09	22	11.96	6	3.26	108	58.70
Specialists	67	51.44	35.80	20	30.30	16	24.24	2	3.03	28	42.42
Total	250	57.20	36.40	68	27.20	38	15.20	8	3.20	136	54.40

* $P < 0.05$

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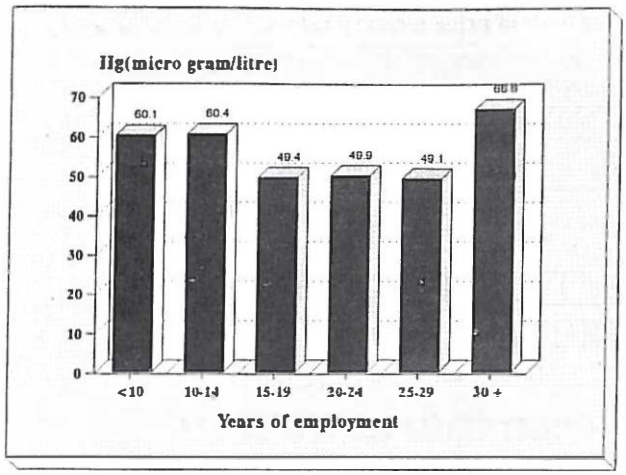


Fig. 2. Mean of urine mercury values versus years in practice in dentists.

Table III. Mean and standard deviation of urine mercury levels (μg/L).

	Male	Female	Total
General Practitioner	60.0	56.8	59.2
	(36.8)	(35.9)	(36.5)
Specialist	54.7	42.7	51.4
	(36.2)	(34.1)	(35.8)
Total	58.6	52.6	57.2
	(36.6)	(35.7)	(36.4)

Table IV. Mean and standard deviation of urine mercury levels (μg/L) according to weekly work hours.

	Hours of work per week				
	< 20	**20-29**	**30-39**	**40-49**	**> 50**
Mean	49.4	58.2	59.4	60.7	67.4
Standard deviation	38.1	36.7	35.5	35.6	34.9
No.	10	36	58	85	61

divided into four ranges and the percentages of all dentists (general practitioners and specialists) whose urine values fell in each range are given.

In Fig. 2 the mean concentration of mercury in urine samples are compared according to the number of years spent in practice. It appears that dentists with less than 15 years and those with more than 30 years of practice had higher mercury values than the dentists with 15-30 years in practice, but urine mercury levels usually increase with increasing weekly hours or weekly exposure, as shown in Table IV.

Dentists were asked whether they were currently experiencing a variety of symptoms which might be indicative of mercury toxicity.[6,9] The most frequently reported symptoms were fatigue (41.2%), nervousness (36.8%), memory-lapses (22.4%), joint pain (51.2%) and hand trembling (18.8%).

The association between the above symptoms and urinary mercury levels are shown in Table V.

DISCUSSION

This investigation revealed an important health risk in dentists, such that only 27.2 percent (67 dentists) had levels within normal limits (0-19 μg/L). Our results are in contrast with other cross-sectional studies performed by Langworth et al.[8] and Sällsten et al.[11]

The mercury concentration ranged from 0 to 99 μg/L. This is due to wide variation in the quality and facilities of the dental office and characteristics of the working environment such as ventilation, cleaning up services in the event of a mercury spill and its disposal, etc. In addition, elevated room temperature due to projectors could contribute to an increase in mercury vapor concentration.

As seen in Table II, the urinary mercury measurements had a small and statistically insignificant increased value for specialists. It is also shown that there is no significant difference in mercury values between female and male dentists. In relation to the years in practice, the data shows that 65.6 percent of the dentists (the youngest and the oldest) displayed the highest mercury levels. Among those, the less experienced may be less careful or skillful than those who are more experienced, and the oldest dentists have more assurance because of their experience and therefore do not follow safety recommendations. The results obtained in this study are the same as those found in a research made by Battistone et al.[2]

In the case of symptoms and their relationship with mercury concentration, the results showed that contrary to the results obtained by Goldberg et al,[6] there is an association between the dentists' symptoms (except hand-trembling) and urine mercury values above 50 μg/L, so that the frequency of symptoms in this group is higher than that of dentists with 20-50 μg/L of mercury, and these differences are statistically significant ($P < 0.05$). On the basis of this investigation, we conclude that urine mercury values could be an index of exposure to this contaminant. Considering the health hazards of mercury exposure, the prevention of mercury exposure in dental offices and decontamination of the

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Table V. Health symptoms distribution on the basis of urine mercury values.

Health Symptoms			Urinary Mercury Level (μg/L)					
			< 20		20-50		> 50	
	No.	%	No.	%	No.	%	No.	%
Fatigue	103	41.2	21	20.4	23	22.3	59	57.3
Nervousness	92	36.8	19	20.6	23	25	50	54.5
Joint pain	128	51.2	37	28.9	33	25.8	58	45.31
Memory lapses	56	22.4	13	23.2	17	30.4	26	46.4
Hand trembling	47	18.8	13	27.7	12	25.5	22	46.8

work area by using appropriate control programs are necessary.

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