

# 치과기공실 공기중 및 치과기공사의 혈액, 요중 중금속 함량에 관한 연구

진주간호보건전문대학 치기공과

## 목 차

가

(William, 1984),

(Kendrey , 1969)

- 1.
- 2.
- 3.

1.

가

2.

3.

Butt(1964), Kopito(1967), Kubota(1968)

4.

가

(1982)

5.

6.

7.

가

가

## I. 서 론

가

가

1987 6 1 1987 9 30 4

Imbus(1963)

, T.Murry (1981)

Table 1

, 工藤 光弘

31.1 ,

8.9

(1984)

가

## 2. 연구방법

### 1)

(personal sampler) 6  
glass fiber filter

5

Sodium diethyl diethiocarbamate  
chelate methyl iso-butyl  
ketone(MIBK)

228.8nm

232.0nm

## II . 연구대상 및 방법

### 1. 연구대상

20 ~ 50 72

25 ~ 50

48

가

concHcl  
dipheny carbazid UV  
Spectrophotometer(Perkin Elmer, comp.,  
Germany) 540nm

### 2)

10ml

5ml

polyethylene bittle 6  
100ml

Table 1. Distribution of subjects by age and duration of work

Unit : no(%)

Age(year)	No. of subjects	Duration of work(year)	No. of subjects
~29	25 (52.1)	~ 5	17 (35.4)
30~39	18 (37.5)	6~ 9	13 (27.1)
40~	5 (10.4)	10~	18 (37.5)
Total	48 (100.9)	Total	48 (100.0)
Mean	31.1	Mean	8.9

DDTC(solium diethly  
dithiocarbamete) chelate  
methyl isobutyl ketone(MIBK)

228.8nm,

232.0nm

100ml	5ml,	Table 2	0.0087 ±
		0.0016mg/m <sup>3</sup> 가	
	KMnO4	0.0073 ± 0.0024mg/m <sup>3</sup> ,	
	trioxylamine-metaly sio-butyl ketone	0.0058 ± 0.0011mg/m <sup>3</sup> ,	0.0048
		± 0.0013mg/m <sup>3</sup> .(TLV : 0.05mg/m <sup>3</sup> )	
357.9nm			0.4253 ± 0.0052mg
		/m <sup>3</sup> 가	
3. 자료분석		0.4062 ± 0.0052mg/m <sup>3</sup> ,	
	computer	0.2523 ± 0.0041mg/m <sup>3</sup> ,	0.0846 ±
		0.0012mg/m <sup>3</sup> .(TLV : 1.0mg/m <sup>3</sup> )	
			0.1063 ± 0.0024mg/
	t-teat	m <sup>3</sup> 가	
		0.0834 ± 0.0085mg/m <sup>3</sup> ,	0.0423
F-		± 0.0014mg/m <sup>3</sup> ,	0.0101 ±
		0.0015mg/m <sup>3</sup> .(TLV : 0.5mg/m <sup>3</sup> )	

2. 폭로군과 대조군과의 혈액 및 요종의 카드뮴, 니켈, 크롬농도 비교

III. 연구결과

Table 3

1. 작업부서별 공기중 카드뮴, 니켈, 크롬 농도비교

1.92 ± 1.23µg/100ml	
03.90 ± 0.73µg/100ml	가 2

Table 2. Cadmium, Nickel, Chromium concentration of air in each work-place G.M ± S.D

Work-place	Breathing zone, Air concentration (mg / m <sup>3</sup> )		
	cadmium (TLV : 0.05)	nickel (TLV : 1.0)	chromium (TLV : 0.5)
Crown bridge	0.0058 ± 0.0011 (0.0028 ~ 0.0113)	0.4253 ± 0.0052 (0.0541 ~ 4.4431)	0.0834 ± 0.0085 (0.0532 ~ 0.1821)
Partial denture	0.0073 ± 0.0024 (0.0039 ~ 0.0135)	0.4062 ± 0.0052 (0.1413 ~ 1.1835)	0.1063 ± 0.0024 (0.0642 ~ 0.4514)
Porcelain	0.0087 ± 0.0016 (0.0039 ~ 0.0157)	0.2523 ± 0.0041 (0.0422 ~ 1.5824)	0.0423 ± 0.0014 (0.0023 ~ 0.3412)
Complete denture	0.0048 ± 0.0013 (0.0018 ~ 0.0245)	0.0846 ± 0.0012 (0.0038 ~ 1.2537)	0.0101 ± 0.0015 (0.0094 ~ 0.1273)

( ) : Range  
G.M. : Geometric mean  
TLV :: Threshold limit value (ACGIH, 1983-84)

Table 3. Blood and urinary cadmium, nickel, chromium concentration of each group Mean±S.D.

Group	No. of subjects	Blood (μg/100ml)			Urine (μg/ℓ)		
		cadmium	nickel	Chromium	Cadmium	nickel	chromium
Exposed group	48	1.92±1.23 (0.24~ 4.52)	63.02±34.25 (15.12~ 195.9)	2.17±1.51 (0.23~ 5.31)	1.95±1.90 (0.24~ 12.20)	48.53±38.83 (7.20~ 225.40)	13.54±10.25 (2.43~ 48.60)
Control group	72	0.90±0.73 (0.13~ 3.26)	45.64±35.23 (4.60~ 70.40)	1.41±0.72 (0.09~ 4.16)	1.32±0.93 (0.05~ 6.86)	20.24±15.35 (2.30~ 52.60)	7.82±6.83 (1.20~ 25.70)
t-value		5.795*	2.683*	3.695*	2.355*	5.581*	3.682*

\* : p<0.05

가 63.02 ± 34.25 μg/100ml,                      45.64 ± 35.23  
 가 2.17 ± 1.51 μg/100ml,  
 1.41 ± 0.72 μg/100ml  
 , ,  
 .(P<0.05)  
 가 1.95  
 ± 1.90 μg/ ,                      1.32 μg/ ,  
 가 48.53 ± 38.83 μg/  
 2    가 13.54 ± 10.25 μg/ ,  
 7.82 ± 6.83 μg/  
 , ,  
 .(P<0.05)

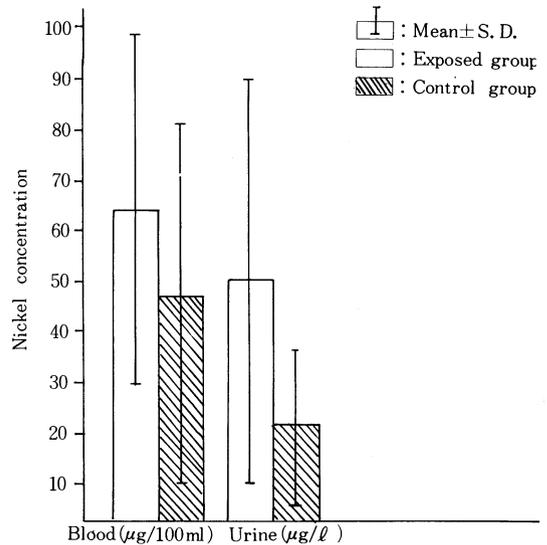


Fig 2. Blood and urinary nickel concentration of exposed group and control group.

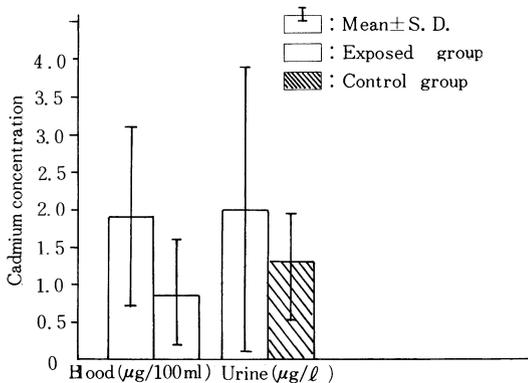


Fig 1. Blood and urinary cadmium concentration of exposed group and control group.

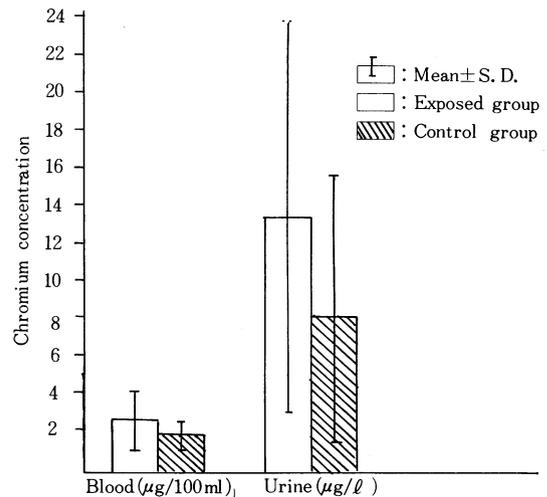


Fig 3. Blood and urinary chromium concentration of exposed group and control group.

### 3. 근속년수별 혈액 및 요중의 카드뮴, 니켈, 크롬농도의 비교

1.85 ± 1.28 μg/100ml  
1.36 ± 0.98 μg/100ml 가

Table 4  
± 2.05 μg/100ml, 10  
10  
10  
/100ml  
가

1.81  
2.05 ± 1.14 μg/100ml  
64.53 ± 53.04  
76.03 ± 4266 μg/100ml 가  
67.01 ± 38.83 μg/100ml,  
47.15 ± 20.95 μg/100ml

3.60 ± 1.02 μg/100ml 가  
Table 5  
1.90 ± 1.27  
2.73 ± 1.46 μg/100ml,  
1.29 ± 0.73 μg/100ml,  
1.18 ± 0.63 μg/100ml

μg/ 10  
1.50 ± 0.98 μg/  
10 10

(P<0.05)

### 4. 작업부서별 혈액 및 요중의 카드뮴, 니켈, 크롬농도 비교

Table 6

1.08 μg/100ml 가  
2.47 ± 1.24 μg/100ml,

Table 7  
3.141 ± 3.15 μg/ 가  
3.17 ± 1.12 μg/ ,  
1.26 ± 0.63  
2.53 ± μg/ , 1.02 ± 0.91 μg/  
(p<0.05)

Table 4. Blood cadmium, nickel, chromium concentration Blood by duration of work Meak ± S.D.

Group	Duration of work (year)	No. of subjects	Blood concentration (μg/100 ml)		
			cadmium	nickel	chromium
Control		72	0.90 ± 0.73	45.64 ± 35.23	1.41 ± 0.72
DLT	~ 9	30	1.81 ± 2.05	64.53 ± 53.04	2.10 ± 1.46
DLT	10~	18	2.05 ± 1.14	53.02 ± 21.13	2.08 ± 1.46

DLT : Dental laboratory technician

Table 5. Urinary cadmium, nickel, chromium concentration Blood by duration of work Meak ± S.D.

Group	Duration of work (year)	No. of subjects	Urinary concentration (μg/ℓ)		
			cadmium	nickel	chromium
control		72	1.32 ± 0.93	20.24 ± 15.35	7.82 ± 6.83
DLT	~ 9	30	1.50 ± 0.98	54.33 ± 43.03	13.75 ± 9.74
DLT	10~	18	1.90 ± 1.27	39.92 ± 30.41	12.84 ± 11.63

Table 6. Blood cadmium, nickel, chromium concentration by work-place Mean±S.D.

Work-place	No. of subjects	Blood concentration ( $\mu\text{g}/100\text{ml}$ )		
		cadmium	nickel	chromium
Crown-bridge	18	1.36±0.98	67.01±38.83	2.73±1.46
Partial denture	6	1.47±1.24	76.03±42.66	3.60±1.02
Porcelain	11	2.53±1.08	55.72±19.73	1.29±0.73
Complete denture	13	1.85±1.28	47.15±20.95	1.18±0.63
F - Value		2.992*	1.580	9.634*

\* :  $p < 0.05$

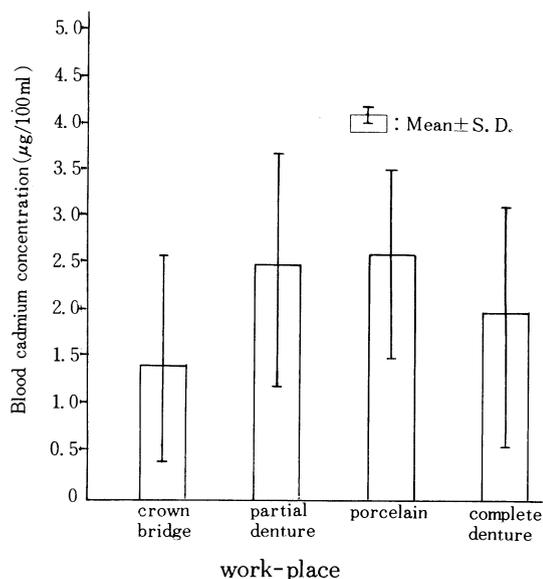


Fig 4. Blood cadmium concentration by work-place.

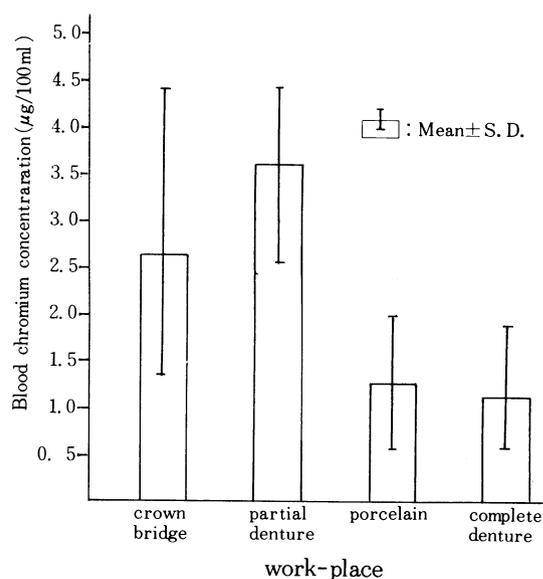


Fig 5. Blood chromium concentration by work-place.

Table 7. Urinary cadmium, nickel, chromium concentration by work-place Mean±S.D.

Work-place	No. of subjects	Urinary concentration ( $\mu\text{g}/\ell$ )		
		cadmium	nickel	chromium
Crown-bridge	18	1.26±0.63	57.12±29.71	14.85±10.44
Partial denture	6	3.17±1.12	68.41±68.82	15.12±12.73
Porcelain	11	3.41±3.15	38.73±28.54	13.43±10.72
Complete denture	13	1.02±0.91	37.12±32.21	9.94±6.72
F - Value		9.586*	1.450	0.709

\* :  $p < 0.05$

68.82 $\mu\text{g}/$  가  
 57.12  $\pm$  29.71 $\mu\text{g}/$  ,  
 38.73  $\pm$  28.54 $\mu\text{g}/$  ,  
 $\mu\text{g}/$  가

68.41  $\pm$   
 15.12  $\pm$  12.73 $\mu\text{g}/$  가  
 14.85  $\pm$  10.44 $\mu\text{g}/$  ,  
 12.43  $\pm$  10.72 $\mu\text{g}/$  , 9.94  $\pm$   
 6.72 $\mu\text{g}/$  가

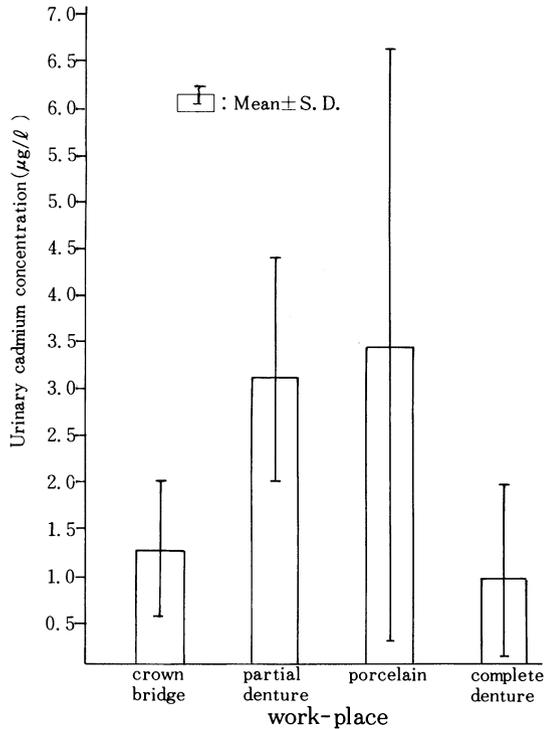


Fig 6. Urinary cadmium concentration by work-place.

### 5. 업무내용별 혈액 및 요중의 카드뮴, 니켈, 크롬농도 비교

group , wax  
 group( A )  
 group( Brns )

Table 8

Arns 1.77  $\pm$  1.25 $\mu\text{g}/100\text{ml}$ , B  
 2.19  $\pm$  1.20 $\mu\text{g}/100\text{ml}$ , A 58.31  $\pm$  38.34  
 $\mu\text{g}/100\text{ml}$ , B 66.52  $\pm$  29.12 $\mu\text{g}/100\text{ml}$ , A  
 1.76  $\pm$  1.34 $\mu\text{g}/100\text{ml}$ , B 2.51  $\pm$  1.63 $\mu\text{g}$   
 /100ml group  
 waxwhrkr group

B 2.64  $\pm$  2.41 $\mu\text{g}/$   
 A 1.39  $\pm$  1.18 $\mu\text{g}/$   
 (P<0.05)  
 B 54.52  $\pm$  44.92 $\mu\text{g}/$   
 A 43.52  $\pm$  31.91 $\mu\text{g}/$   
 B  
 16.38  $\pm$  12.97 $\mu\text{g}/$  A 11.22  $\pm$  6.90 $\mu\text{g}/$

Table 8. Blood and Urinary cadmium, nickel, chromium concentration by work-place Mean  $\pm$  S.D.

Work-process	No. of Subjects	Blood ( $\mu\text{g}/100\text{ml}$ )			Urine ( $\mu\text{g}/\ell$ )		
		cadmium	nickel	chromium	cadmium	nickel	chromium
wax-up & Complete (A) denture	26	1.77 $\pm$ 1.25	58.31 $\pm$ 38.34	1.76 $\pm$ 1.34	1.39 $\pm$ 1.18	43.52 $\pm$ 31.91	11.22 $\pm$ 6.90
Metal polishing (B)	22	2.19 $\pm$ 1.20	66.52 $\pm$ 29.12	2.51 $\pm$ 1.63	2.64 $\pm$ 2.41	54.52 $\pm$ 44.92	16.38 $\pm$ 12.97
t-value		1.183	0.827	1.748	2.336*	0.990	1.759

\* : p < 0.05

(A) : Non-metal trimming group

(B) : Metal trimming group

6. 흡연여부별 혈액 및 요중의 카드뮴, 니켈, 크롬농도 비교

Table 9

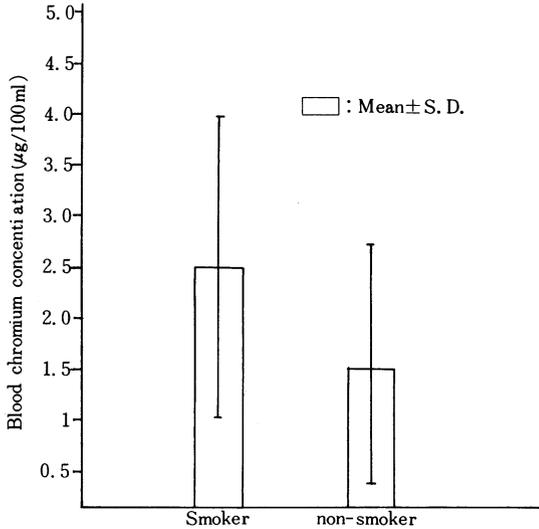


Fig 7. Blood chromium concentration by smoking group

7. 혈액과 요중사이의 카드뮴, 니켈, 크롬 농도 사이의 상관관계

Table 10, 11

0.605 가

Table 9. Blood & Urinary cadmium, chromium, nickel concentration by smoking group Mean±S.D.

Blood concn (µg/100ml)	smoker (n=33)	Non-smoker (n=15)	p-value	Urinary concn (µg/l)	Smoker (n=33)	Non-smoker (n=15)	p-value
cadmium	2.00±1.23	1.73±1.26	0.509	cadmium	1.75±1.11	1.43±1.08	0.347
nickel	66.82±38.91	53.43±20.12	0.332	nickel	56.03±43.82	33.23±18.80	0.059
chromium	2.46±1.54	1.54±1.25	0.049*	chromium	14.21±11.53	11.62±7.23	0.433

\* : p<0.05

concen : concentration

0.550,

0.472

0.387,

0.383,

0.346,

0.325,

0.35,

(P<0.05).

0.309,

0.295

IV. 고찰

(kendrey , 1969)

67-98%,

12-15%

40-60%,

가 32-40%가

가  
가

.(William N , 1984),

(1982)

가

가

0.0087mg/mm<sup>3</sup>

가



Glyseth (1977)

Langard (1978) rat 42.00 $\mu$ g/ , 43.00 $\mu$ g/  
 工藤 光弘(1984) 2.84 $\mu$ g/ ,  
 Osaner (1984) Tanning 6.60 $\mu$ g/

가  
 가 Mutti  
 (1979) 가  
 , 工藤 光弘(1984) 가  
 가  
 가 Thomas Murry  
 (1981)

Mutti (1979)  
 Mutti (1979)

J.Clausen(1977) E.L  
 Baker (1979) 가

1.92 $\mu$ g/100ml , J.Clausen (1977)  
 1.56 $\mu$ g/100ml, Soichiro Iwao 가  
 (1980) 1.80 $\mu$ g/100ml

1.95 $\mu$ g/ 가 , 가  
 , Plastic 가 가  
 5.40 $\mu$ g/ 가 가

63.02 $\mu$ g/100ml , J.Clausen (1977)  
 53.0 $\mu$ g/100ml 가 ,1969) Wax (Kendrey  
 가 가  
 48.53 ( , 1987)  
 10.1 $\mu$ g ,  
 가 70 $\mu$ g/  
 가 가  
 .(Stokinger ,1981) 가 Wax  
 2.17 $\mu$ g Wax

/100ml Gafafer(1953)가  
 6.00 $\mu$ g/100ml 가  
 fh (1986) Gafafer(1953)가 13.54 $\mu$ g/ 가

가

2.  $1.92 \pm 1.23 \mu\text{g}/100\text{ml}$ ,  $63.02 \pm 34.25 \mu\text{g}/100\text{ml}$ ,  
 $2.17 \pm 1.51 \mu\text{g}/100\text{ml}$   
 $0.90 \pm 0.73 \mu\text{g}/100\text{ml}$ ,  $45.64 \pm 35.23 \mu\text{g}/100\text{ml}$ ,  $1.41 \pm 0.72 \mu\text{g}/100\text{ml}$

가

가

가

$1.95 \pm 1.90 \mu\text{g}/$  ,  $48.53 \pm 38.83 \mu\text{g}/$  ,  $13.54 \pm 10.25 \mu\text{g}/$  ,  $1.32 \pm 0.93 \mu\text{g}/$   
 $/$  ,  $20.24 \pm 15.35 \mu\text{g}/$  ,  $7.82 \pm 6.83 \mu\text{g}/$

가

各務守 (1978)

3.

$2.53 \pm 1.08 \mu\text{g}/100\text{ml}$ , 가

$3.60 \pm 1.02 \mu\text{g}/100\text{ml}$  가

$3.41 \pm 3.15 \mu\text{g}/$

가

가

4.

$2.64 \pm 2.41 \mu\text{g}/$

$1.39 \pm 1.18 \mu\text{g}/$

5.

$2.46 \pm 1.54 \mu\text{g}$

$/100\text{ml}$

$1.54 \pm 1.25 \mu\text{g}/100\text{ml}$

가

6.

가

7.

$0.605 (P < 0.01)$  가

가

가

## V. 결론

48

가

72

1987 6 1

1987 9 30

4

## 참고 문헌

1.

$0.0087 \pm 0.0016 \text{mg}/\text{mm}^3$  가

$0.4253 \pm 0.0052 \text{mg}/\text{mm}^3$  가

$0.1063 \pm 0.0024 \text{mg}/\text{mm}^3$  가

김웅철. 치과기공작업중 발생되는 분진의 양상 및 그의 처리효과에 관한 실험적연구. 연세대학교 보건대학원 석사논문, 1982  
차성수. 치과기공사의 직무태도에 영향을 미치는

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- 三浦 滋, 林 康久, 森田 秀芳. Flameless 原子吸光法

- Abstract -

## **A Study on the Heavy Metals Concentrations in the Air of the Dental Laboratories, in the Blood and Urine of Dental Laboratory Technicians**

Sung Soo Cha

*Graduate School of  
Health Science and Management  
Yonsei University*

(Directed by Professor Chong Youl Kim D. D. S.)

The purpose of this study was to determine the concentration of cadmium, nickel and chromium in the air of the work-place, blood of and urine of workers and compare the level of those heavy metals by the duration of work, work-place, process of work, smoking and other factors.

In this study, 48 male dental laboratory technicians and 72 office workers as the control group were subjected. The concentration of cadmium, nickel and chromium in their blood and urine, and that of heavy metals in the air of their work-rooms were examined and analyzed from June 1 1987 to September 30, 1987.

The results were as follows :

1. The concentration of cadmium in the air was the highest in the porcelain part,  $0.0087 \pm 0.0016 \text{ mg/m}^3$ , that of nickel was the highest in the crown bridge part,  $0.4253 \pm 0.0052 \text{ mg/m}^3$ , and that of chromium was highest in the partial denture part,  $0.1063 \pm 0.0024 \text{ mg/m}^3$ .
2. cadmium, nickel and chromium concentrations in the blood and urine of dental laboratory technicians were higher than in the office workers'. Especially the concentration of cadmium in the blood ( $1.92 \pm 1.23 \text{ } \mu\text{g}/100\text{ml}$ ) of the dental laboratory technician was about two times as high as that in the office workers' ( $0.90 \pm 0.73 \text{ } \mu\text{g}/100\text{ml}$ ), and the concentration of nickel in the urine ( $48.53 \pm 38.83 \text{ } \mu\text{g}/e$ ) of the dental laboratory technician was about two times as high as that in the office workers' ( $20.24 \pm 15.35 \text{ } \mu\text{g}/e$ ).
3. there was no difference in the concentration of cadmium, nickel and chromium in the blood and urine with a longer duration of work.
4. The concentration of cadmium and chromium in the blood and urine differed significantly depending upon the place of work. The concentration of cadmium was the highest in the blood of dental laboratory technicians working in the porcelain part marking at  $2.53 \pm 1.08 \text{ } \mu\text{g}/100\text{ml}$ . The chromium level was the highest in the blood of partial denture part workers with a concentration of  $3.60 \pm 1.02 \text{ } \mu\text{g}/100\text{ml}$ . Concerning the level of cadmium in urine, it was the highest in the porcelain part workers with a concentration of  $3.41 \pm 3.15 \text{ } \mu\text{g}/e$ .

5. The concentration of cadmium in the urine of metal trimming and polishing group( $2.64 \pm 2.41 \mu\text{g/e}$ ) was higher than that of non-metal trimming and polishing group( $1.39 \pm 1.18 \mu\text{g/e}$ ).
6. The concentration of chromium in the blood of smoking group( $2.46 \pm 1.54 \mu\text{g}/100\text{ml}$ ) was higher than that of non-smoking group( $1.54 \pm 1.25 \mu\text{g}/100\text{ml}$ ).
7. The highest positive correlation coefficient was shown between the concentration of nickel and chromium in the blood among the all correlations between 3 metals (Cd, Ni, Cr) in the blood and those in urine. The correlation coefficient was relatively high ( $r=0.605$ ,  $p<0.01$ ).

In general, the higher the concentration of heavy metals in the air of work places the higher the concentration of them in the blood and urine of workers, more attention should be paid to the working environment of dental laboratory workers. Furthermore, continuous biological monitoring and further research are required for an efficient health management for dental laboratory workers.