Iran J Public Health, Vol. 44, No.4, Apr 2015, pp.583-585

Letter to the Editor

Fluoride Burden of Aluminum Plant Workers

Jun TU [1], ****Ke-jian LIU*** [2], ***Long-ju RAN*** [1], ***Xing-ping PAN*** [1]

1. *Chengdu Municipal Center for Disease Control and Prevention, Chengdu, Sichuan, China*
2. *Dept. of Occupational and Environmental Health, School of Public Health, Tongji Medical College, Huazhong University of Science and Technology, Wuhan, Hubei, China*

***Corresponding Author:** Email: 172929473@qq.com

(Received 16 Dec 2014; accepted 11 Jan 2015)

Dear Editor-in-Chief

Fluoride (F), a powerful oxidizing agent, is used in a variety of industries in China. Health problems among industrial workers due to F poisoning are on the rise. Long-term F exposure, together with varieties of relevant factors, leads to high F burden [blood fluoride (BF), urinary fluoride (UF)], which can finally result in F bone injury (1). As F burden is the major cause of F bone injury, to prevent the F bone injury, we have to control the F burden to a moderate level. The purpose of the present study was to examine the F burden and relevant factors of aluminum plant workers, and provide the basis for the early prevention of F bone injury.

Overall, 300 subjects, 20 to 50 of age, were randomly selected from workshops of an aluminum plant, who have been working in their present position for 5 years or longer. We conducted a face-to-face questionnaire for the 300 subjects. After finishing the questionnaire, only 279 subjects were included in our study. The participating subjects signed informed consent forms. Blood samples were collected from a brachial vein within a few minutes after the end of the shift. Urine samples were collected as follows: just before the afternoon half-shift, the workers were asked to empty their bladders; then a sample of urine was collected at the end of the shift, just after blood drawing. Blood and urine samples were kept refrigerated until analysis. Air samples were collected from 6 different points in each workshop 16 times per day, for two consecutive days. The levels of BF and UF were determined by fluoride ion-selective electrode method. Levels of AF were determined by filter sampling and fluoride ion-selective electrode method (2, 3).

This study was approved by the Institutional Ethical Boards of Tongji Medical College, Wuhan China, and had been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments. Statistical analyses were performed using SPSS 16.0 statistical software.

The highest AF was observed in aluminum electrolytic workshop (2.31±1.01mg/m3), followed by aluminum pole workshop (0.36±0.10mg/m3), the lowest observed in the office area (0.11±0.09mg/m3). The differences among the three workshops were significant (P<0.01).Means and standard deviations of BF and UF levels are presented in Table1, for workers classified by different factors. Results showed that BF of aluminum electrolytic workers were significantly higher than that of aluminum pole workers and that of office workers (P<0.01); BF of aluminum pole workers were significantly higher than that of office workers (P<0.01). UF of aluminum electrolytic workers were significantly higher than that of aluminum pole workers and that of office workers (P<0.01); UF of aluminum pole workers were sig-

nificantly higher than that of office workers (*P*<0.01). Age, Working history, smoking and alcohol consumption did not significantly affect the BF and UF levels (*P*>0.05).

Table1: BF and UF levels (mean ± SD, mg/L) in relation to different factors

Factors	n	BFa (mean ± SD)	UFa (mean ± SD)
All subjects	279	0.20±0.06	4.49±4.49
Work category			
1. Office workers (af: 0.11±0.09mg/m3)	94	0.06±0.02	1.32±0.87
2. Aluminum pole workers (af: 0.36±0.10mg/m3)	90	0.12±0.03 b	2.85±1.94 b
3. Aluminum electrolytic workers (af: 2. 31±1.01mg/m3)	95	0.21±0.06bc	7.13±5.72bc
Age(yr)			
1. <30	89	0.20±0.05	6.92±5.62
2. 30~40	102	0.19±0.05	5.92±4.68
3. >40	88	0.22±0.07	5.82±5.52
Working history(yr)			
1. <10	92	0.21±0.06	5.78±5.28
2. 10~20	113	0.19±0.05	4.20±4.18
3. >20	74	0.22±0.07	4.65±4.04
Smoking			
1. Never smoker	99	0.20±0.05	4.61±4.80
2. Non-daily smoker	69	0.19±0.06	3.17±1.99
3. Daily smoker	111	0.20±0.06	4.61±4.49
Alcohol consumption			
1. Never consumer	62	0.20±0.06	4.55±4.92
2. Non-daily consumer	101	0.20±0.06	4.25±4.24
3. Daily consumer	116	0.20±0.05	5.06±4.66

a: BF, blood fluoride level; UF, urinary fluoride level;b: compare with work category 1, *P*<0.01 by ANOVA; c: compare with work category 2, *P*<0.01 by ANOVA

BF and UF levels of aluminum electrolytic and aluminum pole workshop workers were significantly higher (*P*<0.01), which were due to higher level of AF in the workshop. Since the large-scale use of cryolite, which is rich in F and could emit a lot of F into the air (4), the levels of AF in the aluminum electrolytic and aluminum pole workshop were significantly higher than the office area, (*P*<0.01). As the AF level increased, the BF and UF levels increased too. Related studies have shown that F bone injury is mainly caused by high F burden (5), so reduce the AF of the workplace contribute to the prevention of F bone injury. Meanwhile enhancing the operations of the personal protection of workers, workshop monitoring and occupational health care of the workers are still necessary. To sum up, our study found that due to AF, the work category could affect the F burden indirectly. Some appropriate measures were presented to reduce AF and prevent F bone injury. However, the relevant factors of F burden in our study are not comprehensive enough, and thus, our survey need further in-depth study.

Acknowledgments

This research was sponsored by the China National Nature Science Foundation (Grant NO.81372941). The authors declare that there is no conflict of interests.

References

1. Junxiang MA, Mingfeng LI, Yu'e SONG, et al. (2009). Serum osteocalcin and calcitonin in adult males with different fluoride exposures. *Fluoride*, 42(2): 133-36.
2. Deyhimi F, Salamat-Ahangari R (2003). An initial-rate potentiometric method for the determination of uric acid using afluoride ion-selective electrode. *Talanta*, 61 (4): 493-99.
3. Shi SX, Zhu ZG, Suo R,et al. (2003). Rapid method for the determination of trace fluoride and activation of ion-selective electrode. *Anal Sci*, 19(5): 671-73.
4. Zhang SJ (2007). Survey of morbidity of industrial fluorosis in workers exposed to electrolytic aluminum. *Zhonghua LaoDong Wei Sheng Zhi Ye Bing Za Zhi*, 25(2): 107-08 (in Chinese).
5. A S, M K, M B (2008). Incidence of skeletal deformities in endemic fluorosis. *Trop Doct*, 38 (4): 231-33.