

THYROID FUNCTION TESTS IN ALUMINUM POTROOM WORKERS EXPOSED TO FLUORIDE EMISSIONS

Vahid Reza Momeni,^a Maryam Dehghani-Beshne,^b Akbar Sharifian,^b Alireza Esteghamati,^c
Ebrahim Masoudi^b

Tehran, Iran

SUMMARY: Following a previous study on parathyroid hormone determinations in 200 aluminum potroom workers, we conducted a cross-sectional survey of 116 (58%) of these workers for their levels of serum triiodothyronine (T3), tetraiodothyronine (T4), thyroid stimulating hormone (TSH), urinary creatinine, and preshift urinary fluoride (F). The mean serum TSH measured by radioimmunoassay was 1.42 ± 1.26 mIU/L. Serum F measured by the ion selective electrode showed a mean urinary F/creatinine ratio of 2.1 ± 1.36 mg F/g of creatinine with 16 percent of workers having levels above 3 mg F/g of urinary creatinine. Serum TSH concentration did not appear to be related to work duration.

Keywords: Aluminum potroom workers; Arak, Iran; Industrial fluoride exposure; Thyroid function tests; Thyroid stimulating hormone.

INTRODUCTION

In primary aluminum production, cryolyte (Na_3AlF_6) and fluorspar (CaF_2) are used to lower the temperature required for the electrolytic reduction of alumina (Al_2O_3). In this process cryolyte and fluorspar release gaseous and particulate fluoride (F) that is a significant health hazard. In a recent survey we found that parathyroid hormone (PTH) levels were increased in 16% of F-exposed aluminum potroom workers.¹ Likewise, altered thyroid function has been found in F-treated animals,² and a human study indicated that exposure to endemic F can alter thyroid function and induce TSH elevation especially in children.³ However, there appears to be limited information about thyroid function in adults with occupational F exposure. Other F adverse effects studies on thyroid glands are reviewed in the 2006 US National Research Council (NRC) report.⁴

MATERIALS AND METHODS

Among 200 aluminum potroom workers in Arak, Iran, whom we examined in our previous study,¹ 84 workers did not agree to participate in our new study. We therefore were able to examine only 116 (58%) of the 200 workers in our earlier study. Individual data about age and work duration in potroom were obtained from the Health Safety Environmental (HSE) unit of the factory. All workers were healthy males without a history of chronic disease or drug consumption. Serum triiodothyronine (T3), tetraiodothyronine (T4), and thyroid stimulating hormone (TSH) were measured by standard radioimmunoassay (RIA). Urinary creatinine was measured by the Jaffe method using a kit supplied by Pars Azmon, Iran, and preshift urinary F levels were measured by a F ion selective electrode (ISE). Correlation and regression analyses were conducted on these variables

RESULTS AND DISCUSSION

The mean age of the 116 aluminum potroom workers examined was 35.8 ± 4.7 years, and their work duration in the potroom was 11.04 ± 4.7 years. The mean

^aFor correspondence: Dr Vahid Reza Momeni, Arak University of Medical Sciences, Arak, Iran. E-mail: vmomeni@Razi.tums.ac.ir; ^bDepartment of Occupational Medicine, Tehran University of Medical Sciences, Tehran, Iran; ^cEndocrine Research Center, Vali-Asr Hospital, Tehran University of Medical Sciences, Tehran, Iran.

levels and standard deviations of the measured variables are shown in the table. The serum T3 and T4 levels appeared to be well within the normal range in all workers. Using correlation tests and linear regression analysis, we did not find any significant relationship between potroom work duration and elevation of serum TSH ($p = 0.642$). We also did not detect any significant relationship between worker age and serum TSH ($p = 0.472$) and between serum TSH and urinary F ($p = 0.453$) or urinary F/g creatinine ($p = 0.276$). Preshift urinary F/g creatinine in 19 (16.4%) of the potroom workers was higher than the ACGIH recommendation (<3 mg F/g creatinine) for preshift urinary F.⁵ As seen earlier,¹ urinary F was significantly higher for potroom workers with longer work duration. However, we did not observe any significant relationship between serum TSH and thyroid hormone levels and work duration.

In summary, our observations indicated that chronic F exposure had no significant relationship with thyroid dysfunction in our aluminum potroom workers, nor was any relationship detected between serum TSH and urinary F. Our study thus indicated that chronic excessive F exposure of potroom workers does not appreciably alter their thyroid function. Only six workers (5.2%) had subclinical hypothyroidism with a TSH above the new normal TSH range of 0.3–3 mIU/L.

Table. Number, mean, standard deviation, and normal ranges of the laboratory variables

Variable	Number	Mean±SD	Normal range
T3 (ng/dL)	116	137.45±18.4	75–195 ^a
T4 (mcg/dL)	116	7.77±1.3	4.6–11.2 ^a
TSH (mIU/L)	116	1.42±1.26	0.5–5 ^a
Urinary creatinine (mg/dL)	116	97.19±33.91	32–241 ^b
Urinary F (mg/L)	116	1.94±1.34	0.1 ^c
F/gram creatinine (mg/g)	116	2.1±1.36	<3 ^d

^aNormal range according to kit used; ^bNormal range in US population; ^cNormal urinary upper limit;

^dAccording to ACGIH recommendation for preshift urinary F.⁵

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