

# A preliminary study of the submandibular gland of the rat after one-year cadmium intoxication. Part I. Cadmium concentration

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## Abstract

The aim of the present study was to establish to what degree a one-year exposure of rat females to 5, 50 and 100 mg Cd/l affects the weight of the submandibular glands and their cadmium levels. We observed a decrease in the weight of the submandibular glands in the rat females from Groups I, II and III, compared to the control rats. We also found an increase in cadmium levels in the submandibular glands in Groups I, II and III, in comparison to the control. The highest cadmium concentration was noted in the submandibular glands in Group III, which was accompanied by the greatest weight reduction, the correlation being negative. The present experiment indicates that one-year administration of cadmium to rat females at a dose of 5, 50 and 100 mg Cd/l leads to a cadmium dose-dependent decrease in the weight of the submandibular glands.

**Key words:** submandibular gland, rat, cadmium concentration.

## Introduction

Cadmium (Cd) is a trace metal, found in the polluted environment of towns, in water and food. During a prolonged exposure, this metal accumulates mainly in the kidneys and in the liver [1, 2]. Cadmium levels in the submandibular gland, although considerably lower, lead to function disorders in this organ, including a decrease in protein content and amylase

activity in the saliva, and a rise in salivary Ca level [1, 2, 3]. The aim of the present study was to establish to what degree a one-year exposure of rat females to 5, 50 and 100 mg Cd/l affects the weight of the submandibular glands and their cadmium levels.

## Material and methods

The study involved twenty-two young female Wistar rats, allocated to 4 Groups. Six control rats received only redistilled water to drink. Eighteen experimental rats were given aqueous solution of cadmium chloride (CdCl<sub>2</sub>): six rats in Group I received a dose of 5mg Cd/l, six animals in Group II received a dose of 50 mg Cd/l and the remaining four in Group III - 100 mg Cd/l. The animals were sacrificed in pentobarbital narcosis. Both submandibular glands were collected from each rat. One of them was weighed and the cadmium concentration was measured by the atomic absorption spectrometry method. Experimental groups were compared, using a one-way analysis of variance (ANOVA) by the Kruskal-Wallis ranks test and the Mann-Whitney test. A linear Pearson's correlation analysis was performed to evaluate the relationship between submandibular gland weight and Cd concentrations in the gland. P-values < 0.05 were considered significant. Statistical tests were performed, using Statistica 6.0. The experiment received acceptance No 2001/6 from the Local Ethical Committee for Animal Testing in Białystok.

## Results

After one year, the weight of the submandibular glands in rats was 0.25±0.02 g (0.23-0.29) in the control, 0.24±0.02 g (0.22-0.27) in Group I, 0.23±0.03 g (0.19-0.26) in Group II and 0.18±0.02 g (0.17-0.21) in Group III. Statistically significant differences were noted in the weights between Group III

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Figure 1. Submandibular gland weights (g) of rats exposed to Cd (0, 5, 50 or 100 mg/l water) after one year. \*  $p < 0.05$  in comparison to those in the control, \*\*  $p < 0.05$  in comparison with 5 mg Cd/l, \*\*\*  $p < 0.05$  in comparison with 50 mg Cd/l.

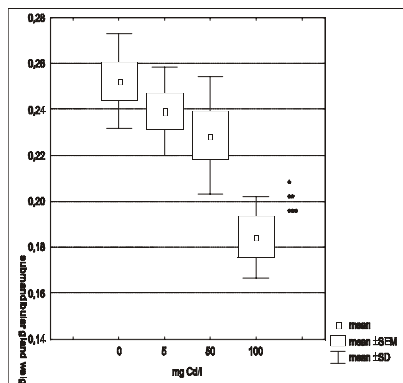


Figure 2. Cd concentrations in the submandibular glands ( $\mu\text{g/g}$  wet weight) of rats exposed to Cd (0, 5, 50 or 100 mg/l water) after one year. \*  $p < 0.05$  in comparison to those in the control, \*\*  $p < 0.05$  in comparison with 5 mg Cd/l, \*\*\*  $p < 0.05$  in comparison with 50 mg Cd/l.

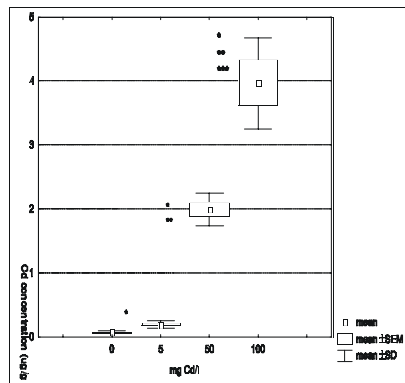
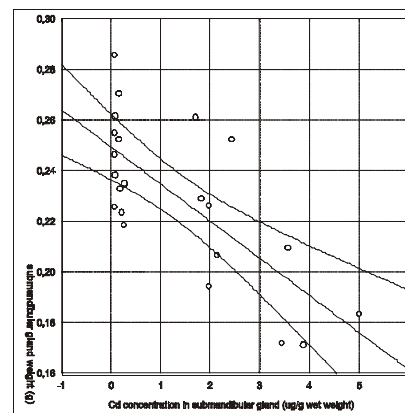


Figure 3. Correlation between submandibular gland weight and Cd concentrations in the submandibular glands of rats, exposed to Cd (0, 5, 50 or 100 mgCd/l water) after one year.



and the other three groups (Fig. 1). Cadmium concentration in the submandibular glands was found to be  $0.07 \pm 0.01 \mu\text{g Cd/g}$  (0.05-0.09) in the control rats,  $0.19 \pm 0.5 \mu\text{g Cd/g}$  (0.13-0.27) in rats exposed to 5 mg Cd/l,  $1.99 \pm 0.26 \mu\text{g Cd/g}$  (1.70-2.43) in rats exposed to 50 mg Cd/l and  $3.96 \pm 0.71 \mu\text{g Cd/g}$  (3.43-4.99) in rats receiving 100 mg Cd/l. Statistically significant differences were noted between the control group and the three experimental groups, as well as between Groups I, II and III, and Groups II and III (Fig. 2). The increase in cadmium concentrations in the rat submandibular glands was found to be accompanied by a decrease in the gland weights, the correlation being negative (Fig. 3).

## Discussion

After one year of the experiment, a cadmium dose-dependent decrease was observed in the weights of the rat submandibular glands in Groups I, II and III, compared to the respective values in the control. The results, as reported by other authors for doses of 5 and 50 mg Cd/l after 24-week exposure, did not reveal any decrease in the weight of the rat submandibular glands [4]. These discrepancies may be due to the fact that, in our experimental model, the exposure to cadmium was twice as long [4].

We also found cadmium accumulation in the rat submandibular glands, which was dose-dependent. Our results, concerning cadmium concentrations in the submandibular glands, are consistent with our previous observations of rats which were administered 5 and 50 mg Cd/l for 24 weeks [5]. After one year, in comparison to the 24-week exposure, the increase in cadmium concentration in the rat submandibular gland was 58% with the dose of 5 mg Cd/l, and 70% at a dose of 50 mg Cd/l [5]. The relatively high accumulation of cadmium, noted in the female rat submandibular glands after one-

year exposure, compared to the 24-week exposure of male rats (at the same Cd doses) can, according to some authors, be influenced by age and sex [6]. According to Taguchi [6], the half-life of  $^{109}\text{Cd}$  of the older mice is twice as long as that of the younger mice and that of the female mice is longer, compared to the males. The effects of age and sex on Cd elimination may also occur in rats.

The present experiment indicates that the one-year exposure of cadmium to rat females, at doses of 5, 50 and 100 mg Cd/l, leads to a decrease in the weight of the submandibular glands, which is cadmium-dose dependent.

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