
Vascular system changes among the workers in surroundings contaminated with manganese

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We have investigated the character of the vascular system changes in 392 workers exposed to manganese at the Jiesia Artistic Ceramics Factory (JACF) in the Kaunas city. The control group, chosen randomly from local residents relatively clean with respect to contact with manganese at their workplace, comprised 451 people. The level of manganese in the subject's scalp hair was determined. The study subjects had been consulted by a cardiologist and an ophthalmologist. Their arterical blood pressure was measured, ECG recorded. They had been interviewed according to the Rose questionnaire. The ophthalmological examination included visual acuity testing, performing biomicroscopy of the conjunctival microcirculation, direct and indirect ophthalmoscopy. Impaired conjunctival microcirculation was found in 70.66% of JACF workers and in 31.3% of residents from control group. Impaired cardiovascular system was found in 63.77% of JACF workers and in 37.2% of residents from control group. The relation between the increase of manganese content in the hair and changes in conjunctival microcirculation and cardiovascular system was statistically reliable ($p < 0.05$). Thus, our investigations show the possible harmful effect of manganese on conjunctival microcirculation and cardiovascular system.

Key words: eye, conjunctival microcirculation, environmental impact, manganese, cardiovascular system

INTRODUCTION

Environmental contamination with harmful agents exerts a negative impact on the health of people and rather frequently may become a cause of occupational illnesses [1, 4, 9, 10, 13, 14, 16–19, 22–26]. Early diagnosis of the disorders could contribute to prevention of progression of severe diseases. Everyday life and work in noxious setting increase cardiovascular morbidity in comparison with the number of disorders in people living and working in relatively clean areas. Investigations show a significantly greater number of cardiovascular patients among persons with a higher level of heavy metals in their hair [17]. 1444 inhabitants of the Panevėžys city were investigated for the structure of morbidity in the population of the microdistricts. Cardiovascular di-

seases occupied the second place. Investigations show a significantly greater number of cardiovascular patients among residents exposed to heavy metals in the working places [19]. The overall morbidity and the rate of arterial hypertension was higher in the group of persons exposed to heavy metals [18]. Manganese is known, beside its negative effects on the respiratory system, liver, thyroid, to exert an injuring influence on the nervous and vascular system [25, 15]. No harmful effects of manganese on the eyes were discovered. However, most of the authors agree that the eye vascular system is most sensitive to distortions caused by contamination [14, 16, 23, 26]. Many scientists confirm the harmful effects of other heavy metals (lead, chromium) on the eyes [22, 9, 10, 24, 14, 23]. Therefore, we decided to try to reveal changes in the vascular system of the workers exposed to manganese, taking into consideration its level in their hair. To this end, we performed a periodical checkup of the health of the people working in the surroundings contaminated with manganese.

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MATERIALS AND METHODS

The present work analyses the results of medical examinations of workers of the Jiesia Artistic Ceramics Factory (JACF) and local residents of the city of Kaunas. The workers of JACF were chosen as the production of ceramics involves the use of manganese. The concentration of manganese varies in different shops of the factory. We have investigated 392 workers of JACF, all from the morning shift. Among them there were 295 (75.26%) female and 97 (24.74%) male. Distribution by age is shown in the Fig. 1. The control group, chosen randomly from local residents relatively clean with respect to contact with heavy metals at their workplace, comprised 451 people, among them 273 (60.53%) female and 178 (39.47%) male. Distribution by age is shown in Fig. 2.

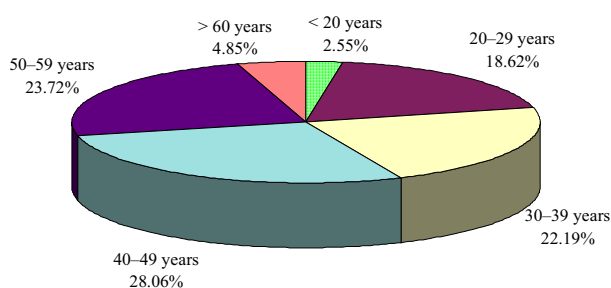


Fig. 1. Distribution by age (study group)
1 pav. Pasiskirstymas pagal amžių (tyrimo grupė)

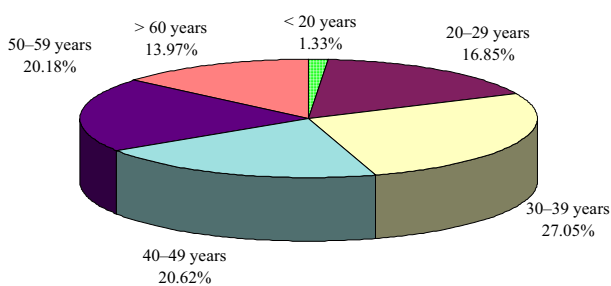


Fig. 2. Distribution by age (control group)
2 pav. Pasiskirstymas pagal amžių (kontrolinė grupė)

The study subjects were consulted by a cardiologist and an ophthalmologist. Their artery blood pressure was measured, ECG recorded. They were interviewed according to the Rose questionnaire. The ophthalmological examination included visual acuity testing, biomicroscopy with slight lamp of the conjunctival microcirculation, direct and indirect ophthalmoscopy. The level of hair manganese was determined by a Zeeman 3030 atomic spectrophotometer. The normal level of hair manganese was 1.40 to 2.93 $\mu\text{g/g}$.

RESULTS

The investigations of the level of manganese in the hair of the workers of JACF demonstrated an increase in manganese content 61.22% of the workers. No relation was noted between the length of exposure to contaminated surroundings and increase in manganese content in the hair ($p < 0.5$). The increase was related to the location of workplace and was predominately found among the staff of the fine bone china shop (64.16%) and the souvenir shop (51.32%). Manganese can be found in the paint used in those shops. The control group was also checked for the content of manganese in the hair, even though the members of the group claimed not to have had any direct contact with the metals. The increased level of manganese in the hair of the persons from the control group might be due to pollution or other unknown reasons. It was very small (2.93–3.0 $\mu\text{g/g}$). The increase in the level of manganese in their hair could not be explained and was considered to be an accidental occurrence. The amount of manganese in the hair of the workers from JACF varied from 3.0 to 30.0 $\mu\text{g/g}$ and more.

The cardiovascular system changes included arterial hypertension, changes in ECG. The conjunctival vessel changes included the changes of the lumen, tortuosity, uneven blood flow, extravasal changes, aggregation of erythrocytes, etc.

Impaired conjunctival microcirculation was observed in 277 (70.66%) of the workers from JACF and in 141 (31.3%) of the local residents from control group. Impaired cardiovascular system was observed in 249 (63.77%) of the workers from JACF and in 168 (37.2%) of the residents from control group (Fig. 3). It is obvious that impaired conjunctival microcirculation and impaired cardiovascular system were more frequent among the workers of JACF. However, age was irrelevant for the increase in the changes, because the largest part of the JACF workers were 30–59-year-old females (54.79%). In contrast, the conjunctival microcirculation and cardiovascular system changes among members of the control group proved to be directly dependent on age. Moreover, among the representatives of JACF many more cases of conjunctival and cardiovascular changes and high levels of manganese in the hair were identified in comparison with control group subjected to examination of manganese level in the hair. Statistically significant relationships were established between the increased levels of manganese in the hair and impaired conjunctival microcirculation and cardiovascular system ($p < 0.05$).

Thus, our investigations showed a possible harmful effect of manganese on conjunctival microcirculation and cardiovascular changes. Most authors

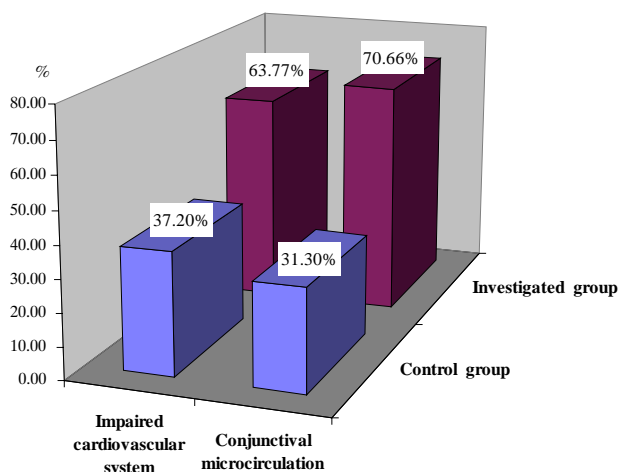


Fig. 3. Results of the study
3 pav. Tyrimo rezultatai

agree that environmental contamination with harmful agents exerts a negative impact on the cardiovascular system and on the eye [22, 2, 9, 10, 24, 13–19, 23, 26]. The identified changes in the cardiovascular system and conjunctival microcirculation mostly depended on the age of the control group, because most of its members were aged 40 and over.

Received
23 April 2002

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ŽMONIŲ, DIRBANČIŲ MANGANU UŽTERŠTOJE APLINKOJE, KRAUJAGYSLIŲ SISTEMOS POKYČIAI

S a n t r a u k a

Aplinkoje yra daugybė biologinių, cheminių, fizinių, socialinių, ekonominių bei kitų veiksnių, kurie gali sukelti įvairius sveikatos sutrikimus, ligas ir mirtį. Žmones veikianti aplinka yra ne tik oras, bet ir vanduo, dirvožemis,

maistas, darbietė, žmonių tarpusavio santykiai ir kt. Pagrindiniai aplinkos teršalai yra cheminės medžiagos. Jos, būdamos gyvenamojoje ar darbo aplinkoje, gali sukelti įvairius sveikatos sutrikimus tada, kai į organizmą jų patenka daugiau, negu organizmas pajėgia juos nukenkinti. Aplinkos užterštumas žalingais veiksniais neretai tampa ir profesinių ligų priežastimi. Ankstyva šių ligų diagnostika padeda išvengti sunkių pasekmių, todėl ypač svarbu periodiškai tikrinti įvairiais žalingais veiksniais užterštoje aplinkoje dirbančių žmonių sveikatą.

Šio darbo tikslas buvo įvertinti žmonių, dirbančių manganu užterštoje aplinkoje, kraujagyslių sistemos pokyčius. Iš viso ištirti 392 žmonės, dirbantys manganu užterštoje aplinkoje, ir 451 žmogus, darbe neturėjęs tiesioginio ryšio su kenksmingais veiksniais (kontrolinė grupė). Visus tiriamuosius konsultavo kardiologas ir oftalmologas. Jiems buvo matuojamas arterinis kraujo spaudimas, registruojama elektrokardiograma, tiriama akių junginių mikrocirkuliacija ir tinklainės kraujagyslių būklė, nustatomas mangano kiekis plaukuose. Įvertinus tyrimų rezultatus, 70,66% žmonių, dirbančių manganu užterštoje aplinkoje, nustatyta junginių mikrocirkuliacijos ir 63,77% – kardiovaskulinės sistemos pakitimai. Tuo tarpu kontrolinėje grupėje junginių mikrocirkuliacijos pakitimai nustatyti 31,3%, o kardiovaskulinės sistemos pakitimai – 37,2% žmonių. Gautas mangano kiekio plaukuose padidėjimo bei junginių mikrocirkuliacijos ir kardiovaskulinės sistemos pakitimų statistiškai patikimas ryšys. Vadinasi, manganas galėjo turėti įtakos kardiovaskulinės sistemos ir junginių mikrocirkuliacijos pakitimų atsiradimui.

Raktažodžiai: akis, konjunktyvos mikrocirkuliacija, aplinkos poveikis, manganas, širdies ir kraujagyslių sistema