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Noise and cardiovascular effects in workers of the sanitary fixtures industry

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ABSTRACT

The aim of the present study is to evaluate whether workers in the sanitary fixtures industry are a category at risk of developing cardiovascular diseases, and in particular, whether chronic noise exposure may play a role in cardiovascular effects in exposed workers. Seventy-five employees engaged in sanitation fixtures production and a control group of sixty-four office workers, who were not exposed to agents that could damage the cardiovascular system, participated in our study.

The selected workers completed a clinical-anamnestic questionnaire, and underwent a medical examination, blood pressure test, electrocardiogram (ECG), blood tests, and audiometry. Measurements of environmental noise, dust, and lead were also carried out. The exposed workers, in comparison to the control group, showed a higher frequency of hypertension, systolic and diastolic blood pressure ($p < 0.05$, $p < 0.05$), as well as electrocardiographic abnormalities ($p < 0.05$). There was also a higher frequency of hypertension and electrocardiographic abnormalities among subjects with audiometric deficit compared to normoacoustic subjects ($p < 0.05$ and $p < 0.05$).

Results: from our study suggest that work activity in the sanitary fixtures industry can have an influence on the cardiovascular system, and noise can be the main cause of damage for the cardiovascular system in exposed workers, as cardiovascular damage seems to be linked to hearing loss.

Introduction

Cardiovascular diseases (CVDs) are some of the most important and frequent chronic non-communicable diseases (World Health Organization, 2008). The risk factors for cardiovascular disease, such as hypertension and cardiac arrhythmias, can be avoidable (for example smoking, obesity, and hypertension) or not avoidable (such as age, sex, race, and lifestyle). In addition to these well-known risk factors, other occupational hazards related to the job include: shift work and/or night work, noise, and high temperature. Risk factors associated with work tasks can be identified and in many cases they can be eliminated.

Workers employed in the manufacturing sector are exposed to severe occupational hazards such as noise, heat stress, physical effort and dust (Gradinariu et al., 2006). Specific studies about the cardiovascular system in the sanitary fixtures sector are lacking.

Undoubtedly, the risk factor most studied in the field of ceramic work is represented by exposure to dust containing silica dioxide (Monti et al., 2008) although studies on the cardiovascular system in the field of ceramics are also very few.

It is well known that noise may seriously damage hearing. However, its role in arterial hypertension and cardiovascular diseases has been studied only recently. Some extra-auditory effects of noise influence the gastro-enteric system (Tomei et al., 1994), respiratory system (Castelo Branco et al., 1999), immune system (Zheng and Ariizumi, 2007), endocrine system (Tomei et al., 2003), reproductive system (Hrubá et al., 1999), the nervous (Tomei et al., 2010) and cognitive systems (Belojevic et al., 2003).

In recent years several studies have been conducted on relationships between noise exposure and cardiovascular pathologies; many of these studies found that noise exposure may alter arterioles (Tomei et al., 1991), heart rate (Raggam et al., 2007), blood pressure (Aydin and Kaltenbach, 2007; Sancini et al., 2011, 2012;

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Tomei et al., 2013) and urinary concentration of catecholamines (Babisch et al., 2001; Sancini et al., 2011).

Recently, several studies have been carried on relationships between noise exposure and cardiovascular pathology (Aydin and Kaltenbach, 2007; Raggam et al., 2007). The aim of the present study is to evaluate whether the category of sanitary fixtures workers is at risk of developing cardiovascular diseases.

Materials and methods

In this study, we evaluated whether chronic exposure to noise can play a role in the development of cardiovascular effects in exposed workers compared to a group of non-exposed workers.

Population and setting

A total of 132 male subjects were studied originally, working for a large company of sanitary fixtures and exposed to the following risks: dust, lead, noise and microclimate with high temperatures (Gradinariu et al., 2006). Employees rotate to perform different tasks and are engaged in a number of activities. These include:

- Modeling and mother mould, where models are prepared to shape the product
- Mixing, where clays are mixed for the preparation of ceramic to be cast later
- Molding or casting, for the realization of crude product by the fluidization of clays with special mixers that use water (an operation which takes place manually and automatically)
- Manual and wet finishing with hands and metal spatulas to remove burrs or imperfections (the product is aged for natural drying inside or outside the company)
- First firing in the oven (950–1000 °C), a tunnel type with a continuous conveyor belt
- Production of the so-called biscuit
- Enameling carried out in booths, using spray guns with compressed air
- Glazing
- Second firing (annealing) when there is the stabilization of enamels, which occurs at a temperature of about 50 °C lower than the first firing in order to determine changes in the biscuit
- Testing of the product and cleaning
- Palletizing and warehouse operations (storage and retrieval with forklift)
- Workshop activities that use various tools (drills, cutters, whisks, mole wrench).

Work areas are provided with appropriate ventilation systems and air conditioning. The tunnel-type ovens are equipped with a rapid cooling system recirculating preheated hot air; the introduction of the material to be fired is carried out by use of machinery.

The firing areas are placed in separate rooms from the rest of the production cycle and surrounding areas are large, so they allow heat dissipation; the company has been structured in such a way that these areas are not affected by excessive heat from the sun.

For the control group, 207 office workers from a large company originally participated; the company from which the control group was selected was chosen randomly among the companies with administrative activities that are located in the same geographic area of the sanitary fixtures factory. Workers who perform administrative activities are exposed only to occupational risks of visual fatigue, and are not exposed to occupational hazards such as noise, lead, dust and micro-climate with high temperatures (Table 1).

Questionnaire

All workers completed a clinical-anamnestic questionnaire (instrument used to obtain medical-scientific information from patients regarding personal data, general data, voluptuary habits, previous and/or current health status, history of some diseases, etc.) in the presence of a physician with items aimed at characterizing the job and exposure. Use of personal protective equipment was also investigated.

The confounding factors (or confounders: factors that intervene to confuse the association between exposure and outcome. The confounding factor is independently associated with both exposure and outcome) were identified in the process of the study design, in order to exclude cases with cardiovascular and/or audiological diseases due to known factors unrelated to the job; identification was made through medical documentation and consultation of scientific literature.

The purpose of the clinical medical history questionnaire is twofold:

- *The exclusion of confounding factors for audiological risk:* use of ototoxic drugs (i.e. streptomycin, neomycin, erythromycin, furosemide, phenylbutazone), acoustic trauma, exposure to blast bombs, mines, use of firearms (pistols, rifles, etc.), previous ear infections (bacterial etiology: *Staphylococcus aureus*, *Haemophilus*

Table 1
Characteristics of the study population.

	Workers exposed (N. 75)	Workers non-exposed (N. 64)	*p*-Value
Age (years)			
Mean ± sd (min–max)	41.36 ± 9.4 (21–59)	38.8 ± 7.9 (23–53)	>0.05
Body mass index (kg/m^2)			
Mean ± sd (min–max)	25.79 ± 2.63 (21.14–32.78)	25.7 ± 2.5(19.4–32.1)	>0.05
Length of service (years)			
Mean ± sd (min–max)	15.93 ± 9.72 (1–39)	13.1 ± 9.7 (1–30)	>0.05
Smokers			
No. of subjects (%)	35 (46.7%)	35 (54%)	>0.05
Alcohol consumption			
No. of subjects (%)	21 (28%)	15(23.4%)	>0.05
Familiarity for cardiovascular diseases			
No. of subjects (%)	17 (22.7%)	24 (37.5)	>0.05
Blood glucose >5.5 mmol/l			
No. of subjects (%)	9 (12%)	11 (17.2%)	>0.05
Total cholesterol >5.2 mmol/l			
No. of subjects (%)	15 (20%)	18 (28.1%)	>0.05
Triglycerides >1.7 mmol/l			
No. of subjects (%)	22 (29.3%)	21 (32.8%)	>0.05
HDL < 1.03 mmol/l			
No. of subjects (%)	11 (14.7%)	10 (15.6%)	>0.05

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