

## EARLY DETECTION OF THYROID DISEASE IN WORKERS PROFESSIONALLY EXPOSED TO NOISE THROUGH PREVENTIVE MEDICAL CHECK-UPS

Vesna Veljović<sup>1</sup>, Jovica Jovanović<sup>1</sup>, Ljubodrag Radević<sup>1</sup>, Zoran Radovanović<sup>2</sup>, Snežana Gligorijević<sup>3</sup>  
and Ljiljana Blagojević<sup>4</sup>

The aim of the study was to test the influence of noise on the occurrence of thyroid disease.

A group of examinees included the noise-exposed workers (300) who work in the production halls and the control group (50) doing administrative jobs in the office. The testing was performed by the service of occupational medicine, within regular control and periodic check-ups of the noise-exposed group and health systematic examinations of the control group. Some laboratory analyses of the thyroid hormone were used for the purpose of this study.

The percentage of those with an increased thyroid activity in the control group is 2%, while in the group of workers exposed to noise it equals 6,8%. In the control group, the total number of those with a decreased thyroid function is 0,85% and 4,85% in the noise-exposed group. In the control group, the total number of workers with the changed thyroid function is 2,85%, while in the group exposed to noise, the total number of workers with the changed thyroid function is 11,65%.

By comparing the number of workers having disturbances in the thyroid function from the control group to those from the noise-exposed group who have hearing nerve damage, it can be noticed that there is no statistically significant difference.

There were 21 examinees that had subjective health complaints with the levels of hormones increased; 15 examinees had subjective health complaints while the levels of hormones were decreased, and 77 examinees had subjective health complaints with the levels of hormones within the normal range.

The largest number of workers with a changed thyroid function had between 10 and 20 years of service.

After analyzing the results, obtained in both control and noise-exposed groups, the conclusion was that the number of workers having problems with the thyroid activity is larger in the group exposed to noise in relation to the workers from the control group. These values are in correlation with the level of noise at the working place. *Acta Medica Medianae* 2010;49(3):45-49.

**Key words:** noise, thyroid, hyperthyreosis, hypothyreosis

Institute of Occupational Safety and Health Niš, Serbia<sup>1</sup>  
Clinical Center Niš, Institute of Radiology Niš, Serbia<sup>2</sup>  
Public Health Institute Niš, Serbia<sup>3</sup>  
Faculty of Occupational Safety in Niš, Serbia<sup>4</sup>

Contact: Vesna Veljović  
Zavod za zdravstvenu zaštitu radnika, 18000 Niš, Srbija  
E-mail: docvesna@yahoo.com

### Introduction

Professional risk is an assessment of possible consequences in the workplace, and the risk itself has been assessed in the context of a situation that is considered risky (1).

There are some harmful effects that appear in industry, which are above the allowed values, such as noise, vibration, microclimatic factors, dust, and others, which carry the risk of disease. The goal of the professional risk assessments is to identify hazards and to make assessment of the

possible consequences in the workplace, identify employees who are exposed to their influence and determine appropriate measures of protection (2). At the national level, the obligation of the professional risk assessment is determined by the Law on Occupational Safety and is further developed by a special by-law (3). The level of noise is growing every day, so in the last ten years, exposure to noise is one of the main causes of damage to human health. Noise is any sound that causes a subjective feeling of discomfort in humans. Exposure is one of the important factors in assessing risk, so integrated knowledge of this issue is required (4). The effects of noise on human body can be auditive and extra-auditive.

Auditive effects of noise are manifested in the form of an acute acoustic trauma and a chronic acoustic trauma (occupational deafness and hearing loss).

Sound stimulation is transmitted via sense of hearing located in the central nervous system and the reticular formation to other centers, so the numerous extra-auditive noise effects on the body can be explained. They cause changes in many physiological functions and disrupt the operation of the systems such as: endocrine system, central nervous system, organs of sight, composition of blood, digestive system, heart conduction system, blood pressure, reproductive system, glucose concentration increase, triglycerides and cholesterol.

Diseases of the thyroid gland in some countries are among the most common diseases in general, not only among the most common endocrine system diseases. The thyroid gland diseases are: hyperthyroidism, hypothyroidism, goiter (Struma), inflammation and tumors of the thyroid gland. Among the diseases, syndromes and disorders that are seen in occupational medicine, endocrine diseases often remain unnoticed because they are disguised in other diseases and conditions, or are discrete and take subclinical forms. It is known that some heavy metals, organic solvents, pesticides, radiation and chronic stress at work can be directly etiologically related to some endocrine disorders. For these reasons, first of all, it is important to think of the possibility of the endocrine system damage when dealing with a particular profession, no matter whether the endocrine disease was directly caused by some external influences or whether it occurred prior to some other occupational disease or after it.

Another aspect is the impact of thyroid gland disease on the working capacity, disability and termination of work. For the Occupational Medicine, the chronic conditions, such as hyperfunction, hypo function and malignant thyroid diseases are significant. Struma, benign adenomas and thyroiditis are of less importance because the diseases themselves are either transient or are the conditions that require no treatment and do not affect working ability.

### Aim

The purpose of this research is the analysis of working conditions and working environment and the analysis of the influence of physical hazards (noise) on development of thyroid disease.

### Examinees and methods

Group of examinees included a group of exposed workers (300) and a control group of employees (50), in the tobacco factory. The exposed group worked in manufacturing plants for tobacco preparation (Primary), cigarette making and packing (Secondary) and warehouse, where they were exposed to different levels of noise, and the control group consisted of workers who did administrative work in office conditions. The examination was conducted in three phases:

Phase I - work environment conditions. Research-level of noise was measured with a phonometer. Adding octave and third-octave filters enabled octave i.e. third-octave band analysis of noise, frequent composure in the range of medium frequencies from 31.5 Hz to 16 kHz. Bruel & Kjaer device was used.

Phase II - examination of the employees' health condition - the examination was conducted in the Occupational Medicine Health Center within the regular control and periodic examinations for the exposed group and scheduled systematic examinations for the control group. For the purpose of this research, some target laboratory analyses of thyroid hormone were done.

Phase III - comparing the health status of the workers from the exposed and control groups. Thyroid hormone values were obtained by the laboratory analysis, and the mean value was shown comparatively in the exposed and control groups. All stated data would be displayed in the form of tables, graphs and text, and statistically significant difference between the exposed and control groups and within subgroups would be tested using the *t* test and  $\chi^2$  test.

### Results

Analysing the results we find that the noise levels at most working places are above the MDN values.

Table 1. Number of employees working under different noise levels

Noise level	Number of employees	%
75-85 dB Preparation	107	35,67
86-90 dB Warehouse	27	9,00
91-105 dB Production and Packaging	16	55,33
TOTAL	300	100%

Table 1 shows that majority of exposed employees (55.33%) work in Production and Packaging plant, where the highest noise levels were found.

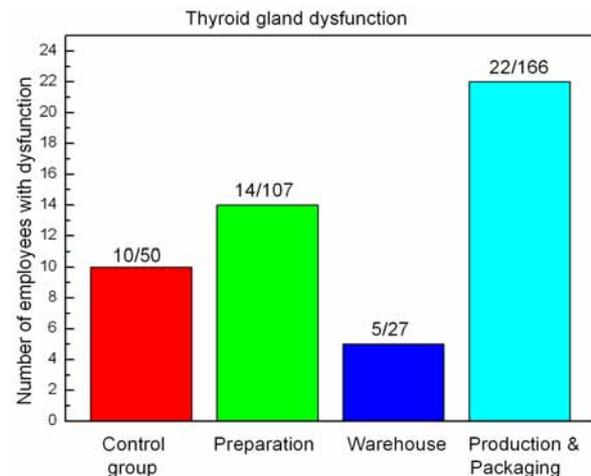


Figure 1. Number of employees with thyroid gland dysfunction in control group and exposed group.

Table 2. Number of employees with thyroid gland functional disabilities in exposed and control groups

Dysfunction of n.cochlearis	Control group n-50			75-85 dB n-107		86-90 dB n-27		91-105 dB n-166		TOTAL n-300		
	With dys.	No dys.	Σ (% n350)	With dys.	No dys.	With dys.	No dys.	With dys.	No dys.	With dys.	No dys.	Σ (%)
Hyperthyroidism	3	4	7 (2%)	6	3	1	2	11	1	18	6	24 (6,8%)
Hypothyroidism	1	2	3 (0,85%)	4	1	1	1	3	7	8	9	17 (4,85%)
TOTAL	4	6	10 (2,85%)	10	4	2	3	14	8	26	15	41 (11,65%)

Table 3. Comparison of the numbers of employees with thyroid gland functional disabilities between the control and exposed groups

Dysfunction of n. cochlearis	Number of employees with thyroid gland functional disabilities n-350					
	Control group n-50		Control group n-50		t	p
	No. e.	%	No. e.	%		
Hyperthyroidism	3	0,85	18	5,14	0,00	N.S.
Hypothyroidism	1	0,28	8	2,28	0,27	N.S.
TOTAL n-350	4	1,13	26	7,42	0,14	N.S.

Table 4. Number of employees with subjective disabilities and altered functioning of thyroid gland in exposed and control groups

Hormone Levels	Subjective disturbances		
		Number of employees	%
Hyperthyreosis	No disturbances	21	67.74
	TOTAL	10	32.26
	With disturbances	31	100%
Hypothyreosis	No disturbances	15	75
	TOTAL	5	25
	With disturbances	20	100%
Euthyreosis	No disturbances	77	33.62
	TOTAL	222	66.38
	No disturbances	299	100%

Table 5. Structure of the exposed group in terms of working experience under various levels of noise

Noise level	Working experience in noisy environment											
	Less than 10 yrs.			Less than 10 yrs.			Less than 10 yrs.			Less than 10 yrs.		
	Σ	Noise level	Σ	Noise level	Σ	Noise level	Σ	Noise level	Σ	Noise level	Σ	Noise level
75-85dB	20	1	-	42	3	1	31	3	1	14	2	3
86-90dB	5	-	-	11	2	1	7	1	1	4	-	-
91-105dB	35	3	2	51	3	2	63	4	2	17	2	4
TOTAL	60	4	2	104	8	4	101	8	4	35	4	7

Accelerated functioning of the thyroid gland was found in 2% and 6.8% of employees in control and exposed groups, respectively, whereas reduced functioning of the thyroid gland was found in 0.85% and 4.85% of employees in control and exposed groups, respectively. Overall percentages of employees with altered functioning of the thyroid gland were 2.85% in the control group, and 11.65% in the exposed one.

Considering the employees with hearing nerve damage statistically significant differences between the control and exposed groups in terms of thyroid gland functional disabilities were not found.

Twenty-one examined employees had subjective disturbances with elevated hormone levels, 15 patients had subjective disturbances with decreased hormone levels, and 77 patients had subjective

disturbances with their hormone levels within the range of allowed values.

Considering the working experience in noisy environment, majority of employees with altered function of thyroid gland is found in categories with 10-20 and 20-30 years experience, including 8 employees with Hyperthyroidism in each of these two categories.

## Discussion

Noise acts as stressor on the human organism and its non-auditive effects on the body are mediated by stress. Chronic professional stress, in short, is initially affecting the feelings, thoughts and behavior, which is manifested in increased irritability, excessive smoking and intake of alcoholic beverages, poor nutrition, sleep disorders and sexual behavior. In addition, it can cause negative emotions - anxiety, depression, tension, nervousness, and a series of changes in physiological functions. These behavioral changes can be combined with changes in the endocrine and immune functions and represent mechanisms through which psychological stress experienced at work is translated into somatic pathology (5).

The effect of noise on the human body is cumulative. Accumulation of the impact of noise occurs not only during the eight-hour exposure in the workplace but also during the entire working life, and the consequences are caused by the cumulative influence of noise in the workplace and outside of it (6). Endocrinological disorders in workers exposed to noise are generally manifested in elevated blood sugar levels and altered thyroid function.

Under the influence of noise, increased secretion of catecholamine takes place, which stimulates pituitary gland to increasingly secrete ACTH, which further stimulates adrenal to increasingly secrete mineral corticoids and glucocorticoids (7,8,9).

By following the analysis of thyroid hormone in the examined workers, some modified values were found in both control and exposed groups. The largest number of workers exposed to noise (55.33%) are those working in plants where the highest noise levels were measured (Table 1).

Increased or decreased thyroid functions more often appear in the workers of the exposed group. In the control group, an accelerated function of thyroid appears in 2% of cases and in the workers of the exposed group this percent is 6.8%. As far as the reduced function of thyroid

gland is concerned, in the control group it is 0.85% and in the exposed group of workers it is 4.85% (Table 2). With hyperthyroidism, at the stage of active disease, the person is unable to perform any job (usually 6-8 weeks). In hypothyroidism, until the patient reaches euthyroid state, there is a temporary work disability (10).

Comparing the number of workers with the thyroid gland disorders from the control group and from the exposed group with the hearing nerve damage, no statistically significant difference was found (Table 3). By tracking the number of employees with changes in the function of the thyroid gland, depending on the intensity of noise in the workplace, it was found that it was most present in workers who worked under the highest level of noise. At the same time, it was where the largest number of employees actually worked. Workers with the least alternations in the thyroid function worked in a warehouse. (Figure 1). The largest number of examinees who had elevated level of hormones, had also most often subjective disturbances (Table 3), as well as a long work history (Table 4). The growing length of service was in direct connection with the increased number of workers with disturbances in the thyroid gland function.

Noise is definitely a stressor for the whole organism and presents professional stress for an employee. The assessment of the professional stress begins with objective characteristics of a job, but there are differences between the objective factors and events in the work environment and an employee's perception of these factors, which depend on the individual characteristics of a person (11,12).

Factors in the work environment can lead to violations of the general health of an employee, affect the course of the disease, work capacity, quality and efficiency of work.

## Conclusion

By analyzing the results obtained in both control and exposed groups of employees, we came to the conclusion that the number of workers with disturbances in the thyroid gland function was higher in the exposed group compared to the control group, and these values were in correlation with the level of noise in the workplace. The number of workers with disturbances in the thyroid gland function, in both exposed and control groups, was higher in the workers having the hearing nerve damaged.

## References

1. Milanović S, Ilić Ž, Vasilev G. Percepcija rizika – principi i značaj. Nacionalna konferencija sa međunarodnim učešćem Niš 2003. Ocena profesionalnog rizika – teorija i praksa 2003; 137-9. (Articles in Serbian)
2. Ivanjac M. Usklađivanje nacionalnog zakonodavstva o zaštiti na radu sa aktima MOR-a i EU, Pravni fakultet Kragujevac 2003;99-109. (Articles in Serbian)
3. Ivanjac M. Pravni osnovi ocene profesionalnog rizika, Nacionalna konferencija sa međunarodnim učešćem Nis, 2003. Ocena profesionalnog rizika – teorija i praksa 2003; 13-8. (Articles in Serbian)
4. Cvetković D, Prašćević M. Merodavni nivo buke - indikator buke u životnoj sredini. Facta universitatis 2000, 1(5):39-50. (Articles in Serbian)
5. Veljović V. Zdravstveni indikatori profesionalnog rizika radnika eksponiranih buci. Ph.D. Disertation, Nis: Medicinski fakultet Univerzitet u Nišu, 2010. (Articles in Serbian)
6. Jovanović J. Štetna dejstva industrijske buke i mogućnosti prevencije. Acta medica medianae 1999;2:13-8. (Articles in Serbian)
7. Moudon AV. Real noise from the urban environment: how ambient community noise affects health and what can be done about it. Am J Prev Med. 2009 Aug;37(2):167-71.
8. Clinical and diagnostic value of heart rate variabilities in workers exposed to noise and vibration. Med Tr Prom Ekol 2010;(7):1-6. (Articles in Russian)
9. Lee JH, Kang W, Yaang SR, Choy N, Lee CR. Cohort study for the effect of chronic noise exposure on blood pressure among male workers in Busan, Korea. Am J Ind Med 2009; 52(6):509-17.
10. Tomei G, Fioravanti M, Cerratti D, Sancini A, Tomao E, Rosati MV, et al. Occupational exposure to noise and the cardiovascular system: a meta-analysis. Sci Total Environ 2010; 408(4):681-9.
11. Veljović V, Manić S, Jovanović J, Đorđević D, Todorović Z. Prikaz rezultata procene rizika u ustanovi kulture. Svet Rada 2008;5:17-22. (Articles in Serbian)
12. Schell LM, Gallo MV, Denham M, Ravenscroft J. Effects of pollution on human growth and development: an introduction. J Physiol Anthropol 2006; 25(1):103-12.

## RANO OTKRIVANJE BOLESTI ŠTITNE ŽLEZDE KOD RADNIKA PROFESIONALNO IZLOŽENIH BUCI KROZ PREVENTIVNE MEDICINSKE PREGLEDE

Vesna Veljović, Jovica Jovanović, Ljubodrag Radević, Zoran Radovanović, Snežana Gligorijević i Ljiljana Blagojević

Cilj rada bio je da se ispita dejstvo buke na nastanak bolesti štitne žlezde.

Grupu ispitanika činili su eksponirani radnici (300) koji rade u proizvodnim pogonima i kontrolna grupa (50) koja radi administrativne poslove u kancelarijskim uslovima. Ispitivanje je obavljeno u službi Medicine rada u okviru redovnih kontrolno-periodičnih pregleda za eksponiranu grupu i sistematskih pregleda kontrolne grupe. Za ovo istraživanje korišćene su laboratorijske analize hormona štitne žlezde.

U kontrolnoj grupi sa ubrzanim radom štitne žlezde je 2 i 6,8% kod eksponiranih radnika. U kontrolnoj grupi sa sniženom funkcijom štitne žlezde je 0,85 i 4,85% kod eksponiranih radnika. U kontrolnoj grupi ukupan broj sa izmenjenom funkcijom štitne žlezde je 2,85%, u eksponiranoj grupi ukupan broj sa izmenjenom funkcijom štitne žlezde je 11,65%.

Poređenjem broja radnika sa smetnjama u radu štitne žlezde kontrolne grupe i eksponirane grupe sa oštećenjem slušnog živca zapaža se da nema statistički značajne razlike.

Subjektivne smetnje imao je 21 ispitanik, a nivoi hormona bili su povišeni, 15 ispitanika imalo je subjektivne smetnje a nivoi hormona bili su sniženi. Subjektivne smetnje imalo je 77 ispitanika, a nivoi hormona bili su u dozvoljenim vrednostima.

Najveći broj radnika sa izmenjenom funkcijom štitne žlezde u odnosu na radni staž radi između 10-20 godina.

Analizom rezultata kod radnika kontrolne i eksponirane grupe došli smo do zaključka da je broj radnika sa smetnjama u radu štitne žlezde veći kod radnika eksponirane grupe u odnosu na radnike kontrolne grupe, a te vrednosti su u korelaciji sa nivoom buke na radnom mestu. *Acta Medica Medianae 2010;49(3):45-49.*

**Ključne reči:** buka, štitna žlezda, hyperthyreosis, hypothyreosis