ASSESSMENT OF THE GENERAL PSYCHOLOGICAL AND FUNCTIONAL CHARACTERISTICS CAUSED BY VIBRATIONS AT DRIVERS OF HEAVY MOTOR VEHICLES

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ABSTRACT

In this paper we presented a research that estimates general psychological and functional characteristics of motor vehicle drivers, with the goal of determining the adverse effects of noise and vibration on the drivers. The study was conducted on a sample of 56 participants, professional drivers of motor vehicles, randomly chosen from companies of various types operating in transport of passengers and goods. For the evaluation of the results,we used descriptive and correlational analysis.

The results showed that there were significant negative side effects caused by the nature of work of drivers, especially those under the influence of noise and vibration, which are even more significant in older participants and those with more years of service and those who spend more time driving during the interval of 24 hours , as well as those who drive heavier vehicles.

Keywords: *drivers of motor vehicles, noise, vibration, psychological and functional characteristics*

INTRODUCTION

Drivers due to a seated position at work, the increased number of working hours, often have unhealthy lifestyles, such as lack of exercise, lack of sleep, unhealthy eating habits, obesity, high blood pressure, diabetes, and ulcers. Everyday stress at work which relates to the traffic situation, regulations, rules at the workplace and communication were identified as the primary topics that are important for the lifestyle of the drivers. Stressful experiences encountered are: long waits for loading and unloading, the pressure of deadlines, traffic jams, the requirements of employers at the short notice, border crossings, mechanical breakdowns, long absences from home, problems with access to healthy foods (diets low in fruits and vegetables and high in saturated fat, calories and salt), working in areas of high traffic pollution, problems with parking space, fines (McDonough and Associates, 2014).

The problem is additionally complicated with continuous exposure to vibrations. The exposure to the vibrations and lengthy sitting of professional drivers causes a high risk of back pain. Musculoskeletal disorders in professional drivers are associated with ergonomic and psychosocial factors. The most common physical factors are: prolonged sitting, vibrations that are transmitted to the whole body, ergonomic: disagreement among drivers, type of vehicle seats and mechanism of the vehicle and driving. Psychosocial factors such as a level of satisfaction with the job, mental requirements, difficult conditions in traffic, passenger dissatisfaction, a short break for lunch, or the unavailability of toilets causes stress which can cause muscle tightness, mechanical pressure on the spine and fatigue, and eventually injury.

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The Alperovitch-Najenson and Associates Study (2010) demonstrated a statistically significant association between the four stressful situations (traffic jams, passenger dissatisfaction, and inadequate use of the day when working in shifts, crowded bus station exits and entries) with back pain. Psychological stress contributes to greater muscle tone, causing increased mechanical pressure on the spinal structures. It also creates fatigue that can lead to traumatic injury (Alperovitch-Najenson and Associates, 2010).

The vibrations have a harmful effect on the human body, depending on the length of exposure, place of the transmission to the body and individual sensitivity of the persons. Due to the effect on the neurovegetative system, vibrations are the cause of many disorders such as high blood pressure, diseases of the stomach, peptic ulcer disease, hearing loss, brain ischemia, and fatigue, headache, and sleep disturbance. Many people, during their professional activities are exposed to whole-body vibrations, especially drivers of tractors and trucks. The effects of whole-body vibrations are decreased sense of comfort interfered with damaged health and emersion of movement disease. The vibration of the vehicle has a direct impact on human comfort during the driving, driver's fatigue, and thus the security. The human body in a sitting position is most sensitive to vibrations caused by low frequencies. However, the subjective experience of vibration is related to the amount of energy absorbed by the body vibration (Szczepaniak and Associates, 2014).

Exposure to the vibrations at work is regulated by the ISO standards and regulations, which vary from state to state (Hasanbegović, 2013).

By the regulations from 1993., the German Federal Ministry of Labour, in the Official Journal of occupational diseases has added a new disease "disease of the lumbar spine" caused by prolonged exposure of the whole-body to the vibrations (Battie and Associates, 2002).

Noise at the workplace, during the last two decades, has become one of the important social and political issues. Noise and vibrations can cause damage to the hearing organs, but also can leave the consequences on the entire personality. The consequences are manifested through psychological and functional disorders (Hasanbegović, 2013).

Noise is unwanted sound that in many ways threatens human health. But, what is the noise for the most people may not be for an individual, and vice versa. If a certain limit of the sound level is exceeded, it will cause a hearing damage – wherever it was considered the noise or not. The sound below the threshold that leads to hearing loss, if it is considered a noise, acts as a hindrance and may have harmful consequences for the health of an individual.

The noise from the environment is a psychological and physiological stress that can affect physical health (Van Camp and Associates, 2012 as per Babisch and Associates, 2014).

The main causes of death, of more than a quarter of adults, are cardiovascular diseases. One of cardiovascular diseases is hypertension (high blood pressure), and one of the causes of cardiovascular disease is exposure to noise. Stress, acute noise exposure triggers autonomic and endocrine systems, which continue to cause temporary changes in blood pressure or vasoconstriction. There is evidence that continuous noise exposure is associated with an increased risk of developing hypertension. During three decades of risk assessment has increased from 0.97 in 1980 to 1.28 in 2010 (Banerjee, 2014).

Epidemiological Services have documented the association between hypertension and traffic exposure to noise at low and mid-high frequencies to which is the sense of hearing sensitive. The increase of the noise from 50 dB to 65 dB, which is an increase of 13%, leads to irritability, anger. (Istamto and Associates, 2014).

Chang and Associates (2014) came to the conclusion that exposure to road traffic noise with different frequencies can have a different effect on the incidence of high blood pressure. They found that exposure to noise at a frequency of 125 Hz has a significant effect on high blood pressure.

Continuous exposure to noise affects the endocrine and autonomic nervous system. Stress due to the noise causes vasoconstriction, which can be a cause of hypertension during short period of exposure. (Babisch and Associates, 2014).

There is a growing number of hearing loss due to noise exposure in the world. The occurrence of hearing loss due to noise depends on the frequency, intensity and duration of the noise. Hearing loss caused by noise is a slow and progressive disease. Changes usually occur in both ears and include frequencies in the range 3000 to 6000 Hz, while the lower frequencies are cause of hearing loss during a longtime illness. (Sayapathi and Associates, 2014).

Reactions to noise may depend on the sound characteristics, including intensity, frequency, complexity level, duration and significance of sound.

The most widespread subjective response to noise is a nuisance, which may include fear and mild anger, which is associated with the belief that one should avoid unpleasantness.

A number of studies have found an association between chronic aircraft noise exposure and decrease in motivation. The obvious effects of noise on human health are sleeping disorder and disturbances in cognitive abilities. (Stansfeld and Matheson, 2003).

According to data from the American Association of safety at work (Occupational Safety and Health Administration OSHA) permissible limit for noise exposure is 90 dB during eight hours. As for the National Institute for Occupational Safety and Health (NIOSH) allowed limit of noise exposure that is 85 dB during eight hours. (Sayapathi and Associates, 2014).

Today's society concept of sleep during 24 hours has changed dramatically. Sleeping is viewed as waste of time and often associated with laziness. Problems with sleep are the medical problem, but a small number of people with sleep disorder consult a doctor, although poor sleep can lead to decreased quality of life (constant daytime sleepiness, bad mood, changes in behavior, reduced social and recreational activities, increased human errors, loss of productivity, and increased risk of accidents).

Natural human biorhythm is to work during the day and to sleep during the night. That is not the case for the people who work in shifts or who work as drivers. Gallup Organization Study shows that most drivers stop the vehicle to take the sleep - 43% and 15% stop the vehicle when they feel tired. Other activities in case of drowsiness or fatigue included: opening windows (26%), consumption of coffee (17%), listening to the radio (14%). Unfortunately, except the vehicle stopping, other activities provide little benefit for drivers. According to the Gallup Organization, 37% of drivers reported having fallen asleep while driving at least once in their career. The characteristics of those drivers are: they have less than 6 hours of sleep the night before, drove more than 2.9 hours, drove during the night (21,00-06,00). Studies have shown that the increased risk of accidents occurs about 9 hours after the onset of labor. This risk may be increased twice after 12 hours of work and three times after 14 hours of continuous work. Increased rate of accidents occurs after 5 hours of continuous work, and it relates to people who work in shifts and have disturbed sleeping rhythm. National Sleep Foundation (2002) according to Pandi-Perumal and Associates (2006) presents that 91% of respondents agreed that lack of sleep puts a person at risk while driving, and 51% of respondents said they were driving when they were sleepy.

The workers who work shifts and also the drivers encountered: chronic insomnia, loss of sleep, excessive sleepiness, narcolepsy (excessive sleepiness and sudden attacks of sleep in inappropriate situations), which directly affects their ability to properly carry out daily activities. (Pandi-Perumal and Associates, 2006).

Exposure to traffic noise may cause interference with cortical and subcortical structures that affect the communication tasks that require a high degree of concentration, relaxation and sleep. (Chang, 2014)

The job of the drivers is not like an office job with a clear time frame and schedule. Mental fatigue of drivers is accepted as part of the job. The drivers practice various techniques to avoid sleepiness: opening windows, a longer stay in the fresh air, more smoking, drinking coffee or some energy drink... (McDonough and Associates, 2014).

Aim: Assess the general psychological and functional characteristics of the drivers of motor vehicles (buses, trucks, trailers, excavators and dumper trucks) to identify any adverse effects of noise and vibrations.

Hypothesis: Long-term, professional engagement in activities of driving different motor vehicles has a significantly negative impact on the psychological and functional characteristics of a driver.

METHODS

The sample of respondents

The sample of respondents (56) consisted of professional drivers of motor vehicles (buses, trucks, trailers, excavators and dumper trucks), randomly selected from companies that deal with different kinds of transportation of passengers and goods.

Measuring instruments and manner of conducting the research

For the purpose of the research the closed type of questionnaires is used, which consisted of two parts. The first part covered the most important general information about the respondents (drivers): age, time spent behind the wheel for 24 hours, years of service, and the type of traffic that they are engaged in and the types of vehicles they drive.

The second part of the survey consisted of 16 variables on which it was possible to assess the psychological and functional characteristics of the driver: irritability, aggression towards the relatives, annoyance by the masses and large gatherings, the need for solitude, memory impairment, appearance of nervousness, the occurrence of nightmares, tiredness, loss of concentration, the emersion of high blood pressure, reduce of operating efficiency, feeling muscle pain, feeling joint pains, decrease in sexual drive, the loss of interest for any type of work, the appearance of insomnia caused by fatigue.
Respondents were provided with answers by Likert scale, with the following possible responses: strongly agree, mostly agree, I can not decide, mostly disagree and strongly disagree. The respondents by their personal estimate have chosen whether the specified mental and functional abnormalities are present. The research was conducted with every person separately, at the workplace of the subjects, and carried out by an audiologist.

Methods of data processing

The obtained data were analyzed using descriptive and correlation analysis. Within a descriptive analysis frequencies and percentages were calculated, and to determine the influence of driving on the psychological and functional characteristics of the driver, Pearson's correlation coefficient was calculated. Data were analyzed using the computer program SPSS for Windows and the results are presented in tables.

RESULTS AND DISCUSSION

The description of the results in the applied variables

The sample of respondents for this study was classified according to age, which may significantly affect the psychological and functional disorders caused by exposure to the noise and vibrations. In this sample the highest percentage of motor vehicle drivers is aged 35 to 45 years of age (44.6%), and significant frequencies are present in age from 25 to 35 (25%), and 45 and over (26.8%),(Table 1).
Individual factors such as age, sex, weight, height, body mass index and general health were also associated with the occurrence of occupational diseases of the drivers. (Alperovitch-Najenson and Associates, 2010).

Table 1. Frequencies and percentages for the variable-age of the respondents

Age	f	%
Till 25	2	3.6
25 to 35	14	25.0
35 to 45	25	44.6
45 and over	15	26.8
Total	56	100.0

Respondents were classified according to the time spent behind the wheel during 24 hours. The percentage of 50% shows that the largest number of respondents spent behind the wheel more than 10 hours during 24 hours. A significant percentage of those who were driving for 8 hours is shown (42.9%), (Table 2).

Table 2. Frequencies and percentages for the variable- time spent driving

Time spent driving (24 h)	f	%
Up to 4	1	1.8
4	3	5.4
8	24	42.9
10	28	50.0
Total	56	100.0

Table 3 shows the frequencies and percentages for the variable "length of service of the respondents." Years of service in the driving profession can significantly affect the psychological and functional disorders due to long exposure to vibrations and noise. Most of the respondents fells in the category of 10 to 20 years of service (37.5%). A somewhat smaller percentage belongs in the category of 5 to 10 years of service (33.9%). The rest of respondents, approximately 30%, are allocated to the categories till 5 years of service, 20 to 30 years of service and 30 to 40 years of service.

Table 3. Frequencies and percentages for the variable - years of driving service of respondents

Years of service	f	%
do 5	4	7.1
5 do 10	19	33.9
10 do 20	21	37.5
20 do 30	7	12.5
30 do 40	5	8.9
Total	56	100.0

Table 4 shows the frequencies and percentages for the variable "type of traffic" (local or international). The highest percentage, 67.9% of respondents belongs to the category of local traffic, while 28.6% of respondents belong to the category of international traffic.

Table 4. Frequencies and percentages for the variable – types of traffic (local or international)

Types of traffic	f	%
Local	38	67.9
International	16	28.6
Unknown	2	3.6
Total	56	100.0

Table 5 presents the frequency and percentages for variable "type of vehicle". Respondents are classified into five categories, depending on whether they are drivers of buses, trucks, trailers, excavators and dumper trucks. The largest number of respondents (51.8%), were bus drivers, significantly fewer respondents (19.6%) were truck drivers, the same number of respondents were drivers trailers and excavators (10.7%), while a small number of respondents were drivers of dumper trucks.

Table 5. Frequencies and percentages for the variable- "type of vehicles"

Types of vehicles	f	%
Bus	29	51.8
Truck	11	19.6
Trailer	6	10.7
Excavator	6	10.7
Dumper Truck	4	7.1
Total	56	100.0

Table 6 gives an overview of frequencies and percentages for the 16 variables used in the assessment of psychological and functional characteristics of the drivers. It is evident that the highest percentage (over 60%) of the respondents shows overall pattern denying the occurrence of negative consequences such as: aggression towards relatives, frequent occurrence of nightmares, increased blood pressure, decreased sexual drive and decrease of willingness to work, while the highest percentage (over 50 %) confirm: memory impairment, increased fatigue, aches and pain in the joints and the occurrence of insomnia due to fatigue. Other results were equally distributed between the variables.

The results show that this is not a very healthy population of drivers, given the demands of occupations which are they engaged in, and the evident negative effects may be influenced by long-term practice in this profession. Despite the large percentage of respondents who waiver certain difficulties, those difficulties cannot be ignored at the rest of the respondents.

Table 6. Frequencies and percentages for the variable of evaluating psychological and functional characteristics

Scale	Strongly agree	Mostly agree	I can not decide	Mostly disagree	Strongly disagree
Irritability	6 (10.7%)	15 (26.8%)	8 (14.3%)	12 (21.4%)	15 (26.8%)
Aggression towards the relatives	6 (10.7%)	9 (16.1%)	4 (7.1%)	**6 (10.7%)**	**31 (55.4%)**
Annoyance by the masses and large gatherings	8 (14.3%)	12 (21.4%)	8 (14.3%)	5 (8.9%)	23 (41.1%)
The need for solitude	12 (21.4%)	7 (12.5%)	10 (17.9%)	3 (5.4%)	24 (42.9%)
Memory impairment	**16 (28.6%)**	**10 (17.9%)**	7 (12.5%)	8 (14.3%)	15 (26.8%)
Frequent nervousness	9 (16.1%)	12 (21.4%)	7 (12.5%)	12 (21.4%)	16 (28.6%)
Frequent nightmares	2 (3.6%)	5 (8.9%)	11 (19.6%)	**6 (10.7%)**	**32 (57.1%)**
Increased tiredness	**12 (21.4%)**	**19 (33.9%)**	6 (10.7%)	7 (12.5%)	12 (21.4%)
Loss of concentration	5 (8.9%)	14 (25.0%)	7 (12.5%)	11 (19.6%)	19 (33.9%)
High blood pressure	8 (14.3%)	9 (16.1%)	5 (8.9%)	**4 (7.1%)**	**30 (53.6%)**
Reduce of operating efficiency	5 (8.9%)	13 (23.3%)	6 (10.7%)	8 (14.3%)	24 (42.9%)
Appearance of muscle pain	7 (12.5%)	15 (26.8%)	6 (10.7%)	7 (12.5%)	21 (37.5%)
Appearance of joint pains	**9 (16.1%)**	**19 (33.9%)**	4 (7.1%)	2 (3.6%)	22 (39.3%)
Loss of sexual drive	4 (7.1%)	9 (16.1%)	5 (8.9%)	**8 (14.3%)**	**30 (53.6%)**
Loss of interest for any type of work	5 (8.9%)	9 (16.1%)	7 (12.5%)	**6 (10.7%)**	**29 (51.8%)**
Appearance of insomnia caused by fatigue	**24 (42.9%)**	**11 (19.6%)**	2 (3.6%)	6 (10.7%)	13 (23.2%)

Correlation analysis

Descriptive analysis enabled an insight into the global results which show some negative changes in psychological and functional characteristics of the drivers. However, the actual impact on the occurrence of these changes, and their correlation is determined by the correlation analysis.

The results of correlation analysis, with Pearson's correlation coefficients which indicate medium and high strength bonds, showed a correlation between the general data that defines the sample of respondents (age, years of service, time spent driving, etc.) , with the consequences related to psychological and functional characteristics, as well as the consequences within them.

At the level of significance $p < 0.01$ statistically significant correlations were determined:

- Age with length of service, type of traffic, the weakening of the memory, nightmares, high blood pressure, reduction in labor efficiency and joint pains;
- Years of service with the kind of traffic, the appearance of nightmares and reduction of operating effectiveness;
- Aggression towards the closest relatives with nervousness at mass gatherings and decline of decrease of interest in sexual activity;
- Nervousness at mass gatherings with the need of solitude;
- Frequent nervousness with a growing sense of fatigue;
- Frequent nightmares with reduced of working efficiency, joint pains and reduced in sexual activity;
- Increased sense of fatigue with elevated blood pressure;
- High blood pressure with a decrease in concentration and labor activity, muscle pain, joint pains, nightmares and insomnia;
- Reduced work efficiency with joint pains and reduction of sexual activity;
- Joint pain with muscle pain;
- Loss of interest in sexual activity with the loss of will for any type of work;

At the level of significance p <0.05 statistically significant correlations were determined:

- Age with the appearance of fatigue, muscle pain and a loss of interest in sexual activity;
- Time spent behind the wheel for 24 hours, and high blood pressure;
- Types of traffic and frequent nightmares;
- Types of vehicles and muscle pain;
- Irritability with memory impairment, frequent anxiety, high blood pressure, weakening of the willingness for any type work;
- Aggression towards the closest relatives with frequent nightmares, tiredness, decreased willingness to work;
- Nervousness at mass gatherings with increasing fatigue, joint pains and insomnia;
- The need for solitude and lack of will for any type of work;
- Memory impairment with a decrease in operating efficiency and the lack of will for any work;
- Nervousness with the lack of will for any type of work;
- Nightmare with frequent loss of concentration;
- Fatigue and insomnia;
- Frequent loss of concentration with reduced working efficiency, joint pains and insomnia;
- High blood pressure with a decrease in interest for sexual activity and the lack of will for any type of work;
- Reduction of operating efficiency with muscle pain;
- Joint pains with decrease in interest for sexual activity;
- The lack of willingness to work and insomnia.

The results are consistent with the research and claims of researchers mentioned in the introduction part of the study (van Camp and Associates. 2012; Hasanbegović, 2013; Banerjee, 2014; Istamto and Associates, 2014; Chang and Associates, 2014, and others.), who in similar way processed the issue and reported a negative influence of workplaces of drivers on their psychological and functional characteristics, especially the influence of noise and vibrations.

CONCLUSION

The study results or estimates between the relation of variables which relate to general information about respondents - drivers and variables that relate to examined psychological and functional characteristics, indicate that there are the identified negative effects caused by the nature of work of drivers, especially by the influence of noise and vibrations. It was found that these consequences are more pronounced in older patients and those with more years in service and those who spent more time driving during 24 hours, as well as those who drive heavier vehicles (excavators and dumpers). Results of correlation analysis also confirmed that negative changes are not isolated cases, but the value of Pearson's correlation coefficients showed that usually several negative effects on the psychological and functional characteristics were present at each respondent. Most of significant connections belonging to middle and high intensity.

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