OCCUPATIONAL RISK FACTORS FOR MUSCULOSKELETAL DISORDERS IN HUNGARIAN TAXI DRIVERS: A CROSS-SECTIONAL STUDY

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ABSTRACT

Introduction. Musculoskeletal disorders (MSDs), especially low back pain (LBP) are common occupational health problems for vehicle drivers all over the world. However, few epidemiological studies have investigated MSDs and LBP among professional taxi drivers, and no studies have dealt with the problem in Hungary so far. *Objective* of this study was to investigate the role of occupational risk factors in the aetiology of certain MSDs among Hungarian taxi drivers and to assess the actual situation of their LBP from the perspective of their working conditions. *Methods.* A questionnaire survey was carried out among taxi drivers in Nyíregyháza city, Hungary, to collect information on demographic characteristics, working conditions, health behaviour and lifestyle factors, health status including the presence of MSDs, the severity of LBP based on Visual Analogue Scale (VAS) score and the level of physical disability based on the Roland-Morris Disability Questionnaire (RMDQ) score. *Results.* The total number of valid responses was 88 from 117 taxi drivers approached, giving a participation rate of 75.21%. The self-reported lifetime prevalence of MSDs was 73.86%, among which LBP had the highest prevalence with 61.36%. The average VAS score was 5.94/10, the average RMDQ score was 6.44/24 among taxi drivers with LBP. There was a positive correlation between the VAS and RMDQ scores with a correlation coefficient of 0.445 and a regression coefficient of 0.217 ($p < 0.001$). Logistic regression analysis adjusted for age and BMI revealed that badly designed driver's seat (OR = 5.53; 95% CI: 1.76 - 17.34) and perception of mental stress (OR = 4.59; 95% CI: 1.28 - 16.46 for feeling mental stress rarely and OR= 27.39; 95% CI: 2.90 - 258.79 for feeling mental stress often while driving) were risk factors of MSDs, and similarly, badly designed driver's seat (OR = 2.90; 95% CI:

1.14 - 7.34) and higher degree of mental stress (OR = 45.87; 95% CI: 5.05 - 416.50 for often feeling of mental stress and OR = 15.28; 95% CI: 1.43 - 162.98 for feeling mental stress always while driving) were also risk factors for LBP. *Conclusions.* The prevalence of MSDs and LBP among professional taxi drivers in Hungary was associated with several occupational risk factors. The study provides data to inform targeted health interventions for improving the health and safety of taxi drivers.

KEY WORDS: taxi driver, musculoskeletal disorders, low back pain, ergonomic hazards

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ABBREVIATIONS

BMI	body mass index
CI	confidence interval
IPAQ	International Physical Activity Questionnaire
LBP	low back pain
LTPA	leisure time physical activity
MSDs	musculoskeletal disorders
OR	odds ratio
RMDQ	Roland-Morris Disability Questionnaire
VAS	Visual Analogue Scale

INTRODUCTION

Over the past few decades, the socioeconomic development and the resulting improvement of living standards in Hungary have fundamentally changed the modes of public transport making taxis an indispensable means of local passenger transport after tramways and buses. Currently we have no reliable data on the number of taxi drivers in Hungary because the Hungarian Central Statistical Office does not collect or do not publish statistical data with regard to the number of professional taxi drivers. The majority of Hungarian taxi drivers per-form their activities as self-employed, and only a relatively small number of them works for taxi associations that are predominantly micro enterprises (European Comission, 2016). Although the Hungarian taxi industry is regulated both at national and municipality level, it is very difficult to incorporate occupational health and safety practices into the driver's daily routine.

Taxi industry is an industry with many problems in terms of occupational safety and health. It is a strong requirement to maintain and improve taxi drivers' health as it is directly linked to the health and safety of passengers, pedestrians and others on the road. Driving vehicles is a specific sedentary working condition characterized by the need for constant attention, long hours of driving – often at night – in a restricted posture, repetitive movements, physical and chemical factors such as car vibration, shocks from roads, air and noise pollution, as well as mental stress associated complicated traffic conditions (Keyserling, 2000; Chen et al., 2003). Taxi drivers also have to face elevated risk for psychological and physical abuse from passengers (Burgel et al., 2014; Montoro et al., 2018). For those who travel long distances or work long hours, there are actual difficulties related to ensuring a healthy diet or finding opportunities for physical activity. As a consequence, taxi drivers are at increased risk for a range of health concerns such as frequent occurrence of ischemic heart disease (Kurosaka et al., 2000; Bigert et al., 2004), gastrointestinal symptoms (Ueda et al., 1989), type 2 diabetes mellitus (Adedokun et al., 2019), obesity (Ueda et al., 1989; Martin et al., 2016) and hypertension (Ueda et al., 1992). Moreover, international epidemiological studies of taxi drivers in several countries have identified elevated prevalence of musculoskeletal disorders (MSDs) including lower and upper back pain, neck pain, shoulder pain, knee pain, hip/thigh pain, elbow pain, ankle/feet pain, and wrist/hand pain as compared to the general population, mainly due to inadequate ergonomic conditions of the vehicle (Keyserling, 2000; Funakoshi et al., 2003; Chen et al., 2004; Bawa and Srivastav, 2013; Abledu et al., 2014; Wang et al., 2017; Murray et al., 2019). With regard to MSDs, low back pain (LBP) was the most commonly reported symptom with a prevalence of 45.8% in Japanese (Funakoshi et al., 2003), 54% in Chinese (Wang et al., 2017) and 50.7% in American taxi drivers (Murray et al., 2019). LBP of professional drivers is not only an individual health burden, but it has also been identified as one of the most common causes of decreased efficiency in work and in everyday life (Gebauer et al., 2015). The resulting social and economic consequences both on individual and community level justify the need to investigate the occurrence and risk factors of MSDs among taxi drivers.

In this study, a questionnaire survey was conducted among Hungarian taxi drivers to determine the role of occupational risk factors in the aetiology of certain MSDs and to assess the actual situation of drivers' LBP from the perspective of their working conditions.

MATERIALS AND METHODS

Study design

A cross-sectional survey was conducted from September 2018 to October 2018 in Nyíregyháza, Szabolcs-Szatmár-Bereg County, Hungary. Data collection was in accordance with the ethical standards of the Ethical Committee of the University of Debrecen, the Ethical Committee of the Hungarian Scientific Council on Health and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Approval was obtained from the participating taxi associations and written informed consent was obtained from each participant included in the study.

Subjects

Company-employed and self-employed taxi drivers were recruited for the present study. The chiefs of three major taxi companies in Nyíregyháza were asked to distribute self-administered questionnaires among all of their employees considering the relatively low number of taxi drivers per each company. In addition, self-employed taxi drivers were randomly approached personally in parking areas reserved for taxis in Nyíregyháza and asked to fill in the questionnaire.

Questionnaire

Each company-employed respondent completed the questionnaire in the company building or in the taxi, and then returned it back in a sealed envelope to the chief of the company. Self-employed drivers filled in the questionnaire in the taxi, and after completion, gave it directly back to the investigator in a sealed envelope. Each respondent was informed about their voluntary participation and anonymity of the completed questionnaires, as well as about the brief description and aim of the study.

The applied questionnaire was self-developed and pilot tested before its use. It included fifty open-ended and close-ended questions in total, logically arranged into six question blocks *(Table I).*

Table I. Question topics included in the questionnaire

Block 1	
	Gender, age group, marital status, height and body weight
Block 2	
	Length of service as a taxi driver, working hours, night-shift frequency, ergonomic design of driver's seat, feeling of vibration in the car, frequency of rest periods
Block 3	
	Smoking habit, physical activity level (IPAQ)
Block 4	
	Perceived psychological stress, general health status, musculoskeletal problems, sick leave and decreased efficiency in work due to musculoskeletal problems
Block 5	
	Visual Analogue Scale (VAS) for low back pain
Block 6	
	Roland-Morris Disability Questionnaire (RMDQ) for low back pain

The first block of the questionnaire collected demographic information and general characteristics of the subject. Five age groups were defined as 18-29, 30-39, 40-49 and 50≤ years. The second block of the questionnaire focused on work-related factors. Length of service as a taxi driver was defined as <5, 5-9, 10-19 and 20≤ years. Working hours were categorized into four durations such as <6, 6-8, 9-12 and 12< hours per day. Average frequency of night shifts per week was defined as "never", "once in a week", "twice in a week" and "more than twice in a week". Frequency of rest periods, i.e. when the driver leaves the vehicle, was divided into four categories such as "several times per hour", "hourly", "every two to three hours" and "I do not take rest time". The third block of the questionnaire regarded health behaviour and lifestyle factors of the respondent. The questions about smoking habits collected information on the current or former smoking status, the number of cigarettes smoked and the consumption of tobacco products other than cigarettes. Current and maintained physical activity among questionnaire respondents was assessed by the short form of International Physical Activity Questionnaire (IPAQ) (Lee et al., 2011) and classes of physical activity were defined as recommended (Lamb and Brodie, 1991) in low, medium, and high leisure time physical activity (LTPA) categories. The fourth block of the questionnaire gathered data on the health status of the individual, including experience of deterioration in health functions due to work, perceived mental stress, and preferentially certain MSDs such as low and upper back pain, diagnosed spinal disc herniation, stiff neck, pain in the neck, diagnosed cervical disk herniation, shoulder joint pain or diagnosed shoulder joint inflammation, elbow pain, diagnosed arthrosis in any joint, hip pain, knee pain and foot pain. Information on sick leave and decreased efficiency in work due to MSDs was also collected in this section. In the fifth block of the questionnaire, intensity of LBP was evaluated by the Visual Analogue Scale (VAS) which is well recognised as one of the most reliable of all existing pain measures (Price and Harkins, 1987). It is a ten-grade scale, the ends of which are defined as the extreme limits of the sensation to be measured. The sixth block of the questionnaire comprised the Roland-Morris Disability Questionnaire (RMDQ) score to assess physical disability due to LBP (Roland and Morris, 1983). It consists of 24 statements related to activities of daily living commonly affected by LBP. Respondents were asked to check the statements that represented their status in that day. Each statement was awarded 1 point if checked, giving a score out of 24. An individual’s score could thus vary from zero (no disability) to 24 (severe disability).

Statistical analyses

Data were analysed using Stata v12.0 (StataCorp LP, College Station, TX, USA) software. Descriptive statistics were used to summarize the demographic characteristics and the prevalence of MSDs of study subjects. The associations of MSDs and LBP as well as VAS scores with potential risk factors were evaluated by univariate and multivariate logistic (MSDs and LBP) or linear (VAS score) regression models with and without adjustment for age and body mass index (BMI) since both are well-defined risk factors of work-related MSDs (da Costa and Vieira, 2010). The associations were calculated as odds ratio (OR) and β-coefficient with 95% confidence interval (CI). The relationship between VAS and RMDQ scores was tested by simple linear regression. The threshold for statistical significance was 0.05.

RESULTS

The total number of completed questionnaires was 88, giving a participation rate of 75.21%. *Table II*. provides an overview on the general, occupational and health characteristics of the study population.

Table II. Descriptive characteristics of the surveyed taxi drivers

Variables	n (%)
Gender	
Male	88 (100)
Age group (years)	
18-29	22 (25)
30-39	22 (25)
40-49	31 (35.23)
50≤	13 (14.77)
BMI (kg/m^2)	
18.5-24.99	26 (29.55)
25-29.99	34 (38.64)
30≤	28 (31.82)
Work years	
<5	19 (21.59)
5-9	39 (44.32)
10-19	19 (21.59)
20≤	11 (12.5)
Daily working time (h)	
<6	9 (10.23)
6-8	63 (71.59)
9-12	16 (18.18)
Night shift (number per week)	
0	14 (15.91)
1	26 (29.55)
2	25 (28.41)
3≤	23 (26.14)
Rest periods in work time	
Several times per hour	14 (15.91)
Hourly	41 (46.59)
Every two to three hours	24 (27.27)
Never	9 (10.23)
Ergonomic design of driver's seat	
Well designed	41 (46.59)
Badly designed	47 (53.41)
Existence of annoying vibration in the car	
No	30 (34.1)
Yes	58 (65.91)
Smoking status	
Never	34 (38.64)
Ever	54 (61.36)
Physical activity level	
Low	54 (61.36)
Medium	21 (23.86)
High	13 (14.77)
Deterioration in health functions due to work	
Yes	47 (53.41)
No	41 (46.59)
Feeling of excessive mental stress due to work	
Never	24 (27.27)
Rarely	34 (38.64)

Often	23 (26.14)
Always	7 (7.95)
Self-reported lifetime prevalence of musculoskeletal problems lasting for at least one week	
Low back pain	54 (61.36)
Upper back pain	37 (42.05)
Diagnosed spinal disc herniation	8 (9.09)
Stiff neck (torticollis)	21 (23.86)
Pain in the neck	30 (34.09)
Diagnosed cervical disk herniation	3 (3.41)
Shoulder joint pain	14 (15.91)
Diagnosed shoulder joint inflammation	2 (2.27)
Elbow pain	9 (10.23)
Diagnosed arthrosis in any joint	9 (10.23)
Hip pain	7 (7.95)
Knee pain	22 (25)
Foot pain	15 (17.05)
Sick leave due to musculoskeletal problems	27 (30.68)
Experience of decreased efficiency in work due to musculoskeletal problems	45 (51.14)

All of the respondents were male. Most of them belonged to the age group of 40-49 (35.23%) and worked for 5-9 years (44.32%) as professional taxi drivers. The daily driving time was 6-8 hours for 71.59% of the respondents and 80.09% of the drivers undertook at least one night shift per week. A significant number of taxi drivers were overweight (38.64%) or obese (31.82%), current smoker (52.27%) and could be characterized by low physical activity level (61.36%). The self-reported lifetime prevalence of any of the questionnaire-listed MSDs lasting for at least one week was 73.86%, among which LBP had the highest prevalence with 61.36%. About half of the drivers (53.41%) felt the seat of the vehicle to be inadequate for long-time driving, and one-third of them (65.91%) experienced annoying vibration in the car while driving.

The associations of general and work-related factors with the presence of any questionnaire-listed MSDs and LBP, as well as with VAS scores are presented in *Table III*. Univariate logistic regression analyses revealed statistically significant associations between reporting any MSDs and age groups (OR = 12.00; 95% CI: 2.24 - 64.28 for age group of 30-39 years and OR = 5.00; 95% CI: 1.47 - 17.00 for age group of 40 - 49 years), BMI (OR = 4.97; 95% CI: 1.46 - 16.89 for 25-29.99 kg/m^2), undertaking night shifts (OR = 5.00; 95% CI: 1.00 - 25.02 for 3≤ night shifts per week), badly designed driver's seat (OR = 6.57; 95% CI: 2.16 – 20.02) and perception of mental stress (OR = 22.00; 95% CI: 2.54 - 190.36 for often feeling of mental stress). After adjustment for age and BMI, badly designed driver's seat (OR = 5.53; 95% CI: 1.76 - 17.34) and perception of mental stress (OR = 4.59; 95% CI: 1.28 - 16.46 for feeling mental stress rarely and OR = 27.39; 95% CI: 2.90-258.79 for feeling mental stress often while driving) remained in significant association with reporting any MSDs.

The risk of reporting LBP increased with older age (OR = 9.64; 95% CI: 2.36 - 39.36 for age group of 30-39 years, OR = 3.39; 95% CI: 1.07 - 10.74 for age group of 40-49 years and OR = 7.14, 95% CI: 1.48 - 34.38 for age group of 50≤ years), more work years (OR = 3.43; 95% CI: 1.09 - 10.78 for work years' group of 5-9 years), more night shifts (OR = 4.63; 95% CI: 1.14 - 18.75 for 2 night shifts per week), badly designed driver's seat (OR = 3.38; 95% CI: 1.38 - 8.29) and increasing perception of mental stress (OR = 44.00; 95% CI: 4.99-387.80 for often feeling of mental stress and OR = 12.00; 95% CI: 1.23 - 117.41 for feeling mental stress always while driving) in univariate analyses. However, when age and BMI were adjusted for, the association of badly designed driver's seat (OR = 2.90; 95% CI: 1.14 - 7.34) and perception of mental stress (OR = 45.87; 95% CI: 5.05 - 416.50 for often feeling of mental stress and OR = 15.28; 95% CI: 1.43 - 162.98 for feeling mental stress always while driving) with LBP remained statistically significant.

The intensity of LBP was increased with undertaking more night shifts (β = 2.59; 95% CI: 0.13 - 5.05 for 1 night shift per week and β = 2.8; 95% CI: 0.32 - 5.28 for 3≤ night shifts per week), fewer rest periods in work time (β = 3.34; 95% CI: 0.56 - 6.13 for taking rest hourly and β = 2.43; 95% CI: 0.11 - 4.75 for taking rest every two or three hours) and increasing perception of mental stress (β = 2.08; 95% CI: 0.21 - 3.95 for often feeling of mental stress and β = 3.79; 95% CI: 1.35 - 6.24 for feeling mental stress always while driving) in univariate linear regression models. The severity of LBP was only significantly linked to the perception of mental stress (β = 2.06; 95% CI: 0.27 - 3.86 for often feeling of mental stress and β = 4.34; 95% CI: 1.94 - 6.74 for feeling mental stress always while driving) when adjusting for age and BMI.

The average value of VAS scores which quantify the intensity of LBP was 5.94/10 among the taxi drivers who had experienced LBP for at least one week in their career (n = 54). The average RMDQ scores which reflect the physical disability of those who had LBP was 6.44/24. High positive response rates were found in the following questions of the RMDQ (i) I stay at home most of the time because of my back (57.41%); (ii) I change position frequently to try and get my back comfortable (74.07%); (iii) I walk more slowly than usual because of my back (51.85%); (iv) Because of my back, I lie down to rest more often (51.9%); (v) I get dressed more slowly than usual because of my back (54%); (vi) My back is painful almost all the time (46.3%); (vii) I sleep less well because of my back (55.6%). Figure 1 shows the relationship between the intensity of LBP and the level of physical disability.

Table 3. **Associations of occupational and non-occupational factors with the presence of any musculoskeletal disorders (MSDs), low back pain LBP and Visual Analogue Scale (VAS) scores.**

	Any MSDs (n=65)		**LBP (n=54)**		**VAS scores (n=54)**	
Explanatory variables*	Unadjusted analyses	Adjusted analyses for age and BMI	Unadjusted analyses	Adjusted analyses for age group and BMI	Unadjusted analyses	Adjusted analyses for age and BMI
	OR [95% CI]	OR [95% CI]	OR [95% CI]	OR [95% CI]	β [95% CI]	β [95% CI]
Age group						
(18-29)	1	-	1	-	1	-
30-39	**12.00 [2.24-64.28]**	-	**9.64 [2.36-39.36]**	-	-0.37 [-2.52-1.77]	-
40-49	**5.00 [1.47-17.00]**	-	**3.39 [1.07-10.74]**	-	1.15 [-0.98-3.28]	-
50≤	4.00 [0.86-18.64]	-	**7.14 [1.48-34.38]**	-	1.27 [-1.1-3.64]	-
BMI						
(18.5-24.99)	1	-	1	-	1	-
25-29.99	**4.97 [1.46-16.89]**	-	2.09 [0.73-5.99]	-	-0.56 [-2.27-1.16]	-
30≤	3.14 [0.96-10.30]	-	1.80 [0.61-5.35]	-	0.31 [-1.49-2.11]	-
Smoking						
(Never)	1	1	1	1	1	1
Ever	1.11 [0.42-2.92]	1.36 [0.47-3.91]	0.81 [0.34-1.92]	0.84 [0.34-2.10]	0.40 [-0.98-1.78]	0.17 [-1.23-1.57]
Physical activity level						
(Low)	1	1	1	1	1	1
Medium	2.37 [0.61-9.23]	2.25 [0.55-9.15]	1.92 [0.64-5.71]	1.78 [0.58-5.48]	0.57 [-1.01-2.14]	0.25 [-1.36-1.87]
High	0.89 [0.24-3.33]	1.05 [0.26-4.17]	1.73 [0.47-6.31]	1.95 [0.51-7.47]	0.52 [-1.37-2.41]	0.45 [-1.45-2.38]
Work years						
(<5)	1	1	1	1	1	1
5-9	2.42 [0.75-7.86]	2.01 [0.51-7.95]	**3.43 [1.09-10.78]**	2.62 [0.71-9.66]	-0.90 [-2.99-1.19]	-1.30 [-3.48-0.87]
10-19	2.04 [0.52-7.99]	0.98 [0.16-5.92]	3.71 [0.97-14.23]	2.17 [0.41-11.41]	0.02 [-2.28-2.33]	-0.83 [-3.51-1.86]
20≤	7.27 [0.77-68.89]	2.64 [0.15-45.50]	4.57 [0.90-23.14]	2.03 [0.22-18.49]	0.59 [-1.95-3.13]	-0.91 [-4.29-2.47]
Daily working duration						
(<6 h)	1	1	1	1	1	1
6-8	0.29 [0.03-2.49]	0.23 [0.02-2.07]	0.66 [0.15-2.91]	0.53 [0.11-2.41]	1.00 [-1.18-3.18]	0.85 [-1.34-3.05]
9-12	0.54 [0.05-6.14]	0.36 [0.03-4.59]	1.50 [0.25-8.98]	0.96 [0.14-6.37]	1.25 [-1.23-3.73]	1.00 [-1.49-3.49]
Night shift						
(0 per week)	1	1	1	1	1	1
1	1.2 [0.32-4.50]	0.99 [0.25-3.90]	2.88 [0.75-11.10]	2.47 [0.62-9.88]	**2.59 [0.13-5.05]**	2.17 [-0.39-4.73]
2	3.94 [0.87-17.73]	2.98 [0.63-14.13]	**4.63 [1.14-18.75]**	3.94 [0.92-16.87]	2.40 [-0.03-4.83]	2.07 [-0.43-4.58]
3≤	**5.00 [1.00-25.02]**	3.48 [0.65-18.48]	3.38 [0.84-13.55]	2.65 [0.62-11.41]	**2.8 [0.32-5.28]**	2.37 [-0.24-4.98]
Rest periods in work time						
(Several times per hour)	1	1	1	1	1	1
Hourly	0.17 [0.02-1.72]	0.17 [0.02-1.85]	0.8 [0.15-4.30]	0.79 [0.14-4.43]	**3.34 [0.56-6.13]**	2.98 [0.13-5.83]
Every two or three hours	0.34 [0.04-3.05]	0.35 [0.03-3.42]	1.39 [0.32-5.97]	1.16 [0.24-5.52]	**2.43 [0.11-4.75]**	2.07 [-0.42-4.57]
Never	0.48 [0.05-4.74]	0.47 [0.04-5.00]	1.60 [0.33-7.65]	1.36 [0.26-6.99]	1.83 [-0.61-4.26]	1.39 [-1.18-3.95]
Ergonomic design of driver's seat						
(Well designed)	1	1	1	1	1	1
Badly designed	**6.57 [2.16-20.02]**	**5.53 [1.76-17.34]**	**3.38 [1.38-8.29]**	**2.90 [1.14-7.34]**	-0.09 [-1.50-1.33]	-0.21 [-1.61-1.20]
Vibration in the car						
(No)	1	1	1	1	1	1
Yes	2.22 [0.84-5.90]	1.90 [0.68-5.25]	2.05 [0.83-5.06]	1.87 [0.73-4.77]	0.57 [-0.93-2.07]	0.70 [-0.78-2.18]
Feeling of mental stress						
(Never)	1	1	1	1	1	1
Rarely	2.78 [0.92-8.39]	**4.59 [1.28-16.46]**	2.25 [0.76-6.65]	2.92 [0.91-9.39]	0.90 [-1.02-2.83]	1.11 [-0.75-2.97]
Often	**22.00 [2.54-190.36]**	**27.39 [2.90-258.79]**	**44.00 [4.99-387.80]**	**45.87 [5.05-416.50]**	**2.08 [0.21-3.95]**	**2.06 [0.27-3.86]**
Always	6.00 [0.62-57.68]	6.59 [0.64-68.22]	**12.00 [1.23-117.41]**	**15.28 [1.43-162.98]**	**3.79 [1.35-6.24]**	**4.34 [1.94-6.74]**

*For each variable, the reference category is in parentheses.

OR: odds ratio; CI: confidence interval; β: regression coefficient

There was a positive correlation between the VAS and RMDQ scores with a correlation coefficient of 0.445 and a regression coefficient of 0.217 ($p < 0.001$).

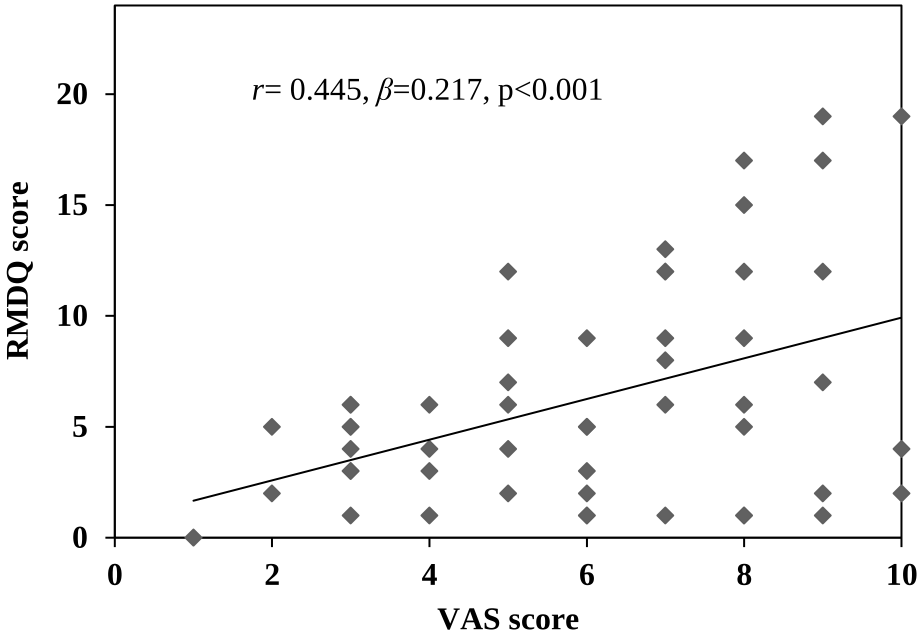

Figure 1. The relationship between the intensity of low back pain [Visual Analogue Scale (VAS) score] and physical disability [Roland-Morris Disability Questionnaire (RMDQ) score] due to low back pain.

DISCUSSION

Sedentary working environment, a well-recognized contributing factor to MSDs, becomes increasingly common in our times. MSDs, especially LBP, make up the largest category of work-related health problems in the European Union (EUROSTAT, 2010), and are frequently reported by professional vehicle drivers (Netterstrom and Juel, 1989; Chen et al., 2005a; Alperovitch-Najenson et al., 2010; Hakim and Mohsen, 2017; Wang et al., 2017; Sekkay et al., 2018). Previous studies have highlighted the role of workplace-specific ergonomic factors in the occurrence of LBP among sedentary workers (Franco and Fusetti, 2004; Phimphasak et al., 2016). The development of LBP can be prevented by adequately designed and applied workplace interventions such as height-adjustable desks, saddle or kneeling chairs (Bettany-Saltikov et al., 2008; van Niekerk et al., 2012; Tew et al., 2015). Nevertheless, given the unique occupational characteristics of drivers' cabs, these preventive measures are not applicable to taxi drivers.

In the present study, the self-reported lifetime prevalence of LBP was found to be 61.36%, the value that is considerably higher than the one-week prevalence of LBP among Japanese (20.5%) (Miyamoto et al., 2008) and Indian (22.9%) (Jaiswal, 2013) taxi drivers, as well as the one-year prevalence of LBP among Chinese (54%) (Wang et al., 2017) and Japanese (45.8%) (Funakoshi et al., 2003) taxi drivers. By assessing lifetime prevalence, we might overestimate the frequency of LBP in our study population, however; our results are consistent with the one-year prevalence of LBP among U.S. (63%) (Burgel and Elshatarat, 2017) and Norwegian taxi drivers (59% for men and 66% for women) (Raanaas and Anderson, 2008). In order to account for the possible recall bias, only the LBP lasting for at least one week, the period of which can be considered long enough to remember, was assessed in this study.

Regarding the occupational factors related to MSDs in the study subjects; it was found that the number of night shifts per week, ergonomic design of driver's seat and mental stress was found to be significant risk factors for the development of any of the studied MSDs, as well as solely of LBP; however, only the latter two factors remained statistically significant after adjusting the logistic regression model for age and BMI.

The association of MSDs and LBP with night-shift work conforms to a Chinese study by Wang and colleagues, demonstrating that night-shift drivers were more likely to report LBP (OR = 2.3, 95% CI: 1.7–3.2) (Wang et al., 2017). Ergonomically inadequate driver's seat without lumbar support that has no biomechanical benefits, and the consequent muscle fatigue have been described as cofactors in the pathogenesis of MSDs by a number of previous studies (Johanning, 2000; Chen et al., 2005b).

Mental stress, having the strongest association with MSDs in our study, was also a significant risk factor of MSDs of U.S. urban bus drivers (Krause et al., 1998). Chen and colleagues found that psychosocial factors were significantly associated with higher LBP prevalence among Taiwanese taxi drivers, especially for those who felt moderateto-severe job stress (OR = 2.19, 95% CI: 1.57–3.04), and who reported a high degree of job dissatisfaction (OR = 1.48, 95% CI: 1.11–1.96) (Chen et al., 2005a). Funakoshi reported unequivocal association between work stress and LBP in a study on Japanese taxi drivers; for drivers who perceived job stress, the adjusted odds ratio was 2.06 (95% CI: 1.15–3.75) (Funakoshi et al., 2003). Association between psychosocial occupational factors and MSDs was analyzed in depth in a review by Bongers and colleagues who concluded that monotonous work, high perceived work load, and time pressure are related to musculoskeletal symptoms (Bongers et al., 1993), the factors of which are well defined elements of the working environment of taxi drivers (Keyserling, 2000).

Results of the VAS score suggest that the intensity of LBP is significantly influenced by the number of night shifts undertaken, the number of rest periods during work time (without adjustment for age and BMI) and the level of perceived mental stress (both with and without adjustment for age and BMI). A previous study has reported that the rest is the most relieving factor while prolonged static postures are the most aggravating factors of LBP (Mohseni-Bandpei et al., 2011). The correlation of VAS and RMDQ scores demonstrated that individuals with higher intensity of LBP have more restricted physical ability. It is in agreement with the findings reported by Miyamoto and colleagues who also found a positive correlation between VAS and RMDQ scores (r = 0.41).

Other factors such as smoking, physical activity, daily working time, perceived vibration in the car showed no association with MSDs, LBP or VAS scores in this study. Age and BMI are well-recognized independent risk factors for work-related MSDs (da Costa and Vieira, 2010). However, the highest age group (50≤) was not significantly related to more MSDs in our analyses; the disappearing significance at higher age might be a consequence of healthy worker effect. Furthermore, the highest BMI category (30≤) did not show significant association with MSDs, as well as BMI was associated with LBP in our study.

To the best of our knowledge, this might be the first paper to report the prevalence and associated factors of MSDs and LBP among professional taxi drivers in Hungary. However, as a cross-sectional study using self-reported data, this study has limitations.

First, we could not draw any conclusions on causal relationships, only on associations, as the study had a cross-sectional design. Second, the recall period of participants in regards to experiencing MSDs was their entire career, which could entail a degree of misclassification due to recall bias. In addition, like other cross-sectional studies, the study subjects with MSDs might have been inclined to over-report certain work-related factors. Finally, the relatively small sample size of this study determined increased uncertainty and consequently less chance to find significant association. It also limits our ability to generalize the results to larger and geographically diverse populations of taxi drivers within Hungary (e.g. taxi drivers' population in Budapest).

In conclusion, the results of this study revealed that taxi drivers have a high lifetime prevalence of MSDs, especially of LBP and the substantial intensity of physical pain due to LBP was also confirmed. Considering the specific occupational risk factors identified in this study, targeted occupational health and safety interventions should be carried out to prevent the development and progression of MSDs in taxi drivers. In particular, taking more resting periods during work time, introduction of appropriate resting areas, reducing the number of night shifts per week, improvement of ergonomic characteristics of driver's seat and psychological counselling can be recommended. The findings of this study also suggest that it would be beneficial for the drivers to become more aware and knowledgeable of MSDs and their ergonomic risk factors so that they could be encouraged to take up risk avoiding behaviour and seek treatment when needed.

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