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Original articles

Hearing risk in motorcycle taxi drivers of a Southern Brazilian city

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ABSTRACT

Objective: to characterize the hearing profile of motorcycle taxi drivers and analyze the risk of their exposure to noise.

Methods: a cross-sectional study with 17 motorcycle taxi drivers of a city on the Southern coast of Brazil, in 2008. Noise was measured at workplace and during a standard route. The dose of exposure to noise was calculated, a questionnaire on the perception of auditory and extra-auditory effects was applied and an auditory hearing assessment through threshold tonal audiometry was performed.

Results: at workplace, noise was around 73dBA (decibels, A scale), and while commuting, noise was above 100% for a 12-hour working day. Strain and stress/fatigue after work were reported by 58.8% of the subjects and 52.9% of them showed hearing losses, five presenting characteristic noise-induced hearing losses (NIHL). However, the motorcycle taxi drivers did not associate the adverse health effects to the continuous exposure to noise.

Conclusion: the motorcycle taxi drivers presented hearing risk, 29% of them presenting hearing alterations with characteristics suggestive of noise-induced hearing loss, which makes the implementation of auditory conservation programs of extremely importance for this class of workers.

Keywords: Hearing; Noise; Motorcycles; Occupational Health

INTRODUCTION

In the past decades, the growth of urban populations has caused the increase

in vehicle circulation, which consequently increases the fleet of cars, motorcycles, buses and trucks, among others, making cities noisier and noisier.

Bad performance of means of transport and poorly maintained public roads, making move around slower, has led the population to choose faster and economic individual transportation, such as motorcycles. Moreover, the expansion of motorcycle fleet all over the world has been attributed to the increasing use of this means of transport in the formal and informal labor market, transporting not only passengers, but also delivering service by transporting small loads[1].

In Brazil, around 20,000,000 motorcycles are registered, and in Santa Catarina State, the study venue, there are around 800,000 motorcycles. Such a high number of motorcycles also increases the cases of traffic accidents[2]. A study on traffic accidents involving motorcycles between 2001 and 2010, observed an increase of 327% in deaths and 620% of hospital expenses with hospitalizations of injured motorcyclists, despite the legislation demands minimum safety and comfort conditions for motorcycle users[3,4].

Being traffic their workplace, that exposes drivers to different aggressive agents, such as: extended work journeys, insufficient sleep, improper diet, urban violence, accident hazards, noise and carbon monoxide[5,6].

Studies show that traffic noise in Brazil exceeds the levels suggested by the Conselho Nacional do Meio Ambiente – CONAMA (National Environmental Council), which is 65dB. Therefore, traffic noise exposure may cause negative hearing and non-hearing effects[6,7], and additionally, increases the chance of accidents[6,8].

Despite several studies on drivers' work conditions and health problems, national and international literature is still insipient on motorcyclists, noise exposure and its effects[9]. Study from Cartagena, Spain, for example, investigated the work conditions of 423 motorcycle taxi drivers. The authors verified that the profession is an option for those with low level of schooling, low economic condition or unemployed. Therefore, they are submitted to improper work conditions, such as high levels of noise exposure, bad weather, humidity, dust, among others[5,10]. The authors observed high number of accidents, whose main causes are terrible road conditions, lack of signaling, poor road maintenance and non-compliance with the use of the personal protective equipment[5,8]. In Brazil, study in Pernambuco State analyzed 152 motorcycle taxi drivers, working between one and five years, day and night shift and work hours longer than nine hours. It was observed that those professionals had scarce knowledge on the use of safety equipment[8]. In Jequié, Bahia State, Brazil, studies on practices and perceptions of using Personal Protective Equipment (PPE) with 30 motorcycle taxi drivers, all males, ages between 18 and 30 years and incomplete High School, observed that some of them had knowledge on PPE, however, they do not always make proper use of them[8]. Traffic violence, specially involving motorcycle taxi drivers is focused on a study carried out in Uberaba (Brazil), and confirms the mentioned profile of the studies above: prevalence of male professionals, low level of schooling, bad habits, such as smoking and drinking. The precarious work conditions are directly correlated with the traffic violence, specially the extended work hours[11].

The already mentioned scarcity of work involving motorcycle taxi drivers and traffic noise exposure, scarce knowledge on its risks and how to prevent them among motorcycle taxi professionals, justify studies in this area in order to contribute to public policies which ensure their hearing integrity and health[3,6,8].

This study objectifies to typify active motorcycle taxi drivers from a coastal city of Santa Catarina State, Brazil, and analyze those professionals' noise-exposure risk.

METHODS

The current study was approved by the Ethics Committee on Research, Santa Catarina Federal University, under number 019/08 FR 177837. All the procedures were carried out with the consent of the involved subjects, who signed the Free Informed Consent Form.

It is a preliminary, cross-sectional study held with motorcycle taxi drivers from a coastal city in Santa Catarina State – Brazil.

As inclusion criteria in the research, being a motorcycle taxi driver for over a year, registered in the competent agencies of the municipality, stationed at the selected moto taxi rank, and having signed the Free Informed Consent Form. Exclusion criteria were: working less than a year and not being stationed at the selected taxi rank.

Seventeen (17) motorcycle taxi drivers stationed at a motorcycle taxi rank participated, ages between 19

and 63 years, all males, working in 12-hour work shifts, divided in work groups from 7:00 AM to 7:00 PM and 7:00 PM to 7:00 AM at a single motorcycle taxi rank in the city. That motorcycle taxi rank was selected for being located next to the University where the research was carried out, and all motorcycle taxi drivers working at that taxi rank were invited to participate in the study.

The study was held in three steps:

1 - Assessment of motorcycle taxi drivers' noise exposure, carried out in two sites, as follows:

- at the workplace: venue (room) where the motorcycle taxi drivers waited for the phone calls (around 600 calls a day), measuring 15 square meters, having a refrigerator, a sofa, a wooden bench, a desk, a metal file cabinet and two chairs, a radio and a TV set (24 hours on), two telephone networks and a cell phone in order to take the ride requests of the motorcycle taxi drivers. The assessment of environmental noise was held with a Solo 01 dB Model Sound Pressure Meter, instant reading, in three periods (morning, afternoon, evening), on a high season day (January).
- during a pre-established itinerary in the traffic noise: itinerary choice was held considering the ride time length, the allowed average speed and the avenue structure. Itinerary average speed was 40Km/h, and the assessment lasted ten minutes. The amount of traffic lights, three in all, results in stops and sudden starts, thus contributing to the variability of the noise level during the ride. During the itinerary, the Sound Pressure Level (SPL), which the motorcycle taxi driver was exposed to, was recorded. Two kinds of equipment were used: a NPS Solo 01 dB and a Quest 300 Dosimeter. The Sound Pressure Meter was carried by the researcher, passenger on the motorcycle, near the driver's back, thus preventing it from taking straight wind. In order to measure the noise-exposure level, dosimeter microphone was placed inside the motorcycle taxi driver's helmet, more precisely near his ear. Traffic noise exposure was assessed to all motorcycle taxi drivers.

2) Application of a questionnaire: designed and applied by the researcher, comprising questions on motorcycle taxi drivers' demographic data (age, gender, time length of noise exposure to motorcycles at work), specifications of motorcycle and helmet, and perceptions on the auditory and extra-auditory effects, considering their daily exposure.

3) Hearing assessment: tone threshold audiometry was performed, after screening of the external acoustic meatus by means of an AD28 *Interacoustics* audiometer, calibrated according to the Federal Council of Speech-Language Therapy[12], frequencies from 500 Hz to 8000 Hz. Hearing thresholds were considered within normality when the tone thresholds by airway were up to dBHL in all the reported frequencies, according to the criteria of the World Health Organization[12].

In the data analysis of the noise exposure at the workplace, frequency bands and environmental noise level were analyzed. In the data analysis of the traffic noise exposure, work hours of each motorcycle taxi driver was adequated for 12 hours, their scheduled work hours. Noise level of 82.1 dBA (A Scale) was then considered acceptable for daily exposure, reported as the allowed percentage of daily exposure, reference value of 85 dBHL, mentioned by the Regulatory Standard NR15[10,13]. In the assessment by means of the dosimeter, it was recorded the Equivalent Threshold, which is the continuous equivalent level related to the acoustic energy which an individual is exposed to[12]. The parameters for measuring the noise level with a dosimeter were: steady time in Slow, Compensation circuit "A", average level of 5 dB, Minimum level: 70 dB, measured every 10 minutes. Three measurements were held every ten minutes for each motorcycle taxi drivers, and their average was used for the data analysis.

For the analysis of the results, statistical analyses were used, such as Friedman's ANOVA test, in the result of the threshold tonal audiometry by frequency in the same ear, and the Wilcoxon Test in order to compare hearing thresholds between right and left ears. Significance level of 0.05 was used.

RESULTS

In the motorcycle taxi drivers, all males, it was observed that the time working as a motorcycle taxi driver varied from three to 30 years. That profession is predominantly male, and exercised by people with low schooling level. During summer season, comprising December to February, the amount of daily rides varied from 20 to 30 a day, an average of 250 km per day being covered, average speed of 60 km per hour. All motorcycles were 125cc, models from years 2004 to 2007, complying with power, year, and model requested by the municipality agency.

Results of the noise level assessment at the workplace showed that noise level frequencies in that environment are between 500 and 1000Hz, and global sound pressure level found was 73 dBA. An average of

600 phone calls are answered daily with transportation requests for different sites in town and region.

Regarding noise levels in the 10-minute itinerary, evaluated by the pressure sound level meter carried by the researcher, it was observed 87.5 equivalent dB level. In Table 1, we can observe the dosimeter values, assessed by the microphone inside the motorcycle taxi drivers' helmets, related to the average level of noise exposure, with values extrapolated for 12 hours.

Table 1. Distribution of dose of traffic-noise per motorcycle taxi drivers, assessed for a 12-hour period (N=17)

Dose (%)	Absolute Frequency	Relative Frequency (%)
160 – 190	6	35.30
200 – 240	7	41.17
250 – 290	3	17.64
Over 300	1	5.88

Exposure levels above 100% were observed to all the participants, with an average level of 124%.

From the 17 interviewees, 11 (65%) were already involved in traffic accidents. The motorcycle taxi drivers did not consider collisions and motorcycle falls as occupational accidents, and they did not report any health conditions as occupational disease.

The use of personal protective equipment (PPE) is reported by all motorcycle taxi drivers; the white helmet and the vest in the color of and having the identification number of the motorcycle taxi rank mandatory to work within the municipality.

Table 2 shows the data on the use of personal protectors (helmets) and noise perception.

Table 2. Aspects of the helmet and noise perception by the motorcycle taxi drivers (N=17)

Aspects of the Helmet	Absolute Frequency	Relative Frequency (%)
Helmet Model:		
Full-face helmet	11	64.70
Open-face helmet	6	35.29
Helmet size:		
Small (Size 56 or smaller)		
Medium (Size 58)	11	64.70
Large (Size 60 or larger)	6	35.29
Noise Perception with the helmet:		
Reduces noise	8	47.05
Does not reduce noise	7	41.17
Cannot answer	2	11.76

It was observed that 11 motorcycle taxi drivers reported the use of full face, medium-sized helmet. Regarding the influence of the helmet on noise level control, 47% of the motorcycle taxi drivers reported that the helmet reduced traffic noise levels.

Table 3 shows the perception of auditory and non-auditory effects by the motorcycle taxi drivers.

Table 3. Motorcycle taxi drivers' perception on the possible auditory and non-auditory effects of noise exposure (N=17)

Perception	Absolute Frequency	Relative Frequency (%)
Auditory Effects:		
Hearing Loss	3	17.64
Tinnitus	2	11.76
Aural fullness	2	11.76
Otalgy	1	5.88
Non-Auditory Effects:		
Irritability	10	58.82
Fatigue/stress	10	58.82
Sleep disorders	4	24
Mood swings	4	24
Anxiety	2	11.76
Headache	1	6
Gastric intestinal disorders	1	6
Distress	1	6
Others/distraction	1	6

Hearing loss was reported by three motorcycle taxi drivers, and irritability, fatigue/stress were mentioned by 10 professionals.

In the audiological screening of the studied motorcycle taxi drivers, 9 (52.9%) featured alteration in the tone auditory thresholds. Among them, two featured unilateral alteration, and the others featured bilateral alteration. From those seven motorcycle taxi drivers who featured bilateral alteration, five featured characteristics of noise-induced hearing loss. Significant difference was observed, by means of Friedman's ANOVA, in the significance level of 0.05 between auditory thresholds in the frequencies in the same ear, with significant difference at 6000Hz in the right ear ($p = 0.00001$), and in the left ear ($p = 0.00068$), evidencing bilateral acoustic notch.

Table 4 shows the average tone auditory thresholds (and standard deviations) by motorcycle taxi drivers' ears:

Table 4. Average of tone auditory thresholds (and standard deviations), both ears of the motorcycle taxi drivers (N=17)

Frequencies (Hz)	Right Ear		Left Ear		p
	Average (dB)	Standard deviation	Average (dB)	Standard deviation	
500	23.8	6.3	25.9	5.1	0.0630
1000	24.7	5.7	25.6	4.6	0.4838
2000	18.2	12.4	21.2	11.3	0.0367*
3000	18.8	12.3	22.4	12.4	0.0505
4000	18.8	13.3	23.2	16	0.0244*
6000	28.2	16.6	30.3	17.1	0.2026
8000	18.5	15.1	24.7	20	0.0284*

Obs: *Wilcoxon Test, significance level < 0.05

By comparing the auditory thresholds between right and left ears, using Wilcoxon's Test, there was significant difference between the thresholds of right and left ears at frequencies of 2000Hz, 4000Hz and 8000Hz, with worse air conduction thresholds in the left ear. The same is evidenced in studies with drivers of front engine buses, which is traffic-related.

DISCUSSION

It was verified in the study that all motorcycle taxi drivers were male, with middle-school level of education (8 or 9 years of schooling)[5]. At the motorcycle taxi rank, motorcycle taxi drivers' workplace, the observed average noise level was 73 dBA, which is above the suggested level for such environments. According to the NBR 10152 (technical regulation by the Brazilian Association for Technical Standards (ABNT, in Portuguese), an office should feature noise levels between 30 and 40 dBA. Inadequate workplace is evidenced, which may bring about acoustic distress for any situations or activities [5,14]. In such conditions, loss of speech intelligibility, hindering the necessary communication to wait on customers, and the tasks to be forwarded by the secretary to the motorcycle taxi drivers[14].

However, the noise levels evaluated during the itinerary (Table 1) are over 85 dBA. When noise levels are analyzed for 12 daily work hours[10], they are above 100% recommended by the labor legislation, which enhances the risk of the auditory and/or non-auditory effects[5]. Motorcycle taxi drivers are self-employed and they work the most possible hours, mainly in the summer season[15]. Another study of dosimetry with 13 bus drivers evidenced that 76% of those professionals were daily exposed to traffic noise levels above 100%[15]. Some motorcycle taxi drivers' attitudes would contribute to increase noise levels, such as inadequate maintenance of their motorcycles, as well as some passengers' demand to speed up in order to get faster to their destination[11,16,17].

Regarding the use of the PPE (Table 2), the use of helmets was observed in order to keep and protect the physical integrity of motorcycle taxi drivers. However, not complying with the legal demands, six motorcycle taxi drivers wear open-face helmets, which could expose them to higher traffic noise than the use of full-face helmets[8]. Eight motorcycle taxi drivers reported that the helmet reduces traffic noise, but they said they were aware that that was not its primary function. That observation requires further investigation, though. In Brazil, it is not possible for drivers to wear ear protectors as in the Middle East[16]. It is not possible to wear ear protectors in Brazil, as they may lead to sound level losses above 40 dBNA and hinder motorcyclists' attention[8].

In relation to the possible auditory and non-auditory noise-related effects (Table 3), reported by the motorcycle taxi drivers, the most mentioned ones were: irritability and fatigue/stress[6,7]. Hearing loss was reported by three motorcycle taxi drivers. Authors report that exposure to occupational noise is one of the greatest problems which affect workers, causing non-auditory effects, such as annoyance, decrease of work effectiveness and physiological dysfunctions[11,14,15.] Studies report that after an hour of high speed on motorcycles, it is evidenced tinnitus complaints, and after long periods of high speed, motorcyclists report complaints of fatigue, headache and even imbalance[18]. A study with motorcycle couriers in Porto Alegre found tiredness/fatigue as their main complaint, when questioned on the main causes of accidents in the category[3]. Study with 400 truck drivers found stress reports in 14% of them, and hearing impairment in 6.7%[8].

Despite only three motorcycle taxi drivers having reported hearing loss as the noise-related complaint, in the hearing profile analysis, nine motorcycle taxi drivers were found with neurosensory hearing alterations (52%), and five of those (29.4%) with characteristic acoustic notch for Noise-Induced Hearing Loss. Auditory thresholds were worse in the left ear. Another study verified the risk for hearing loss in motorcyclists based on the exposure to high sound levels, between 90 and 103 dBA[9]. Study from Great Britain with 200 police officers, who ride motorcycles, reported 40% of them with hearing impairments[17]. Study from Iran with 1,836 drivers found 23.8% of them with bilateral hearing loss, 4.2% with hearing loss in the right ear, and 10.2% in the left ear, reporting statistically significant difference ($p=0.041$)[17]. The authors justified that result by the fact that most drivers drive with the left side window glass lowered down, increasing noise exposure[17]. However, in the present study, there is no explanation for worse auditory thresholds in the left ear due to noise exposure, as both ears are equally exposed to traffic noise on their motorcycles. Motorcycle taxi drivers' age in this study could justify the hearing alterations found, however, it is worth pointing out that from those with alterations in their auditory thresholds, five featured NIHL characteristics, not presbycusis[14].

The fact that nine (52.9%) motorcycle taxi drivers in this study feature hearing loss, may also increase the chance of traffic accidents[10]. Study associates high levels of noise exposure with hearing alteration as factors which contribute to occupational accidents[19].

Given the size of the study sample, there is a limitation in the possible analyses to be carried out. Other studies expanding the number of investigated professional drivers are suggested, enabling to define factors that would influence in the hearing profile.

In addition to the auditory effects, work conditions, long work journeys and the external pressures, described above, are directly correlated with job dissatisfaction, traffic violence and damages in motorcycle taxi drivers' general health[11].

CONCLUSION

It was evidenced that all the researched motorcycle taxi drivers featured traffic noise exposure above 100%, considering a 12 hour-work shift, therefore, they are at risk for hearing loss.

The motorcycle taxi drivers do not report noise as uncomfortable, but it was already possible to observe hearing alterations with characteristics of noise-induced hearing loss in 29.4% of the subjects.

In addition to the hearing effects, unhealthy conditions and violence at workplace, in this case, in the traffic, fatigue, irritability and general health alterations are pointed out as disastrous consequences.

It is considered that the development of Hearing Conservation Programs would be valuable for this category of workers, as long as their specificities are complied, as those professionals cannot currently wear the ear protectors available on the market.

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