European Archives of Oto-Rhino-Laryngology (2020) 277:2285–2291
https://doi.org/10.1007/s00405-020-05983-z

LARYNGOLOGY

The prevalence of signs and symptoms of laryngopharyngeal reflux and laryngeal precancerous lesions in urban taxi drivers

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Received: 11 March 2020 / Accepted: 13 April 2020 / Published online: 23 April 2020
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Abstract

Purpose Taxi drivers represent a large group of workers employed in the service sector of transport. Many studies found an increased risk of a range of health disorders in relation to their irregular work shifts, inappropriate diet, drinking and smoking habits and their high exposure to gasoline- and diesel-engine exhaust fumes. The aim of the present study was to assess the sample of a larynx from taxi drivers, considering symptoms and endoscopic signs of laryngopharyngeal reflux (LPR) and precancerous lesions.

Methods Taxi drivers enrolled ($n=74$) were questioned about their nicotine dependence using the Fagerstrom scale. The Reflux Symptom Index (RSI) was administered to screen LPR symptoms. Each subject underwent videolaryngoscopy with Reflux Finding Score (RFS) calculation. Data were compared with those obtained from the control group ($n=102$).

Results Taxi drivers' group did not show a significantly greater dependence on cigarette smoking ($p<0.05$) based on the Fagerstrom scale. RSI resulted greater or equal to 13 (cut-off for reflux disease) for 28/74 (37.3%) taxi drivers and 14/102 (13.7%) controls, with a statistically significant difference between the two groups ($p=0.0015$; OR = 3.14). RFS was greater or equal to 7 (95% certainty of having LPR) in 40/74 (53%) cases and 30/102 (29.4%) controls ($p=0.0010$, OR = 2.82). Three taxi drivers (4%) had leucoplastic lesions of the vocal cords worthy of biopsy, which turned out to be infiltrating squamous cell carcinoma on histological examination.

Conclusions Taxi drivers resulted at risk of LPR and presented high-prevalence laryngeal precancerous lesions and carcinoma.

Keywords Taxi drivers · Laryngopharyngeal reflux · Laryngeal precancerous lesions · Occupational health

Introduction

Taxi drivers are a large group of workers in the travel and tourism industry as shown in the results of a recent survey of the Bank of Italy on the main Italian cities, with about 6000 licenses in force and 20 taxis per 10,000 inhabitants in the city of Rome [1].

Many epidemiological studies suggest an excess risk for a range of health disorders among professional drivers employed in the public and the private transport correlated to their poor health behaviors (exposure to noise and whole body vibration, inappropriate diet, drinking and smoking habits) [2]. Taxi industry particularly is quite different from conventional transport occupations; ambiguous work hours and a variable income on a daily basis make them particularly exposed to many stressful and unhealthy working conditions, such as long hours, irregular work shifts, sleep disturbances and harmful exposure to traffic pollutants [3, 4]. International studies identified a significant relationship between occupational taxi driving and cardiovascular diseases, including ischemic heart disease and cardiac arrhythmia [5, 6], musculoskeletal system disorders [7], gastrointestinal diseases [8], with an increased risk of chronic gastritis and peptic ulcer [9], respiratory problems especially for chronic obstructive pulmonary disease [10] and neoplastic diseases [11–13].

A few studies found that the habit of smoking cigarettes is higher among taxi drivers compared to other professional drivers [14]; they are commonly exposed to gasoline- and

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diesel-engine exhaust fumes and spending more time in the city traffic, where the pollution is the highest, than bus or truck drivers who cover the entire road grid including suburban and rural areas [12]. The vehicle cabin has been recognized as an important microenvironment that can increase personal exposure to organic pollutants [15], and the concentrations of pollutants may be higher inside the cars than inside the buses [16]. Many taxi drivers opt to drive for long hours, even during the night time, with limited access to healthy food, prolonged sitting and physical inactivity [17].

Night shifts, irregular diet and smoking habit could lead to the chronic inflammation of the laryngeal mucosa, both through the direct mutagen action of cigarette smoke and air pollution on the upper airways and the possible coexistence of other inflammation factors, such as laryngopharyngeal reflux (LPR), an entity frequently encountered in clinical ENT practice. It includes a combination of supra-oesophageal signs and symptoms affecting, in particular, the otorhinolaryngologic area caused by the chronic exposure of the laryngeal mucosa to gastric secretions, HCl and pepsin, which generally occurs during spontaneous reductions of continence of the superior oesophageal sphincter [18].

The direct action of the reflux, promoted by limited access to healthy food and prolonged sitting, would have a predisposing effect upon the mutagenic action of the well-known cancerogenic exogenous factors (cigarette smoke, alcohol, traffic pollutants) on the laryngeal mucosa.

The aim of this survey was to study the precence of symptoms and endoscopic signs of LPR among taxi drivers, as well as the presence of precancerous lesions of the vocal cords, whereas all the above cited factors could contribute to the chronic inflammation of the upper airways, especially the larynx.

Materials and methods

A total of 74 taxi drivers were enrolled in the study; recruitment letters were sent to many taxi companies of Rome asking owners to post flyers about the study. Appointments were agreed by telephone at the Phoniatric Service of our Institution, in a day clinic, between March and September 2019.

Only the people who have been working as taxi drivers for at least 1 year were admitted in the study. We excluded people with a history of previous laryngeal surgery or laryngeal carcinoma. Written consent was obtained at the time of their visit.

The cases aged from 29 to 70 years (mean age 49.5 ± 8.0 years); 14 were females (18.9%) and 60 males (81%) (Table 1).

A brief survey with 14 questions in Italian, specifically developed by the coauthors, was given to each taxi driver at the time of visit to assess general socio-demographic variables (age and gender), data about their smoking habit, alcohol and coffee consumption, work-related information including years they worked as taxi drivers, shifts (day and/or night), hours worked in the prior week and the city areas most covered, health conditions (ongoing diseases), family history and information about the possible exposure to toxic substances during after-work activities.

All smoking taxi drivers were also questioned in detail about the level of their nicotine dependence using the

Table 1 Demographic characteristics, occupation, drinking and smoking habit, coffee consumtion, number of asymptomatic subjects in taxi drivers group and healthy controls group

	Taxi drivers $n = 74$	Controls $n = 102$
Age, mean year ± SD	49.5 ± 8.0	45.3 ± 9.8
Elderly (age > 60 yr) *n*/total (%)	8/74 (10.8%)	12/102 (11.7%)
Sex, female *n*/total (%)	14 /74 (18.9%)	36/102 (35.3%)
Occupation *n*/total (%)	74/74 (100%) taxi drivers	34/102 (33.3%) day clinic nurses 30/102 (29.4%) office workers 16/102 (15.7%) doctors 12/102 (11.8%) speech therapists 6/102 (5.9%) shop-keepers 4/102 (3.9%) audiology technicians
Smoking habit *n*/total (%)	24/74 (32.4%)	32/102 (31.3%)
Alcohol daily users *n*/total (%)	32/74 (23.68%)	22/102 (21.5%)
Coffee consumers *n*/total (%), *n* cups a day	74/74 (100%), 2.5	102/102 (100%), 2.5
Asymptomatic subjects (RSI = 0) *n*/total (%)	7/74 (9.5%)	10/102 (9.8%)

RSI Reflux Symptom Index

Fagerstrom scale [19]. All those who were found to be using tobacco in any form were invited to contact the tobacco cessation service of our Institution.

The Reflux Symptom Index (RSI) [20] was administered to all subjects to measure laryngeal symptoms. Each subject underwent physical examination of the larynx by means of fiber-optic nasopahryngolaryngoscopy. The Reflux Finding Score (RFS) [21] was collected in all cases.

The data were compared with those obtained from a control group of 102 subjects, aged between 30 and 68 years (45.3 years ± 9.8). In the control group, 36/102 (35.3%) were females and 66/102 (64.7%) were males. Controls were enrolled at our hospital and consisted of 34/102 (33.3%) day clinic nurses, 30/102 (29.4%) office workers, 16/102 (15.7%) doctors, 12/102 (11.8%) speech therapists, 6/102 (5.9%) shopkeepers and 4/102 (3.9%) audiology technicians (Table 1).

We used SSPS for Windows software. The discrete data were summarized as absolute frequencies and relative frequency percentages. Missing values were not considered for the calculation of the relative frequency percentages. Statistical analysis was performed through the χ^2 test and the odds ratios (OR) with 95% confidence intervals. The results were considered significant for p value < 0.05. Pearson correlation coefficient was used to evaluate the relationship between RSI and RFS.

Results

The survey showed that they have been working as taxi drivers for an average of 16.9 (± 10.7) years, 47 (± 8.4) hours a week. 38/74 (50.6%) worked also during the night hours. Questions about cigarette smoking habit showed that 24/74 (32.4%) were current smokers (66.6% M, 33.4% F), with a smoking mean of 16.8 (± 10.8) cigarettes a day, for an average of 17.8 (± 10.3) years. The Fagerstrom scale was used to evaluate their nicotine dependence (Table 2): 41.7% had a total score between 0 and 2, resulted in a very slight dependence; 29.1% had a score between 3 and 4, slight dependence; 16.7% with a score of 5, medium dependence; 8.3% had a score between 6 and 7, serious dependence; and 4.2% had a score between 8 and 10, very serious dependence. The total Fagerstrom score was on an average 3.08 (slight cigarette dependence) for all smoking taxi drivers and 5 (medium cigarette dependence) for those who worked also at night. 17/74 (22.9%) taxi drivers were former smokers for at least one year showing an average time of exposure of 18.7 (± 10.5) years; therefore, a total of 41/74 (55.5%) taxi drivers were current or former smokers.

Table 2 Fagerstrom test for nicotine dependence

Fagerstrom test for nicotine dependence	Taxi drivers (*n* actual smokers 24/74, 32.4%)	Controls (*n* actual smokers 32/102, 31.3%)
0–2 very slight	10/24 (41.7%)	16/32 (50.0%)
3–4 slight	7/24 (29.1%)	6/32 (18.7%)
5 medium	4/24 (16.7%)	4/32 (12.5%)
6–7 hight	2/24 (8.3%)	4/32 (12.5%)
8–10 serious	1/24 (4.2%)	2/32 (6.2%)

In the control group, 32/102 (31.3%) were actual smokers with a mean of 13.2 (± 5.8) cigarettes a day for an average of 22.3 (± 10.1) years, with a mean score on the Fagerstrom test of 3.1 (slight dependence); 14/102 (13.7%) were former smokers.

Considering the rate of actual smokers in the taxi drivers' group and the control group (32.4% vs. 31.3%) and the mean of Fagerstrom score (3.08 vs. 3.1), the taxi drivers' group did not show a significantly greater dependence on cigarette smoking ($p > 0.05$).

32/74 (23.6%) taxi drivers and 22/102 (21.5%) controls said that they consumed daily alcoholic beverages during non-working hours, without a statistically significant difference between the two groups ($p > 0.05$). All of them in both the groups consume coffee daily, a mean of 2.5 cups a day (Table 1).

Only 2/74 (2.6%) in the taxi drivers' group and 2/102 (1.9%) in the control group had a positive family history of laryngeal cancer.

The administration of the RSI showed that the score ranged from 0 to 37 (mean 9.5). It resulted greater or equal to 13 (cut-off for reflux disease) in 28/74 taxi drivers (37.3%) and 14/102 (13.7%) controls, with a statistically significant difference between the two groups ($p = 0.0015$; OR = 3.14). Table 3 shows the results in each item of RSI in absolute numbers and percentages among taxi drivers and controls. Taxi drivers showed laryngeal symptoms in a significantly higher percentage ($p < 0.05$) than the controls in the following items of the questionnaire: hoarseness ($p = 0.0166$; OR 2.10), need to clear the throat ($p = 0.0006$; OR 3.23), difficulty in swallowing ($p = 0.0009$; OR 4.77), cough after eating ($p = 0.0400$; OR 1.98), breathing difficulties ($p < 0.0001$; OR 6.36), annoying cough ($p = 0.0029$; OR 3.17) and pharyngeal globe ($p = 0.0010$; OR 2.82). Postnasal drip was the only symptom manifested mostly in controls.

The RFS mean score was 7.45 that ranged from 0 to 19. The total score was greater or equal to 7 (95% certainty of having laryngopharyngeal reflux) in 40/74 (53%) cases and 30/102 (28.4%) controls, with a statistically significant difference between the two groups ($p = 0.0010$, OR = 2.82). Table 4 shows the frequencies of each endoscopic sign of LPR in both groups and the statistical differences. The most frequent sign in both groups was the subglottic edema or pseudosulcus; the posterior commissure hypertrophy

Table 3 Prevalence of each symptoms of Reflux Symptom Index (RSI) in the cases and controls groups and the results of the χ^2 test

RSI	Taxi drivers ($n=74$)	Controls ($n=102$)	p	OR
Hoarseness	44 (58.6%)	42 (41.2%)	0.0166	2.1
Need to clear the throat	59 (78.6%)	56 (54.9%)	0.0006	3.23
Postnasal drip	28 (37.3%)	54 (52.9%)	> 0.05	/
Difficulty swallowing	17 (22.6%)	6 (5.8%)	0.0009	4.77
Cough after eating	28 (37.3%)	24 (23.5%)	0.04	1.98
Breathing difficulties	26 (34.6%)	8 (7.8%)	< 0.0001	6.36
Annoying cough	22 (29%)	12 (11.7%)	0.0029	3.17
Globus	40 (53.3%)	30 (29.4%)	0.001	2.82
Heart burn	36 (48%)	46 (45%)	> 0.05	/
RSI ≥ 13	28 (37.3%)	14 (13.7%)	0.0015	3.14

p *p* values, *OR* odds ratio

Table 4 Prevalence of each sign of Reflux Finding Score (RFS) in the cases and controls groups and the results of the χ^2 test

RFS	Taxi drivers ($n=74$)	Controls ($n=102$)	p	OR
Subglottic edema	42 (56.0%)	48 (47.0%)	> 0.05	/
Partial or complete ventricular obliteration	35 (46.6%)	36 (35.3%)	> 0.05	/
Arytenoids or diffuse hyperemia	45 (60.0%)	36 (33.3%)	0.0008	2.84
Vocal fold edema	23 (30.6%)	24 (23.5%)	> 0.05	/
Diffuse laryngeal edema	34 (45.3%)	14 (13.7%)	< 0.0001	5.34
Posterior commissure hypertrophy	61 (81.3%)	42 (41.2%)	< 0.0001	6.7
Granuloma/granulation tissue	10 (13.3%)	3 (2.9%)	0.0081	5.16
Thick endolaryngeal mucus	43 (57.3%)	40 (39.2%)	0.0132	2.15
RFS ≥ 7	40 (53.3%)	30 (29.4%)	0.0010	2.82

p *p* value, OR odds ratio

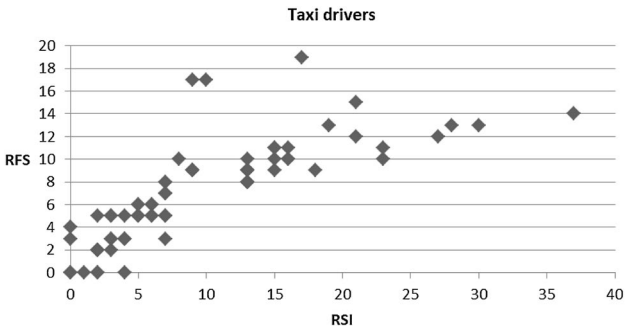

Fig. 1 Scatter plot showing the relationship between RSI (Reflux Symptom Index) and RFS (Reflux Finding Score) in taxi drivers group (Pearson's $r=0.78$)

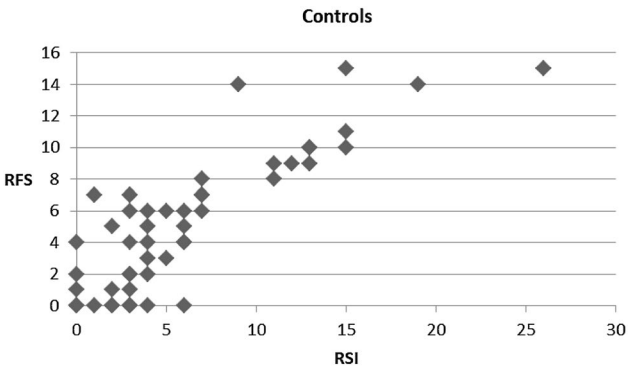

Fig. 2 Scatter plot showing the relationship between RSI (Reflux Symptom Index) and RFS (Reflux Finding Score) in controls group (Pearson's $r=0.83$)

was found in 95% of taxi drivers with RFS ≥ 7, representing the most specific sign of laryngopharyngeal reflux.

In both groups, the correlation between RSI and RFS was high. Pearson's r was 0.78 in taxi drivers' group (Fig. 1) and 0.83 in the control group (Fig. 2). In both groups, RSI showed a lower sensitivity to detect LPR compared to RFS (37.3% vs. 53% in taxi drivers group; 13.7% vs. 29.4% in control group).

In 6/74 taxi drivers (8%), 3 males and 3 females, we found leukoplakia of the vocal cords deserving control after one month of therapy with pump protonic inhibitors and folate. 5/6 (83.3%) were actual smokers and 1/6 (10.7%) were former smokers, with an average score of the Fagerstom test equal to 5, higher than the score (2.5) obtained from the remaining taxi drivers. 3/6 (50%) had RSI ≥ 13; 6/6 (100%) had RFS ≥ 7.

In 3/6 (4%) cases, leukoplakia completely regressed without the need of further diagnostic investigations. 3/6 cases (4%) with persistent leukoplakia underwent biopsy in microlaryngoscopy with histologic result of infiltrating squamous cell carcinoma in all cases. Cancers were all staged T1N0M0 basing on the 8th AJCC [22] and treated with surgery (two cases) or radiotherapy (one case). The cases affected by cancer were all males, who were actual smokers with a medium dependence on the Fagerstom test and daily habitual alcoholic consumers. All of them worked also at night and said that they smoked more cigarettes during the night; all of them had RFS ≥ 7, positive for chronic inflammation of the larynx, but only one of them had RSI ≥ 13. No suspicious lesions were found in the control group.

Discussion

Many studies in the literature evidenced an increased risk of developing various pathologies among taxi drivers [5–13] in relation to their irregular work shifts, inappropriate diet, drinking and smoking habit, and their exposure to gasoline and diesel engine exhaust fumes. Shetty et al. [14], in 2017, screened a total of 450 Indian cab drivers for oral cancer and found 48 precancerous lesions; they associated this data with the high tobacco consumption among drivers. Luo et al. [9] correlated the prevalence of finding peptic ulcer by electronic endoscopy among taxi drivers to dining time, taste spicy, meal temperature, smoking, alcohol, mental stress and HP infection.

Smoking habit has been shown to have a linear association with the development of laryngeal cancer with a risk of 10–15 times higher compared to non-smokers; heaviest smokers have as much as 30 times greater risk [23]. It has also been shown that alcohol and tobacco have a multiplicative effect on the risk of laryngeal cancer [24], followed by the exposure to several other environmental/occupational factors, such as asbestos, polycyclic aromatic hydrocarbons, and textile dust [25]. Chronic inflammation, with the regular alternation of tissue damage and repair phases, represents a mutagenic factor in the cancerogenesis of many tumours; a certain correlation with the inflammation induced by vocal abuse or laryngopharyngeal reflux (LPR) is currently debated [26, 27].

Although the high presence of LPR among patients is affected by laryngeal carcinoma (between 68 and 87% in the world literature) [28], the complex multi-factoriality of neoplastic transformation does not yet permit to establish a causal relationship between cancer and reflux. In an objective way, through the use of 4 h multi-electrode pH-metry, Galli et al. [25] proved a strict correlation between the presence of proximal and distal oesophageal reflux and laryngeal precancerous lesions or squamous cell carcinoma.

The identification of occupations, at risk of developing chronic inflammation of the larynx or precancerous lesions/squamous laryngeal carcinoma, is essential to consider the possibility of screening campaigns to identify cancers earlier or to prevent the transformation of suspicious lesions. Videolaryngoscopy (VLS) has been recommended for routine screening of laryngeal pathologies [29], being an ambulatory painless and rapid examination, minimally invasive, which allows the visualization of specific regions of the larynx and data preservation. In our sample, we used the Reflux Symptom Index (RSI) [20] and the Reflux Finding Score (RFS) [21] as easy tools to categorize laryngeal symptoms and the chronic inflammation signs.

Taxi drivers showed hoarseness, need to clear the throat, difficulty in swallowing, breathing difficulties, annoying cough and pharyngeal globe in a significantly higher percentage ($p < 0.05$) than the controls; 37% of them had a total score greater or equal to 13, indicative of significant reflux disease. The two groups showed, with the videolarygoscopic examination, a statistically significant difference ($p < 0.05$) in the finding of arytenoids or diffuse hyperaemia, diffuse laryngeal edema, posterior commissure hypertrophy, granuloma/granulation tissue and thick endolaryngeal mucus; 53.3% of them totalized a score greater or equal to 7 (95% certainty of having laryngopharyngeal reflux). Both the use of RSI and the RFS showed, respectively, a greater presence of symptoms ($p = 0.0015$; OR = 3.14) and endoscopic signs ($p = 0.0025$, OR = 2.7) of chronic inflammation of the larynx among taxi drivers compared to controls. In both groups, the percentage of subjects, affected by LPR and detected with RSI, was lower than those resulted from the use of RFS (37.3% vs. 53% in taxi driver group; 13.7% vs. 29.4% in control group). It is probably due to the clinical features of the LPR, which sometimes present very mild symptoms, and the fact that evidently many of the subjects involved underestimated their laryngeal symptoms because of their chronic condition and the habit of living with them. This datum allows us to confirm the importance of the screening method by means of videolaryngoscopy in some professional categories.

We cannot relate our findings to smoking habit since the two groups did not differ in dependence on cigarette smoking or coffee and alcohol consumption. In our opinion, the increased risk of laryngeal inflammation among taxi drivers is closely related to their occupation with high exposure to air pollution and exhaust gases or to their inadequate diet, thereby facilitating LPR among this professional category. Six (8%) of them showed, with an endoscopic examination suspicious lesions (leukoplakia) of the vocal cords, a high percentage considering that the annual incidence of leukoplakia in the United States is 10.2 and 2.1 lesions per 100,000, males and females, respectively [30, 31]. We retain that, on a substrate of

chronic inflammation related to the occupational exposure, cigarette smoking remains the determining factor for the onset of precancerous lesions of the vocal cords. In our sample, 50% of the leukoplakias completely regressed after medical therapy and abstention from cigarette smoking, but 50% turned out to be infiltrating squamous cell carcinoma after biopsy with an incidence of laryngeal malignancy in our sample of 4%. In all the three cases, this study allowed us to diagnose cancer at an early stage (T1N0M0) [22].

We retain that the main limit of this study is represented by the size of the sample, too small to establish a causal relationship between the high risk of LPR among taxi drivers and laryngeal cancer. It needs to be enlarged in the future to evaluate the feasibility of screening campaigns among taxi drivers and possibly other categories of drivers exposed to similar risk factors; other studies are needed for this purpose. Nevertheless, reflux is a chronic condition worthy of strict follow-up, and videolaryngoscopy is a simple and quick means for this purpose.

Conclusion

Taxi drivers resulted at risk of suffering from symptoms of laryngeal chronic inflammation due to laryngopharyngeal reflux ($p = 0.0015$; OR = 3.14) and of finding the endoscopic signs of this condition ($p = 0.0010$, OR = 2.82). They also presented high-prevalence precancerous lesions of the vocal cords (8%) and laryngeal infiltrating squamous cell carcinoma (4%), probably attributable to their environmental exposition to traffic pollutants.

Laryngeal examination with videolaryngoscopy resulted useful to visualize signs of chronic inflammation, especially in asymptomatic subjects and to diagnose laryngeal cancer at an early stage.

Funding No funds received.

Compliance with ethical standards

Conflict of interest We have not received any funds from any kind of organization; the study is entirely the result of our work. We deny any kind of conflict of interest.

Research involving human participants and/or animals This is not an experimental study; it was based on the analysis of data from medical records of patients referring to the Phoniatric Service of our Institution.

Informed consent Informed consent was obtained by patients at the time of their visit.

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