

# Health surveillance in truck drivers: results of the study “Occupational health and safety of road haulage company employees”

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**KEY WORDS:** Truck driver; fitness to work; workplace health promotion; occupational disease

**PAROLE CHIAVE:** Autista di camion; idoneità lavorativa; promozione della salute negli ambienti di lavoro; patologia lavoro-correlata

## SUMMARY

**Background:** *This paper follows up on a project that was launched in 2008 and contributed to the development of the new Italian Society of Occupational Medicine (SIML) guidelines for the road haulage industry. Objective:* Our final objective is - through the collection and analysis of bio-statistical data - to reach a better understanding of occupational illness amongst truck drivers, in order to define appropriate health monitoring protocols and promote a healthy life-style. **Methods:** *We assessed 673 drivers (mean age 43.85 years, SD 9.56; mean working seniority 27.28 years, SD 10.59), employed by 46 different companies, all of whom were male. The drivers, who were gradually recruited in the study over the years, had a maximum of 8 re-assessments each, for a total of 2608 examinations. We applied a survey protocol consisting in a medical examination, questionnaires for the most common risks and instrumental and laboratory tests in compliance with SIML guidelines. Results:* We identified a total of 44 work-related diseases: 22 cases of noise-induced hearing loss (NIHL) and 22 cases of lumbar degenerative disc disease. As regards metabolic disorders, we observed 28 cases of diabetes mellitus, in most cases (71.4%) as a first diagnosis or under poor therapeutic control. We observed poorly-controlled hypertension in 103 drivers, the majority of whom (54%) were diagnosed for the first time. Over 30% of the workers in our study were obese. Approximately 40% of the sample were tobacco smokers. We identified just 9 individuals (1.3%) with a positive toxicological screening for use of recreational drugs. Our data confirm a high prevalence of occupational illness amongst truck drivers. Cardiovascular and metabolic conditions require close monitoring.

## RIASSUNTO

«**La sorveglianza sanitaria degli autisti di mezzi pesanti: risultati del progetto-studio “Tutela della salute e della sicurezza dei lavoratori dipendenti di società di autotrasporti”.** **Introduzione:** Questo documento segue un progetto iniziato nel 2008 ed è stato parte integrante per lo sviluppo delle nuove linee guida per il settore dei trasporti stradali della Società Italiana di Medicina del Lavoro (SIML). **Obiettivo:** Il nostro obiettivo finale è, attraverso la raccolta e l'analisi di dati biostatistici, raggiungere una migliore comprensione delle malattie lavoro-correlate per i conducenti di camion e definire di conseguenza protocolli di sorveglianza sanitaria appropriati, promuovendo al contempo l'applicazione di stili di vita sani. **Metodi:** Abbiamo valutato 673 autisti (età media 43,85 anni, SD

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9,56, anzianità lavorativa media 27,28 anni, SD 10, 59), impiegati in 46 diverse aziende, tutti di sesso maschile. Gli autisti, gradualmente reclutati nello studio nel corso degli anni, sono stati sottoposti sino ad un massimo di 8 rivalutazioni ciascuno, per un totale di 2608 visite. Abbiamo applicato un protocollo di sorveglianza comprendente un esame medico, questionari per i principali rischi e test strumentali e di laboratorio secondo le linee guida di SIML. **Risultati:** Abbiamo trovato complessivamente 44 malattie a nostro giudizio correlate al lavoro: 22 casi di ipoacusia da trauma acustico cronico e 22 casi di malattia degenerativa del disco lombosacrale. Per quanto riguarda i disturbi metabolici, abbiamo osservato 28 casi di diabete mellito, in prevalenza (71,4%) come prima diagnosi o non adeguatamente compensati. Abbiamo osservato ipertensione non controllata in 103 conducenti, la maggioranza dei quali (54%) è risultata di prima diagnosi. Oltre il 30% dei lavoratori del nostro studio erano obesi. I fumatori rappresentavano circa il 40% del nostro campione. Sono stati individuati 9 lavoratori (1,3%) positivi al test tossicologico di screening per sostanze stupefacenti. I dati confermano l'elevata prevalenza di patologie lavoro-correlate nel settore e l'importanza di monitorare le patologie cardiovascolari e del metabolismo.

## INTRODUCTION

Professional truck drivers need to maintain their mental and physical health, in order to perform their duties safely and without risks to themselves or others (11). As in other industries with a high risk of occupational injuries, such as construction or agriculture, it is possible that pharmacological treatments or undiagnosed or poorly-controlled medical conditions could contribute to an increased risk of occupational injuries for drivers, in particular from road traffic accidents (RTAs) (5, 9, 21).

The range of such medical conditions representing a relative or absolute contraindication to work for truck drivers is diverse, including (5): cardiovascular disease (7, 24), diabetes mellitus (30), central nervous system diseases, sleep disorders (4, 14, 15, 25, 34, 37, 39, 41), sight and hearing impairment, etc. Alcohol use disorders, drug abuse, drug addiction (3, 6, 9, 18, 20, 23, 28, 29) and long-haul driver fatigue (1, 2, 22) are, therefore, not the only conditions to be considered when addressing the occupational safety and health of truck drivers, despite being undoubtedly the most extensively studied and monitored.

In this paper, we do not take into account certain environmental risk factors that could be important for these workers. Truck drivers are consistently found to have a higher incidence of and mortality from lung cancer than controls (10, 22, 26). Some studies consider the occupational exposure to diesel exhaust fumes to be the main cause (26), and this

kind of exposure is also thought to be the cause of an increased risk of bladder cancer (8, 17, 31).

In their retrospective cohort study, Garshick et al measured exposure to vehicle exhaust fumes (21), and found an increased risk of mortality from lung cancer amongst haulage workers with regular exposure to vehicle exhaust fumes. Furthermore, local drivers were seen to have greater exposure to dust than long-distance drivers, who showed no difference compared to a control group (40). This finding was explained by the fact that local drivers spend more time in polluted environments. Unfortunately, literature does not allow for firm conclusions regarding chemical hazards, since exposure assessment in most epidemiological studies on, for instance, occupational cancer, is based on job title rather than actual exposure measurements (13).

In 2008, in view also of the new Italian occupational health and safety law (according to which mandatory toxicological screenings were required) the Department of Occupational Medicine at Ospedale Papa Giovanni XXIII in Bergamo designed a study to identify the health and safety issues of haulage company employees, with the support of EBITRAL, Italy's main advisory body for this sector. We collected a large sample of biostatistical data and analysed the prevalence and incidence of occupational diseases and their influence on the employees' fitness for work, in order to formulate a new occupational health protocol for this industry.

Indeed, our survey made a significant contribution to the development of the new Italian Society

of Occupational Medicine (SIML) guidelines for this industry (13).

In this paper, we present the results of the biostatistical data we have collected thus far.

## METHODS

For every driver enrolled in our descriptive cohort study, we followed an occupational health protocol based on the guidelines of the Italian Society of Occupational Medicine, which we helped revise with our previous experimental work (13).

During the initial assessment, every driver had to provide a full medical history, placing particular emphasis on musculoskeletal disorders (MSDs), sleep disorders, hearing and lifestyle resulting in higher level of risk factors.

We performed a full physical exam, an electrocardiogram (ECG), a pure tone audiometry test and a visual test with a digital vision screener.

With a blood test, we measured the complete blood count (CBC), aspartate aminotransferase (AST), alanine aminotransferase (ALT), Gamma-glutamyltransferase (GGT), cholesterol levels, (total, low-density lipoprotein [LDL] and high-density lipoprotein [HDL]), triglycerides, serum creatinine and blood glucose.

Chemical and physical and microscopic urine analysis (urinalysis) and urine flow cytometry were performed. Toxicological screening for recreational drugs was performed, on the urine sample by on-site immunochemical assay.

When screening was positive, we requested a confirmatory analysis by liquid chromatography–mass spectrometry (LC-MS) in an accredited laboratory.

We screened for the following substances (directly or through secondary metabolites): cocaine (COC), opiates (OPI), amphetamines and methamphetamines (MAMP), 3,4-methylenedioxym-

ethamphetamine (MDMA), buprenorphine (BUP) and delta-9-tetrahydrocannabinol (THC).

By analysing the risk evaluation and assessment documentation for these companies and through our surveillance work, in some cases we identified a possible chemical risk: animal feed from recycled livestock, powder or liquid chemicals and livestock can have an irritating or sensitizing effect on the driver's respiratory system. Therefore, in these cases, we implemented our protocol with respiratory function tests.

We considered the importance of sleep disorders due to their role in road accidents (4, 14,15, 25, 34, 37) exposure to whole-body vibration, prolonged sitting in the same position, the fact that many drivers are involved in loading and unloading and potential addiction to substances. We therefore complemented the clinical history with questionnaires to obtain a better understanding of musculoskeletal problems, substance and alcohol use, sleep disorders and daytime drowsiness. Some questionnaires were already widely used (CAGE and Epworth) (19, 27) and in some cases we designed our own questionnaires for the purpose.

We assessed 673 drivers, working for 46 different companies, who took part to our research voluntarily. All subjects were male. Table 1 summarizes their demographic characteristics (at the final visit).

The companies involved in this project were very diverse with regard to the type of goods transported (food and beverages, vehicles, powdered material, livestock and mixed cargo), and therefore also with regard to the distances travelled (from a few kilometres to international drives). As a consequence, the exposure to particular risk factors (noise, vibrations, etc.), based on the measurements made by each company was not homogenous.

The drivers, who were recruited in the study gradually over 8 years, attended up to 8 annual re-as-

**Table 1** - Personal characteristics of the 673 truck drivers, all of them male, involved in the survey

Job	Number of workers	Mean age (SD)	Mean work seniority (SD)	Mean truck driver seniority (SD)
Truck drivers	673	43,85 (9,56)	7,28 (10,59)	18,53 (10,78)

assessments each, for a total of 2608 examinations. As regards frequency, the examinations were performed in compliance with the abovementioned Italian Society of Occupational Medicine (SIML) guidelines.

## RESULTS

Of a total of 2608 medical examinations conducted using our standard protocol, 218 (8.4%) led to the need for further investigation for the assessment of fitness to work or in order to diagnose a possible occupational condition. We carried out a total of 306 further medical tests on 168 workers.

A diverse range of medical tests was performed: 52.9% involved the cardiovascular system (24-hour Holter ECG monitoring, blood pressure monitoring, cardiology consultation with echocardiogram, ergometric stress test or spiro-ergometric test, myocardial perfusion scintigraphy); investigation of type 2 diabetes mellitus (fasting blood glucose, glycated hemoglobin, diabetologist consultation) accounted for 31.4% of the tests performed; the remaining investigations concerned eye problems (7.9%), musculoskeletal disorders (4.3%) or sleep disorders, liver

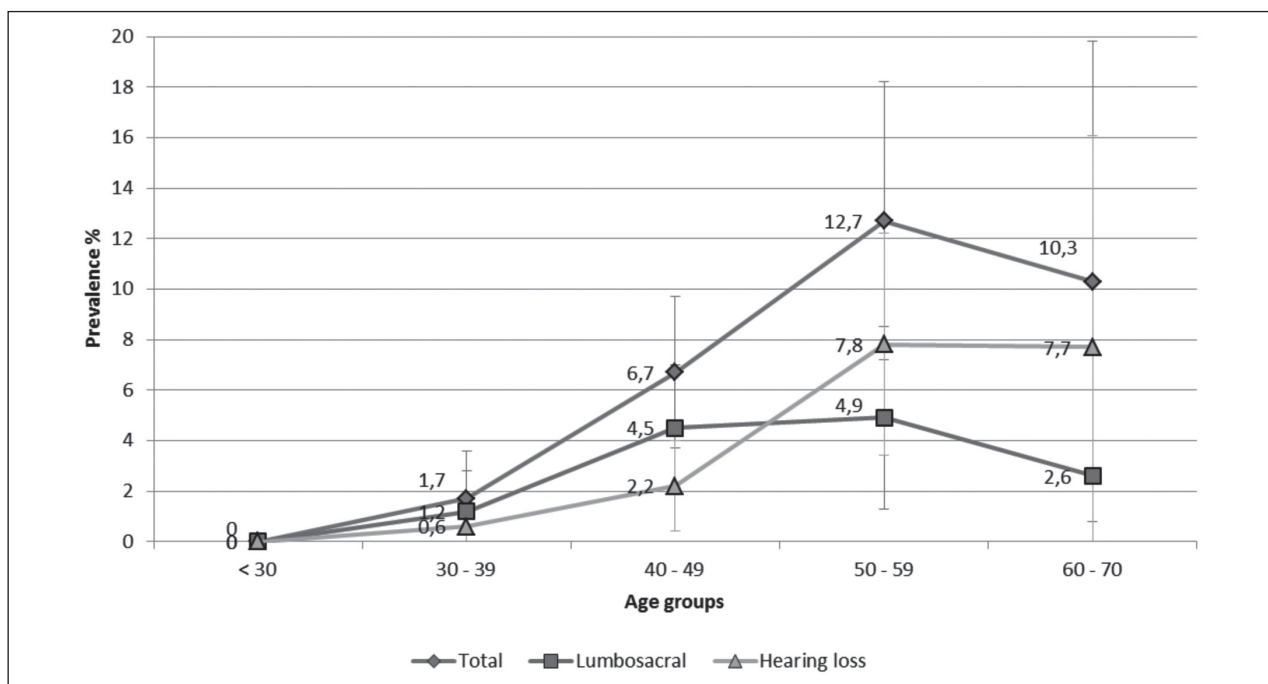
disease, hematologic conditions, neurological and psychiatric disorders, which combined represented 3.9% of our investigations.

Amongst the workers enrolled in our study, including those subject to health monitoring in the past, none had a documented diagnosis of an occupational condition. In all, we identified 44 diseases we believe to be related to specific occupational risk factors, for all of which we provided the relevant authorities with a medical report, an occupational disease report and a first medical certificate.

The prevalence of occupational illness was 6.5%. Figure 1 shows the overall prevalence broken down according to age bracket; the Confidence Interval (95% CI) was defined in this and the following cases by applying the formula  $\pm 1.96 \cdot \sqrt{P \cdot (1-P) / N}$ .

More specifically, we referred to the relevant authorities 22 cases of noise-induced hearing loss (NIHL) and 22 cases of degenerative disc disease in the lumbosacral spine, often associated with spinal disc herniation.

When referring a worker with NIHL, we used the medicolegal criteria defined by Marengo et al (32) In the referred cases, in the presence of a specific audio-



**Figure 1** - Prevalence in the different age groups of the work-related disease (total, lumbosacral and hearing loss)

gram, we were able to trace back through the driver's medical history to previous professional exposure to noise with significant duration and intensity. In the driving of heavy goods vehicles, which once lacked the soundproofing and frequent maintenance they have now, noise exposure almost always originated from the use of noisy devices (e.g. air compressors) and/or loading and unloading activities in environments with high noise levels. On a worldwide level, the provision and use of personal protection equipment is a relatively recent practice and, moreover, it is not homogeneously implemented. We also considered potential exposure to wind turbulence noise due to the habit of driving with the windows down, which often dates back to before air conditioning was widespread, but is still common practice today.

As far as lumbosacral disc disease is concerned, we considered whether there had been exposure, with significant duration and intensity, to occupational risk factors, for example, manual handling of loads. We did not take into account physiological age-related spinal changes, or alterations due to accidents or congenital deformities. We were able to collect very little information on previous exposure to vi-

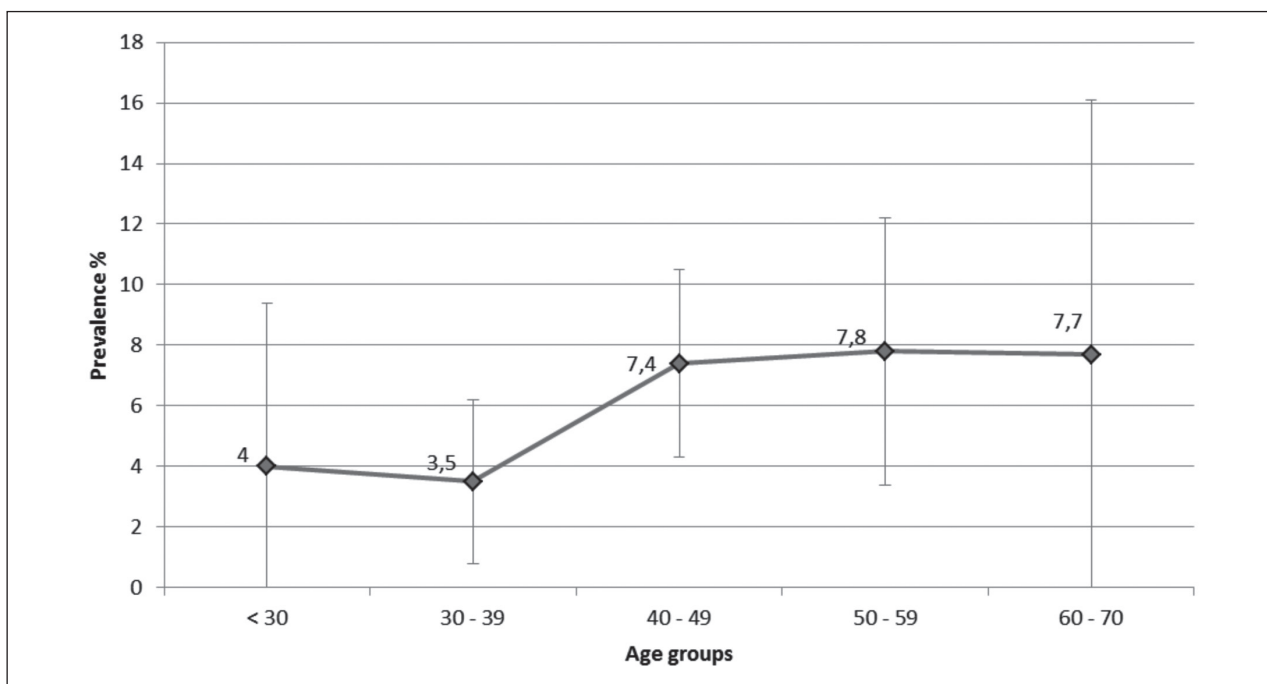
brations, because the only available data were recent and in just a very few cases were slightly above the "action level" for hand-arm and whole-body vibration; therefore, we considered exposure to vibration as a complementary risk factor when the driver had been working in the sector for at least 10 years.

Figure 1 shows also the prevalence of occupational spinal disease broken down by age bracket and, similarly, the prevalence of NIHL.

Considering also drivers with no fully documented occupational risk factors for lumbosacral disorders, a total of 42 drivers had a MRI scan allowing diagnosis of lumbosacral disc herniation. Prevalence broken down by age bracket is shown in figure 2.

As regards metabolic disorders, we observed 28 cases of diabetes mellitus, most of which (71.4%) were a first diagnosis or previously-diagnosed diabetes that was not satisfactorily controlled. In one recent study, we recorded a standardized prevalence ratio for diabetes mellitus amongst drivers of 2.13 (95% CI 1.29 to 2.96) in individuals aged 35 to 59 (37).

We found 103 cases of poorly-controlled high blood pressure (hypertension), most of which (54%)



**Figure 2** - Prevalence in the different age groups of lumbosacral disc herniation

were diagnosed for the first time. The median Body Mass Index (BMI) of our population was 28 Kg/m<sup>2</sup>; 175 individuals or 26% had a BMI over 30 Kg/m<sup>2</sup>, 36 individuals or 5.4% a BMI over 35 Kg/m<sup>2</sup> and 9 individuals or 1.3% over 40 Kg/m<sup>2</sup>.

In our investigation regarding sleep disorders, a thorough medical history focused on the quality of sleep and a physical exam (including an examination of neck, trunk, throat, etc.) proved to be more effective than the Epworth Sleepiness Scale (ESS) in identifying individuals at risk of Obstruction Sleep Apnea Syndrome (OSAS), in our experience. Indeed, no driver in our study had an ESS questionnaire score of over 10; therefore, we took the score into account as a complement to the medical history and physical examination. Nonetheless, in many cases, the ESS score proved to be a hindrance in the diagnosis of OSAS, because drivers with normal results were not keen to undertake further diagnostic tests. For this reason, second-tier testing after a working hypothesis of OSAS was not always feasible, and ultimately a total of 6 individuals were diagnosed with OSAS and subsequently prescribed treatment.

The prevalence of tobacco consumption in our study was 40.1%, of which 54% (or 21.7% of the total) said they smoked an average of at least 20 cigarettes a day; 27.6% of drivers said they were ex-smokers and 32.3% said they had never smoked.

We identified 9 individuals (1.3% of study population) with a positive toxicological screening for abuse substances, which was subsequently confirmed by liquid chromatography-mass spectrometry (LC-MS). Specifically, we found 5 positive tests for COC, 3 for THC, and 1 for MTD. None of the screened subjects tested positive for multiple substances. Finally, we established a diagnosis of substance addiction for just 1 worker; however, we must point out that, although we referred all 9 workers to a specific substance abuse counselling service (SERT) for further investigations, 4 of them refused to undertake second-level tests and quit their job.

Table 2 and table 3 provide a summary of the medical history and the questionnaires regarding the consumption of substances and alcohol.

As regards the drivers' fitness for duty, having excluded preliminary diagnoses awaiting a definitive diagnosis or the outcomes of particular clinical situ-

**Table 2** - Recreational drug use (anamnestic data)

Drug Use	n (%)	Mean Age** (SD)	Mean Time of use** (SD)	Mean time of abstinence* (SD)	Way of use		Substance the worker admitted to use*				
					Occasional	Abuse/ Addiction	COC	THC	AMP	MDMA	OPI
Never	568 (84.4)	44.4 (9.7)	-	-	-	-	-	-	-	-	-
Yes	105 (15.6)	40.8 (8.4)	5.2(5.4)	16.1(9.6)	93	12	29	89	3	2	4

\* Some individuals take more than one simultaneously

\*\* Expressed in years

**Table 3** - Alcohol consumption, (anamnestic data)

Alcohol consumption	n (%)	Mean age**(SD)	Frequent consumptions of liquors (%)
Non-drinker	291 (43.3)	43.7 (10.1)	-
Occasional drinker	149 (22.1)	41.6 (8.3)	-
Frequent drinker*	≤ 3 AU/die	224 (33.3)	9
	> 3 AU/die	9 (1.3)	1

\* An Alcohol Unit (AU) represents 10 ml or 8 grams of ethanol, a quantity approximately contained in a beer can (330 ml), a glass of wine (125 ml), or a small glass of liquor (40 ml), at the usual pure alcohol concentrations for these drinks.

\*\* Expressed in years

ations, we ultimately assessed: 594 workers as being fit for work or fit for work with medical prescriptions (88.3% of the study population), 71 as being fit for work with limitations (10.5%) and 8 as being unfit for work (1.2% of the study population).

Figure 3 shows the percentage of individuals with limitations according to age bracket.

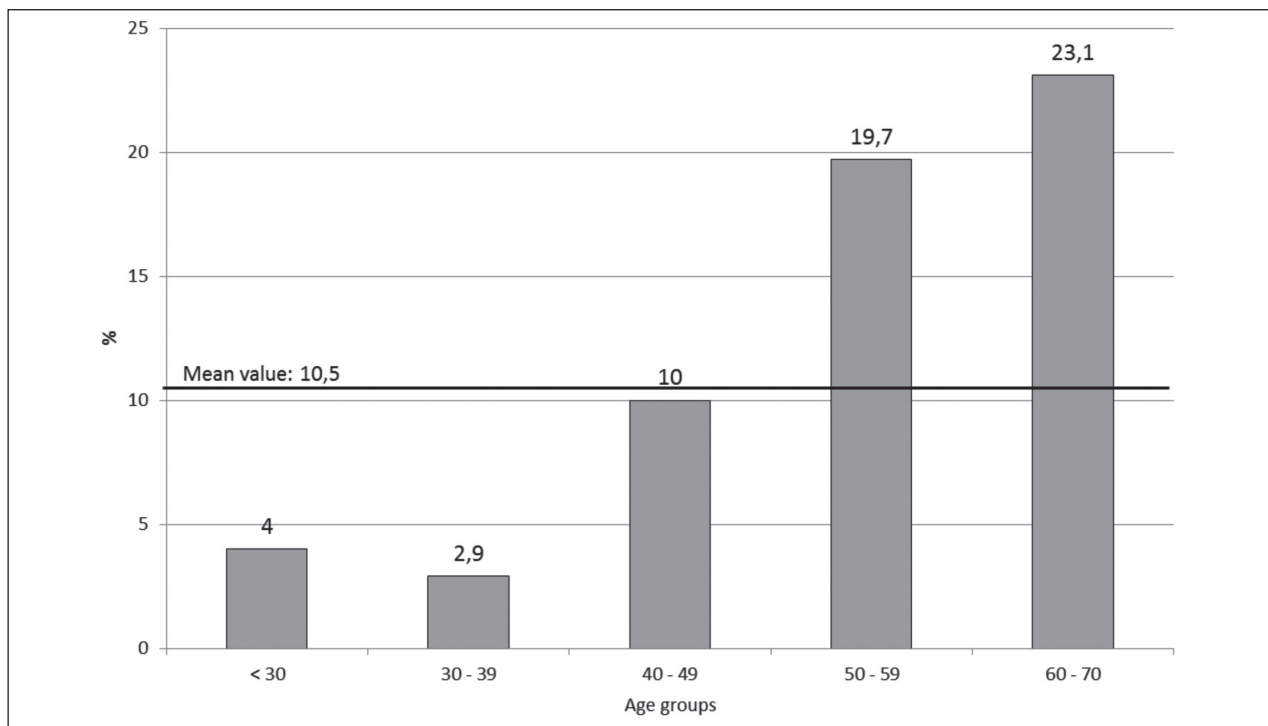
Figure 4 refers to the most common conditions observed amongst individuals who were deemed to be fit for work with limitations and the occurrence of the same conditions amongst individuals judged to be fit for work without limitations.

The reasons for judging an individual to be unfit for work in our assessments were: in 4 cases, positive toxicological screening for recreational drugs. As mentioned above, these workers decided of their own accord to quit their job and did not undertake any second-level tests, making it impossible to reassess their fitness for work after a therapeutic or monitoring process; in 2 cases, the presence of sight impairment which, even after correction, did not allow the individual to achieve sufficient visual acuity for the specific driving licenses required; in 1 case,

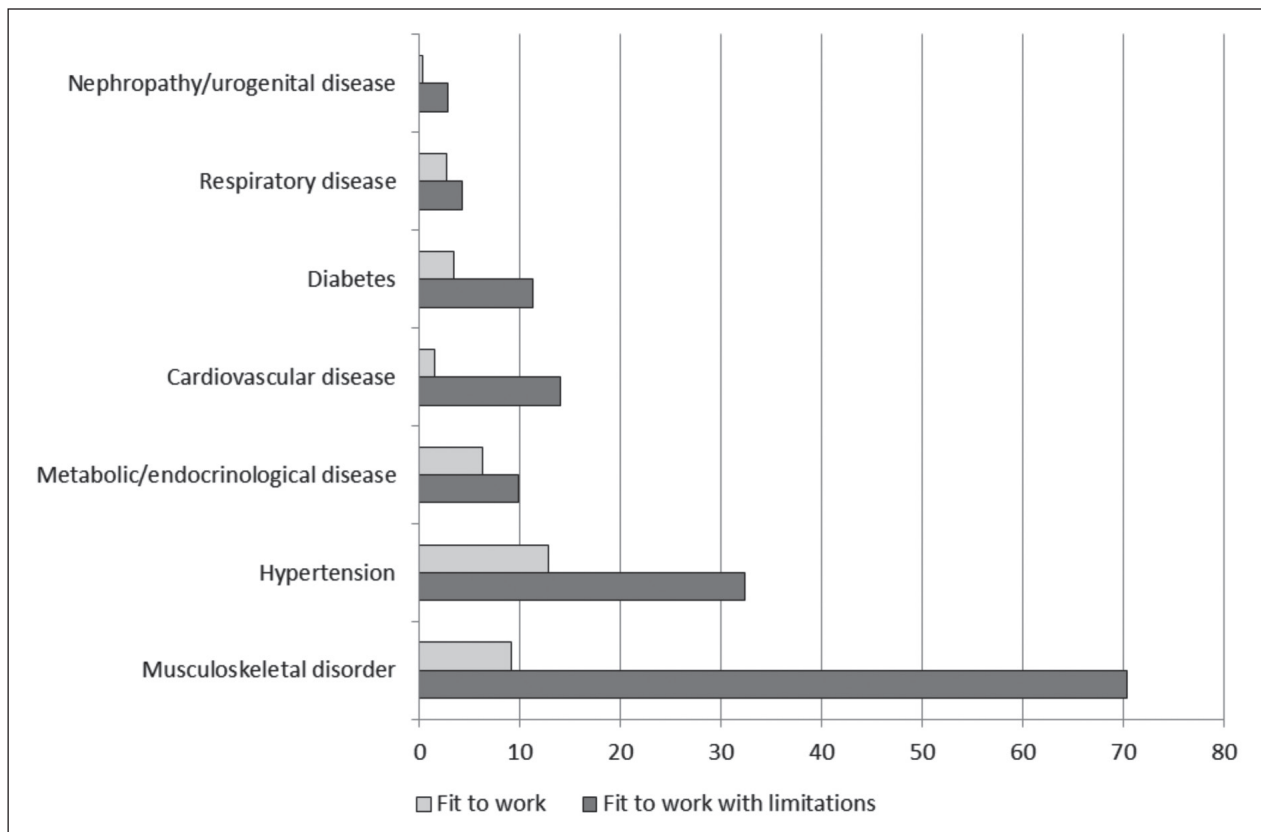
a blood disorder for which the driver refused further investigation or treatment (more specifically, he refused to have a blood transfusion); in 1 case, for concomitant cardiovascular and metabolic conditions and vision impairment, which, combined, made it impossible to guarantee that the driver was fit for duty.

## DISCUSSION

The health protocol we applied in our study, as validated previously by the guidelines issued by the Italian Society of Occupational Medicine (SIML), proved, in our opinion, to be effective for the purposes set. We consider the high number of second-level tests we had to perform as reliable proof of its efficacy. The outcomes of the clinical examination, medical history, laboratory tests and diagnostic procedures provided for by our protocol proved to be highly sensitive in identifying those health issues associated with specific occupational risk factors, and with the potential of impairing the individual's fitness for work.



**Figure 3** - Percentage of workers in the different age groups who were considered fit-for-work with limitations



**Figure 4** - Health conditions in drivers without work limitations vs drivers with work limitations

Cardiovascular and metabolic disorders (especially diabetes mellitus) were the most common conditions, and were often poorly controlled by treatment or had not yet been diagnosed. In our opinion, the importance of an early diagnosis of any chronic or degenerative disease, besides the potential impact on driving safety, also lies in the ability to maintain, in the long term, fitness to work, which, without early intervention would inevitably deteriorate, with serious health and economic repercussions for the worker. We consider the long-term maintenance of the ability to work an extremely important issue in our field, because of both the epidemiological transition (increased life expectancy of the working population), and the scope of practice of occupational physicians, who in our opinion will be increasingly called on to pursue long-term objectives.

The paucity of second-level testing involving the musculoskeletal system is not surprising: musculo-

skeletal syndromes, particularly when they affect the lumbosacral region of the spine, are typically symptomatic at an early stage and can be debilitating (33), meaning that, in most cases, workers consult their general practitioner or a specialist, undertake diagnostic procedures and before long are provided with a clear diagnosis. Spinal disorders, therefore, have both a high prevalence and an important effect on the fitness for work, but, at the same time, are the only conditions that have usually already been well investigated. One possible shortcoming in this respect is a failure to inform the relevant authorities of an occupational condition, probably due to an underestimation of its occupational origin and repercussions, by the clinicians who diagnosed and treated it.

In our study, we found a high prevalence of work-related noise-induced hearing loss and lumbosacral disc disease, particularly in the 40- to 59- years age



group. Amongst the older individuals, we observed a non-statistically significant apparent decrease in work-related conditions, which can be explained by the well-known healthy worker effect and by the fact that it is more difficult to associate with the workplace a late diagnosis of a condition that can be caused in part by physiological ageing and in part by certain occupational risk factors, to which the worker was often exposed a long time beforehand. Moreover, our sample of older workers is too small to be significant. In our study, we identified a relative small number of people with OSAS. It is worth noting that this could be due to the inadequacy of clear tests to be used to identify it, such as those that exist for other conditions.

We were able to recruit a larger number of workers than in our first study of this kind. Nevertheless, we believe that studies with even larger samples are warranted in order to validate the efficacy of this method.

As in our previous works (35, 36) we would like to stress the high prevalence of diabetes mellitus and hypertension (which are often misdiagnosed or poorly controlled by therapy), together with the high prevalence of obesity and tobacco smoking, compared to the general population. We are all well aware of the impact these conditions and the associated metabolic syndrome have on our ageing population, as regards both quality of life and the costs in terms of productivity. Occupational doctors can play an important role with active health surveillance and also through programs of Workplace Health Promotion (WHP) (12, 36). The WHO recognizes the concept of WHP as increasingly relevant in a globalizing marketplace, as the development of WHP will be a pre-requisite for sustainable social and economic development.

Occupational physicians, while focusing on employees' work-specific conditions, may overlook the bigger picture: conditions such as hypertension, diabetes, overweight and the associated metabolic syndrome have the potential, when they go unchecked, to severely impair in an individual health as well as his fitness to work.

NO POTENTIAL CONFLICT OF INTEREST RELEVANT TO THIS ARTICLE WAS REPORTED BY THE AUTHORS

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