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Abstract

Objective: The aim of this study is to detect the main individual and transportation factors associated with obesity and its prevalence among Italian professional drivers (PDs).

Methods: We performed a cross-sectional questionnaire survey. Data from PDs (*n* = 497) were used for analyses.

Results: Sixty-one percent of participants were either overweight or obese according to their Body Mass Index. Predictive factors for obesity were travelling more than 40,000 miles per year (odds ratio (OR) 4.20, confidence interval (CI) 1.41-12.56) and hours spent behind the wheel per day (OR 1.27, CI 1.02-1.58). Bus drivers had half the risk of being obese compared to truck drivers (OR 0.45, CI 0.23-0.87). An inverse association was detected between educational attainment and obesity (OR 0.32, CI 0.11-0.90).

Conclusions: PDs with high number of driving hours per day, miles driven per year and low educational level should be subject to special educational programmes to reduce and prevent obesity.

Keywords: obesity, professional drivers, driver health, risk factors.

INTRODUCTION

In recent years, the prevalence of obesity in adults has undergone a dramatic increase in developed countries along with chronic conditions that are associated with higher mortality, morbidity and absenteeism rates (Schmier et al., 2006). A high prevalence of overweight and obesity has been observed especially among Professional Drivers (PDs) (Anderson et al., 2012; Moreno et al., 2006). The primary reasons for this are the hours spent sitting in a cab, along with poor food choices (Bigert et al., 2003) but several other factors have been associated with overweight and obesity among PDs (lack of physical activity, varying driving shifts, etc.). Obesity is also considered an important public health problem because it is associated with obstructive sleep apnea (OSA), diabetes and hypertension (NIH report, 1998). In particular, OSA is the cause of frequent awakening at night and, hence, sleepiness during the day. For these reasons sleepiness and obesity are considered important risk factors for traffic accidents among PDs (Rosso et al., 2007). An Israeli study stressed the fact that self-reported fatigue and falling asleep at the wheel occurred frequently in PDs who do not experience problems in sleep quality, pointing to the importance of long working hours and poor working conditions (Sabbagh-Ehrlich et al., 2005). Indeed, sleepiness at the wheel is a major contributing factor to the occurrence of near-miss or actual accidents (Sagaspe et al., 2010).

Thus, the prevention of obesity among PDs should be a priority. It is likely that the hours driven per day and miles driven per year are in some way closely related to the ability to perform physical activity and may also affect the diet of the driver. Moreover, seniority may be associated with BMI and obesity. The possible explanation is that long tenure as a professional driver might lead to sedentary behaviour, lack of exercise and poor diet, which contribute to the risk of obesity. Increased alcohol consumption and body mass index associated with increased years of driving among transit vehicle operators were suggested as possible causes of this increased hypertension (Ragland et al., 1997). It is also possible that an increased risk of hypertension and obesity is related to the stress of driving long hours.

The purpose of this study is to investigate the most important factors that lead to obesity among PDs. The data used are taken from the High Risk Professional Driver (HiRis PD) study, and was collected through anonymous questionnaires administered in a context totally unrelated to the usual inspections carried out by the Occupational Health Physician (OHP) or by inspectors (health officers, police officers, etc.). The HiRis PD study investigated the characteristics of PDs who are at high risk of accidents through a questionnaire (for the assessment of sleepiness, cell phone use, etc.) and a measurement of their reaction times in different situations. Some of these data have been published (Rosso et al., 2013) and some are under consideration for publication or in the elaboration phase.

The main study hypotheses that we tested were: 1) the presence of a direct correlation between BMI increase and PDs' years of driving, mileage and hours of work and 2) the existence of differences in BMI and obesity between truck drivers and bus drivers.

In this regard, studies in recent decades have demonstrated that PDs are at greater risk of diseases related to excess caloric intake and sedentary behaviour (Cavagioni et al., 2010). Hannerz and Tüchsen found that bus drivers tend to have higher standardised hospital admission ratios for circulatory diseases than truck drivers. They also found a significant excess risk of cerebrovascular disease (CVD), one of the reasons probably being that the stress of driving long hours increases the risk of hypertension and obesity (Hannerz et al., 2001). Drawing from these studies, we hypothesize that bus drivers might have higher BMI or a greater prevalence of obesity than truck drivers.

MATERIALS AND METHODS

Study design

From October 1, 2012 to May 31, 2013 we conducted a survey using a self-administered and anonymous questionnaire during Certificate of Professional Competence (CPC) courses for professional truck and bus drivers. Study participants were recruited on a voluntary basis from driving schools and associations across six towns in the province of Cuneo (an area of the Piedmont

region in northern Italy). The main purpose of CPC training is to set and maintain high safety and driving standards among PDs (drivers of trucks and/or buses) across Europe. CPC training applies to all Italian PDs whether they are full-time or part-time and whether they drive on public or private roads. CPC compliance is necessary in order to drive professionally but failure to complete the course does not lead to driving licence suspension.

PDs were asked to fill in a questionnaire, which included a list of questions regarding the following information: 1) PDs' characteristics (7 questions about age, years of service, educational level, pharmacological treatment declared, smoking habits, coffee consumption and BMI); 2) job characteristics (6 questions regarding the size and location of the company, type of routes travelled, type of transport, mileage per year and hours of work per day); 3) PDs' experiences and behaviours at the wheel (10 questions aimed at investigating accidents and near misses, eating habits and alcoholic beverage consumption on the job, the experience of falling asleep at the wheel, the use of cell phones or other sources of distraction while driving and two validated questionnaires, the Audit C and the Chalder Fatigue questionnaire (Chalder et al., 1993)). The years of service referred to the number of years that the subject had been a professional driver. The hours spent behind the wheel were estimated as the mean number of working hours per day during the past year.

We used the BMI as a surrogate measure of body fat. Body Mass Index (BMI) was calculated as weight divided by height squared and expressed as kg/m^2 (height and weight were self-reported). According to the standards established by the World Health Organization, a BMI of 30 kg/m^2 or greater signifies obesity (WHO, 2000). Overweight was defined by a BMI ranging between 25 kg/m^2 and 29.9 kg/m^2.

The questionnaire also included the Alcohol Use Disorders Identification Test Consumption (AUDIT C), which is derived from the first three questions of the full AUDIT (a gold standard of identification tests, developed by WHO and consisting of 10 alcohol identification questions) (Saunders et al., 1993).

Ethics approval was not required, because the research involved anonymised records collected on a voluntary basis (and, therefore, participants did not sign written informed consent) in which participants could not be identified.

Statistical analysis

Descriptive statistics were used to report the prevalence of various factors. Categorical data were presented as numbers (percent), continuous data as means ± standard deviation (SD) for normally distributed variables. The Shapiro-Wilk test was used to evaluate whether or not the distribution of the variables was normal. The mean values of any two groups were compared using the Student's T-test and the means of more than two groups were assessed using Analysis of Variance followed by the Bonferroni multiple-comparison test. The Pearson $\chi 2$ test and the Fisher exact test were used for comparing categorical variables.

A linear regression model using BMI as a continuous variable was used to estimate the association between the work-related, individual, anthropometric and medication intake variables, and the BMI levels. The variables with $P < 0.20$ in the univariate linear regression analysis were employed in the multivariate regression model. Variables that showed co-linearity or low frequency were excluded from the multivariate model, whereas variables with more than two categories were transformed into indicator (dummy) variables. The final models for the linear regression analysis were constructed using stepwise regression analysis to select the minimum set of predictors that significantly ($P \leq 0.05$) maximized the model R^2. Logistic regression was applied to explain PDs' obesity in relation to their demographic and work information. The outcome variable was coded 1 for PDs who were obese (BMI ≥ 30) and 0 otherwise. The analysis was undertaken as follows: we fitted univariate logistic regression models to identify factors associated with obesity. We then included in a multivariate logistic regression model, the factors that were associated with the outcome measure with a *P*-Value < 0.20 in the univariate analysis. We adjusted the odds ratios for potential confounders, namely, demographic characteristics potentially associated with obesity: age, years of driving experience, occupational category, coffee and alcohol intake, smoking and

medication intake. Results were considered significant if $P \leq 0.05$. All statistical calculations were performed on STATA software (version 11.0 STATA Corporation, College Station, TX, USA).

RESULTS

We received responses to the questionnaire from 497 of the 508 PDs participating in CPC courses. In order to ensure anonymity, gender was not required in the questionnaire. Table 1 shows the main characteristics of PDs on the HiRis PD study.

We did not detect any differences in length of service between truck drivers and bus drivers (mean number of years 18 and 18.9 respectively, $P = 0.46$) while the difference was statistically significant between obese and non-obese PDs (mean number of years 17.5 and 21.2 respectively, $P = 0.009$). In our study population there was a higher prevalence of journeys on national routes made by bus drivers compared to truck drivers (95.1% vs. 83.4%, $P = 0.003$). No differences in educational level were detected between truck and bus drivers (data shown in Table 1).

Twenty-nine percent of PDs declared themselves as substantial out-of-home eaters, 53% home eaters, the remaining 18% claimed they eat meals at home or at restaurants indifferently. No differences in BMI among these three groups were detected (mean BMI 26.4, 27.1 and 26.1 respectively, $P = 0.1$). Twenty-one percent declared they drink alcoholic beverages during working hours or work breaks. Fifteen percent of the participants have an AUDIT C score ≥ 5 (a score >4 for men means the subject is probably drinking at unhealthy levels) (Rumpf et al., 2002), and the mean score was higher in truck drivers than bus drivers (respectively 2.82 and 2.01, $P < 0.01$), as previously reported in a specific article related to the HiRis PD study (Rosso et al., 2013).

Of the participants 90/497 (18.1%) declared the use of medicines for reasons including allergies 3.8%, anxiety and depression 0.6%, diabetes 2%, heart conditions 1.4% and high blood pressure 12.1%. Table 1 includes only data from questionnaires which were fully completed.

Eighty-two PDs (16.8%) had a body mass index indicating obesity (BMI ≥ 30). Mean BMI was

statistically different between truck and bus drivers (27.3 versus 26.1 respectively, $P = 0.017$). Furthermore, bus drivers were at decreased risk of obesity (unadjusted OR 0.45; CI 0.23-0.87, $P = 0.018$). However, the lower prevalence of obesity that we observed in bus drivers is statistically explained by the fact that truck drivers in our study drive for more hours per day and for more miles per year. Table 2 shows the effect of hours and miles driven as potential mediators between the predictor – truck vs. bus drivers – and the condition of being obese.

In the univariate linear regression analysis, BMI levels were significantly related to seniority, hours spent at the wheel, age, medication intake and educational achievement. The effects of smoking, coffee intake, dietary habit (eating at home vs. away from home) and drinking behaviours on the BMI were insignificant. In the linear regression analysis using BMI as a dependent variable, the effects of length of service ($\beta = .049$, $P = 0.015$) and hours spent at the wheel ($\beta = .240$, $P = 0.001$) are significant (adjusted for medication intake) and their coefficients are positive, indicating that the greater the length of service and the numbers of hours spent at the wheel, the greater the BMI (data shown in Table 3). This final model explained 7.2% (R^2 adjusted) of the BMI variability.

The best predictive factors for obesity in the multivariate regression were travelling more than 40 thousand miles per year (OR 4.20, CI 1.41-12.56, $P = 0.010$) and the numbers of hours per day spent at the wheel (OR 1.27, CI 1.02-1.58, $P = 0.032$). Obese PDs were more likely to report taking antihypertensive and antidiabetic drugs (OR 5.90, CI 1.66-20.95, $P = 0.006$). An inverse association was detected between educational attainment and obesity. Indeed, having attended high schools or university was a protective factor against obesity (OR 0.32, CI 0.11-0.90, $P = 0.031$). Factors associated with obesity and the relative odds ratio are presented in Table 4.

DISCUSSION

Studies in recent decades have demonstrated that PDs have higher mortality and morbidity rates possibly related to obesity (Tuchsen et al., 2006; Winkleby et al., 1988) and that hypertension is one of the main cardiovascular risk factors among PDs (Malinauskiene, 2003).

In northwest Italy, the prevalence of normal-weight subjects among the working age population is 57.5%, while overweight and obese subjects are respectively 30.3% and 7.8% (Gallus et al., 2013). These data are much lower than those reported by Luckhaupt et al. in a recent study (27.7% of U.S. workers are obese) (Luckhaupt et al., 2014).

In the present study, the prevalence of overweight and obesity was higher (if compared with the national data mentioned above), as more than half of the population of PDs (61.6%) was characterized as overweight or obese (respectively 44.8% and 16.8%). These results are similar to those reported by Lemos in a Brazilian study (prevalence values of 47.8% and 16.2% for overweight and obesity, respectively) and by Sabbagh-Ehrlich in an Israeli study (prevalence values of 37.5% and 15% respectively), both involving truck drivers (Lemos et al., 2009; Sabbagh-Ehrlich et al., 2005). In the United States the prevalence of obesity among male employees who work as motor vehicle operators was found to be much higher than in our study (31.7%) (Caban et al., 2005) and if we consider the data from a national survey conducted in 2010 among U.S. long-haul truck drivers, 69% were obese (Sieber et al., 2014). A Brazilian study also reported a high prevalence rate of overweight and obesity: 57.5% of the population of bus drivers was characterized as overweight and approximately 19.5% was considered obese (Hirata et al., 2012).

Our study was conducted in an area where the Mediterranean diet is deep-rooted, nevertheless obesity is a real problem among Italian PDs. Our results suggest the importance of driver seniority and number of hours spent at the wheel as risk factors of obesity (the greater the seniority and the number of hours spent at the wheel, the greater the BMI). This association was also seen in a Colombian study that found a positive association between time spent traveling in motor vehicles per week and overweight and abdominal obesity (Florez Pregonero et al., 2012). The inverse association between educational attainment and obesity in higher-income countries might be independent from socioeconomic status (socioeconomic status of our group of PDs was homogeneous) and a high educational level is an independent protective factor against obesity. This

in agreement with a recent systematic review on the association between educational attainment and obesity (Cohen et al., 2013).

Obesity is not only an important risk factor for several diseases but it appears to increase the risk of accidents in operators of heavy commercial motor vehicles. A study of BMI among heavy transportation vehicle workers at the time of their initial training suggests that there could be an association between extreme obesity and vehicle crashes (Anderson et al., 2012).

In our study, we registered significant differences in BMI and obesity between truck and bus drivers. The differences are mainly attributable to the differences in hours of work between the two categories.

The present study was conducted investigating a large sample of PDs, most of whom work for companies based in only one Italian province. This characteristic may appear as a limitation of the study, however to our knowledge there are no local factors which impact or influence the application or interpretation of the results of this study on a national basis. The study population was selected from those doing the CPC and there was no randomisation. The response rate was high (blank questionnaires were considered as refusals). In our opinion the main reason for this was because participants had fully understood the purpose of the study and they trusted the course instructor. The HiRis PD study was conducted to detect the most important predictive factors for accidents and near misses, therefore the analysis conducted in the present study must be considered as a secondary analysis. In addition, the results are based on cross-sectional data that include only a range of variables that can potentially determine obesity among PDs (we do not record the role of work-family conflict, lack of physical activity, varying driving shifts, etc.). Finally, the limitations of self-reported data are well known and clearly need to be considered in interpreting these results.

In Italy, there are no programs or defined strategies to support integrative approaches that address health risk from both the work environment (physical and organizational) and individual behaviour. The results highlighted in this study might provide precious information to focus attention on PDs at high risk of obesity, in particular those who have greater seniority, more demanding jobs (in

terms of hours spent at the wheel and miles driven in a year), and lower educational level. For these reasons the assessment of risk in the category of PDs (as described by Legislative Decree 81/2008, which reorganized legislation regarding safety and security in the workplace in Italy), should also consider dedicating efforts to the prevention of obesity, indicating the measures put in place by the employer to reduce this risk factor. These measures are not necessarily always the same but must be specifically identified for each individual company (worksite nutrition education, wellness screenings or worksite social supports organized by employers). In addition to reducing the number of hours of work and the amount of mileage where possible, it would be necessary to indicate which strategies are designed to reduce the risk of obesity (for example: exercise classes, nutrition and weight management sponsored by the company, or rooms with fitness facilities etc.). The OHP could play a key role by promoting and managing prevention programs that counter hazards and risks faced by workers both on and off the job. Measures might include:

1) weight management, through registered dietician-directed wellness programs that include education, support, and cooperation of driver-stop restaurants, as suggested by a previous study (Whitfield Jacobson, 2007);
2) sedentary behaviour prevention, by carrying out special courses for teaching simple exercises to perform both on and off the job;
3) intensification of preventive efforts in the truck driver category because our results suggest this category has a higher prevalence of smokers and higher numbers of subjects taking drug therapy (data shown in Table 1).

The OHP should intensify checks on PDs:

- with a high number of hours and miles spent driving (in order to closely monitor weight and reduce the common cardiovascular risk factors);
- who are either overweight or obese (working with a dietician who will create a plan based on PDs' working conditions, lifestyle and food preferences).

In conclusion, the results of this study show that obesity is prevalent in Italian PDs. Several significant correlated risk factors were identified both on the individual and occupational level. The implementation of educational programmes, particularly targeting obese PDs and promoting increased awareness of the deleterious effects of obesity, may help to improve PDs' well-being and to reduce accidents among this category.

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APPENDIX

Description of the main questions related to this study
Main routes: I usually travel (cross the option that best fits your situation): a) on regional routes b) on national routes c) on international routes
Dietary habit: During work, I usually eat (breakfast / lunch / dinner / snacks): a) at the restaurant and/or at the roadside restaurant and/or at the bar b) food brought from home c) at home
Drinking alcohol in the workplace: Have you ever drunk alcohol during work or during lunch at

work? a) Never, I only drink water or soft drinks b) rarely c) often d) regularly while I am having lunch
Pharmacological treatment declared: I take on a regular basis or at least periodically a) sleeping pills b) allergy medication c) anti-diabetic medication d) anti-epileptic drugs e) antihypertensive drugs f) cardiac medication
Driven distance: My total yearly mileage estimate is: _____
Coffee intake: How many cups of coffee do you consume daily?:_____
Smoking: Only if you are smoker: a) I never smoke while driving b) I usually smoke while driving
Time spent driving: Average number of daily hours spent driving:_____
BMI: Enter your weight (in kilograms) ____ and height (in centimetres) ____ (to determine if you are underweight, overweight, or within the normal range)

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TABLE 1. Main characteristics of PDs in the HiRis PD study

TABLE 2. Multivariate analysis of driver category and obesity

TABLE 3. Determinants of BMI in PDs

TABLE 4. Multivariate analysis of Obesity Risk among PDs

Table 1

Variable	All n(%)	Truck drivers n(%)	Bus drivers n(%)	*P*-Value	PDs with BMI < 30 n(%)	PDs with BMI ≥ 30 n(%)	*P*-Value
Number of PDs	497	308 (73.2)	113 (26.8)		407 (83.2)	82 (16.8)	
Age (year, mean ± SD)	43.7±9.3	42.8±9.7	46.3±8.6	< 0.01	43.2±9	46.1±10.7	0.02
Seniority (year, mean ± SD)	18.2 ±9.9	18 ±9.9	18.9 ±10	0.46	17.5 ±9.4	21.2 ±11.5	< 0.01
Main routes: 4) national 5) international	 376 (86.4) 59 (13.6)	 241 (83.4) 48 (16.6)	 98 (95.1) 5 (4.9)	< 0.01	 310 (87.3) 45 (12.7)	 62 (81.6) 14 (18.4)	0.19
Educational level • elementary school • middle school • high school • university degree	 11 (2.4) 274 (58.8) 174 (37.3) 7 (1.5)	 9 (3.1) 179 (62.1) 99 (34.4) 1 (0.4)	 2 (1.8) 64 (57.7) 42 (37.8) 3 (2.7)	0.14	 5 (1.3) 216 (56.5) 154 (40.3) 7 (1.8)	 5 (6.4) 54 (69.2) 19 (24.4) 0 (0)	< 0.01
BMI • normal (≤25) • overweight • class I obesity • class II obesity • class III obesity	 188 (38.4) 219 (44.8) 59 (12.1) 15 (3.1) 8 (1.6)	 99 (32.8) 139 (46) 47 (15.6) 11 (3.6) 6 (2)	 46 (41.4) 53 (47.8) 8 (7.2) 3 (2.7) 1 (0.9)	0.15	-	-	-
Smoking	149 (35.6)	121 (39.4)	28 (25)	< 0.01	101 (24.9)	14 (17.1)	0.13
Treatment declared • none • antihypertensive • antidiabetic • sedatives • other drugs	 407 (81.9) 59 (11.9) 5 (1) 2 (0.4) 24 (4.8)	 258 (83.8) 34 (11) 3 (1) 1 (0.3) 12 (3.9)	 80 (70.8) 21 (18.6) 2 (1.8) 1 (0.9) 9 (8)	0.03	 345 (84.8) 32 (7.9) 5 (1.2) 2 (0.5) 23 (5.6)	 55 (67.1) 26 (31.7) 0 (0) 0 (0) 1 (1.2)	< 0.01
Coffee (number of cups, mean ± SD)	3.1±2.1	3.4±2.4	2.8±1.8	0.04	3±1.9	3.8±3.4	0.19
Driven distance (miles/year x 1000, mean ± SD)	46.9±39	54±41.1	33.3±24.9	< 0.01	44±36.9	56.7±21.2	< 0.01
Time spent driving (h/day, mean ± SD)	6.8±2.6	7.7±2.4	5.8±1.9	< 0.01	6.6±2.6	8.2±2.3	< 0.01

Table 2

Variable	Obesity		Obesity, adjusted for potential confounders		Obesity, adjusted for potential confounders and driven distance (a potential mediator)		Obesity, adjusted for potential confounders and time spent driving (a potential mediator)	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Truck vs. bus driver referent: truck driver bus driver	1.0 0.45	NA 0.23-0.87*	1.0 0.19	NA 0.05-0.70*	1.0 0.31	NA 0.08-1.16	1.0 0.34	NA 0.09-1.31
Age			0.98	0.93-1.03	0.95	0.89-1.01	0.99	0.94-1.05
Main routes, national vs. international referent: national international			1.87	0.66-5.29	3.04	0.90-10.22	1.97	0.59-6.53
Smoking			0.61	0.25-1.49	0.75	0.29-1.90	0.76	0.30-1.94
Coffee intake			1.12	0.94-1.33	1.15	0.94-1.40	1.06	0.87-1.29
Taking antihypertensive and antidiabetic drugs			4.89	1.47-16.18*	7.88	1.79-34.62*	3.59	0.94-13.68
Having attended high schools or university			0.33	0.12-0.96*	0.22	0.07-0.73*	0.38	0.13-1.13
Driving miles					1.00	0.99-1.01		
Time spent driving							1.25	1.00-1.56*

* Indicates statistical significance: $P \leq 0.05$.

Table 3

Variables	Univariate analysis		Final model (model R^2 = .086)			
	Beta	*P*-Value	Beta	*SD*	95% CI	*P*-Value
Time spent driving	0.25	< 0.01	0.24	0.07	0.10-0.38	< 0.01
Seniority	0.06	< 0.01	0.04	0.02	0.01-0.09	0.01
Taking antihypertensive and antidiabetic drugs	1.32	0.01	0.96	0.49	-0.01-1.93	0.05
Age	0.06	< 0.01				
Having attended high schools or university	-0.69	0.02				
Coffee intake	0.18	0.05				
Driving distance	0.01	0.37				

Beta, standardized beta coefficient.

Table 4

Variable	Final model with four variables		Model with four variables, adjusted for age		Model with four variables, adjusted for age and seniority	
	OR	95% CI	OR	95% CI	OR	95% CI
Driving > 40,000 miles/y	4.20	1.41-12.56*	4.06	1.35-12.26*	3.42	1.12-10.43*
Time spent driving	1.27	1.02-1.58*	1.26	1.01-1.56*	1.24	1.00-1.54*
Having attended high schools or university	0.32	0.11-.90*	0.27	0.09-0.81*	0.29	0.09-0.87*
Taking antihypertensive and antidiabetic drugs	5.90	1.66-20.95*	8.02	1.95-33.00*	7.40	1.75-31.26*
Age			0.97	0.92-1.03	0.93	0.85-1.02
Seniority					1.05	0.96-1.15

* Indicates statistical significance: $P \leq 0.05$.