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Occupational factors associated with low back pain in urban taxi drivers

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Background Urban taxi drivers differ from other professional drivers in their exposures to physical and psychosocial hazards in the work environment. Epidemiological data on low back pain (LBP) of this occupational group are very scarce.

Aims To examine LBP in taxi drivers and its association with prolonged driving and other occupational factors.

Methods We analyzed the cross-sectional data from the Taxi Drivers' Health Study. Standardized instruments were used to collect information on personal factors, work-related physical and psychosocial factors and driving time profiles. LBP prevalence was assessed using the modified Nordic Musculoskeletal Questionnaire. Multiple logistic regression models were employed for statistical analyses.

Results Of 1242 drivers, 51% reported LBP in the past 12 months, significantly ($P < 0.001$) higher than other professional drivers (33%) in Taiwan. After adjusting for the effects of demographic characteristics, lifestyle factors, anthropometric measures and socioeconomic positions, we found that driving time >4 h/day [prevalence odds ratio (POR) 1.78; 95% CI 1.02–3.10], frequent bending/twisting activities while driving (adjusted OR 1.86; 95% CI 1.15–2.99), self-perceived job stress (POR 1.75; 95% CI 1.20–2.55), job dissatisfaction (POR 1.44; 95% CI 1.05–1.98) and registration type were the major occupational factors significantly associated with higher LBP prevalence in taxi drivers.

Conclusions We have identified that long driving time and several physical and psychosocial factors are associated with high prevalence of LBP in taxi drivers. This should be further investigated in prospective studies. Future studies are needed to examine the potential adverse effects of prolonged exposure to low levels of whole-body vibration.

Key words Automobile driving; low back pain; occupational exposure; taxi drivers.

Introduction

Convincing epidemiological evidence has indicated that professional drivers are at higher risk for low back pain (LBP) and various spinal disorders. Population surveys conducted in the USA [1] and Canada [2] have both found that back pain frequency among drivers is ~1.6–2.0 times the reference prevalence. Similar observations on the high frequency of LBP and spinal disorders associated with driving have also been reported in developed countries, for machine drivers [3], forklift truck drivers [4], bus drivers [5], agricultural tractor drivers [6], truck drivers[7,8], police officers [9] and other professional drivers [10,11]. Professional drivers in developing countries, such as India [12] and Taiwan [13], have similar problems. Many workplace physical factors (e.g. whole-body vibration [14], prolonged seating postures [15] and lifting [16]), psychosocial factors [5,17] and work-related injuries (e.g. vehicle collision [18]) have been postulated to be accountable for the observed high frequency of low back disorders in professional drivers.

Taxi drivers, especially those serving urban areas, are distinct from other professional drivers with respect to their risk profiles for work-related low back disorders. Firstly, the time spent behind the wheel is usually much longer. Previous studies have reported that most taxi drivers often drive 8–12 h/day [19,20]. It has also been reported that taxi drivers in Taipei City drive 10 h/day, longer than other employed drivers (~8–8.5 h/day) in Taiwan [13]. Secondly, the major differences in the micro-work environment between taxicabs and other vehicles

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have direct influence on the occupational exposures to whole-body vibration and driving postures. We have recently documented that urban taxi drivers are exposed regularly to lower levels of whole-body vibration (with mean vertical vibration ± SD = 0.41 ± 0.06 m/s^2) [21,22], whereas those operating agricultural and industrial vehicles are reportedly exposed to higher levels of occupational whole-body vibration [14]. The relatively confined space within taxicabs may put taxi drivers at a greater risk for LBP, as biomechanical studies have shown that the driving activities within automobiles can impose postural strains on lumbar spines [23]. In addition, there are other work-related stressors existing in the macro-work environment for urban taxi drivers, such as air pollutants [24], violence [25] and psychological strains [26], which may increase occupational stress and subsequent development of LBP. These are speculated differences in LBP risk, as direct evidence from epidemiological studies is scarce.

Methods

To examine LBP in taxi drivers in association with prolonged driving and any other related occupational factors, we analyzed the cross-sectional data from the Taxi Drivers' Health Study (TDHS) in Taipei City.

The TDHS is an occupational epidemiological study of cardiovascular disease risks, job stressors, low back disorders and occupational health service outcomes. Details of the TDHS design have been reported elsewhere [27]. In brief, the TDHS is an integrated part of a medical monitoring program sponsored by the Taipei City Government. From 31 January to 31 May 2000, 3295 taxi drivers participated in this program and visited five designated hospitals for medical examinations. We selected the hospital with the largest service volume as the study base hospital where 1355 drivers were examined. A baseline cohort of 1242 (92% participation rate) was recruited. To be eligible for enrolment, they had to (i) have been registered taxi drivers in Taipei City for at least 1 year and (ii) be able to read. The study protocol was approved by the Human Subjects Committee of the Harvard School of Public Health, Boston, MA, USA, and by the Institutional Review Board of the Taipei Veterans General Hospital, Taipei, Taiwan.

A standardized self-administered instrument was developed to collect the baseline data. Its feasibility was tested in a sample of drivers before the study began. This instrument consisted mainly of the modified Nordic Musculoskeletal Questionnaire (NMQ) and the job dissatisfaction subscale of the Job Contents Questionnaire (Chinese version) [28], plus other items. The NMQ has been documented to have acceptable validity and reliability [29]. In addition to demographic features (age, gender and marital status), socioeconomic positions (education and income) and lifestyle factors (smoking habit, alcohol drinking and exercise), we collected information on driving time profiles (years worked as a taxi driver, average number of days driving per month and daily driving duration in hours) and average frequency of physical activities (lifting tasks and bending/twisting activities) while driving at work and during leisure time. Previous studies [30] have shown that self-reporting is a relatively reliable and valid method to assess the time spent on motor vehicle driving and exposure to whole-body vibration. In a small subset of subjects who participated in both the TDHS and an exposure assessment study [22], we found that >80% of self-reported daily driving time categories agreed with data retrieved from driving diary records or through structured interviews. Although self-reporting on average gave a higher estimate of daily driving duration by 0.9 h, this measurement error is independent of LBP (P = 0.94). Information on body weight, height and personal medical histories was retrieved from the medical examination files.

To examine the association of LBP prevalence and daily driving duration and to identify LBP-related occupational factors, we used multiple logistic regression to obtain estimates of the prevalence odds ratio (POR) adjusted for the effects of demographic characteristics, lifestyle factors and socioeconomic positions. We grouped the drivers into four categories according to their daily driving durations (≤4, 4–8, 8–10 and >10 h), and fit a simple logistic regression (the 'base model') to obtain the crude POR of LBP for each group, using the LBP prevalence of those driving the shortest time (≤4 h) as the baseline. To compare our results with previous publications [31,32], we also reported the POR associated with dichotomized (≤4 versus >4 h/day) driving time. For any other variable to be included in the final logistic regression, its entering into the base model should have caused at least a 10% change in the estimate of the POR associated with driving time or it had to be significant at the $P < 0.25$ level in its own univariate analysis. We assumed no interaction terms among potential predictors, and only included cases with complete data information in the final analyses. The Hosmer–Lemeshow test was used to assess the goodness of fit. All these statistical analyses were carried out by STATA 7.0 statistical software (Stata 7.0, Stata Press, TX, 2001).

Results

Personal characteristics (demographics, personal health-related factors and socioeconomic positions) and occupational factors of the TDHS cohort of 1242 taxi drivers are presented in Tables 1 and 2, respectively. In a separate report on the taxi drivers' knee pain [27], we noted that, with regard to their personal characteristics, the TDHS cohort did not differ from other drivers who received medical examinations in non-study base hospitals.

Table 1. Personal characteristics of the TDHS cohort

Demographics	n^{a}	Mean ± SD or percentage (%)
Age (years)	1242	44.5 ± 8.7
Gender		
Male	1193	96
Female	49	4
Income from cab service (NT)[b]		
<20K	305	25
20–30K	448	37
30–40K	348	28
>40K	128	10

[a]n = number of subjects. The total number varies slightly across categories because of missing data.

[b]NT = New Taiwan dollars.

Table 2. Baseline information on occupational factors of the TDHS cohort

	n^{a}	Mean ± SD or percentage (%)
Driving time profiles		
Duration of taxi driving (years)	1234	11.4 ± 7.8
Duration of driving per month (days/month)	1239	26.2 ± 2.6
Duration of driving per day (h/day)	1238	9.8 ± 2.8
Physical activities		
Lifting tasks		
Never/rare/seldom	604	49
Often/sometimes	508	41
Very frequently	122	10
Bending/twisting while driving		
Never/rare/seldom	643	52
Often/sometimes	482	39
Very frequently	111	9
Psychosocial factors		
Job dissatisfaction index[b] (0.01–1)	1225	0.61 ± 0.17
Perceived job stress		
None	282	23
Mild	639	52
Moderate to severe	311	25
Registration type		
Individual	497	40
Cooperative	395	32
Cab-company affiliated	341	28

[a]n = number of subjects. The total number varies slightly across categories because of missing data.

[b]As measured by the job dissatisfaction subscale in the Job Contents Questionnaire with higher values indicating lower satisfaction.

As compared to the reference prevalence (33%) of LBP among other professional drivers who entered the regular nationwide survey [13] using the same modified NMQ instrument, taxi drivers had a significantly higher prevalence of LBP ($P < 0.001$) with 51% reportedly having LBP in the past 12 months. Stratified by daily driving duration (≤4, 4–8, 8–10 and >10 h), the crude estimates of 1-year LBP prevalence were 37, 45, 51 and 57%, respectively. This is equivalent to a crude POR of 1.79 (CI 1.09–2.95) comparing driving >4 h/day with driving ≤4 h/day.

Other factors that were significantly ($P < 0.05$) associated with higher LBP prevalence were more frequent bending/twisting activities while staying behind the wheel, perception of moderate-to-severe job stress and reporting a high degree of job dissatisfaction. Individual drivers and those in cooperative practice also had a higher prevalence than those drivers affiliated with taxicab service companies. We did not find any significant association between lifting and LBP prevalence ($P = 0.58$). There were no consistent patterns in LBP prevalence associated with reported leisure-time physical activities or years of taxi driving.

After adjusting for age, gender, body mass index, income, education, marital status, smoking habit, alcohol drinking, frequency of regular exercise, self-perceived job stress, job dissatisfaction index, physical exertion at work and during leisure time and years of taxi driving (Table 3), the association of LBP prevalence and prolonged driving remained statistically significant ($P = 0.005$ for trend test). For drivers who drove >4 h, the adjusted POR was 1.78 (95% CI 1.02–3.10). The observed associations between LBP prevalence and other work-related factors remained statistically significant (Table 4). The results of the Hosmer–Lemeshow test ($P = 0.53$) supported the goodness of fit of the multiple logistic model presented in Tables 3 and 4.

Discussion

Our cross-sectional analyses of the TDHS baseline data suggested that urban taxi drivers were a high-risk group for work-related LBP. The significantly higher prevalence of LBP (51%) in Taipei taxi drivers than other professional drivers (33%) in Taiwan is consistent with a previous study [33]. In that study, taxi drivers in Norway had a higher 1-year LBP prevalence than the community-based references (59 versus 51% for men and 66 versus 58% for women). However, they did not report whether the observed high LBP frequency was related to driving time or other work-related factors. To our knowledge, this is the first study showing a significantly high LBP prevalence in taxi drivers associated with daily driving time and a few modifiable occupational factors.

The observed association between long duration of car driving and LBP conforms to previous studies on other occupational groups often operating small automobiles. Walsh *et al.* [31] found that driving a car or van for >4 h/day was associated with a high prevalence of LBP in the past 12 months (adjusted OR 1.7; 95% CI 1.0–2.9). Pietri *et al.* [32] reported that commercial

Table 3. Summarized results of crude analyses and multiple logistic regression for estimating the PORs of having LBP associated with daily driving duration in Taipei taxi drivers

Occupational factors	Crude prevalence (%)	Crude[a] POR (95% CI)	Adjusted[a] POR (95% CI)
Driving duration (h/day)			
≤4	37	1.00	1.00
4–8	45	1.41 (0.82–2.40)	1.48 (0.82–2.66)
8–10	51	1.76 (1.04–2.97)*	1.85 (1.03–3.31)*
>10	56	2.12 (1.26–3.55)**	2.08 (1.16–3.74)*
Trend test		$P < 0.001$	$P = 0.005$

[a]Crude: univariate analysis; adjusted: controlled for age, gender, body mass index, marital status, education level, income, smoking, alcohol drinking, frequency of lifting tasks, professional seniority (years), days of driving per month, frequency of regular exercise, frequency of bending/twisting, perceived jobs stress, job dissatisfaction and registration type.

*$P < 0.05$;

**$P < 0.01$.

Table 4. Summarized results of crude analyses and multiple logistic regression for estimating the PORs of having LBP associated with other occupational factors

Occupational factors	Crude prevalence (%)	Crude[a] OR (95% CI)	Adjusted[a] OR (95% CI)
Bending/twisting while driving[b]			
Never/rare/seldom	47	1.00	1.00
Often/sometimes	54	1.32 (1.04–1.67)*	1.38 (1.05–1.82)*
Very frequently	61	1.81 (1.20–2.74)**	1.86 (1.15–3.00)*
Perceived job stress[b]			
None	41	1.00	1.00
Mild	50	1.44 (1.08–1.91)*	1.25 (0.91–1.72)
Moderate to severe	60	2.19 (1.57–3.04)**	1.75 (1.20–2.55)**
High job dissatisfaction[c]			
No	49	1.00	1.00
Yes	59	1.48 (1.11–1.96)**	1.44 (1.05–1.98)*
Registration type			
Individual/cooperative practice	54	1.00	1.00
Cab-company affiliated	43	0.64 (0.50–0.82)**	0.59 (0.44–0.79)**

[a]Crude: univariate analysis; adjusted: controlled for age, gender, body mass index, marital status, education level, income, smoking, alcohol drinking, frequency of lifting tasks, professional seniority (years), days of driving per month, frequency of regular exercise, daily driving duration and all the other covariates in the table.

[b]$P < 0.01$ for all trend tests.

[c]High job dissatisfaction defined for those whose job dissatisfaction indexes are in the highest quartile as measured by the job dissatisfaction subscale in the Job Contents Questionnaire.

*$P < 0.05$.

**$P < 0.01$.

travellers in France had OR of 2.0 (CI 1.3–3.1) for 1-year prevalence of LBP when driving >20 h/week. Porter and Gyi [34] also found that driving >20 h/week for work was associated with high frequency of low back trouble and related sickness absence. However, neither of these studies adequately accounted for the potential confounding by work-related psychosocial factors. In this study, after adjustment for variables, the association of LBP prevalence and driving time >4 h/day (POR 1.78; CI 1.02–3.10) was almost the same as the result of the univariate crude analysis (POR 1.79; CI 1.09–2.95).

Many physical factors arising from the work environment of urban taxi drivers may account for the observed association between LBP prevalence and prolonged driving. Firstly, prolonged sitting behind the wheel can cause significant postural strains on back muscles and the lumbar spine [35–37]. Secondly, like other professional drivers, taxi drivers are exposed to whole-body vibration on a daily basis. Both biomechanical studies [38] and animal models [39] support the causal link between vibration exposures and LBP. However, the vibration exposure level for taxi drivers is much lower than that for other professional drivers. Thirdly, direct back injury during motor vehicle accidents (MVAs) is another physical hazard associated with low back disorders of professional drivers [18]. In a subset of 893 subjects in the TDHS with available information on prior MVA-related back injuries, we did not find an association between LBP and prior MVA-related back injuries ($P = 0.78$). This may be because drivers with a history of motor vehicle-related back disorders have left this occupation and thus were not observed in our cross-sectional study.

The association between bending/twisting movements while behind the wheel and higher prevalence of LBP is also supported by recent reports from biomechanical experiments [40,41]. Most of the cab drivers in this study used compact saloons (with a mean engine size of 1600 cc and a mean wheelbase of 254 cm) for their taxicab business. As a result, drivers were constrained to a very limited space behind the wheel, where they had to assume driving postures without too much backward inclination in order to give more room for passengers. They often have to reach the passenger seats in bending and twisting postures to open/shut the back door or help move passengers' baggage. The additional exposure to such biomechanical strains during prolonged driving may explain why we found in both crude and adjusted analyses a consistently significant association between LBP and bending/twisting activities while driving.

The observed high frequency of LBP among drivers with either a high level of self-rated job stress or job dissatisfaction is consistent with studies of other workers [5,17]. Another interesting finding, possibly related to psychosocial factors, is that cab-company-affiliated drivers had a significantly lower prevalence of LBP (43%) than those in cooperative (55%) or individual practice (53%). This difference was statistically significant in the multiple logistic regression, suggesting that some LBP-related factors, other than those physical and psychosocial variables retained in the model, should be more (or less) common among affiliated cab drivers than the others. A similar finding on knee pain has also been reported in the TDHS cohort [27]. It is possible that factors such as social support could partially explain this observation because individual drivers and those in cooperative practice may be more isolated than those affiliated with cab companies. Further detailed work analyzing data from the Job Contents Questionnaire is ongoing to test this hypothesis.

There are several limitations in this study. First, although we observed a statistically significant and consistent association of LBP prevalence and daily automobile driving time, without direct measurements on more specific physical exposures, the contribution of any individual exposure cannot be ascertained. Secondly, results of our study were subject to residual confounding. Although we have included the self-perceived job stress and job dissatisfaction in the multiple logistic regression analyses, we cannot rule out completely the possibility of residual confounding of job stress on the observed long driving–LBP association. This may come from measurement errors of self-rated job stress or any specific domains of job stress (e.g. psychosocial demands and job controls). Due to the lack of complete data on prior LBP, the extent to which LBP in the past year might be due to LBP symptoms prior to becoming taxi drivers is uncertain. In an exposure assessment study on whole-body vibration [21,22], we noted that drivers with prior LBP on average drove 1 h less than those with no prior LBP. It is possible that this confounder may have biased our study results towards the null. The third limitation is its cross-sectional design. Because LBP is such a common musculoskeletal disorder, it is possible that prolonged driving may not be an etiological factor but an occupational factor related to progression or recurrence of existing LBP symptoms. It is also possible that the TDHS baseline data may over-represent those LBP cases with relatively longer symptomatic duration. In addition, the healthy worker effect may have selected those with more severe LBP out of the TDHS or led to changes of driving duration among the remaining taxi drivers. A prospective study would be required to consider this.

In conclusion, we found that the high LBP frequency in taxi drivers was associated with long driving time, frequent bending/twisting activities while driving, self-perceived job stress, job dissatisfaction and registration type. These cross-sectional associations should be further confirmed in prospective studies.

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Conflicts of interest

None declared.

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