Work-related stress and role of personality in a sample of Italian bus drivers

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Abstract

BACKGROUND: Several studies have shown that professional drivers are at risk of developing work-related stress. Stress may be responsible for a variety of adverse effects and may also be associated with an increased number of accidents.

OBJECTIVE: Perform an integrated, objective and subjective evaluation of work-related stress in bus drivers, that also considered the role of personality traits.

METHODS: Salivary α-amylase and cortisol were measured in 42 bus drivers. Subjective stress evaluation was performed with the Perceived Stress Scale (PSS-10) and Driver Stress Inventory (DSI). To evaluate personality traits, we administered the Eysenck Personality Questionnaire-Revised (EPQ-R) and the Impulsivity Inventory (IVE).

RESULTS: Salivary biomarkers showed no associations with PSS-10 and personality traits. Cortisol levels were positively correlated with fatigue ($r = 0.44$) at the middle of the work-shift and with aggression ($r = 0.51$) at the end of a day off. At the end of the work-shift, cortisol levels were negatively correlated with hazard monitoring ($r = -0.37$) and salivary α-amylase was positively correlated with thrill-seeking ($r = 0.36$). Neuroticism ($\beta = 0.44$) and impulsiveness ($\beta = 0.38$) were predictors of perceived stress by multiple regression.

CONCLUSIONS: An integrated method, considering both objective and subjective indicators, seems adequate to evaluate work-related stress in professional drivers. Personality traits are relevant in determining perception of stress.

Keywords: Occupational stress, biological monitoring, personality trait, accident prevention

1. Introduction

According to the 2004 European Agreement on stress at work, “stress is a state, which is accompanied by physical, psychological or social complaints or dysfunctions and which results from individuals feeling unable to bridge a gap with the requirements or expectations placed on them” [1]. Preliminary analysis of work-related risk factors, such as high job demands and low job control, and of context risk factors, including the role of the worker inside the organization and the relationships with co-workers and supervisors, is needed for comprehensive evaluation of work-related stress. Specific occupational risk factors must also be considered with regards to driving among content factors, and in particular exposure to noise, microclimate, vibration, and biomechanical overload related to the adoption of prolonged fixed postures. For drivers in public transport service, there is a relevant risk of aggression from passengers, which is another potential cause of distress [2, 3].

A large number of studies have reported that bus drivers are exposed to significant mental and physical effort. One of the main reasons is the large numbers of complex tasks these workers must carry out.
These working conditions require a high, continuous level of attention from drivers, who are unable to control external factors, such as interference with other vehicles, cyclists, pedestrians, and possible roadway obstacles [4–10]. Long-term exposure to these factors in susceptible subjects may induce a distress condition that can lead to dysregulation of various hormone and neurotransmitter levels, such as cortisol and catecholamine, as well as increased susceptibility for negative cardiovascular and neuro-muscular effects [11]. In particular, for bus drivers, Du et al. reported that elevated 24-hour urine cortisol levels were associated with poor relationships between workers and their supervisors [12]. Various studies showed a relationship between exposure to heavy traffic and the level of urinary catecholamine [13, 14]. Djindjic et al. found an association between work-related stress and dyslipidemia and increased blood pressure in bus drivers [15].

It has also been noted that elevated stress in bus drivers, in addition to increasing the likelihood of accidents, may also lead to a significant risk of injury for transport users, other vehicle drivers, pedestrians, and cyclists. It has been suggested that some personality traits may be potential predictors of hazardous driving behaviors [16]. Ruiz-Grosso et al. [17] have shown that common mental disorders such as alcohol abuse, major depressive episode, anxiety symptoms, and burnout syndrome are higher in public transportation drivers than in the general population [17].

To consider these premises, the objective of this study was to evaluate work-related stress in a sample of bus drivers using both subjective and objective investigation methods, as well as to estimate the impact of the individual personality traits on stress in bus drivers.

2. Materials and methods

The data presented herein were derived from a collaboration between the university’s Department of Public Health and a public transport company located in a north Italian city during the period from November 2010 to October 2011. Forty-two bus drivers were recruited on a voluntary basis, and a signed informed consent form was obtained from all. All data was managed in accordance with the Italian law for privacy protection (D. Lgs. n° 196 of 30 January 2003).

A multidisciplinary team of health professionals collected the data using several instruments. Perceived stress was evaluated with the 10-item Perceived Stress Scale (PSS-10), a self-administered questionnaire that measures the degree to which situations are appraised as stressful, referring to the last year [18].

The Driver Stress Inventory (DSI) was used to measure susceptibility to stress during driving. This self-administered questionnaire is composed of 5 scales with different stressful aspects of driving: aggression, dislike of driving, hazard monitoring, proneness to fatigue, and thrill-seeking [19].

The third and fourth self-administered questionnaires used were the Eysenck Personality Questionnaire - Revised (EPQ-R) and Eysenck’s Impulsivity Inventory (IVE), which investigate personality traits such as extraversion, neuroticism, psychoticism, impulsiveness, audacity, and empathy. These questionnaires do not evaluate psychiatric symptoms, but only specific behaviors and attitudes that are common in the general population [20].

Two types of biochemical indicators were used as objective measurements, salivary α-amylase and salivary cortisol [21, 22]. Salivary samples were collected with Salivette® at the beginning (WD1), mid-way (WD2), and at the end of a work-shift (WD3) and also on a day off at approximately the same hours (DO1, DO2, DO3) to reduce variabilities in hormone secretion related to circadian rhythm [23]. Salivary concentration was determined with an immunoenzymatic method (IMMULITE 2000, DPC, 2005-04-05) for cortisol; α-amylase salivary concentration was estimated indirectly by measuring enzymatic activity with a colorimetric method (DiaMetra, Ed. 01/08).

Statistical analysis was performed using SPSS-21.0 for Windows (SPSS Inc. Chicago, IL, USA). Continuous variables were correlated with Pearson’s coefficient (r). A multivariate regression model was built to look for significant association between the variables investigated with questionnaires and the levels of biomarkers. Finally, a t-test analysis was used to evaluate differences in salivary cortisol and α-amylase concentrations between work days and days off.

3. Results

A total of 42 subjects (10% of the total number of drivers employed in the company on 31 May 2011) were recruited (37 men and 5 women), with a mean age of 40 years (min = 27, max = 57, SD = 6) and with
Table 1

Mean scores in the PSS-10, DSI, EPQ-R, and IVE questionnaires compared with similar studies

<table>
<thead>
<tr>
<th>Questionnaire</th>
<th>Scale</th>
<th>Range</th>
<th>Bus drivers score</th>
<th>Values reported in other studies</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Min ± SD</td>
<td>Mean ± DS</td>
</tr>
<tr>
<td>PSS-10</td>
<td>Perceived Stress</td>
<td>0–40</td>
<td>0 ± 28.0</td>
<td>12.76 ± 6.10</td>
</tr>
<tr>
<td>DSI</td>
<td></td>
<td></td>
<td>28.0</td>
<td>14.49 ± 5.25*</td>
</tr>
<tr>
<td></td>
<td>Aggression</td>
<td>0–100</td>
<td>17.5 ± 59.1</td>
<td>43.33 ± 15.27</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>95.0</td>
<td>46.00 ± 13.40**</td>
</tr>
<tr>
<td></td>
<td>Dislike of Driving</td>
<td>0–100</td>
<td>1.67 ± 100</td>
<td>24.93 ± 8.75</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>59.1</td>
<td>37.60 ± 13.01**</td>
</tr>
<tr>
<td></td>
<td>Hazard Monitoring</td>
<td>0–100</td>
<td>57.0 ± 100</td>
<td>83.48 ± 8.75</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>100</td>
<td>65.40 ± 12.60**</td>
</tr>
<tr>
<td></td>
<td>Fatigue Proneness</td>
<td>0–100</td>
<td>1.25 ± 100</td>
<td>35.62 ± 23.52</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>100</td>
<td>45.10 ± 15.50**</td>
</tr>
<tr>
<td></td>
<td>Thrill-seeking</td>
<td>0–100</td>
<td>1.25 ± 100</td>
<td>25.54 ± 23.55</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>88.7</td>
<td>25.90 ± 16.40*</td>
</tr>
<tr>
<td>EPQ-R</td>
<td>Extraversion</td>
<td>0–12</td>
<td>0 ± 11.0</td>
<td>8.24 ± 2.14</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>12</td>
<td>9.15 ± 2.34**</td>
</tr>
<tr>
<td></td>
<td>Psychoticism</td>
<td>0–12</td>
<td>0 ± 5.0</td>
<td>2.36 ± 1.23</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>12</td>
<td>8.20 ± 2.74**</td>
</tr>
<tr>
<td></td>
<td>Neuroticism</td>
<td>0–12</td>
<td>0 ± 9.0</td>
<td>2.67 ± 2.57</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>12</td>
<td>1.72 ± 2.07**</td>
</tr>
<tr>
<td></td>
<td>Impulsiveness</td>
<td>0–19</td>
<td>1.0 ± 15.0</td>
<td>5.70 ± 3.33</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>19</td>
<td>3.80 ± 2.61***</td>
</tr>
<tr>
<td></td>
<td>Audacity</td>
<td>0–16</td>
<td>0 ± 14.0</td>
<td>7.10 ± 3.62</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>16</td>
<td>6.70 ± 4.32***</td>
</tr>
<tr>
<td></td>
<td>Empathy</td>
<td>0–19</td>
<td>5.0 ± 18.0</td>
<td>11.67 ± 3.43</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>19</td>
<td>11.78 ± 2.91***</td>
</tr>
</tbody>
</table>

*a Ge et al., [23]; **Matthews et al., [24]; ***Łuczak & Tarnowski, [25].

A mean length of service of 10.5 years. The drivers were distributed on different work-shifts, both during the morning and the afternoon.

Table 1 shows the scores of the four questionnaires collected (PSS-10, DSI, EPQ-R, and IVE) in addition to scores reported by similar studies [23–25].

In total, 37 saliva samples were collected (33 from men and 4 from women). To avoid possible variability related to gender, we considered only the 33 male samples in statistical analysis [26]. The mean values of the concentration of cortisol and α-amylase in the salivary samples, collected at WD1, WD2, and WD3 and at DO1, DO2, and DO3 are shown in Tables 2 and 3. The values obtained were within the reference range indicated by technical details of test kits (respectively, IMMULITE 2000 and Diametra).

A significant increase in salivary cortisol was found between the levels at DO2 and WD2 (t = 2.228; p = 0.033). Salivary α-amylase also increased significantly, comparing the concentrations at DO1 and WD1 (t = 2.312; p = 0.027).

No significant associations were seen between salivary α-amylase and salivary cortisol levels with scores on the PSS-10. There was also no association between these concentrations and the scores obtained with the EPQ-R and IVE questionnaires. However, we found a positive significant correlation between some subscales of the DSI and cortisol levels. In particular, correlations between WD2 cortisol and fatigue (r = 0.444; p = 0.007) and between DO3 cortisol and aggression (r = 0.508; p = 0.003) were seen. A negative correlation between WD3 cortisol and hazard monitoring (r = –0.369; p = 0.032) was also found. Regarding salivary α-amylase, there was a positive correlation between WD3 levels and thrill-seeking (r = 0.361; p = 0.046).

Comparing the scores obtained with the different scales, we found a positive correlation between neuroticism (EPQ-R) and impulsiveness (IVE).

Table 2

Mean concentrations of salivary cortisol during work-shifts and day-off

<table>
<thead>
<tr>
<th>SALIVARY CORTISOL</th>
<th>Mean concentration ± SD (ng/mL)</th>
<th>SALIVARY CORTISOL</th>
<th>Mean concentration ± SD (ng/mL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Work-Day 1 (WD1)</td>
<td>5.29 ± 2.53</td>
<td>Day-Off (DO1)</td>
<td>6.20 ± 6.87</td>
</tr>
<tr>
<td>Work-Day 2 (WD2)</td>
<td>6.20 ± 5.33</td>
<td>Day-Off 2 (DO2)</td>
<td>4.09 ± 3.15</td>
</tr>
<tr>
<td>Work-Day 3 (WD3)</td>
<td>3.76 ± 2.65</td>
<td>Day-Off 3 (DO3)</td>
<td>4.36 ± 3.57</td>
</tr>
</tbody>
</table>

Table 3

Mean concentrations of salivary α-amylase during work-shifts and day-off

<table>
<thead>
<tr>
<th>SALIVARY α-AMYLASE</th>
<th>Mean concentration ± SD (U/mL)</th>
<th>SALIVARY α-AMYLASE</th>
<th>Mean concentration ± SD (U/mL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Work-Day 1 (WD1)</td>
<td>72.29 ± 72.72</td>
<td>Day-Off (DO1)</td>
<td>54.47 ± 46.12</td>
</tr>
<tr>
<td>Work-Day 2 (WD2)</td>
<td>92.43 ± 82.93</td>
<td>Day-Off 2 (DO2)</td>
<td>90.42 ± 68.76</td>
</tr>
<tr>
<td>Work-Day 3 (WD3)</td>
<td>86.71 ± 57.70</td>
<td>Day-Off 3 (DO3)</td>
<td>71.41 ± 62.55</td>
</tr>
</tbody>
</table>
(r = 0.358; p = 0.02), aggression (DSI) (r = 0.618; p = 0.00), and dislike of driving (DSI) (r = 0.343; p = 0.026). In addition, impulsiveness (IVE) and dislike of driving (DSI) were also positively correlated (r = 0.398; p = 0.009).

Considering the scores of the PSS-10 and personality traits, we found positive correlations with neuroticism (EPQ-R) (r = 0.609; p = 0.00) (Fig. 1), impulsiveness (IVE) (r = 0.558; p = 0.00) (Fig. 2), and aggression (DSI) (r = 0.473; p = 0.002) (Fig. 3).

Multivariate linear regression analysis was used to identify the personality traits that correlated with perception of stress, considering the PSS-10 score as the dependent variable. The independent variables that had a positive correlation with PSS-10 at univariate analysis were neuroticism (EPQ-R), impulsiveness (IVE), and aggression (DSI). Neuroticism and impulsiveness positively correlated with PSS-10, with β values of 0.44 (p = 0.004) and 0.38 (p = 0.004), respectively.

Fig. 1. Correlation between neuroticism (EPQ-R) and Perceived Stress Scale (PSS-10).

Fig. 2. Correlation between impulsiveness (IVE) and Perceived Stress Scale (PSS-10).

Fig. 3. Correlation between aggression (DSI) and Perceived Stress Scale (PSS-10).

4. Discussion

According to the Italian national law on occupational safety and health from 2008, work-related stress is included among the occupational risks that employers in Italy are mandated to assess. The evaluation is very complex because it must consider both objective and subjective factors. Unfortunately, after estimating risk, according to the recent scientific literature, to date adequate biomarkers or other individual measures to objectively monitor the effects of work-related stress, before the occurrence of medical or psychological disorders in workers, have not been identified. Currently, subjective questionnaires are the only tools available to investigate work-related stress individually, but, nonetheless present a variety of problems. For example, they are not specific for the work activity we evaluated, they are susceptible to the action of non-occupational stressors, and can produce a very different output depending on the specific period of administration. For instance, if a questionnaire is administered in a moment of extreme work overload due to an impending delivery of a large quantity of goods or during a considerable organizational change inside the company, the score will be higher.

Bus driving activity, especially in city traffic, exposes drivers to numerous stressors: complex interactions with other vehicles, frequent stops at traffic lights, fixed times of travel, repetitive paths, interference with passengers, episodes of violence, etc. Evaluation of work-related stress in bus drivers is of high importance both to protect workers’ health and to increase the safety of passengers. In fact, it is well documented that distress and fatigue decrease alertness and psychomotor performance, increasing the risk of traffic accidents.
We considered that there is a risk of residual stress in the public driving sector that is related both to the work itself and to contextual factors. For these reasons, we tried to evaluate the individual components and to identify personal correlates of susceptibility to the consequences of stress. In this sample of Italian bus drivers, a very specific questionnaire was administered that investigated signs of stress during driving, namely the DSI. At the same time, a general questionnaire for stress monitoring that is applicable both to occupational and non-occupational exposure, the PSS-10, was used. Next, in order to identify individual correlates, we firstly employed widely used and easily obtainable biomarkers, salivary cortisol and α-amylase, and also investigated the intrinsic characteristics of personality using the EPQ-R and IVE questionnaires.

The mean scores of perceived stress (PSS-10) obtained in our cohort are comparable with data from similar studies in samples of drivers in other countries and can be considered quite low [23, 27–29]. Regarding the scores of questionnaires investigating personality traits (EPQ-R and IVE) and stress perception during driving (DSI), our data is also comparable with similar studies. The only exceptions were:

- a lower mean score for the subscale “dislike of driving” and a higher mean score for the subscale “hazard monitoring” of the DSI [24];
- a lower mean score for the subscale “psychoticism” of the EPQ-R and a higher mean score for the subscale “impulsiveness” in the IVE [25].

Considering biochemical markers as possible indicators of stress, we observed an increase in salivary levels of cortisol between Days-Off and Work-Days in the second monitoring period (at the middle of the DO/WD); for α-amylase, we observed an increase between Day-Off and Work-Day in the third monitoring period (end of the shift). It should, however, be noted that these indicators have a high individual variability and also vary according to a circadian rhythm during the day. Regarding detection of these biomarkers in saliva, cortisol is secreted in the blood from the adrenal glands and takes some time to be detected in the saliva, while α-amylase is secreted directly in saliva. It should also be recalled that, within certain limits, neuroendocrine activation of the organism is physiological during working activity and is also useful, e.g. to increase the level of attention, which is fundamental in a complicated task such as driving [30–35]. We did not find any significant association between the levels of these two biomarkers and perceived stress, in contrast with a recent Taiwanese study where elevated 24-hour urine cortisol levels were associated with a high score in the Occupational Stress Index. This can probably be explained by differences between the two types of questionnaires administered: PSS-10 is a very short questionnaire, useful for rapid detection of stress, while the OSI is a complex, long questionnaire, specifically meant to investigate many content and context risk factors that may be associated with individual stress [36]. Nevertheless, we found a positive significant correlation between cortisol at the middle of the work-shift and fatigue and between cortisol at the end of the work-shift and aggression. These associations seem concordant with the clinical features of hypercortisolism, even if it should be pointed out that the levels of salivary cortisol detected in our sample were within the reference range for the general population.

Finally, in the present study we also compared the scores obtained in the different scales of the questionnaires administered to drivers. At multivariate analysis, we found that the personality traits neuroticism and impulsiveness best correlated with the perception of stress. The scale “neuroticism” of the EPQ-R questionnaire outlines a person who tends to be overly worried, anxious, and emotional, while the scale “impulsivity” of the IVE questionnaire outlines the tendency to act in a risky way, without adequately considering the consequences of one’s actions. These results confirm the influence of individual personality traits on vulnerability to stress in drivers [37–40].

4.1. Limitations of the study

It has to be underscored that the present study has several limitations considering the type of study – cross-sectional – and the methodology used, both in selecting the sample and measuring the different indicators considered.

Our sample size is small, probably because subjects were recruited on a voluntary basis, without a direct and immediate advantage from their participation in the research.

Regarding the subjective indicators selected, we considered the possible biases related to a self-reported investigation in a small sample of subjects. In order to minimize these limitations, we administered several questionnaires and also performed objective measurements. For subjective stress perception, both the PSS-10 and the DSI have limitations. The PSS-10 is quite short and investigates stress
perception in a general manner: this questionnaire is sensitive for detecting distress situations and is widely used, but is not specifically meant to identify work-related issues [18]. We tried to cover this gap by using another subjective questionnaire, the DSI, which is very specific for professional driving, but data in the scientific literature is scanty [24].

Considering objective measurements, the two biomarkers used in the present study, salivary cortisol and α-amylase, are easily detectable and widely employed [41–43], but the results of their association with job stress are often conflicting, possibly due to their high inter- and intra-variability in following circadian rhythms. We tried to avoid these limitations by using standardized methods during the same periods of the day off and working days. However, we believe that further research is needed to confirm the lack of association of these biomarkers with stress perception and correlations with the various personality traits considered.

5. Conclusion

In the present study, we performed a detailed investigation of individual work-related stress in a sample of Italian bus drivers, using both subjective (questionnaires) and objective (salivary biochemical indicators) methods, thus providing an integrated evaluation of this complex phenomenon.

Bus driving in city traffic, according to data in the international literature, can be considerably stressful for some individuals. Our data confirm the important role that personality traits play as they are associated with both activation of the neuro-endocrine response (cortisol and salivary α-amylase) during driving and with the drivers’ perception of stress.

Despite the limited size of our sample, which may not be representative of the overall population of urban bus drivers, the results of our study provide useful considerations, especially when comparing them with the recent scientific literature. In disagreement with other studies, we found no significant association between biochemical markers and scores of the questionnaire specifically investigating “perceived stress”. This finding is in agreement with the statement that stress assessment in workers must consider integrated measures, and thus it cannot be based on a single indicator.

However, considering the limitations in the measurement of salivary α-amylase and cortisol, as well as the conflicting results in the literature, further research is needed to better understand these aspects.

Regarding the personality traits investigated through specific questionnaires, we found that certain personality characteristics have an interesting role in the vulnerability of bus drivers to stress: in particular, “neurotic” and “impulsive” traits were associated with higher stress perception. This result may be useful for future research, in order to further investigate this association and possibly implement measures to prevent accidents in the professional driving sector, for example by employing specific preventive actions for workers with these types of behaviors that aim to minimize their vulnerability to work-related stress.

In conclusion, our data affirms that adequate consideration of individual factors, such as personality traits, are useful within a global organizational intervention focused on reducing stress in professional drivers. Among the possible preventive strategies to reduce work-related stress, organizational and individual interventions, e.g. adequate rest intervals between shifts, barriers between drivers and passengers, ergonomic seats, providing information to workers about risks and specific individual training for possible behaviors to adequately manage stressors may be beneficial. Such actions are definitely useful to improve the health of drivers, but also the safety of passengers.

Acknowledgments

We wish to thank the public transportation company of our city for the availability and interest in investigating the complex phenomenon of stress during driving.

Conflict of interest

None to report.

References


