

Bus driver well-being review: 50 years of research

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Abstract

This review paper consolidates the key research on the occupational health of urban bus drivers since the 1950s. Several electronic databases were searched and 27 key studies were identified, which form the basis of this paper. Early findings that bus drivers are liable to suffer ill health as a result of the job remain true today. The research has, however, demonstrated a greater understanding that specific stressors result in certain physical (cardiovascular disease, gastrointestinal disorders, musculoskeletal problems, fatigue), psychological (depression, anxiety, post-traumatic stress disorder) and behavioural outcomes (substance abuse). Bus driver ill health will have consequences for organisational performance in terms of employee absence, labour turnover and accidents. Stressors for bus drivers include poor cabin ergonomics, rotating shift patterns and inflexible running times. Over the last few decades, the heightening of other work stressors such as traffic, and violence from passengers have compounded the situation for bus drivers. Greater attention to salient moderating and mediating variables in the stressor–strain relationship is featuring in more recent research. Despite such theoretical advances, the research needs to also concentrate on practical interventions that are systematically implemented and evaluated, to improve the well-being of bus drivers. By improving this ‘human side’ of the role, it is expected that the efficiency of this transport will be enhanced for bus drivers, operators and passengers alike.

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1. Introduction

It was in 1829 when horse-drawn passenger services (omnibuses) were first introduced to the UK. The advent of regular motorbus services did not arrive until circa 1898 (Hibbs, 1968). Today in the UK (2000/01), there is an estimated 116,400 bus/coach drivers and crew, operating on 79,700 vehicles covering a total 2542 million kilometres a year (Department for Transport, 2003). Like many other passenger transport industries, the safety of travellers and other road users is of prime importance. Bus drivers must successfully balance the competing demands of safety, customer-focused service and company operating regulations. The physical and psychological health of the bus driver is a critical factor in driving performance. Any impairment can have undesirable consequences for passengers and bus operating companies alike. Acknowledging that the bus is

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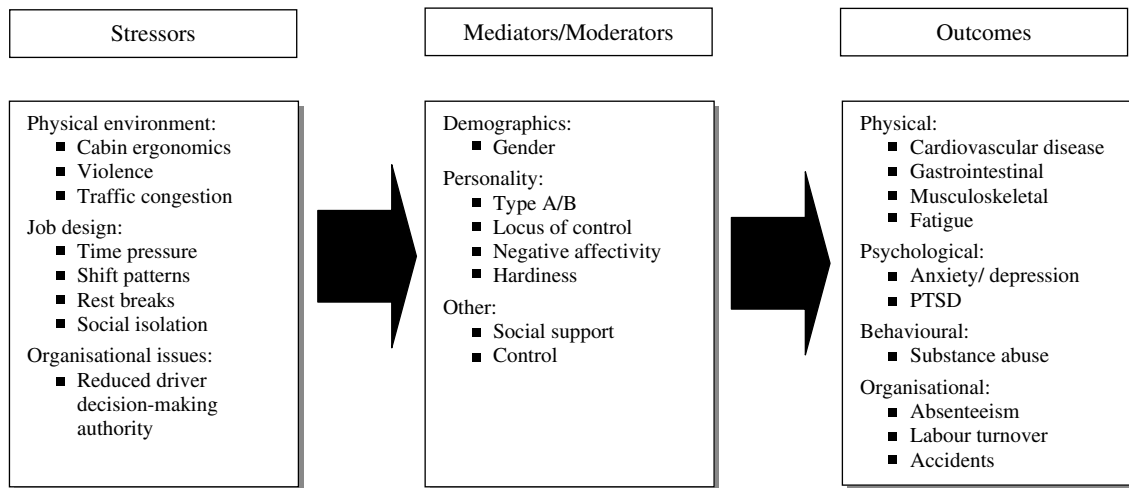


Fig. 1. Key job stressors, mediating/moderating variables, and outcomes of occupational stress for bus drivers.

one of the most popular modes of public transport worldwide, and that the strong likelihood of this transport enduring for the foreseeable future, then there clearly is a need to actively address the psychosocial work environment of bus drivers.

In terms of research interest, it was not until the middle of the 20th century when occupational health into urban bus drivers began. Seminal work published by Morris and colleagues (Morris, Heady, Raffle, Roberts, & Parks, 1953a, 1953b) established the potentially noxious nature of professional bus driving, a fact that largely remains today. A number of related reviews have been undertaken in this area (Evans, 1994; Kompier & di Martino, 1995; Winkleby, Ragland, Fisher, & Syme, 1988a) with the *Journal of Occupational Psychology* devoting an entire issue in 1998, to studies of urban mass-transit operators. This paper considers some of the more recent research as well as attempting to consolidate the earlier studies regarding the job, work stressors and outcomes for bus drivers and operators. Key moderators and mediators in the stress process for bus drivers are also discussed, along with consideration of future directions for research and practice.

The general literature on occupational stress is well developed and several generic models exist. To provide an organising framework for this review, a stressor–strain model focused on bus drivers is presented in Fig. 1 similar to general models conceptualised by other researchers (e.g., Cooper & Marshall, 1976; French, Caplan, & Harrison, 1982; Schuler, 1982).

This simple model illustrates the stressors intrinsic to the working environment, moderated and mediated by a series of factors leading to particular individual and organisational costs. Such a model does not take into account individual cognitions (i.e., appraisal), but serves to demonstrate salient variables in the stress process for bus drivers (for a more complete analysis of general stressors see Cox, 1993).

2. Method

Using a combination of search terms including “bus driver”, “occupational stress”, “well-being”, “health” and “professional drivers”, several electronic databases (PsychARTICLES, PsychINFO, PubMed, ScienceDirect, Swetswise and Web of Science) were used. Papers that fulfilled the following criteria were considered: (i) sample included bus drivers, (ii) appeared in peer-reviewed psychological or medical journals and, (iii) published in English. From this process, 27 studies and their key findings were identified and are presented in Table 1. A more thorough detailing of each study is shown in the table in Appendix A. From evaluating these studies, it becomes apparent that they have concentrated on bus drivers’ physical health, psychological health, behavioural/ affective outcomes, and organisational indices of health (i.e., work absence, labour attrition and accidents). Attempts to identify moderating and mediating variables in the stressor–strain relationship are also apparent. This information was supplemented by retrieval of published reports and information from the World Wide Web. Therefore, this paper brings together the main findings of such studies beginning with the physical health of bus drivers.

Table 1

Summary of results of the studies reviewed on the health and well-being of bus drivers (listed in chronological order)

Author/year	Main results in relation to bus drivers
Morris et al. (1953a, 1953b)	Higher mortality rate and risk of first clinical episodes of CHD and earlier onset of CHD for drivers than conductors—linked to sedentary nature of driving
Norman (1958)	Less absence due to bronchitis for drivers above 45 years old than for conductors. Gastroduodenal related absence more apparent for older drivers
Holme et al. (1977)	High blood pressure. CHD and lung cancer mortality consistent with their high smoking, high triglyceride and cholesterol levels
Backman and Järvinen (1983)	Over 10 years, 60% of drivers remained in the job. Drivers perceived the job to be physically light but mentally demanding
Evans et al. (1987)	Type As had higher: diastolic blood pressure, accidents, sickness absence, reprimands, and reported stress than Type B drivers
Ragland et al. (1987)	Hypertension rates amongst drivers greater than for control sample
Winkleby et al. (1988b)	Surprising inverse association between self-reported stress and hypertension. Positive association found between self-report stress and gastrointestinal, respiratory and musculoskeletal problems
Paradis et al. (1989)	IHD not statistically higher in drivers compared to male population. Mortality from a range of cancers was lower than expected
Duffy and McGoldrick (1990)	Mini-bus drivers had less stress and more job satisfaction than traditional bus vehicle drivers. Very poor mental health was found in 13% of the driving sample
Kompier et al. (1990)	Work absence 2–3 times higher than national average. Only 1 out of 9 drivers worked until retirement age, a finding partly related to disablement which was much higher than comparative professions
Carrère et al. (1991)	Blood pressure and Type A behaviour not related to level of job strain. Catecholamines higher for job strained drivers
Evans and Carrère (1991)	Increased traffic congestion related to elevations of adrenaline and noradrenaline. Greater job control reduced noradrenaline
Rosengren et al. (1991)	Drivers had around 3 times greater incidence of CHD and higher mortality than controls
Albright et al. (1992)	Inverse relationship between self-reported stress and hypertension found, but disappeared after confounding variables were controlled
Anderson (1992)	Back pain was the most common musculoskeletal complaint. Pain also found in neck and thorax
Fisher and Jacoby (1992)	Bus drivers experienced fewer assaults than conductors. Of those assaulted, 23% went on to develop PTSD
Alfredsson et al. (1993)	Mortality rate and mortality due to cancer of drivers no different to population. Greater population density appeared to increase mortality risk from MI and IHD, due to more intense psycho-social pressures of the job and environment
Hedberg et al. (1993)	Blood pressure did not differ between bus and truck drivers. Drivers were more obese, smoked more, had less leisure time and physical activity, and less social support at work than controls
Magnusson et al. (1996)	Drivers had greater lower back pain than sedentary workers and this was related to greater work absence for drivers. Stress related to sick leave
Aronsson and Rissler (1998)	Gender differences in perceived demands of traffic congestion and passengers. No differences found for hormone levels nor self-reported mood
Greiner et al. (1998)	Higher levels of stress related to greater work absence. Increased time pressures related to greater accident risk
Peter et al. (1998)	Chronic stress most evident for bus/subway drivers than referents. This stress was associated with physical and behavioural ill-health
Rydstedt et al. (1998a)	Intervention to improve traffic flow improved perceived control, but health status did not improve
Rydstedt et al. (1998b)	Workload increases intensified perceived effort and fatigue
Vedantham et al. (2001)	Experience of PTSD leads to enduring physical health problems
Wang and Lin (2001)	Greater CHD risk seen in bus drivers, compared to others, due to higher: obesity, blood pressure, heart disease, cholesterol and triglyceride levels

Abbreviations: CHD = coronary heart disease; IHD = ischaemic heart disease; MI = myocardial infarction; PTSD = post-traumatic stress disorder.

3. Physical health

Studies have shown that there are marked health differences for urban bus driving compared to other occupations. Holme, Helgeland, Hjermann, Leren, and Lund-Larsen (1977) conducted a study of 14,677 Norwegian males aged between 40 and 49 drawn from a group of different occupations. Bus drivers were one of the professions with worst health, based on a range of health indicators (e.g., serum cholesterol levels, systolic blood pressure, body weight). More specifically, the literature indicates three salient categories of morbidity prominent in populations of bus drivers; cardiovascular disease, gastrointestinal disorders, and musculoskeletal problems (Backman, 1983; Winkleby et al., 1988a). These will now be expanded on in turn:

3.1. Cardiovascular disease (CHD)

There are several main risk factors associated with the development of coronary heart disease (see Wood, 2001) and some studies have indeed corroborated that bus drivers have a high risk of developing CHD as a result of such factors. Ischaemic heart disease (hardening of the coronary vessels) has found to be greatest for the following profile of driver: middle aged, male, between the ages of 50 and 59, driving as opposed to conducting, consumption of cigarettes, obese, short in height, and whose parents die aged between 40 and 64 (Morris, Kagan, Pattison, Gardner, & Raffles, 1966).

Earlier research by Morris et al. (1953a), investigated the CHD risk of bus drivers compared to bus conductors working on the same routes. Drivers were twice as likely to die from CHD and at an earlier age than conductors on the same vehicles. This difference was explained by three possible reasons: (a) selection factors, (b) the greater mental strain for drivers and, (c) the sedentary nature of driving compared to conducting. Although this third explanation is credible since exercise is known to protect against CHD risk (Press, Freestone, & George, 2003), this finding in studies of bus drivers and conductors has been subsequently challenged. Rosenman and Friedman (1958) reanalysed the data from Morris and his team, and found that drivers and conductors in suburban areas had greater CHD rates than for downtown equivalents even though they all had similar levels of exertion. This fact is further supported by an Italian study by Rusconi et al. (1975), as cited by Long and Perry (1985). They showed that CHD was again higher for bus drivers than for conductors, despite the fact that the job of Italian conductors was a stationary one with no discernable differences in energy expenditure to drivers. This pattern of elevated risk of CHD morbidity and mortality for bus drivers is also evident in developing countries (e.g., Wang & Lin, 2001), and from comparisons with other occupational groups and population norms (Rosengren, Anderson, & Wilhelmsen, 1991). Rosengren's study, which controlled for socio-economic status—often seen as a risk factor in CHD aetiology, found a double rate of CHD incidence for bus and tram drivers compared to 30 other sampled occupations. Smoking and systolic blood pressure rates were similar between the drivers and the control group, however drivers were more obese. Obesity as a CHD risk factor has been implicated along with drivers' irregular eating habits, low levels of physical activity at work and at leisure, smoking and even poor social networking (Hedberg, Jacobsson, Janlert, & Langendoen, 1993). However, another Swedish study concluded that smoking was unrelated to the development of myocardial infarction (heart attack) in bus drivers since incidence of lung cancer was no different to population norms, but drivers still had a higher propensity to experience myocardial infarction (Alfredsson, Hammar, & Hogstedt, 1993).

Studies of hypertension have also shown interesting results for bus drivers. Pikus and Tarranikova (1975) as reported by Long and Perry (1985), noted that as much as 42% of their Russian bus driver sample had hypertension with a positive relationship between hypertension and length of service. Such results have been confirmed by other studies, yet as Winkleby et al. (1988a) criticise, many such studies have not adequately controlled for demographic and behaviourally confounding variables. However, even studies that have adopted rigorous methodological controls show similar findings. In a sample of 1500 American bus drivers, hypertension was much higher than matched control groups drawn from the general population (Ragland et al., 1987). Conversely, a later study conducted with 1396 American bus drivers failed to find a significant positive association between subjective reports of occupational stress and prevalence of hypertension (Albright, Winkleby, Ragland, Fisher, & Syme, 1992). In fact, some studies have reported an inverse relationship between hypertension and measures of self-reported stress (Winkleby, Ragland, & Syme, 1988b). They account for this pattern exhibited by hypertensives as a consequence of two possible mechanisms: (a) repres-

sion of anger/hostility as a coping mechanism facilitating the development of hypertension or, (b) elevated blood pressure leading to hemodynamic changes that alter perception. Thus methodologically, it is claimed that self-report indicators of stress may not necessarily provide an objective measurement of the work environment, for hypertensives at least.

Such findings naturally lead on to the question of what aspects of the bus driver's environment augment the risk of coronary related malady. Suggested factors include specific job characteristics—shift work, increased work pace and traffic, rigid time schedules and noise in combination with prolonged exposure to toxic fumes from other vehicles (Alfredsson et al., 1993; Gustavsson et al., 1996; Rosengren et al., 1991).

Carbon monoxide, sulphur dioxide and nitrogen oxides present in vehicle fumes, have been confirmed in escalating CHD risk for bus drivers (Michaels & Zoloth, 1991; Stern, Halperin, Hornung, Ringenburt, & McCammon, 1988). However, a French study by Limasset, Diebold and Hubert (1993) as reported by Gustavsson et al. (1996), found that concentrations of such gases in bus cabins were well within occupational exposure limits and indeed no different to that found in the air of two major French cities. Cabin air toxicity appears to depend on a series of variables including vehicle cabin height/volume, cigarette smoke exposure, fuel type, urban/rural environment and climatic conditions (Gustavsson et al., 1996; Jo & Yu, 2001).

In one study ($n = 376$), 69% of bus drivers rated traffic, as a job stressor, to be a 'regular or major problem' (Duffy & McGoldrick, 1990). Not only has psychological strain been noted for general drivers in traffic congestion (Hennessy & Wiesenthal, 1999), but physiological reactions in bus drivers have been also established (Evans & Carrère, 1991; Gardell, Aronsson, & Barklof, 1983). Indeed, it is time pressure and impediments to the driver's primary task that makes congestion such a stressor especially where time urgency is apparent (Af Wåhlberg, 1997; Evans & Carrère, 1991; Greiner, Ragland, Krause, & Syme, 1997). Relating this back to health, Netterstrøm and Suadicani's (1993) longitudinal study of 2465 bus drivers, showed that drivers in high traffic density areas suffered greater risks of ischaemic heart disease (IHD) after 10 years of service. They conclude that there was an 80% increased risk of IHD for those working in high traffic as opposed to low traffic areas. An intervention study which measured well-being in relation to improved traffic flow initiatives, found that a greater sense of control developed for drivers, whilst systolic blood pressure, heart rate and self-reported stress all significantly reduced (Rydstedt, Johansson, & Evans, 1998a).

Other environmental features affecting traffic flow will act as stressors such as illegally parked vehicles increasing manoeuvring demands, as well as demanding passengers, road diversions, and mechanical problems. However, it is important to note that being 'early' may equally result in similar negative consequences since drivers must adhere to strict times of service delivery. Failure to stay on time will incur passenger complaints, reduced or foregone rest breaks, penalties from management, and even conflicts with colleagues assigned to take over the vehicle.

Shift work involves drivers contending with continually rotating patterns of early and late spells. 'Split-shifts', a combination of a morning and afternoon/evening shift with a long break in-between are common. Bus drivers on irregular shifts tend to show greater subjective fatigue and physiological stress than drivers on regular shift patterns partly due body clock changes (Miller & Mackie, 1980). Social problems result from repeated shift changes such as disruptions to marital relationships (Gardell et al., 1983), reduced parent-child contact (Evans & Johansson, 1998), problems unwinding at home and sleeping disorders (Kompier, 1996). As Brown (1994) points out, human performance adaptation to irregular shift patterns is difficult if not indeed impossible.

Cardiovascular disease has also been linked to high threat-avoidant vigilant work where a high level of continued alertness needs to be maintained (Belkić et al., 2000). Driving can be conceptualised as such a task (Fuller, 1984), with strain for bus drivers arising from the awareness to safeguard passengers from traffic hazards (Joshi, Senior, & Smith, 2001).

The aetiology of CHD has also been studied in relation to the Job Demand-Control (JDC) model (Karasek & Theorell, 1990). The model predicts that individuals who have a high level of job demand coupled with low control in the form of decision latitude will develop job strain. Prolonged job strain is said to predict high levels of CHD. Karasek and Theorell originally classified the role of bus driving as low demand/low control, though Hedberg et al. (1993) found a mixture of self-reported high/low demand and high/low control for their bus drivers. The role is often conceptualised as high in demands (i.e., traffic congestion, rotating shift patterns, negative passenger interaction, tight running times, etc.) and low in control with respect to effectively managing such factors and a distinct lack of input into management decisions and shift allocation. This is thought to predispose

bus drivers to CHD morbidity/mortality (Kompier & di Martino, 1995). Finally, social isolation and poor social support appears to aggravate cardiovascular disease as a result of increased job strain (Johnson & Hall, 1988), a fact that has led to the incorporation of social support into the JDC model. This is important since it is claimed that drivers experience social isolation on-the-job (Evans & Johansson, 1998) due to the lack of opportunity to interact with colleagues, in addition to reduced exposure and convenience in conversing with passengers.

3.2. *Gastrointestinal problems*

Higher rates of stomach and duodenum disease-related work absence in drivers and conductors over male workshop staff in London (over 45 years of age) has been shown (Norman, 1958). This was attributed to the rotating-shift systems in operation for drivers/conductors as opposed to regular daytime factory hours for workshop staff. Similarly, 6400 Italian transport drivers and conductors were nearly 5 times more likely to suffer from digestive problems compared to 4350 transport labourers and office workers (Berlinguer, 1962). Pronounced rates of digestive disorders and nervous problems were also revealed in 800 German bus drivers compared to matched administrative workers (Garbe, 1980). Parallel conclusions are drawn by Aronsson and Barklöf (1980), who discovered that strenuous working conditions and irregular working schedules of bus drivers were related to reported levels of gastrointestinal complaints. They further add that meal hour irregularity and poor eating habits mediated the observed relationship between irregular work schedules and complaints. Another contributory mechanism may be the prolonged seated posture relaxing the abdominal muscles which when combined with curvature of the spine, is counterproductive to digestion and breathing (Grandjean, 1988). Backman (1983) has been one of many researchers who have also demonstrated a high occurrence of stomach ulcers in professional drivers linked to job characteristics, although more recently research implicates bacterial aetiology (NIH Consensus Development Panel, 1994).

3.3. *Musculoskeletal disorders*

A bus driver is fundamentally constrained to the driver's cabin, which does not afford much room for flexing and movement of limbs. A static posture aggravates accumulated muscle tension with little release. This is further worsened from extended hours behind the wheel. As already established (Evans, 1994; Göbel, Springer, & Scherff, 1998; Kompier & di Martino, 1995; Krause, Ragland, Fisher, & Syme, 1998; Winkleby et al., 1988a), backache in particular is an often-reported stressor for drivers, though other areas of pain genesis from the neck, shoulder and knee are also evident (Kompier, 1996; Kompier & di Martino, 1995). The development of musculoskeletal disorders (MSDs) largely relate to an individual's physical development, as well as health status, psychosocial and physical (quantity and quality) load. Physical agents such as whole-body vibration coupled with static postures and frequent twisting of the spine contribute to lower back pain (Bovenzi & Zadini, 1992). Neck pain has been attributed to the frequent sharp turns of the head to the left and right when boarding passengers and driving (Anderson, 1992). Psychosocial load for transit drivers independently predicts spinal injury even when physical load is taken into account (Krause et al., 1998). The psychosocial factors of job dissatisfaction, low supervisor support, high psychological demands, and frequency of specific job problems (e.g., mechanical failure, inability to maintain timetable) are predictive of spinal and neck pain (Krause et al., 1998; Krause, Ragland, Greiner, Syme, & Fisher, 1997). Finally, another implicated factor in the origin of MSDs is associated with the previous mentioned need for continual vigilance particularly in high traffic conditions (Kompier & di Martino, 1995).

The effect of psychosocial stressors is blatantly revealed in one study cited by Aptel and Cnockaert (2002). The research examined 30,000 manufacturing workers over a 6-year period. By reducing psychosocial strain, cases of MSDs dramatically reduced from 255 to 10, coupled with benefits of improved job satisfaction, productivity and reduced labour turnover and absenteeism. Despite such findings, an assessment of the literature suggests that the role of stress and work-related psychosocial factors in the development of MSDs is poorly understood with a lack of consensus in the epidemiological data. According to Bongers, de Winter, Kompier, and Hildebrandt (1993), psychosocial factors may affect mechanical load through changes and movement, and exerted forces such as time pressure increasing hurried movements with high accelerations or poor posture. This subsequently, along with personal coping capacity, may lead to (a) increased muscle tone and, (b) inten-

sified perceptions of the experienced pain symptoms from mechanical load and/or reduced capacity to cope with symptoms.

3.4. Fatigue

Fatigue for drivers is usually apparent “*when an individual cannot meet self-imposed or externally imposed performance goals but is forced to continue working under adverse conditions by a sense of duty and/or the need to safeguard the lives of others*” (Brown, 1994, p. 299). According to Brown, four main mechanisms hinder attainment of goals for drivers. Firstly, duty periods and shifts that are too long cause an individual to take a longer time to respond to simple tasks. For more complicated perceptual-motor skills, responses become mistimed (right action but at the wrong moment). Secondly, missed rest pauses and missed meal breaks are apt to fuel feelings of fatigue. Deficient food intake further impairs driving performance (Lisper & Eriksson, 1980). Thirdly, sleep deprivation promote tiredness, and this can be dangerous where ‘microsleep’ (a period of a few seconds sleep) may occur on-the-job. This phenomenon coupled with degraded signal discrimination means that accidents can occur due to the detection failure of critical signals. Finally, circadian rhythms dictating the daily cycle of activity in organisms, may be disturbed by rotating shifts patterns, which will aggravate fatigue symptoms. Despite European law prescribing the arrangement of working shifts, Brown (1994) points out that commercial pressures to retain maximal flexibility in the scheduling of haulage operations, may lead to rule breaking. Such pressures when applied to passenger services may well encourage drivers to drive even when they feel tired, which can increase driver stress and lead to greater accident risk.

Fatigue has also been documented as an outcome in relation to exposure to physical violence (Bültmann et al., 2000). Even if violence is experienced vicariously (i.e., witnessing someone being assaulted), symptoms of fatigue can persist beyond 5 years from initial time of encounter (Hogh, Borg, & Mikkelsen, 2003).

3.5. Other physical health outcomes

A number of other health documented outcomes for bus drivers include nervous disorders (Norman, 1958), bronchitis and inflammation of the spinal nerve (Maciulyte, 2000). One study reported that subjective health symptoms (weakness and fatigue) increased in parallel with objective measurements of blood carbon monoxide exposure for bus drives (Abdollahi et al., 1998). Other researchers have investigated links between motor vehicle exhaust emissions and the development of cancer but have produced mixed results. Paradis, Theriault, and Tremblay (1989) evaluated 15 studies and found that 10 of those failed to demonstrate a significant excess risk of lung cancer. They also failed to show any elevated risk of lung and bladder cancer in their own study of Canadian bus drivers. They concluded that smoking, alcohol and diet are stronger predictors of lung cancer than a bus driver’s exposure to vehicle exhaust fumes. A more recent study did however find that bus and tram drivers in Copenhagen were at greater risk of developing a range of cancers (larynx, liver, mouth, pharynx and in particular lung) especially for those with longer service (Soll-Johanning, Bach, Olsen, & Tüchsen, 1998). However, acknowledging that smoking and other lifestyle factors had not been controlled for, a subsequent re-analysis of the data revealed that there was actually a decreasing risk for lung cancer with increasing years of service (Soll-Johanning, Bach, & Jensen, 2003).

4. Psychological health

For the general population, the psychological health outcomes typically associated with stress are depression and anxiety. These states along with paranoid ideation (feelings of suspicion and a sense of being persecuted) and psychoticism have been found to be related to lower back pain in Turkish bus drivers (Issever, Onen, Sabuncu, & Altunkaynak, 2002). The same states (except for psychoticism) were also positively associated with service length. Additionally, using the Crown-Crisp Experiential Index, it was found that 13% of 376 British bus drivers had mental well-being comparable with psycho-neurotic outpatients, which is above the instrument’s indication that only 5–10% of the normal population would score equally as high (Duffy & McGoldrick, 1990). It is not clear from such studies what the aetiology of such diminished psychological health is, but it is rationale to suspect that its roots are connected with some characteristic(s) of the job. Beside

the above two studies, within the literature on bus drivers, much more research has pursued the trauma-related psychological outcomes of being assaulted.

4.1. Post-traumatic stress disorder

One particular stressor that has been implicated in poor psychological health for bus drivers is negative passenger interaction (Evans, 1994). This can involve obnoxious behaviour, fare evading, or even physical assault. Longer-term psychological distress in the form of post-traumatic stress disorder (PTSD) may be a rare symptom for bus drivers, but nevertheless an insidious one. PTSD is an anxiety disorder comprised of feelings of intense fear, helplessness accompanied by nightmares, flashbacks, irritability and startled responses that persist beyond a month from onset (DSM-IV—American Psychiatric Association, 1994). Violent transgressions, which could elicit such symptoms, against bus drivers in the UK, are a cause for concern. Indeed the highest reported stressor in a study of British bus drivers was the risk of physical assault from passengers (Duffy & McGoldrick, 1990). This is not surprising given that in 1993, there was a reported 1500 assaults on bus crews in the UK, which amounts to four assaults a day, every day of the year (Department for Transport, 1995). More recent figures published from the British Crime Survey (a nationally representative household survey measuring both the nature and extent of crime against people in England and Wales) indicated that in 2000, public transport workers were the category of occupation most worried about being assaulted (Budd, 2001). A high number of transport workers (47%) were worried about threats, and a similar number were worried about assaults on-the-job (46%). Public transport workers are up to four times more likely to face the threat of violence at work compared to the ‘average worker’ (Violence at work, 2003).

Fisher and Jacoby (1992) found that in a sample of physically assaulted bus drivers, PTSD and mild depression were likely to develop more than for non-assaulted bus drivers. Despite the small sample size of 22 assaulted drivers (typical of studies on victims of assault), they found that 23% developed PTSD as a result. This, they point out, is a percentage rate similar to people drawn from populations experiencing natural disasters, civilian disasters and hospitalised trauma victims. It has also been established that traumatic exposure leading to PTSD is linked to greater health problems (back problems, gastrointestinal disease, chronic bronchitis, *inter alia*) than for people who have not been exposed to trauma, or people who have been exposed to trauma but do not go on to develop PTSD (Vedantham et al., 2001). Thus, there appears to be an interaction effect between physical and psychological health complaints and development of PTSD. Though it must be acknowledged that this cited study relied on self-report measures so it cannot be precluded that there was systematic reporting bias in the group with PTSD compared to the other groups.

In addition to the already declared psychological symptoms, other outcomes for assaulted employees include depression, anxiety, and low job satisfaction (Driscoll, Worthington, & Hurrell, 1995). It appears that fear of danger has a mediating role in producing emotional health outcomes (Schat & Kelloway, 2000), which may be important considering the aforementioned frequency of physical attacks on UK bus drivers. Fear following physical assault additionally appears to promote enduring fatigue (Hogh et al., 2003), as well as reduced driver performance (Blau, 1981).

5. Behavioural outcomes

5.1. Alcohol use

The use of alcohol to help cope with stress has been well researched. Although there are a range of occupational and non-occupational factors involved in alcohol consumption patterns, alcohol use amongst urban bus drivers has been suggested as a form of coping with occupational stress when other forms of coping are not possible or are blocked in some way (Ragland, Greiner, Krause, Holman, & Fisher, 1995). Ragland and his team found that there was a positive association between the number of years driving buses and the average weekly alcohol consumption (from new drivers right through to those serving up to 14 years). The number of ‘heavy drinkers’ (more than 15 drinks per week) was also progressively higher as service tenure increased. Furthermore, they discovered a negative relationship between consumption and job satisfaction. A positive association was found not only between consumption and self-reported frequency of job stress, but also consumption and self-

reported strain reactions. This finding thus supports the idea that the use of alcohol, as a form of coping, helps in some way to manage the psychological effects of strain. There additionally appears to be a correlation between alcohol dependency, problem drinking and volume of drinking with the specific stressor of job monotony for bus drivers (Greiner, 1996). More recently, it has been found that measures of burnout correlate with alcohol dependency amongst transit drivers (Cunradi, Greiner, Ragland, & Fisher, 2003).

5.2. Tobacco use

Smoking is often attributed to relieving feelings of stress. The levels of smoking for bus drivers have been reported in various studies (e.g., Bovenzi & Zadini, 1992; Hedberg et al., 1993; Holme et al., 1977; Maciulyte, 2000). In particular, it has been shown that increased smoking is accompanied by increased levels of on-the-job strain especially in monotonous working conditions (Greiner et al., 1997). Moreover, hindrance to the opportunity to smoke as well as trying to give up smoking has been connected to greater levels of strain in airline pilots as a result of plasma nicotine depletion in the blood, which is related to lowered performance (Sommese & Patterson, 1995). This is important, bearing in mind that many UK bus operators have an anti-smoking policy for drivers.

5.3. Drug use

Another form of coping relates to the use of drugs, whether non-prescribed, prescribed or illegal. Drivers with back pain may seek relief by using medicinal drugs (Anderson, 1992). Mulders, Meijman, O'Hanlon, and Mulder (1982) document a Scandinavian study that found minor tranquillisers (and alcohol) use was related to sleep complaints. Referring back to Ragland et al.'s (1995) study, evidence was found for greater drug abuse linked to greater levels of stress. The influence of shift-work appears to compound such practices, with a pattern of using stimulants during the night to remain alert at work, and consumption of sleeping tablets when attempting to sleep during the day (Grandjean, 1988).

6. Organisational outcomes

6.1. Absenteeism

There are a range of positive and negative reasons not only to be away from work but to stay at work (Kristensen, 1991). Naturally, physical and psychological health status is one key predictor of absenteeism. As mentioned, the potentially noxious nature of bus driving can have health effects that may account for the higher than average work absence figures in the bus industry. According to Winkleby and her colleagues, "*transit studies examining work absences due to illness have consistently shown that bus drivers have more frequent absences of longer duration than groups of employees from other occupations*" (Winkleby et al., 1988a, p. 259). They further comment that the approximate difference in absenteeism levels between bus drivers and control groups is in the region of two to three times greater for drivers. Average rates of absenteeism for Dutch drivers has been reported to be twice greater than the Dutch population average (Kompier et al., 1990; Mulders et al., 1982).

Explanations of such patterns of absence can be further accounted for by job characteristics (North, Syme, Feeney, Shipley, & Marmot, 1996). Berlinguer (1962), as cited by Long and Perry (1985), found a 2.5-fold increased frequency of absence due to illness in Italian drivers/conductors when compared to white-collar workers. Berlinguer suggested that the absenteeism resulted from uncomfortable and fatigue-inducing working conditions, extended hours of work, a situation aggravated by resorting to 'call in sick' when denied leave (establishing the idea of malingering). Other researchers (e.g., Barton & Folkard, 1991; Leahy, Sprague, & Schlegel, 1979) further confirm the economic and social factors in attendance/non-attendance. Due to surplus opportunities for overtime in periods of labour shortages, drivers believe that the pay lost from unofficial days off can easily be regained from overtime. A pattern of more absences falling on the weekends is also apparent. In reviewing the absence literature for bus drivers, Long and Perry (1985) highlight three of the most salient issues being (a) widespread availability of overtime pay makes the economic benefits of regular attendance less

clear, (b) scheduling inflexibility—obstructing legitimate opportunities to take required time off, and (c) occupational stressors (including tight schedules, long hours, split shifts, poorly maintained equipment, difficult interaction with passengers, and threats of physical violence from passengers).

In one study, a higher report of psychosomatic complaints was connected to those temporarily/permanently disabled from bus driving and/or absence frequency (Meijman & Kompier, 1998). Interestingly, illness (psychosomatic complaints and musculo-skeletal problems) contributing to absenteeism, was determined by the driver's priority to either safety or schedule maintenance. Drivers who viewed safe driving as a priority suffered less absenteeism. Those who tried to maintain the running schedule at the expense of safety had higher absenteeism levels. Moreover, drivers who were disabled from working as a result of the job were found to favour balancing both safety and schedule.

The implications of work absence for other drivers may mean that those present must work extra hours to cover their absent colleagues' workloads. This of course may create the added burden of greater working hours promoting greater fatigue. Bus operators on the other hand have to fulfil their primary objective of providing an efficient and reliable service to the public. Therefore, absent employees are in reality unproductive workers, who create scheduling problems, and generate added cost for their employers. Such cost will entail paying other drivers to cover absent employees, and continuing to pay the wages of those on sick leave. Such expense associated with work absence has been estimated to consume over a quarter of the total US government transportation budget (Long & Perry, 1985).

6.2. *Labour turnover*

One other outcome of a job with high occupational strain is high labour turnover. This may be as a consequence of physically demanding work leading to disablement. Referring back to the study by Pikus and Taranikova (1975), drivers aged in their 40s were at particular risk of early retirement as a result of hypertensive morbidity. Moreover, Mulders et al. (1982) recount a study that indicated that only one out of 10 drivers leaving one transport company had reached official retirement age (60 years). Early retirement was the norm, and most drivers retired around the age of 47 due to general medical disability. Similarly, Göbel et al. (1998) refer to a study by Giesser-Weigl and Schmitt (1989), which reports that German bus drivers are often forced to withdraw from the profession aged 50, usually with less than 20 years of bus driving experience. Furthermore, only 5% of drivers usually pass the frequent medical assessments, to eventually retire at the age of 63. Dutch research reports only 11% of drivers leave at official retirement age (Kompier et al., 1990). In that study, 29% of drivers were classed to have medical disablement with no working capacity present. Such disablement was related to three main sources: (a) 35% due to back, tendon and joint disorders; (b) 35% due to mental disorders; and (c) 12% due to cardiovascular diseases. One in four drivers left at their own will, presumably because of dissatisfaction with the job. Finally, it was revealed that long-term absence was a strong predictor of future disability.

6.3. *Accidents*

In 2002 in the UK, 10,781 fatal and non-fatal casualties were recorded from accidents involving buses, coaches and minibuses (Department for Transport, 2003). Developments in technology, safety awareness, and transport legislation have generally reduced casualties over the last few decades in the UK, though this is not the case for many developing countries (Pearce & Maunder, 2000). In comparison to other modes of transport (Department for Transport, 2003), the rates of accidents are relatively low. However, despite this fact, there should be no complacency with the introduction of higher passenger capacity 'double-decker' and articulated bus vehicles, where drivers may be responsible for as many as 140 people. In the event of a major accident, the implications of injury or even death cannot be ignored.

In the research on accidents in the bus industry, there has been consideration of several factors. Age (Greiner, Krause, Ragland, & Fisher, 1998) and experience of drivers (Blom, Pokorny, & van Leeuwen, 1987) appear to influence accident risk (negative association between the number of driving accidents and driving employment experience, modified to a certain extent by age). What is of particular interest however, is accident causation as a direct or indirect consequence of the demands of the job. It has been shown that healthy

drivers working under optimal conditions rather than excessive workload will be less prone to accidents (Evans & Johansson, 1998). The element of time pressure as discussed, is an integral part of the bus driver's role. There appears to be a positive correlation between time pressure and accidents for bus drivers (Greiner et al., 1998). As Af Wählberg (1997) proposes:

When it comes to being late, basically, the only effective way to handle it is to do the job faster, which may include taking less time to answer questions, braking and accelerating harder, but also driving faster, i.e., using a higher mean speed. Many of these driving behaviours have the same consequences: the limits become lower and the risks higher. (p. 2)

As Dorn (2003) details, bus drivers explain their polarisation towards risky behaviour as a result of insufficient time to stick to running schedules. Drivers also personally believe that fatigue on-the-job precipitated by shift pattern rotations increase crash risk. Similarly, Greiner et al. (1998) posit that the lack of guaranteed rest breaks combined with inflexible time scheduling causes fatigue, which is the principal factor in accident causation for bus drivers. This is further confirmed by a Jordanian study, which showed that mini-bus drivers who had too few rest breaks had higher accident rates (Hamed, Jaradat, & Easa, 1998). Shift work and, in particular, continually rotating shift patterns are not conducive to maintaining high levels of performance. As Sluiter, van der Beek, and Frings-Dresen (1999) comment:

Repeated insufficient recovery from work-related fatigue ... is seen as the take-off of a vicious circle where extra effort has to be exerted at the beginning of every new working period to rebalance the sub-optimal psycho-physiological state, and to prevent performance breakdown. (p. 573)

As Brown (1994) points out, errors of omission or commission in driving may increase with fatigue. Commissions include slips of action such as wrong gear selection, with slips increasingly turning into mistakes such as misjudging braking distance at traffic lights, or attempting to overtake other vehicles where there is insufficient time to complete the manoeuvre. Attention is involuntarily and gradually withdrawn from the road and traffic demands, reducing collision avoidance capacity and/or general vehicle control. Fatigue can be seen as a psycho-physiological signal to the organism to disengage in part, or in whole, with its involvement in its current task (Hockey & Meijman, 1998). Viewed in this way, it is not surprising that sleep deprivation and fatigue both reduce vigilant attention and promote sleepiness which is claimed to cause 30% of all traffic accidents (Robertson, 2003).

Deliberation over emotional affect in road traffic accidents is also pertinent as Blasco, Prieto, and Cornejo (2003) specify—acknowledging that anxiety, task distractibility and emotion-focused coping induce:

disturbed behavioural driving patterns that increase the accident probability ... these transitory emotional states seem to diminish the efficacy of both cognitive and psychomotor skills especially when the driving task requires dealing with complex stimuli and situation awareness about what is happening somewhere around in the street. (p. 499)

Anxiety has been shown to reduce functioning in terms of central and peripheral task performance such as the identification of peripheral lights when compared to low anxiety conditions. Thus, not only is the attentional field narrowed, but also susceptibility to distraction is increased (Janelle, Singer, & Williams, 1999). Stress may also compound risk-taking. For car drivers, the likelihood of violating traffic laws is positively associated with higher levels of strain (Simon & Corbett, 1996). Applied to bus drivers, risky practices include speeding, driving off from a stop before passengers have time to get seated; running red and amber traffic lights; and not halting completely at stop signs (Greiner et al., 1998; Kompier, 1996). Making up for lost time was the primary reason drivers gave for this unsafe behaviour. Supplementary research shows that 46% of drivers 'force themselves' to drive on time in order to maintain running schedules, with 57% admitting to regularly exceeding speed limits in the suburbs, and 15% of drivers confessing to occasionally or regularly ignoring local traffic regulations (Meijman & Kompier, 1998).

Social stress (e.g., serious personal conflict with significant others, personal tragedy) is related to fatal road accidents (Brenner & Selzer, 1969). Indeed, they calculate that drivers with social stress are five times more likely to cause a fatal accident than drivers without such stress. Others have found relationships between driver stress, frustration, irritation, negative mood and aggressive driving such as tailgating in conditions

of traffic congestion, in particular under situations of time urgency (Hennessy & Wiesenthal, 1997, 1999). Such studies have usually been conducted with drivers in motorcar vehicles, and thus the applicability of such results to professional drivers who must safeguard passenger safety and indeed their own job, can be debated.

Reactions to the driving task, for the general driver at least, appears not only to be a consequence of the situation ('state'), but also influenced by the driver's 'trait' disposition towards viewing driving as stressful (Hennessy & Wiesenthal, 1999). Evidence does exist indicating that certain personalities are correlated to traffic offences and general occupational injury (Iverson & Erwin, 1997; Simon & Corbett, 1996). Again, whether such traits for driver stress exists at similar levels for professional drivers as it does for the general population is unclear, though intuitively it is assumed that drivers who have a dislike for driving will not choose bus driving as a means of employment.

Physical health outcomes may mediate the relationship between stress and accident outcomes. Issever et al. (2002) found that 74% of bus drivers who reported lower back pain alleged it to have a negative effect on their efficiency as a driver. Hypertensive bus drivers experience a greater number of severe traffic accidents (defined as involving a greater number of injured and fatal casualties) than healthy drivers (Laberge-Nadeau et al., 1996). Some medications such as tranquilisers used to treat psychological symptoms such as anxiety, may also contribute to drowsiness perpetuating likelihood of accidents (Macdonald, 1998).

Consideration of traffic hazards encountered by bus drivers such as poor climatic conditions, and erratic driving behaviour of other road users, will further add to the demands of the driver. Therefore, the greater the level of stress experienced, coupled with poor personal coping ability, the greater the accident risk.

7. Moderators/mediators

The role of individual differences in the experience of events is clear from the abundant research that exists on the subject of stress and these may act as moderating and mediating variables between exposure and effect. Moderators affect the direction/strength of the relation between a predictor and a criterion variable, specifying when certain effects will hold. Mediators explain the 'how' or 'why' such effects occur, and account for the relation between a predictor and criterion variable (Baron & Kenny, 1986). Aspects of Type A behaviour, locus of control, and negative affectivity are prominent aspects of the individual in the experience of stress (Spector & O'Connell, 1994). In addition, other personal characteristics such as hardiness, gender, social support, and control are worth mentioning, as these also appear to be relevant to bus drivers. These elements are captured in Fig. 1.

7.1. Type A/B construct

Friedman and Rosenman's (1974) conceptualisation of Type A personality has been applied to bus drivers but with conflicting findings. Carrère and colleagues found no association between Type A personality and perceived job strain (Carrère, Evans, Palsane, & Rivas, 1991). Contrastingly, their earlier research did find that Type As report a greater level of occupational stress than Type Bs (Evans, Palsane, & Carrère, 1987). They provide evidence to support the claim that Type A bus drivers have higher accident risk, have a greater number of official reprimands from management, and experience higher levels of work absence. Acknowledging such research, bus operators may have a useful criterion for prospective employee selection. Evidence that Type A personality is also open to modification (Friedman et al., 1986) may have practical implications for strengthening coping skills for current employees.

7.2. Locus of control (LOC)

There has been little research into the effects of LOC in the process of stress for bus drivers but a review of the general stress literature would suggest it is a relevant concept. LOC is a construct, which is measured by the level to which a person believes situations are in his/her control. 'Internal' LOC individuals have the faith that they are directly responsible for the consequences of events in their own lives. On the other hand, 'external' LOC persons feel that their lives are dictated by fate, chance or powerful others (Taylor & Cooper, 1989). It has been found that LOC mediates between stress and well-being via coping. Internals tend to employ active

coping strategies under conditions of stress, whilst externals believe that coping is not within their control (Parkes, 1984). Therefore, it may be important to understand how the construct of LOC could be employed in training to reduce levels of stress for bus drivers.

7.3. *Negative affectivity (NA)*

High NA individuals are characterised by their tendency to experience negative emotions across time and situations (Spector & O'Connell, 1994). This tendency is apt to affect perceptions of job conditions and affective reactions. This can have important implications for research in terms of ensuring that NA does not bias the report of psychological strains in self-report measures. Despite this, in one study of Swedish bus drivers, controlling for the NA component did not have a significant influence on results (Rydstedt, Johansson, & Evans, 1998b).

7.4. *Hardiness*

Conceived by Kobasa (1979), hardy personalities demonstrate high levels of commitment and perceived control whereby challenge is relished rather than feared. Bartone (1989) showed that low hardiness in bus drivers helped predict ill health in the presence of high occupational stress.

7.5. *Gender*

Professional driving is an occupation that traditionally has attracted a greater proportion of males. The bus industry is no different and only in certain countries (e.g., Scandinavia) does it attract sufficient numbers of women in order that any proper study of gender differences can be achieved. In the few studies that do exist, one failed to find any significant psychophysiological differences (Rydstedt et al., 1998b). Another study did conclude that physiological reactions to work stress were similar between male and female bus drivers, though psychologically, females reported greater road traffic pressure and greater strain from negative passenger behaviour (Aronsson & Rissler, 1998). For work absence in bus drivers, women have been found to have a higher rate than men (Greiner et al., 1998). Such findings need further corroboration since women are entering the workforce in increasing numbers in many developed countries and therefore a better understanding of the role of occupational stress on women drivers is needed.

7.6. *Social support*

As mentioned earlier, social isolation appears in some studies focussing on occupational stressors in bus driving. Within the context of social support, the level of support from social relationships not only at work, but home and community are important 'buffers' of stress (Quick, Quick, Nelson, & Hurrell, 1997). However, the bus driving research has established little evidence to support this buffering effect at work. This may be as a consequence, as intimated by Evans (1994), of the lack of opportunity for social interaction. Therefore, "*there may be insufficient variance in social support among bus drivers to adequately test its importance as a work environment factor involved in the health and well-being of bus operators*" (Evans, 1994, p. 188).

7.7. *Control*

According to the JDC model (Karasek, 1979), it is generally assumed that in conditions of high demands coupled with low control, strain will occur. However, one review study looking at the buffering hypothesis of control on the negative effects of high demands on psychological health in varied occupations, indicated that high control appears to only benefit certain subpopulations (Van der Doef & Maes, 1999). Some of the reviewed studies showed a beneficial effect of high control for those with an internal LOC, other studies demonstrated a beneficial effect for type B individuals, yet others showed positive effects of high control for those with high levels of private self-consciousness (habitual attentiveness to or awareness of the self). Such findings propose that personality may dictate the value of control in moderating the effects of high demands on health.

8. Future directions

Considering the literature to date surrounding occupational stress in bus drivers, “...there is a remarkable distinction between the impressive number of studies that demonstrate adverse health effects of the bus driver’s occupation and the small amount of documented prevention and intervention projects in bus companies” (Kompier, Aust, van den Berg, & Siegrist, 2000, p. 12). Since the research has quite clearly established the stressors in the bus driver’s role and their effects on personal and organisational outcomes, the next logical step for bus operators is to develop best practices that can be universally adopted to help safeguard health. Thus, the role of researchers is to assist in evaluation, such as in the study by Rydstedt et al. (1998a) who found that a package of interventions that improved bus traffic flow and increased information for passengers, led to a reduction in psychological strains and physiological reactions. Longitudinal studies are needed with appropriate control groups, to test the impact of reducing physical and psychological stressors on the driving workforce rather than additional investigations to describe stressors. More careful analysis of the role of moderators/mediators in the stressor–strain relationship, as detailed in Fig. 1, will further uncover what and where interventions can be applied to human and technological structures/processes. As Kompier and di Martino (1995) advise, the design of an intervention program should be systematic, and include the participation of bus drivers themselves. Moreover, an intervention that is directed at several problem areas, as opposed to concentrating solely on one aspect, appears to guarantee the best outcome (Kompier et al., 2000). Certainly, a genuine endeavour to improve the whole work environment is warranted, which may extend not only to the pursuit of ‘distress’ prevention, but ways to generate ‘eustress’ (Nelson & Simmons, 2003).

It is debatable to what extent bus operators are aware of and have access to the research. Knowledge of such work might enable them to cooperate with researchers to develop interventions that are evidence-based rather than ad-hoc attempts, and two particular areas for attention are recruitment and management strategies.

8.1. Recruitment

Besides the recommendations outlined by Kompier and di Martino (1995) and Evans (1994), such as bus signal prioritisation, longer rest breaks, and supportive leadership, further areas such as the recruitment process could be focused upon. Though operators’ selection of drivers with particular individual personality characteristics may be fruitful, Evans (1994) advocates that the existing research suffers methodological weaknesses, calling into question predictive validity. However, there will be utility in enhancing selection by offering realistic job previews (RJPs) to potential employees outlining positive and negative job-related information, so individuals can form more accurate expectations of the job (Mottram & Flin, 1988). This should mean that the person–environment fit will be more aligned, leading to a workforce more resilient to the difficulties of the job, generating fewer negative health outcomes and behavioural consequences such as absenteeism and turnover (French et al., 1982).

8.2. Management strategies

Strategies to enhance the job are intertwined with principles of organisational development (defined as the application of psychology and organisational behaviour to improve organisational effectiveness and employee well-being, Beer & Walton, 1987). A bus company having a shared vision and values for all staff could help promote a return of investment. The aim would be to create a culture that is conducive to reaching organisational goals that is not at odds with employee health. This could involve having systems in place such as targeted training to strengthen and enhance stress coping strategies for bus drivers (e.g., exploiting relaxation exercises, and learning how to change negative appraisals of stressful situations). Similarly, employee assistance programmes (EAPs) to provide workers with the counselling support to manage their personal problems. This would be particularly effective in assisting drivers who have been victims of violence to ensure that good psychological health is maintained and to arrest the development of PTSD. Also, health promotion on-site educating drivers of the benefits of a healthy lifestyle would also be justified; motivating drivers to engage in regular physical exercise, adopt a healthy and balanced diet, and reduce tobacco and alcohol intake.

These measures will likely reduce CHD risk. The reintroduction of two-man crews (dedicated driver and conductor), which have all but been phased out in the UK (Duffy & McGoldrick, 1990) would largely address the sense of isolation felt by drivers on-the-job that has been reported by Evans and Johansson (1998), which may further reduce CHD risk.

The proposed fixed work schedules rather than the usual rotating shift patterns that may change from week to week, will go some way to minimise fatigue (as highlighted by Evans, 1994), but will also help to establish regular meal times discouraging meal skipping which would further lessen fatigue. Though improvements in vehicle design have made significant steps in decreasing physical load and hence lessening musculoskeletal problems that drivers face in their job (e.g., seats with air suspension that reduce whole-body vibrations, automatic gears, and power-assisted steering), risk could be further reduced by adding more breaks for drivers to allow for stretching of limbs outside of the driver's cabin. Perhaps most crucially, a slackening of running times by giving drivers more time to drive routes (though still adhering to a timely service) will subside much of the pressure experienced by bus drivers. This is particularly important since road congestion is increasing, which can impair the task of driving to strict timings. Attention should also concentrate on managing the progressively demanding stressor of violent passengers, which has become more evident over the last few decades. This may include conflict management training for drivers to abate aggressive travellers.

Recent research supports the notion that organisational policies and procedures are perceived by workers to indicate organisational goals and priorities, which in turn help to define organisational climate (Zohar & Luria, 2005). It is through such policies and procedures that supervisors operate within, and help set the 'agenda' for workers. Therefore, if management manifest a genuine desire to take care of their workers in terms of physical and psychological health, then it is likely that workers, in turn, will feel supported and exhibit greater organisational commitment (Mearns & Hope, 2005), which can only be of benefit to companies. Collaborative working between operators, bus drivers, and trade unions, should enable fluid communication between all stakeholders about company changes and initiatives.

Following the arguments laid out from the studies accounting for organisational outcomes of poor bus driver health, it is envisaged that by implementing these measures, an improvement in worker well-being (better physical health, enhanced psychological health, reduced fatigue, lowered alcohol, tobacco and drug consumption) coupled with favourable outcomes for operators (reduced bus driver accident involvement, decreased work absence and labour turnover) should be anticipated.

9. Conclusion

The lifestyle of the bus driver at home and at work is inextricably linked to his/her physical and psychological health. A predisposition to ill health as a result of the job is clear from the studies drawn from the last 50 years of research presented in this paper. Growing threats to well-being such as increased road traffic, violent passengers, and increasingly tight running schedules from commercial pressure will no doubt add to the burden felt by bus drivers. Such observations may add to the notion that poor well-being in drivers is part and parcel of the job for urban bus drivers, though this perspective is not helpful or ethically appropriate. What the studies reviewed indicate, is a necessity for bus operators to improve workplace practices to reduce job stressors and ameliorate the work environment of bus drivers. Operators need to work with researchers, trade unions, policy makers and bus drivers themselves, to formulate initiatives that safeguard drivers against work stress. This may involve RJPs during the recruitment process, training to enhance coping ability of drivers, combined with socio-technical improvements to reduce environmental demands. The additional role of companies and their supervisors should also be capitalised upon. Finally, by achieving an enhanced role and work environment, it is envisaged that the job will help to meet the expectations of those individuals who are fulfilling what Kompier (1996) calls "*their childhood dream of being a bus driver*" (p. 1).

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Appendix A

Table A.1

Expanded results of the reviewed studies (listed in chronological order)

Author/year	Sample population	Country	Method ^a	Key reported outcomes
Morris et al. (1953a, 1953b)	31,000 male bus, tram, trolley bus drivers and conductors; motormen and guards from underground railway	UK	1, 2	(a) A 2.7 incidence rate of first clinical episodes of CHD per 1000 bus, tram, trolley bus drivers vs. a 1.9 incidence rate for conductors Suggested earlier onset of disease in drivers than conductors Immediate mortality as a result of coronary thrombosis is twice as high for drivers than conductors Rate of death within first 3 months following coronary thrombosis is 50% for drivers; 30% for conductors (b) Follow-up study—again, drivers suffered higher premature mortality rates than conductors, due to the lower physical activity of drivers
Norman (1958)	14,000 bus drivers	UK	3	Younger drivers and conductors have more short-term absences than their older counterparts Bronchitis related absence is higher for male conductors than for drivers post-45 years of age Positive association of age with gastroduodenal related absence Functional nervous disorders similar for drivers, conductors and workshop staff until age of 50
Holme et al. (1977)	14,677 males aged 40–49 from a range of occupations (98 bus drivers)	Norway	4, 5	Taxi and bus drivers more sedentary at leisure than other occupational groups Bus and tram drivers have high blood pressure and lipid values Mortality from lung cancer and CHD figures for bus drivers appear to be accounted for by their smoking habits, high serum triglycerides, and cholesterol levels
Backman and Järvinen (1983)	391 bus drivers	Finland	4	From 1969, 60% of drivers in employment were still driving buses in 1979 Bus driving was seen to be a physically light but mentally demanding job

Evans et al. (1987)	100 bus drivers (60 Indian, 40 American)	India and USA	4, 5, 6	Diastolic blood pressure for US Type As increased, but fell for Type Bs Catecholamines increased on-the-job for both Type As and Bs Type As reported greater workday stress and had more accidents (both US and Indian samples) Type As had more non-verbal stress behaviours (Indian sample), higher sickness absence, official reprimands and higher self-reported overall occupational stress (US sample) than their direct Type B comparisons
Ragland et al. (1987)	1500 bus drivers (inclusive of cable cars)	USA	5	Bus drivers suffered higher hypertension rates than controls (drawn from varied job roles)
Winkleby et al. (1988b)	1428 bus drivers	USA	2, 4	Significant inverse association between self-reported stress and hypertension (even when adjusting for 12 confounding variables) Suggestion that studies using objective measures of stress usually find a positive relationship, whilst those based on subjective measures find a null or negative association; high blood pressure individuals may inaccurately self-report objective stressors Significant positive association between self-reported stress and gastrointestinal, respiratory and musculoskeletal problems
Paradis et al. (1989)	2134 male bus drivers, controls from Montreal	Canada	7	A trend of increased IHD but not statistically significant No excess risk of lung cancer or bladder cancer From cancers of the buccal cavity and pharynx, trauma and digestive system disease, observed mortality was lower than expected
Duffy and McGoldrick (1990)	376 male bus drivers	UK	6	60% of work stress accounted for by health and home problems; practical job problems; lack of knowledge, involvement and support from organisation; money handling and injury risk Mini-bus drivers had lower work stress and higher job satisfaction than the other bus drivers Younger drivers concerned with health and home; older/ longer serving drivers concerned with risk of assault and lack of involvement 13% of drivers had as poor mental well-being as psycho-neurotic outpatients Higher job satisfaction was related to better mental health and self-reported better physical health

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Table A.1 (continued)

Author/year	Sample population	Country	Method ^a	Key reported outcomes
Kompier et al. (1990)	Various	The Netherlands	7	Bus drivers had 2–3 times higher work absence than Dutch national average. Absenteeism was related to future disability 26% of drivers requested termination of employment after an average of 4–5 years 8 out of 9 drivers did not manage to work in the job to reach the retirement age of 60 30% of drivers left the job (average age of 51 with an average of 17 years service) as a result of being classified as having no partial working capacity remaining Bus driver disablement occurred at a mean age of 47, (6 years earlier than for firemen, policemen, craftsmen, and providing personnel) Compared with civil servants, bus drivers had 4 times higher disablement from musculoskeletal disorders, and had 2 times higher disablement from mental disorders
Carrère et al. (1991)	60 male bus drivers	USA	4, 5, 6	No significant effect of perceived strain on systolic or diastolic blood pressure. Perceptions of job strain did not correlate with Type A, coping styles or sociodemographic factors Significantly higher levels of catecholamines, non-verbal stress behaviour and reported stress levels for the high vs. low strain group
Evans and Carrère (1991)	62 male bus drivers	USA	4, 5	Traffic congestion significantly associated with elevations of urinary adrenaline and noradrenaline Job control reduced noradrenaline concentrations in relation to traffic congestion. For adrenaline, this trend was not so clear-cut
Rosengren et al. (1991)	103 bus and tram drivers, 6596 males in control (over 30 different occupations)	Sweden	2, 4	18% incidence of CHD for bus and tram drivers vs. 6% risk for controls Odds ratio of CHD occurrence at 3.3 for drivers over controls. Only the occupation of taxi driving had a similar odds ratio (3.1) Bus and tram drivers had an increased all cause mortality compared to controls
Albright et al. (1992)	1396 black and white bus drivers	USA	2, 4	Lower levels of job demands and job strain (self-reported) were related to a higher incidence of hypertension, (but became nonsignificant after controlling for 12 potentially confounding variables) Decision latitude not significantly associated with hypertension

Anderson (1992)	128 bus drivers, 67 non-drivers	USA	2, 8	Significantly greater musculoskeletal pain for bus drivers for the spine, lower back, neck, and thorax. Mild back and neck pain was greater for drivers, but severe pain was similar for drivers and non-drivers Length of experience and level of spinal disease failed to show an association Drivers exercised more than non-drivers and used more counter medicines/prescribed drugs for back pain than non-drivers
Fisher and Jacoby (1992)	22 assaulted bus drivers	UK	4, 8	Assaults related to fare disputes (10 cases), unprovoked episodes (5 cases), boarding/alighting incidents (4 cases), hooliganism (2 cases), and robbery (1 case) with bruising the most common injury but also stabbings and fractures Positive correlation between severity of assault and time taken off sick. 23% of those assaulted developed PTSD
Alfredsson et al. (1993)	9446 bus and tram drivers	Sweden	7	Overall, mortality rate and mortality from ‘all cancers’ and ‘lung cancer’ amongst drivers was the same as the national population An increased mortality from MI was noted in 2 out of 3 of the largest counties (containing dense urban centres). Mortality as a result of IHD was found in these regions (relative risk of 1.2 and 1.4) For Stockholm county, bus drivers who had experienced MI for the first time demonstrated a subsequently higher relative risk of repeat IHD of 1.6 compared to the population (especially aged 55–64) Authors hypothesise the increased MI incidence in urban centres is a result of psycho-social work factors concerned with job strain, irregular working hours, automobile exhaust fumes and noise
Hedberg et al. (1993)	110 bus drivers, 330 truck drivers, 250 controls	Sweden	4, 5	No significant difference between drivers (bus and truck) in blood pressure readings Significantly more drivers smoked, were more obese and had less social support at work than referents More drivers involved in sedentary and heavy work with less leisure time physical activity 40% of drivers felt their job was high in psychological demands and low in decision latitude (compared to 18% of referents) Cardiovascular risk index of 3.18 for drivers (2.34 when adjusted for age, heredity, shift work, educational level, marital status, and working class membership)

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Table A.1 (continued)

Author/year	Sample population	Country	Method ^a	Key reported outcomes
Magnusson et al. (1996)	111 bus drivers, 117 truck drivers, 137 sedentary workers	Sweden and USA	4, 9	Lower back pain was significantly higher for drivers (60%) than sedentary workers (42%) Bus drivers suffered significantly greater work loss as a result of lower back pain 36% of bus drivers had shoulder pain versus 15% for sedentary workers Differences between bus drivers' reported symptoms of musculo-skeletal disorder between the two countries is apparent Stress significantly related with sick leave
Aronsson and Rissler (1998)	20 bus drivers (10 male)	Stockholm	4, 5	No significant gender differences in measured hormones or mood Adrenaline increased by 100%, noradrenaline and cortisol increased 50% for the driving condition vs. the resting condition Systolic and diastolic blood pressure did not significantly change from each condition Women drivers described traffic congestion as worse, and irritated/aggressive passengers as a cause for greater mental strain
Greiner et al. (1998)	308 bus drivers	USA	4, 6	High stress (impediments/interruptions to task execution) related to high absenteeism Average absence = 5.5 days. Illness work absence >12 days amounted to 10% in last 2 years Most absences and accidents for 40–54 year olds; least for 25–39 year olds. Higher work absence for women. Work related accidents amounted to 32% in last 2 years Accident risk related to increased time pressures (time banding positively related to accident risk) Work barriers and monotony not associated with accidents
Peter et al. (1998)	528 bus/subway drivers, 515 repair service workers, 282 administrative personnel	Germany	4	Reports of effort-reward imbalance, chemically hazardous and physically demanding work environment, and impaired health was most prevalent in bus/subway drivers than the other workers Effort-reward imbalance in bus drivers was related to elevated risk of musculoskeletal, gastrointestinal, fatigue/sleep disturbances and nausea/dizziness symptoms but not related to common cold

Rydstedt et al. (1998a)	Survey study: 8 bus drivers; 13 comparison Field study: 10 bus drivers; 31 comparison	Sweden	4, 5, 6	Traffic flow intervention had no significant effects on health status/well-being, with no change in perceived effort and fatigue after work 89% of the intervention group felt greater control in the driving situation, and 67% felt there was a better opportunity to provide passenger service Systolic blood pressure reduced for the intervention group though the comparison group experienced a similar reduction even though it was a small effect For intervention group, diastolic blood pressure reduction failed to reach significance but heart rate, self-reported distress, and job hassles did reduce significantly Perceived workload for intervention group reduced but slightly increased for the comparison group
Rydstedt et al. (1998b)	52 bus drivers (35 male, 17 female)	Sweden	4	Increased workload over 18 months strongly associated with self-reported perceived effort to carry out work and fatigue spillover from work to home/leisure time Increased workload led to increased post-work: exhaustion, unwinding, coping with home demands and recreational use of free time Workload (role overload and conflicting demands) related to psychosomatic symptoms but not to pharmacological substance use
Vedantham et al. (2001)	342 bus drivers	Canada	4	3 groups related to trauma exposure: (A) non-exposed (B) exposed, non-PTSD (C) lifetime PTSD Group C had significantly more health problems than the other 2 groups, (back problems, gastrointestinal disease, migraine/headaches, confusion spells, weakness/dizziness, hot/cold flashes and chronic bronchitis) Group C also had a higher percentage of those who had used medications in the past month, visited health specialists in the past year, and described their own health as average or poor Conclusion: trauma that does not lead to PTSD does not lead to increased health problems

(continued on next page)

Table A.1 (continued)

Author/year	Sample population	Country	Method ^a	Key reported outcomes
Wang and Lin (2001)	1761 male bus drivers, 536 male skilled workers (from same company)	Taiwan	5	Bus drivers had significantly greater rates of hypertension than skilled workers (56% vs. 31%) Rates of obesity for bus drivers against skilled workers (9.6% vs. 4.6%); hypercholesterolemia (34% vs. 29%); hypertriglyceridemia (69% vs. 31%); IHD (1.7% vs. 0.9%) Conclusion: bus drivers have a higher prevalence of CHD risk in the form of higher blood pressure, obesity, IHD, and elevated serum cholesterol and triglyceride levels

Abbreviations: CHD = coronary heart disease; IHD = ischaemic heart disease; MI = myocardial infarction; PTSD = post-traumatic stress disorder.

^a 1: company records, 2: medical checks, 3: secondary data drawn from another study, 4: questionnaires, 5: physiological measures, 6: observation, 7: data from national statistics, 8: interview, 9: environmental recording of vibration.

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