

PDF hosted at the Radboud Repository of the Radboud University Nijmegen

The following full text is a publisher's version.

For additional information about this publication click this link.

<http://hdl.handle.net/2066/29776>

Please be advised that this information was generated on 2021-04-11 and may be subject to change.

REVIEW OF BUS DRIVERS' OCCUPATIONAL STRESS AND STRESS PREVENTION

MICHEL A. J. KOMPIER

TNO Health & Prevention, Work and Organizational Psychology, University of Nijmegen, The Netherlands

VITTORIO DI MARTINO*

International Labour Office, Conditions of Work and Welfare Facilities Branch, Working Conditions and Environment Department, Geneva, Switzerland

SUMMARY

Although heterogeneous in methodology and content, 32 studies from 13 countries on bus drivers' work and health are similar in their conclusions. Bus-driving — characterized by high demands, low control and low support — can be regarded as a classic example of high-strain occupation, with high risks of physical and mental occupational ill-health, leading to absenteeism and to decreased productivity of employees and enterprises. Several recommendations — some of them already being implemented by bus companies — are presented in order to reduce work stress in bus drivers. They relate to: (a) ergonomics of the bus cabin, (b) job rotation and 'combination jobs', (c) timetables, shift schedules and quality of break periods, and (d) the social work environment and management style. Stress monitoring and stress reduction is not merely a technical process based on a technical analysis and on the simple 'straightforward' realization of recommendations and findings. It relates to changing and improving organizations and organizational processes. Such organization changes can best be obtained through a stepwise and participative approach. There are indications that those companies that invest in preventive measures receive their rewards.

KEY WORDS—bus drivers; stress; prevention; stepwise participative approach

The aim of this article is to answer three related questions: (a) how can the results of various studies on the work, stress and health of bus drivers be summarized? (b) which preventive measures are indicated in order to provide a more balanced relationship between the workload of the driver and his coping capacity? and (c) how can a preventive approach to reducing work stress best be achieved? In order to answer these questions a review of the literature was conducted and an inventory was made of preventive measures and recommendations.

OVERVIEW OF STUDIES

Table 1 examines 32 studies from 13 countries. Most studies are on city bus drivers, some address

rural and intercity drivers. This overview is not exclusive but it covers the most important studies from three decades and is representative for this field of study.

There is a large variety in studies and study design. Fifteen of the 32 studies compare bus drivers with other employees: office workers, conductors, non-drivers, blue-collar workers, taxi drivers, employees of a brewery, white-collar employees, employees of a printing office or national statistics.

Fifteen studies concern sickness absenteeism, work disablement (sometimes including rehabilitation) and turnover. Twelve authors use broad questionnaires to study health effects and constraints in the working situation. Four ergonomic studies are conducted, while several questionnaires deal with ergonomic problems. Thirteen studies investigate psychophysiological reactions of bus drivers (eg blood pressure, adrenaline, cholesterol) or employ physical examinations. Two authors performed an analysis of the accident risk of bus drivers.

Address for correspondence: Michiel A. J. Kompier, Work and Organizational Psychology, University of Nijmegen, P.O. Box 9107, 6500 HE Nijmegen, The Netherlands.

*The opinions expressed in this article are the sole responsibility of the author and do not necessarily reflect the position of the ILO.

Table 1—Important studies on bus drivers' work and health

Authors	Type of study	Country	Year	Sample population
1. Anderson	4	California	1992	130 drivers
2. Aronsson	2	Sweden	1982	4554 bus and subway drivers
3. Backman	1,4	Finland	1983	1597 professional drivers, inc. bus drivers
4. Brooks	6	UK	1979	30 bus drivers
5. Courtney & Wong	3	Hong Kong	1985	Hong Kong buses
6. Davis & Lowe	3	UK	1987	London buses
7. Duffy & McGoldrick	1	UK	1990	376 bus drivers
8. Erlam	2	UK	1982	12,639 bus drivers
9. Feickert & Forrester	1,2	UK	1983	289 bus drivers
10. Felnemeti & Boon-Heckl	4	Austria	1985	18 bus drivers
11. Garbe	2	Germany	1983	775 bus drivers
12. Gardell <i>et al.</i>	1,2,4	Sweden	1982	1422 bus, tram, train and guard workers
13. Grosfeld	1,2	Netherlands	1993	2050 bus drivers
14. De Haan <i>et al.</i>	1,2	Netherlands	1978	1252 bus drivers
15. Holme <i>et al.</i>	1,4	Norway	1977	98 bus drivers (14,000 other employees)
16. Kompier	1,2,3	Netherlands	1988	4180 bus drivers
17. Kompier	5	Review	1985	
18. Meifort <i>et al.</i>	1,2	Germany	1983	300 bus drivers, 300 tram drivers
19. Meijman <i>et al.</i>	2	Netherlands	1982	135 ex-bus drivers
20. Morris <i>et al.</i>	4	UK	1966	413 bus drivers
21. Mulders <i>et al.</i>	4	Netherlands	1982	12 bus drivers
22. Netterstrom & Laursen	2,4	Denmark	1981	1396 bus drivers
23. Nijhuis & Bullinga	1,2	Netherlands	1991	120 bus drivers
24. Oortman-Gerlings <i>et al.</i>	1,3	Netherlands	1985	8 buses
25. Oversloot <i>et al.</i>	1,2	Netherlands	1982	655 bus drivers
26. Pikus & Tarannikova	4	Soviet Union	1975	930 bus drivers and 312 ex-drivers
27. Pokorny <i>et al.</i>	6	Netherlands	1987	990 bus drivers' accidents
28. Ragland <i>et al.</i>	2,4	USA	1987	1500 bus drivers
29. Reimann	2,4	Germany	1981	28 bus drivers
30. Rissler & Aronsson	4	Sweden	1983	41 bus drivers
31. Rosconi <i>et al.</i>	2,4	Italy	1975	200 bus drivers
32. Winkleby <i>et al.</i>	5	Review	1988	

1, Questionnaire health outcomes and or working situation.

2, Study on absenteeism, work disability (and rehabilitation), turnover.

3, Ergonomic study.

4, Biomedical study or physical examination.

5, Literature review.

6, Accident study.

These studies, although heterogeneous in methodology and contents, are similar in their conclusions:

1. Sickness absenteeism and the risk of disablement are significantly higher as compared to other professional groups or national statistics.^{11,12,16} Bus drivers who have to leave their job for medical reasons do so at a younger
2. Musculoskeletal disorders appear to be a major work-related health problem in bus drivers.^{1,3,9,12,16,25} Frequently reported complaints relate to the back, neck and shoulders, and the knees. Many studies indicate strong

age than comparable groups of employees. The main conditions leading to disablement relate to the back, tendons and joints, mental disorders and cardiovascular disease.

feelings of fatigue, tension and mental overload among bus drivers.^{9,12,14,16,18,25} Also, problems regarding the stomach and intestines^{3,9,12} and sleeping problems, especially related to early shifts, are typical for bus drivers.^{7,16,18}

3. There are high psychophysiological costs involved in driving a bus. Several authors studied the psychophysiological costs of this occupation, during work and leisure. Most of them indicate relatively high blood pressure among bus drivers.^{12,15,20,26,28,29} In an early and classic study, Morris *et al.*²⁰ demonstrated bus drivers' blood pressures to be higher than those of their conductors. Mulders *et al.*²¹ demonstrated relatively high levels of urine-adrenaline in bus drivers. Gardell *et al.*¹² showed that bus drivers, when under time pressure, are characterized by high cortisol levels. Many authors report more diseases of the heart and blood vessels among bus drivers in comparison to other professional groups.
4. Many types of buses have obvious deficiencies in design and construction.¹⁶ These ergonomic deficiencies relate to the lack of uniformity and freedom of movement, and to the driving seat, the steering wheel and pedals. Vibration levels are a major occupational hazard.²⁴ The diameter of the fixed steering wheel (550 mm) is too large, and a large fixed steering wheel has many advantages. As a consequence of these shortcomings, drivers are unable to adjust themselves adequately to the seat, the steering wheels and pedals to accommodate individual body characteristics. Moreover, many drivers report 'a bad layout of the work station' and bad illumination, blinding and reflection, which seem to be primarily related to night driving, bad weather conditions and neon lights.^{3,9,16,18}
5. Major constraints in the working situation relate to references 7, 12, 14, 16, 18 and 29:
 - (a) *High and conflicting demands.* The driver's task is mentally demanding because drivers have to cope with conflicting task demands. The company and the public want the driver to maintain good contact with passengers and to be service-oriented. These are also important aspects for job satisfaction. This demand for service often conflicts with the need to keep to a tight schedule in dense traffic and the demand to drive safely in accordance with traffic regulations.

(b) *Low autonomy and support.* Whichever alternative the driver adopts, he or she cannot resolve the basic problem of conflicting demands. This is a 'low autonomy' situation and an important cause of work stress. Although often bus drivers characterize themselves as 'boss in their own bus', this 'power' is greatly restricted. To a large extent they work isolated from colleagues and superiors. Often bus drivers complain about not knowing what management is at and not getting enough information and support from middle and top management.

(c) *Threats and violence.* Physical harm is increasingly becoming an occupational risk for bus drivers, especially in large cities and during night work. Sometimes drivers are robbed or assaulted.

(d) *Work schedules and the work-leisure relationship.* Irregular working hours are a major inconvenience. Classic problems concern day-to-day assignments, which mean great uncertainty about the time and place of the next day's work. Other problems concern split shifts, slowly rotating and backward rotating (late-day-early) schedules, the length of the working week and working day, the number, length and quality of break periods, the daily rest between two consecutive workings 'days', and the possibility of taking days off.

The results of these 32 studies are summarized in Fig. 1.

Bus-driving appears to be an occupation with high risks for health and well-being. It may also be concluded that these problems concerning health and well-being are to a large extent work-related, that is, caused by work characteristics, since:

1. Comparisons with other occupational groups generally show more psychological and musculoskeletal problems and higher absence and disability figures among bus drivers.
2. Meaningful and plausible relations have been demonstrated between work factors and the nature and size of the health problems.
3. To a large extent, 32 studies from a large number of countries yield comparable results.

Interventions and preventive measures seem indicated in order to provide a more balanced relationship between the workload of the driver and his or her coping capacity.

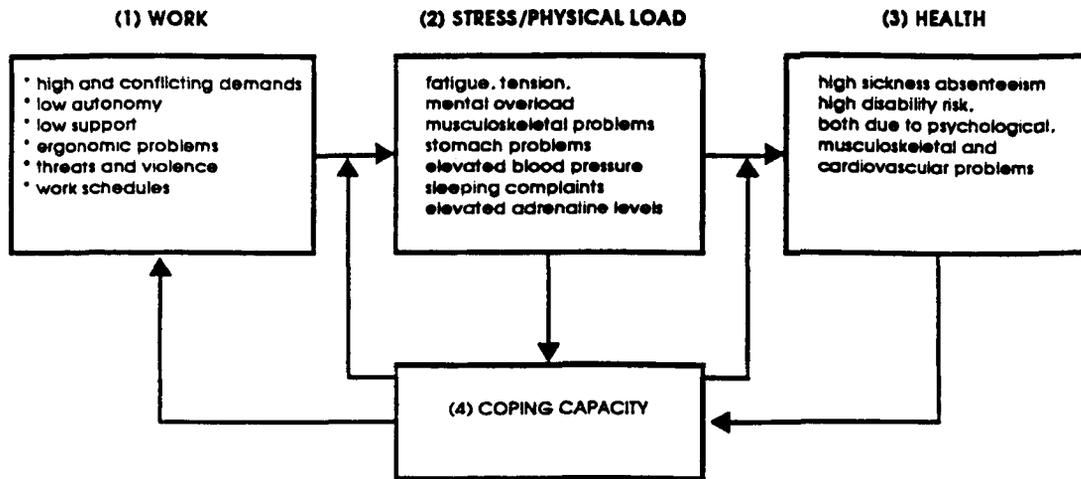


Fig. 1—Work, stress and health of bus drivers

PREVENTION AND INTERVENTION

There is a clear distinction between the large number of studies that demonstrate the adverse health effects of the bus drivers' occupation and the small amount of documented prevention projects in bus companies. In Table 1, only the study by Grosfeld¹³ can be characterized as an intervention project. This study, however, has not yet been finished. This difference might suggest that companies have no experience in stress prevention. However, that would be too negative an image of the preventive policies and experiences of various bus companies. Many of those interventions are not described and evaluated in articles or book chapters. Some of the interventions and preventive measures, together with recommendations based on the first part of this article, are discussed below.

Ergonomics

Important measures affecting the design and construction of cabin components are listed in Table 2. Consequently, cabin components will become more adapted to individual anthropometric characteristics, such as height and weight.

Job rotation and 'combination jobs'

'Combi jobs' refer to the combination of the bus driver's task with other non-driving (eg clerical or mechanics) tasks. In practice, the successful introduction of combination jobs in bus companies

is difficult. This might be due to differences in 'professional status' between the different tasks and to the fact that alternative positions for bus drivers in bus companies are scarce. Although on a

Table 2—Ergonomic recommendations

1. *Driving seat*
The range of adjustments of many seats needs to be enlarged. The vertical range should be 100 mm; the range fore–after should be more than 150 mm
Adjustable springs
There should be a lumbar support, adjustable in height and thickness
2. *Steering wheel*
The diameter should be less than 500 mm
The steering wheel should be adjustable in vertical direction and fore–after
The steering wheel should have an independent adjustment of the angle of inclination: 15–32 degrees
3. *Pedals*
The pedals should have equal angles
The range of the angles should be less than 25 degrees
4. *Dashboard*
Uniform design, easily accessible and user-friendly, clear colours, etc
5. *Working space*
Most cabins are too small; drivers need some moving space!
More effective heating and cooling systems
6. *Training*
With respect to these recommendations, training of drivers is clearly indicated

general basis this approach is hard to manage, it has proved to be very successful in cases of individual drivers. Some recent examples of 'combi jobs' are given by Bailer and Trankle.³³

Timetables, shift schedules and quality of break periods

Several measures can be recommended in order to attain a more balanced relation between work and rest, both during and between working days. Some of these have already been introduced in several companies (Table 3).

Social work environment and management style

Table 4 lists some important recommendations with regard to the social work environment. Some of these principles have already been introduced in various companies.³⁴⁻³⁷

**ORGANIZATIONAL COMMITMENT,
COOPERATION AND A STEPWISE
APPROACH**

Stress monitoring and stress reduction is not merely a technical process, based on a technical analysis and on the simple 'straightforward' realization of recommendations and findings. Instead it relates to changing and improving organizations and organizational processes. The promotion of healthy working conditions is in the first place the (legal) responsibility of the employer. Often this can be stimulated by trade unions, work councils and health and safety committees, who

Table 3—Recommendations for work and rest schedules and timetable

-
1. There should be enough time to reduce task conflicts
 2. Work should be organized in periods of several (maximum 4) consecutive days within the same shift
 3. Avoid split shifts
 4. Regular assignments instead of 'day-to-day' assignments
 5. Choose forward rotation: early-day-late
 6. Two days off between blocks of working days
 7. Guaranteed opportunities to take days off
 8. A break following every 2 working hours
-

can try to get stress placed on the company agenda.

Stress prevention projects in bus companies and in other branches of industry in various countries^{38,39} have demonstrated that a successful approach is participatory and stepwise. A participatory approach means an active role for all the parties involved: (top) management, middle managements, employees, trade unions and, when available, the personnel department and the company doctor. Such an approach also presupposes that all parties consider it worthwhile to work together in reducing work stress. If there is no real commitment from these parties, then there is a high risk that a stress project will not be successful and will fail in its ultimate objectives (ie fewer complaints and absenteeism, an improved working environment, a better and more efficient work organization). Five steps constitute a systematic, stepwise approach to reduce stress: preparation, problem analysis, choice of measures, implementation and evaluation.

Table 4—Recommendations for social work environment

-
1. Divide the total driving staff into fixed groups of 10-20 drivers with one fixed supervisor
 2. Introduce a system of work consultation for these groups, and take comments from the drivers seriously
 3. Introduce a more supportive style of leadership, train supervisors and managements in their new behaviours
 4. Give opportunities for (re)education
 5. Provide special facilities for older drivers and for drivers with health problems
 6. Promote a timely and active rehabilitation policy ('social medical guidance')
 7. Make individual work resumption plans, in cooperation with management, the company doctor, the driver, the personnel department
 8. Teach management to be clear: let them explain when something is not possible
 9. Stimulate non-work contacts, eg social evenings, sporting activities, etc
 10. Stimulate a corporate identity
 11. Maintain a proper information flow in the company; people want to know 'what is going on'
 12. Take into account wishes of individual drivers
 13. On certain lines, high-risk transport calls for two persons on the bus instead of one
-

First step: Preparation

Before starting a work stress project, commitment and sometimes organizational facilities (eg a budget) should be created. This step is directed at a clear determination of aims, planning and financial means. To put stress on the company's agenda one can focus on several data to reveal stress signals: absenteeism figures, high turnover or work disablement rates, number of accidents, data concerning working overtime, backlogs in taking days off, etc. Also, interview with bus drivers and (middle) management can give global indications on possible causes and consequences of stress.

Such data can play an important role in getting different parties involved. Other arguments that can stimulate cooperation between groups within the company can be found in the possible outcomes of the project: more effective work organization and a motivated workforce. Improving working conditions and 'human capital' often requires investments. However, in many cases these investments will lead to profits. By diminishing the absenteeism rate, productivity rates can be improved. There also will be fewer costs related to the introduction and training of new drivers to replace those drivers leaving the company for medical reasons.

Second step: Problem analysis

In this step it is decided in more detail which, in this specific company, are the main stressors. Of course, the major stressors are well known (Fig. 1), but there are differences between companies, for example regarding shift schedules, timetables, leadership style, the ergonomic quality of the bus driver's cabin, and the amounts of threats and violence.

To monitor these stressors the checklist presented in Table 5 can be used for group interviews or in work consultation. Also, several questionnaires can be used.⁴⁰

Furthermore, health indicators such as absenteeism figures, work disability and health complaints can be studied in more detail. Special risk groups, for instance elderly drivers, can be identified.

Third step: Choice of measures

In the third step the focus is on building an integrated action programme, based on workers' participation and commitment. In most cases, in

order to obtain optimum results, a programme for prevention of and intervention in work stress should combine several measures that have been mentioned, based on Levi's⁴¹ three strategies in order of preference:

1. Eliminate or modify the stress-producing situation
2. Change the work to fit the individual characteristics of the bus driver
3. Strengthen the driver's coping capacity

Companies should be careful not to opt for temporary solutions. Some programmes start up then rapidly come to an end. In such cases the old situation often reoccurs. They should also be careful not to concentrate too much on single stressors and partial solutions. This limited approach has been demonstrated in several companies. Some enterprises only try to change the work to fit the individual characteristics of the employee. Other companies start by concentrating on the least preferred path: strengthen the driver's resilience to stress, for instance through physical exercise or relaxation techniques.⁴² It can be argued that this is 'putting the cart before the horse'. In the case of ergonomic problems, the first priority should be to improve the conditions, for instance by installing a chair that meets ergonomic standards. Teaching people how to sit on a bad chair is not very productive. As for dealing with passengers, this only can be done properly when the timetable permits it.

Changing one stressor might affect other stressors. This is what often happens when partial solutions are introduced. Improvements for one group might even mean deterioration for another. In some companies, the introduction of less demanding 'senior schedules' meant that younger drivers had to drive the more demanding shifts. In other companies, the advantages of introducing special bus lanes (less traffic congestion) were cancelled out by a more demanding timetable.

Step 4: Implementation

The success of the implementation is largely dependent on good preparation and communication between the 'change agents', the employees whose working situation is involved and the organizational staff. These 'change agents' can be management representatives, a personnel manager or a company doctor, etc.

Table 5—Checklist to monitor stress risks in bus drivers

	Yes	No
<i>1. Job content</i>		
1.1. Is it possible to drive without problems with aggressive or troublesome passengers? (if no, which lines give problems?)	—	—
1.2. Are drivers sufficiently well informed to provide a service to passengers?	—	—
<i>2. Ergonomics</i>		
<i>Driving seat</i>		
2.1. Vertical range of adjustment > 100 mm?	—	—
2.2. Range fore–after > 150?	—	—
<i>Steering wheel</i>		
2.3. Diameter < 500 mm?	—	—
2.4. Adjustable in vertical direction and fore–after?	—	—
2.5. Independent adjustment of angle of inclination 15–32 degrees?	—	—
<i>Pedals</i>		
2.6. Equal angles?	—	—
2.7. Range of angles < 25 degrees?	—	—
<i>Dashboard</i>		
2.8. Uniform design of dashboards of buses?	—	—
2.9. Easily accessible?	—	—
2.10. User-friendly?	—	—
2.11. Clear colours?	—	—
<i>Working space</i>		
2.12. Enough working space?	—	—
2.13. Effective heating and cooling systems?	—	—
2.14. Are the drivers trained in the use of cabin components?	—	—
<i>3. Work and rest schedules and timetable</i>		
3.1. Is there enough time to drive safely, according to the schedule, and provide service to the passengers?	—	—
3.2. Is work organized in periods of several (maximum 4) consecutive days within the same shift?	—	—
3.3. Are split shifts avoided?	—	—
3.4. Are assignments on a regular basis?	—	—
3.5. Are shifts in forward rotation: early–day–late?	—	—
3.6. Are days off in twos instead of single days?	—	—
3.7. Are there guaranteed opportunities to take days off?	—	—
3.8. Is there a 20-min break following every 2 working hours?	—	—
<i>4. Social work environment</i>		
4.1. Is the total driving staff divided into fixed groups?	—	—
4.2. Is there an effective system of work consultation?	—	—
4.3. Is there a supportive style of leadership?	—	—
4.4. Are there opportunities for (re)education?	—	—
4.5. Are there special facilities for older drivers and for drivers with health problems?	—	—
4.6. Is there a timely and active rehabilitation policy?	—	—
4.7. Are individual resumption plans worked out?	—	—
4.8. Is there a clear management style?	—	—
4.9. Are non-work contacts promoted?	—	—
4.10. Is a corporate identity stimulated?	—	—
4.11. Is there a proper information flow in the company?	—	—
4.12. Are wishes of individual drivers taken into account?	—	—
4.13. Can drivers be replaced during illness?	—	—
4.14. Are canteen facilities good?	—	—
4.15. Are vacancies quickly filled?	—	—

Note: The amount of 'no' scores should be as low as possible. The higher the scores on each of the four subscales, the greater the number of problems. Individual attention should be paid to every 'no' answer.

Table 6—Ten hints for organizational change

1. Promote commitment and participation from all 'parties'. This will take time and demands continuous effort. But it is worthwhile!
2. Spend time beforehand on the ways in which transfer of information ought to take place.
3. Maintain period feedback as the project proceeds. Take time for discussing these developments
4. Promote trust and cooperation between different parties. Maintain good personal contacts
5. Present several interventions in a systematic order. Give people time to accommodate to change
6. Create a proper technical preparation of measures. Technical and organizational mistakes might undermine trust in the final results
7. Try to 'score' one or two points at the beginning. Such results often have a symbolic value and can be an impetus for further positive change
8. 'Key persons' in the company, formal and informal leaders, should 'give the right example', eg taking part in a training programme
9. Pay attention to the position of lower and middle management. Often these groups play a crucial role in the process of organizational change
10. Give employees the opportunity to influence changes

Table 6 specifies some 'golden rules' that are especially useful in this step, but also in the other steps.

Step 5: Evaluation (including costs and benefits)

This final step should provide information about the effectiveness of the measures and indicate if additional measures are needed. A proper evaluation also addresses the financial costs and benefits of the project. It is important that consideration of work stress is no 'one-time' event. Attention to the quality of working life should be — and continue to be — part of the daily management routine of every company.

Naturally this stepwise approach is an 'ideal' one. Organizational change is hard to manage. In practice, consecutive steps will be mixed to some extent. However, these five steps, combined with a continuous focus on organizational commitment, form the backbone of a successful stress prevention approach.

There are indications that those companies that invest in preventive measures receive their rewards. These range from a better management-labour relationship, better morale among the staff and better service to the public to less turnover, less absenteeism and less work disability.

REFERENCES

1. Anderson, R. The back pain of bus drivers: Prevalence in an urban area of California. *Spine* 1992; **17**(12): 1481-1488.
2. Aronsson, G. Sickness absence for local public transport personnel at Stockholm transport. University of Stockholm, Stockholm, report no. 33, 1982.
3. Backman, A. L. Health survey of professional drivers. *Scand. J. Work. Environ. Health* 1983; **9**: 30-35.
4. Brooks, B. M. An investigation into aspects of bus design and passenger requirements. *Ergonomics* 1979; **22**: 175-188.
5. Courtney, A. J. and Wong, M. H. Anthropometry of the Hong Kong male and the design of bus driver cabs. *Appl. Ergonom.* 1985; **16**: 259-266.
6. Davis, G. N. and Lowe, T. J. The ergonomic London bus. In: *Contemporary Ergonomics 1987*. Megaw, E. D. (Ed.) Taylor & Francis, London 1987, pp. 179-184.
7. Duffy, C. A. and McGoldrick, A. E. Stress and the bus driver in the UK transport industry. *Work Stress* 1990; **4**: 17-27.
8. Erlam, A. R. Sickness absence in drivers of London taxis and buses. *J. Soc. Occup. Med.* 1982; **32**: 20-25.
9. Feickert, D. and Forrester, K. Stress factors in urban public transport. Working Environment Research Group, University of Bradford, Report on the Conference 'Working Environment in Urban Public Transport', Stockholm, 1983.
10. Felnemeti, A. and Boon-Heckl, U. Belastungsuntersuchung an Salzburger Busfahrern. *Z. Verkehrssicherheit* 1985; **31**: 16-21.
11. Garbe, C. Ansätze betrieblicher Epidemiologie am Beispiel der Untersuchung gesundheitlicher Selektionsprozesse bei Busfahrern. Report on the Conference 'Working Environment in Urban Public Transport', Stockholm, 1983.
12. Gardell, B., Aronsson, G. and Barklof, K. The working environment for local public transport personnel. Report from the Swedish Work Environment Fund, 1982.

13. Grosfeld, J. A. M. Work quality and absenteeism (in Dutch). In: *Prevention and Reduction of Absenteeism in Bus Drivers* (in Dutch). Boelman, M. (Ed.) Project Reduction of Absenteeism, Nijmegen, 1993, pp. 27–52.
14. De Haan, Onland and Brokerhof. *Work Absenteeism Among Bus Drivers in Amsterdam* (in Dutch). Amsterdam, 1978.
15. Holme, I., Helgelund, A., Hjermann, I., Leren, P. and Lund-Larsen, P. Coronary risk factors in various occupational groups: The Oslo study. *Brit. J. Prev. Soc. Med.* 1977; **31**: 96–100.
16. Kompier, M. A. J. Work and Health of city bus drivers (in Dutch). Doctoral thesis. Eburon, Delft, 1988.
17. Kompier, M. A. J. A literature review on work and health of city bus drivers (in Dutch). University of Groningen, Groningen, Research report, 1985.
18. Meifort, J., Reiners, H. and Schuh, J. Arbeitsbedingungen von Linienbus-, und Strassenbahnfahrern. Bundesanstalt für Arbeitsschutz und Unfallforschung, Dortmund No. 33 Schriftenreihe Arbeitsschutz, 1983.
19. Meijman, T., Linden, T., van der, Mulders, H., Bussel, M. van and Steensma, L. Effects in the development of continuous workload and insufficient recovery in bus drivers in Groningen (in Dutch). In: *Work and Health: Absenteeism and the Quality of Working Life* (in Dutch). Vrooland, V. (Ed.) Alphen aan de Rijn, Samsom, 1982.
20. Morris, J. N., Kajan, A., Pattison, D. C. and Gardiner, M. J. Incidence and prediction of ischaemic heart disease in London busmen. *Lancet* 1966; Sept., 553–559.
21. Mulders, H., Meijman, T. F., O'Hanlan, J. and Mulder, G. Differential psychophysiological reactivity of bus drivers. *Ergonomics* 1982; **25**: 1003–1011.
22. Netterstrom, B. and Laursen, P. Incidence and prevalence of ischaemic heart disease among urban bus drivers in Copenhagen. *Scand. J. Soc. Med.* 1981; **9**: 75–79.
23. Nijhuis, F. J. N. and Bullinga, R. Prevention: Improve the worksite and work organization (in Dutch). *Gedrag & Organisatie* 1991; **19**: 36–39.
24. Oortman-Gerlings, P., Drimmelen, D. van and Musson, Y. Whole body vibration: Results of empirical measurements (in Dutch). Leidschendam, LA-DR-10-04, 1985.
25. Oversloot, J., Dijkstra, A., Grinten, M. van der, Schlatmann, M. and Winter, C. de. *Work and Health: Busdrivers in Rotterdam* (in Dutch). Nederlands Instituut voor Praeventieve Gezondheidszorg, Leiden, 1982.
26. Pikus, W. G. and Tarannikova, W. A. Hypertensive disease incidence in drivers of passenger motor transport. *Ter. Arch.* 1975.
27. Pokorny, M. L. I., Blom, D., Leeuwen, P. van and Nooten, W. van. Shift sequences, duration of rest periods, and accident risk of bus drivers. *Hum. Factors* 1987; **29**: 73–81.
28. Ragland, D. R., Winkleby, M. A., Schwalbe, J. et al. Prevalence of hypertension in bus drivers. *Int. J. Epidemiol.* 1987; **16**: 208–214.
29. Reimann, J. Beanspruchung von Linien Busfahrern. Bundesanstalt für Arbeitsschutz und Unfallforschung, Dortmund, 1981. Forschungsbericht, no. 271.
30. Rissler, A. and Aronsson, G. Stressors, psychophysiological reactions and health complaints among urban bus drivers. Report on the Conference 'Working Environment in Urban Public Transport', Stockholm, 1983.
31. Rusconi, C., Arosio, G., Orlando, G., Petroboni, V., Riva, S., Gola, G. et al. Fattori di rischio coronarico e cardiopatia ischeamica nei conduttori e nei bigliettari di autobus. *Minerva Cardioangiol.* 1975; **23**: 718–727.
32. Winkleby, M. A., Ragland, D. R., Fisher, J. M. and Syme, S. L. Excess risk of sickness and disease in bus drivers: A review and synthesis of epidemiological studies. *Int. J. Epidemiol.* 1988; **17**: 255–262.
33. Bailer, H. and Trankle, U. Mischarbeit mit dem Ziel der Verringerung von Belastungen und Beanspruchungen: Überlegungen am Beispiel Fahrtätigkeiten im öffentlichen Personennahverkehr. *Z. Arb- Organisationspsychol.* 1994; **38**: 126–130.
34. Linden, J. van der. Work stress: The approach by HTM, The Hague (in Dutch). Conference on Working Conditions, April 1992, Maastricht.
35. Hamelink, J., Linde, N. van der and Taylor, J. Company physical fitness (in Dutch). In: *Prevention and Reduction of Absenteeism in Bus Drivers* (in Dutch). Boelman, M. (Ed.) Project Reduction of Absenteeism, Nijmegen, 1993.
36. Hammecher, L., Joppen, R. and Plug, S. Stress management at GSM (in Dutch). In: *Prevention and Reduction of Absenteeism in Bus Drivers* (in Dutch). Boelman, M. (Ed.) Project Reduction of Absenteeism, Nijmegen, 1993, pp. 149–171.
37. Walt van Praag, W. A. van. Work behaviour, muscular tension, and sit instruction (in Dutch). In: *Prevention and Reduction of Absenteeism in Bus Drivers* (in Dutch). Boelman, M. (Ed.) Project Reduction of Absenteeism, Nijmegen, 1993, pp. 84–111.
38. Kompier, M. A. J. and Marcelissen, F. H. G. *Handbook Work Stress* (in Dutch). Nederlands Instituut voor Arbeidsomstandigheden, Amsterdam, 1990.
39. Karasek, R. A. Stress prevention through work reorganization: A summary of 19 international case studies. In: *Preventing Stress at Work*. Di Martino, V. (Ed.) *Conditions of Work Digest*, 11, 2. ILO, Geneva, 1992.
40. Kompier, M. and Levi, L. *Stress at Work: Causes, Effects and Prevention. Guide for Small and Medium-Sized Enterprises*. European Foundation for the

- Improvement of Living and Working Conditions, Dublin, 1994.
41. Levi, L. *Stress in Industry — Causes, Effects and Prevention*. International Labour Office, Geneva, 1984.
42. Boelman, M. (Ed.) *Prevention and Reduction of Absenteeism in Bus Drivers* (in Dutch). Project Reduction of Absenteeism, Nijmegen, 1993.