Sheffield, S3 7HQ

Working Long Hours

HSL/2003/02

Project Leader: **Johanna Beswick MSc**
Author(s): **Joanne White MSc, Johanna Beswick**
Science Group: **Human Factors**

CONTENTS

EXECUTIVE SUMMARY

The Health and Safety Laboratory (HSL) was asked by the Health and Safety Executive (HSE) to review the literature on the relationship between long working hours and fatigue, health and safety and work-life balance outcomes. The review will contribute to the HSE's and the Health and Safety Commission's understanding of the effects of long working hours, rather than shiftwork, on health and safety.

The following areas are covered:

- Description of the Working Time Directive introduced to reduce working hours;
- Description of the prevalence of long working hours in the UK and the rest of the world;
- Overview of the effects of long working hours on fatigue, health and safety outcomes and work-life balance;
- Discussion of the mediating factors that influence the effects of long working hours and the limitations of the research base.

Main conclusions

The literature suggests that there is an association between working long hours and fatigue. Evidence from the literature on accidents and performance also suggests that long hours are related to fatigue.

There is some evidence that working long hours can lead to stress or mental ill health, although this is somewhat equivocal. The way an individual thinks about their job and the amount of control they have over their job will mediate this relationship.

There is sufficient evidence for us to be concerned about the potentially negative effects of working long hours on physical health. The strongest evidence probably concerns the links with cardiovascular disorder. This evidence stems mostly from Japanese men.

The evidence is not conclusive with regard to the impact of long hours on safety and accidents. However, there does seem to be cause for concern, particularly within the driving occupations where most of the research has been carried out.

The evidence is not conclusive with regard to the performance effects of working long hours.

There is strong evidence that people perceive that working long hours leads to poor work-life balance. Control over when an individual works is very important in the extent to which working long hours will impact on home and family life.

Whilst researchers have associated working long hours with various effects, the relationships are complex and are mediated by the following factors:

- Individual factors (gender, age, personality)
- Choice and control over work hours and rest breaks
- Type of job/occupation/task
- Type of work environment or culture

Gaps within the research base

The following areas have received little attention from the research community to date:

- Commuting time and its inclusion in the definition of working hours.
- Longitudinal studies.
- Certain occupations.
- "Ideal hours" and new ways of working, such as flexitime.
- Mechanisms involved in any possible relationships between long hours and health and safety.

Recommendations

1) Further methodologically robust research is needed on the relationship between long working hours and health and safety outcomes. Research should aim for the following:
    - Longitudinal or prospective studies
    - Control for more mediating variables
    - Large scale
    - Use of both objective and subjective measures
    - Involve UK samples.

2) Studies on less researched occupational groups would be helpful, for example, on tele-working, nursing, manual labour.

3) Further research should aim to investigate whether 48 hours a week is the appropriate 'cut off' for the maximum length of time an individual should work. It could also further investigate the acute effects of long hours (for example, after a long day) and the cumulative effects (for example, after weekly or monthly long hours).

4) Good quality studies that look at the effects of reducing working hours could shed more light on the impact of long working hours on health and safety.

5) Further specific literature reviews could be conducted in many of the areas touched upon in this review. For example:
    - New ways of working and new work-life balance practices and their effects on hours of work and health and safety.
    - Further investigation of the literature on driving.

6) The role of loss of or inhibited sleep on health and safety outcomes should be considered in more detail.

1 BACKGROUND, METHOD AND SCOPE OF REVIEW

In April 2002, the Work Psychology Section of the Health and Safety Laboratory (HSL) was asked by June Hanley, SASD, Health and Safety Executive (HSE) to review the literature on the relationship between long working hours and fatigue, health and safety and work-life balance outcomes. The review will contribute to the HSE's and the Health and Safety Commission's understanding of the effects of long working hours, rather than shiftwork, on health and safety.

1.1 AIMS AND OBJECTIVES

This report presents the findings of the literature review. The review aims to:

- Critically review published research from the UK and rest of the world. This includes work funded by HSE and other government departments.
- Describe the scope of the literature and the main conclusions drawn.
- Review the effects of long working hours on various outcomes, including fatigue, health and safety effects, psychological effects, accident rates, and work-life balance.
- Specifically, the review aims to see if any studies suggest that reducing long working hours leads to improvements in health and safety. In addition, the review aims to consider possible mediating factors to the effects of long working hours, such as specific tasks/industries, gender, age, individual differences and culture.
- Report on whether there are any gaps or emerging areas within the literature that need to be considered.

1.2 METHODOLOGY

Literature searches were conducted by the HSE Information Centre search team. The team searched the following databases: OSH-ROM, RILOSH; HSELINE; CISDOC: NIOSHTIC2; Medline; Psychlit; EMED; and Healsafe. The key words used were: long working hours; working time; fatigue; health; safety; work-life balance; accidents; psychological effects; task; industry. Shiftwork was specifically omitted.

In order to keep the review to a manageable size, it was decided to concentrate solely on articles relating to long working hours, and not those relating to shiftwork, and on literature from the last 10 years. Articles from academic journals as well as articles from health and safety related and other journals were retrieved. The articles included in this review were mostly selected on the basis of their abstract. The findings of the review reflect these constraints.

In addition to the HSE search, existing papers held within the Work Psychology Section and the Risk Assessment Section of HSL were considered. Internet searches were also carried out, including the HSE website, with relevant websites noted and relevant articles downloaded. A selection of articles were also chosen from the reference lists contained in some of the more general review papers.

As well as formal searches, existing contacts and sources of information from HSE and HSL were utilised. These included:

- Department of Trade and Industry (DTI) Work Life Balance Team website (www.dti.gov.uk/work-lifebalance)
- Appropriate HSE contacts
- HSE-funded research
- Waterhouse, Harrington and Cox papers (e.g., Harrington, 1978)
- Whitehall II study (e.g., Head, Martikainen, Kumari, Kuper and Marmot, 2002)

1.3 SCOPE OF REVIEW

Comprehensive reviews of the long working hours literature have been conducted recently (e.g., Kodz, Lain, Sheppard, Davis, Bates and Cummings, 2001; Spurgeon, Harrington and Cooper, 1997; and Sparks, Cooper, Fried and Shirom, 1997).

These reviews provided an excellent base for the current investigation. Rather than repeat the work of these detailed reviews we have concentrated on describing some of the key studies within the literature along with the limitations of the research base. We have also highlighted whether there are any gaps in the research base and any emerging or under-researched issues.

The purpose of the review is to highlight the most robust conclusions that can be made about the effects of working long hours and to recommend ways to further our knowledge of the area.

The review concentrates on long working hours and the relationship with various health and safety outcomes. Specifically, the following areas are covered:

- Description of the Working Time Directive introduced to reduce working hours;
- Description of the prevalence of long working hours in the UK and the rest of the world;
- Overview of the effects of long working hours on fatigue, health and safety outcomes and work-life balance;
- Discussion of the mediating factors that influence the effects of long working hours;
- Discussion of the limitations of the research base.

This review does not cover:

- Why people work long hours;
- Shiftwork literature.

2 INTRODUCTION

According to Harrington (2001) over 1 in 20 workers in Europe work extended hours. Extended hours are generally taken to mean working more than 48 hours a week. It is thought that individuals are working longer hours because of increasing workloads and job demands, job insecurity and performance standards and pressures (Sparks et al, 1997). The theory is that such long hours could affect an individual's health, well-being and performance.

This report agrees with Spurgeon et al (1997) that most research in the area of hours of work concerns shiftwork. Although partially relevant, this research is not totally applicable to the concept of long (yet 'normal daytime') working hours. Spurgeon et al (1997) note that shiftwork tends to imply working at times outside the normal daylight hours that humans are "programmed" to operate in, and this inevitably disrupts human circadian rhythms. Such working patterns are likely to have a much more complex interaction with health and safety than simple extensions to the "normal" 8-hour working day.

One area of the shiftwork literature considers the effects of longer shifts (for example 12-hour shifts). Twelve hour days are certainly 'long' and some studies have found adverse health and well-being effects associated with them (e.g., Iskra-Golec, Folkard, Marek and Noworol, 1996).

However, Spurgeon et al (1997) argue that 12 hour shifts should be considered in the shift work category because of their shiftwork properties, for example, rotational nature of the shifts and the different associated motivational factors, that sets them apart from non-shift working hours.

For this reason, and to keep this review to a manageable size, it was decided to concentrate solely on the effects of working long hours and not shiftwork. For a comprehensive review of the HSE shiftwork literature, readers are directed to the Evaluation of the HSE's Shiftwork Research Portfolio (Hills and Keenan, 2000).

2.1 WORKING TIME DIRECTIVE

The 1993 European Directive on Working Time, which came into force in the UK through the Working Time Regulations in October 1998, was introduced to limit the number of hours worked because long or abnormal working hours were thought to be detrimental to health. The main features of the European Directive include working hours of no more than 48 hours a week averaged over a 17-week period, a minimum daily rest period of 11 consecutive hours, and a minimum weekly rest period of 1 day averaged over 14 days. There is an opt-out clause, however, whereby workers can agree to work longer than 48 hours a week by signing a written agreement, although this is currently being reconsidered.

The United Kingdom government was initially in opposition to the introduction of the Directive, as it argued that there was insufficient evidence to support the view that long working hours had a negative effect on the health and safety of employees.

2.2 WHAT ARE LONG WORKING HOURS?

There are many ways of defining long hours. For example, daily, weekly or annual hours, hours in main job and other jobs, commuting time, business travel time could all be considered when calculating time worked. Many researchers seem to focus on weekly hours of at least 48 hours or more, in line with the Working Time Directive. Defining long hours in terms of the working

time regulations is useful as it should hopefully be European wide and allow some consistency amongst studies, certainly from the EU.

Dex, Clark and Taylor (1995) noted that certain issues could complicate the definition of long hours. They discussed that long hours may be considered differently for men (over 60 hours per week) and women (over 40 hours a week). Also, they refer to "working time" to denote commuting time and work that may be done within that time and also to denote whether hours worked in a second job are considered alongside hours in the "main job" (i.e. "total hours").

In the present review however, long hours and their effects are discussed in terms of whatever individual studies reported them to be and this does present difficulties when attempting to generalise research findings (this is highlighted further within the report). Where possible, a definition of 48 hours per week as 'long hours' is referred to.

2.3 PREVALENCE OF LONG WORKING HOURS

2.3.1 International Comparisons

Statistics suggest that the UK workforce work some of the longest hours in Europe (Kodz et al, 2001). Previous reviews have stated that employees in the United Kingdom average a total of 44.7 working hours a week as opposed to 39.9 in Germany, 39 in Denmark and The Netherlands (Spurgeon et al, 1997), 36-39 in Italy, and 38 in Belgium (Sparks et al, 1997). Sparks et al (1997) also reported that a recent survey by Eurostat (the European Commission's Statistical Office) found that the UK is the only European state where weekly working hours have increased over the last decade. Indeed, Kodz et al (2001) reported that 11% of people in the UK work 49-60 hours per week.

In other parts of the world working hours can be even more extreme. A report by the International Labour Organisation (http://news.bbc.co.uk/1/hi/world/439595.stm) stated that the United States has the longest hours, with employees working nearly 2000 hours per capita in 1997. Similarly the Japanese work much longer hours than Europeans (nearly 1900 hours per capita in 1997 compared to approximately 1730 hours per capita for the UK). Spurgeon et al (2001) echoed this, reporting that in 1990 workers in the United States averaged 41 hours a week and Japanese workers work a contracted 41 hour week with, on average, nearly 36 hours of overtime.

2.3.2 Demographic Comparisons in the UK

Kodz et al (2001) report on the Workplace Employee Relations Survey (WERS), 1998, which outlines the distribution of working hours for various groups of people.

In terms of gender, 41% of men and 40% of women work the standard 31-40 hours per week. However, in terms of long hours, 19% of males were found to work 49-60 hours per week compared to only 4% of females.

Regarding age, it was found that those who are most likely to work long hours are aged between 30 and 49 years old (e.g. 31% of 30-39 year olds work over 48 hours a week compared to 5% for those aged 20-24).

In terms of those with family responsibilities, men were more likely than women to work longer hours (49-60 hours) if they had children (22% and 2% respectively).

In terms of occupation, Kodz et al (2001) show that working long hours is more prevalent in some jobs than in others. Long hours workers, working over 48 hours per week, appear to be more concentrated in managerial and professional occupations (22% and 17% respectively). In addition, 20% of operative/assembly occupations and 15% of craft and skilled service occupations often work such long hours.

2.4 HOW COULD LONG WORKING HOURS AFFECT HEALTH AND SAFETY?

What is it about working long hours that could impact on health and safety? What is the mechanism?

Many researchers believe the link is **stress**, certainly with regard to the ill health outcomes associated with working long hours. Park, Kim, Chung and Hisanaga (2001) and Spurgeon et al (1997) argue that long hours act as a direct stressor and also an indirect stressor on employees. The indirect stressor mechanism means that working longer hours leads to employees being exposed to other workplace stressors for longer.

Other researchers concentrate on the **fatiguing** effects of long working hours.

Later sections of the review further discuss the mechanisms involved in the long hours relationships.

3 LIMITATIONS OF THE RESEARCH BASE

The literature relevant to long hours and their associated effects is, in fact, larger than initially anticipated. The literature originates in a variety of countries and looks at a variety of populations and jobs. A table summarising the methodology, findings and conclusions, and limitations of some of the key studies, which captures the essential elements of each study, can be found in Appendix 1.

In order to draw conclusions based on the most robust evidence, it is important to be aware of the limitations of the research base. It could be argued that all research studies will suffer from certain limitations. Whilst it is not the intention to appear overly critical, it is important to highlight the key limitations of the working hours literature.

3.1 CAUSATION

One of the main criticisms of research into the effects of long working hours concerns the inference of causation. Many of the reviewed studies use a cross-sectional study design. This means that data are gathered at one point in time and the variables are often correlated with each other. Strong correlations mean that one variable is associated with another at that point in time, but one cannot truly say that the one variable is causing the change in the other. The causal links between variables cannot be conclusively identified (Kawakami, Araki, Haratani and Hemmi, 1993, Hagihara, Tarumi and Morimoto, 1998). For example, Trimpop, Kirkcaldy, Athanasou and Cooper (2000) noted that their cross-sectional analyses do not establish causal relationships between their variables of job stress, working hours and accident behaviours. Indeed, Sorenson, Pirie, Folsom, Luepker, Jacobs and Gillum (1985, p. 390) note that:

> *"Drawing causal inferences from cross-sectional data rests on a priori assumptions about causal ordering. The present study cannot verify the hypothesized causal ordering about these relationships."*

Furthermore, the possibility of mediating variables in long working hours literature, which will be discussed below, also suggests that single causation cannot be established. The likelihood is that multiple causation exists. Longitudinal or quasi-experimental studies (Van der Hulst and Geurts, 2001) are necessary to further investigate the existence and direction of causation and to check whether associations hold over time.

3.2 SAMPLE ISSUES

Another issue that seems quite prevalent concerns sample characteristics. Who was studied can influence the ability to generalise research findings to other groups of workers.

3.2.1 Sample size

Some of the studies reviewed involved quite small sample sizes which means results are less reliable. For example, Dalziel and Soames-Job (1996) only studied 42 taxi drivers; Meijman (1997) included only 18 bus drivers and 30 driving examiners in their study of mental fatigue and work times; Houston and Allt (1997) surveyed only 30 medical graduates; and Williamson, Feyer and Friswell (1996) had a sample size of only 27.

3.2.2 Gender

Many of the studies used single gender samples or samples with disproportionate numbers of males and females. For example, Hinckle, Whitney, Lehman, Dunn, Benjamin, King, Plakun and Flehinger (1968), Okobaa and Shell (1986), Duffy and McGoldrick (1990), Sokejima and Kagamimori (1998), Maruyama and Morimoto (1996), Park et al (2001), and Liu, Tanaka and the Fukuoka Heart Study Group (2002) all conducted their research on male only samples. Conversely, Ono, Watanabe, Kaneko, Matsumoto and Miyako (1991) and Fox and Dwyer (1999) used female only samples. In addition, Kirkaldy, Trimpop and Cooper (1997) and Barnett, Gareis and Brennan (1999) studied an abundance of females and Russek and Zohman (1958) and Ong, Fung, Chow and Kleevans (1982) had a disproportionate number of males in their samples. Some samples also appeared to be self-selected, which could have influenced results and have consequent implications for generalising the outcomes of the studies (e.g. Raggatt, 1991).

3.2.3 Job

Many of the reviewed studies also tended to involve specific companies or professions, which may make it difficult to generalise the findings. For example, some studies focused on medical professions such as doctors (e.g. Gander, Merry and Miller, 2000), nurses (e.g. Fox and Dwyer, 1999) or vets (e.g. Trimpop et al, 2000). Other studies focused on driving occupations such as truck (e.g. McCartt, Rohrbaugh, Hammer and Fuller, 2000), bus (e.g. Duffy and McGoldrick, 1990), or taxi drivers (e.g. Dalziel and Soames-Job, 1996). Also, other research focused on more specific professions such as Army personnel (e.g. Bliese and Halverson, 1996); lawyers (e.g. Wallace, 1999); police officers (e.g. Cooper, Davidson and Robinson, 1982); accountants (e.g. Daniels and Guppy, 1995) and flight attendants (e.g. Ono et al, 1991). In addition, some studies concentrated on specific companies such as manufacturing or electronics companies, a Japanese technology development company, or a large industrial works (e.g. Ivancevich, 1974; Park et al, 2001; Yasuda, Iwasaki, Sasaki, Oka and Hisanaga, 2001; and Dow-Clarke, 2002). Some of the reviewed research also included some shift workers, which may complicate the conclusiveness of any long working hours outcomes (e.g. Kawakami et al, 1993; Proctor, White, Robins, Echeverria and Rocskay, 1996).

3.2.4 Country

Finally, little of the research reviewed appears to have been carried out on UK samples. Nevertheless, there are some UK based studies (e.g. Wilkinson, Tyler and Varey, 1975; Steptoe, Wardle, Lipsey, Mills, Oliver, Jarvis and Kirschbaum, 1998). Other countries, however, such as Japan (e.g. Liu et al, 2002), USA (e.g. Shepard and Clifton, 2000), Canada (e.g. Jamal, 1986), Australia (e.g. Arnold, Hartley, Corry, Hochstadt, Penna and Feyer, 1997) and some European countries (e.g. Trimpop et al (2000) in Germany and Meijman (1997) in the Netherlands), seem to be more prevalent.

Taken as a whole, a fair spread of industries and countries have been studied, so some conclusions can be fairly general. However, some industries, for example, jobs involving heavy manual labour, tele-working or perhaps nursing, are the base for few studies and research into other factors affecting health and safety suggest that there could be particular issues within these industries.

3.3 SELF REPORT ISSUES

The use of self-report to collect a range of data also appears to be a common limiting factor for several reasons (e.g. Galambos and Walters, 1992; O'Driscoll, Ugen and Hildreth, 1992; Glass

and Fujimoto, 1994; Sokejima and Kagamimori, 1998; Park et al, 2001; and Major, Klein and Ehrhart, 2001).

3.3.1 Accurate reporting

Participants may not accurately report working hours or other variables, such as stress, strain, health problems, lifestyle habits or interference with family. Participants may have been motivated to over report health problems or errors, for example, to increase attention and awareness of long working hours (e.g. Houston and Allt, 1997). Conversely, workers may under report accidents (e.g. Trimpop et al, 2000) as they fear loosing their jobs or overtime.

Furthermore, studies using retrospective techniques may result in unreliable data as participants may not be able to recall hours or other variables, such as lifestyle habits and medical histories, accurately (e.g., Ong et al, 1982, Uehata, 1991). Shields (2000) also noted that individuals with complex work histories involving many different jobs might underestimate the hours worked due to difficulties remembering them.

3.3.2 Subjectivity

Self-report methodology also introduces the issue of subjectivity: Subjective data are considered less reliable than data collected using objective measures. Ono et al (1991) noted that defining fatigue itself is subjective and some of the variables examined in this review are subjective, for example stress (Kirkaldy et al, 1998) and error and safe working hours (Gander et al, 2000).

3.4 POSSIBLE BIASES

Some of the research reviewed here notes the possibility of different biases affecting the findings of such research. For example, Sokejima and Kagamimori (1998) suggested that recall bias might be present whereby participants after an acute myocardial infarction (AMI) may negatively misinterpret work hours or causes of the AMI.

Selection bias is also mentioned as a limitation. For example, Jamal (1986) highlighted that findings regarding the effects of long working hours on health outcomes may be influenced by selection bias because it may only be those individuals who enjoy and can cope with working long hours or doing two jobs that do so. Those who cannot cope and are adversely affected by the long hours will stop. This is often referred to as the 'healthy worker' or 'survival' effect. Indeed, Buell and Breslow (1960) noted that jobs which call for an excess of work hours may be actively sought by people with the appropriate dispositions for this kind of work. Selection bias may also work in the opposite direction with individuals who are working longer hours possibly being reluctant to participate in research.

Other highlighted biases included response bias either due to non-responding (e.g. Trimpop et al, 2000) or social desirability (e.g. Raggatt, 1991) and optimism bias (e.g. Dalziel and Soames-Job, 1996).

3.5 CONCEPTUAL AMBIGUITY

As mentioned above, how researchers define the variables under consideration can cause problems. For example, Arnold et al (1997) noted that a definition of fatigue was not provided to participants despite questioning them about fatigue related experiences.

The definition of long working hours appears to be quite ambiguous in the research reviewed and few studies describe exactly what constitutes "long working hours" (e.g. Cooper et al, 1982; Duffy and McGoldrick, 1990; Daniels and Guppy, 1995; Clark, 1996). Most research used weekly working hours to define long hours. However, some research (e.g. Westman, Eden and Shirom, 1985; Bliese and Halverson, 1996) presented daily working hours. These differences make the comparison of different research findings more difficult. However, considering daily hours is important because focusing on weekly working hours may disguise the more acute effects of long days.

Given the lack of definitions, it may be difficult to determine whether long hours were actually worked in some of the reviewed research and therefore whether the conclusions are valid. Indeed, some studies included working hours that were not actually considered to be that "long". For example, Westman et al (1985) reported that 60% of participants were working up to only 8 hours per day and O'Driscoll et al (1992) reported average hours of work to be 44 hours per week. Furthermore, a review by Shields (2000) looked at weekly working hours of 35 or more. These numbers of hours are not as long as those defined by other studies (e.g. Dowie, 1989 or Gander et al, 2000) or by the Working Time Directive (i.e. 48 hours per week).

3.6 MEDIATING VARIABLES

Finally, it is important to consider the different factors that may mediate any long hours effects. There are likely to be many variables that are involved in the complex relationship between long working hours and various health and safety outcomes. Sparks et al (1997) and Shimomitsu and Levi (1992) discuss many factors, including type of job or occupation; work environment and work culture; culture of country; age; gender; individual differences such as personality; choice over working hours; or lifestyle habits.

3.6.1 Job type

The impact of long hours may be greater for jobs or occupations that require attention, such as driving (e.g. Arnold et al, 1997) and quick thinking, such as doctors (e.g. Houston and Allt, 1997). Also, factors such as amount of physical activity, ergonomic design of the workstation, or levels of noise, heat and lighting may be important in determining health problems but the research reviewed has paid little attention to these factors. Indeed, Wantabe, Torii, Shinkai and Wantabe (1993) studied Japanese government workers who work with visual display terminals (VDT) but it is unclear whether the design of the VDT workstation was considered as a possible factor affecting health status. Furthermore, prevailing cultures of workplaces or countries may mediate the long hours-health relationship, as it is possible that different cultural attitudes towards and perceptions of long hours may affect the impact of long working hours on individuals.

3.6.2 Lifestyle habits

As mentioned in the physical health section of this review, long working hours per se may not be detrimental to physical health but they may increase maladaptive life style habits such as smoking and drinking which are detrimental to physical health. Also, factors such as season (e.g. summer or winter) may influence the amount of exercise taken rather than the number of hours worked (Shields, 2000).

3.6.3 Individual differences

It could be that people of different ages, genders and personalities (e.g. type A behaviour) may be differentially affected by long hours so the outcomes of working hours studies may be inconclusive unless these factors are adequately controlled for.

3.6.4 Choice

One mediating variable that appears to be quite important is that of choice and whether the number of hours worked are voluntary or mandatory. Individual control over working hours is considered to be important in the relationship of working hours and health. Bliese and Halverson (1996, p. 1183) offer support for this view, arguing that an individual who chooses to work 13 hr because he or she enjoys the work would probably report higher well-being scores than an individual who was required to work 13 hr due to a high workload.

Therefore, it is important to know why individuals are working the hours they report in order to draw more informed conclusions about the effect of those hours on health and well-being. This notion of choice may be related to the previous discussions of selection bias: if individuals have chosen to work in a second job, rather than being forced to for financial reasons for example, this may negate any health consequences for such people (Jamal, 1986).

3.6.5 Other factors

Other factors that may have a mediating effect on the complex long hours-health relationship could include, individual susceptibility and the extent of social support systems (Spurgeon and Harrington, 1989); relationships with colleagues (Firth-Cozens and Moss, 1998); level of reward (Van der Hulst and Geurts, 2001); inclusion or not of commuting time (Shimomitsu and Levi, 1992); or presence of adequate rest breaks (Trimpop et al, 2000).

3.7 CONCLUSIONS

The various important variables and limitations highlighted above should be borne in mind when considering the literature on the effects of long working hours. The limitations discussed above were the most common and probably most crucial factors found in the studies reviewed in Appendix 1.

There were a few other limitations apparent from the research reviewed (for example, measurement problems or lack of control groups) but these were quite rare and so are not highlighted.

4 FATIGUE

4.1 SUMMARY

- Fatigue as a concept is difficult to define. It may be measured directly, or indirectly.
- Several different types of fatigue have been measured, including acute and cumulative.
- Several factors can contribute to whether an individual is fatigued. Time at work and lack of sleep due to long hours are possibly the most relevant.
- **The available evidence supports a link between long working hours and fatigue.**
- There is a lack of conclusive evidence for how long an individual can work without becoming fatigued.

One of the first effects of working long hours that many people may think of is fatigue. It seems intuitively obvious that working long hours will make an individual tired or fatigued. Researchers appear to have looked at fatigue effects in two ways: either by measuring it **directly** as an end in itself, or **indirectly** in terms of performance or health effects that are thought to be associated with fatigue.

Spurgeon et al (1997) noted that because fatigue is difficult to define, many studies concentrate on measuring its indirect effects (i.e., performance effects). We shall consider these potential effects of fatigue in later sections of this review.

In this section we consider studies that measure fatigue directly. For example, studies such as those included in the meta-analysis carried out by Sparks et al (1997) which included 'tiredness' as one of the outcome measures in their 'psychological health' category. A meta-analysis is a statistical technique that allows a researcher to combine the results of many studies and to determine whether any significant trends are apparent.

4.2 WHAT IS FATIGUE?

In a review of the literature on the effects of fatigue on performance, Rogers, Spencer and Stone (1999) note that the term fatigue, although widely used, does not have a satisfactory definition. They decide that, in the absence of a scientific definition:

> *"... fatigue, or rather mental fatigue, may perhaps be considered to be a syndrome whose symptoms include, amongst other elements, subjective tiredness and a slowing of normal cognitive function." (Annex, p 1).*

They also conceptualise fatigue as a continuum with differing levels of fatigue (or tiredness) and alertness.

A draft report by HSL (Clapp et al, 2002) also agrees that fatigue is hard to define and points out that it has to be defined by its causes or effects. The authors suggest that there are different 'types' of fatigue e.g., sensory fatigue (e.g., looking at a VDU display for long periods), cognitive fatigue, or alertness, and 'intellectual' fatigue (e.g., associated with problem solving).

There is also physiological fatigue, resulting from prolonged physical work, for example, muscular fatigue.

4.2.1 Acute and cumulative fatigue

Another distinction is acute fatigue (experienced perhaps at the end of a long day), and cumulative fatigue (where you may still feel tired even after a night's sleep).

'Acute fatigue' has been recently explored by Jansen, Kant and van den Brandt (2002). They looked at the relationship between the need for recovery from work, prolonged fatigue and psychological distress in a large sample (N = 12,095) from the Netherlands. They conceptualised need for recovery as the *"need to recuperate from work-induced fatigue, primarily experienced after a day of work."* (p 323). They found that the need for recovery was a separate concept from prolonged fatigue (although they were often co-morbid).

Konz (1998a) recognises that fatigue is likely to be related to long daily work hours - especially if there is a lack of sleep; whereas occasionally, it will be due to long weekly work hours (cumulative fatigue).

Many of the studies that we consider in this review use weekly working hours as their measure of 'long hours' and not daily hours. This means that cumulative fatigue may well be being measured as opposed to acute fatigue.

4.2.2 Why do we get fatigued?

Despite the absence of an agreed scientific definition, there has still been research on fatigue. Rogers et al (1999) note that several different mechanisms can contribute to how fatigued an individual is, for example, loss of sleep, length of working hours, age, health status, general sleep quality, experience at work and motivation and home/family life and responsibilities and commuting times.

For example, a recent article (DeFrank, Konopaske and Ivancevich, 2000) discusses 'travel stress' and notes the many ways that "executives" may be fatigued through business travel. These include missing out on good quality sleep because of unfamiliar or noisy hotels, or working late to complete jobs before departing on a business trip.

For Konz (1998a), one of the main reasons that people become fatigued is insufficient rest. This can result from working at the wrong time (shiftwork) or working too many hours. He suggests that prolonged overtime of over 12 hours a day and 55 hours a week should be avoided. He also alerts us to the fact that an individual will have less of a chance of getting sufficient sleep if a long working day is extended by a long commute or moonlighting (working a second job). In addition, he notes that fatigue can occur for other reasons, for example:

- Too much, or too little stimulation at work.
- A large fatigue dose i.e., through too intensive work and not enough chance to rest.
- Lack of opportunity for different work tasks.
- Not taking sufficient short breaks while at work (fatigue increases exponentially with time).
- Having insufficient time to recover from fatigue. For Konz, long-term fatigue occurs when fatigue is carried over into the next day.

In conclusion, there are many different factors that may affect how fatigued an individual may become. Factors that are directly related to long hours include spending too much time doing work tasks and being exposed to 'stressors' in the work environment, and missing out on sufficient sleep due to long work hours.

4.3 THE EFFECTS OF LONG HOURS ON LEVELS OF FATIGUE

So, what evidence is there to support the intuitive link between long working hours and fatigue? Studies have used objective or subjective measures of fatigue, and, in general, the evidence available supports a link between long hours and fatigue.

In their meta-analysis of the relevant literature, Sparks et al (1997) included 'tiredness' and 'exhaustion' as ill health effects, and their results offer support for a link between hours of work and ill health. For example, Ono et al (1991) suggest that work overload, resulting in turn in long hours of work, has been linked with fatigue. They surveyed female Japanese flight attendants (FA) on both domestic and international flight schedules and found that long flight hours (9 or more for example) were associated with higher levels of fatigue, as were factors such as early morning starts. However, purely subjective measures of fatigue were used and aspects of the FAs' work such as crossing time zones and night work would have contaminated the effects of long hours alone.

Another Japanese article (Shimonitsu and Levi, 1992) reported that the number of weekly working hours in Japan was increasing, with almost one quarter of male workers doing at least 60 hours of work per week. They reported that two thirds of Japanese workers complained of physical or mental fatigue, with around half carrying fatigue over into the next day at work. They also note that studies that have looked at overtime have found links with fatigue and health-related outcomes such as '*karoshi'* – 'death from overwork'.

A recent study looking at fatigue and long hours is that of Park et al (2001). Researchers set out to look at the relationship between working long hours and subjective fatigue complaints of a group of workers in South Korea. They were ultimately trying to determine whether subjective complaints of fatigue could be used as a screening tool for early detection of cumulative fatigue. They had previously detected a relationship between long working hours and poor cardiovascular outcomes. Their hypotheses ultimately presumed that overtime work is associated with chronic fatigue and in turn, this leads to decreased cardiovascular function. They found that complaints of fatigue before going to work were lower for those men who worked shorter hours. Shorter hours were defined as fewer than 60 hours a week, which is still considered 'long' hours if 48 hours is our working definition of long hours.

As with much of the fatigue literature, the Park et al (2001) study relied on self-reports of fatigue and was cross-sectional. This means that causal relationships are difficult to determine.

Another self-report study is that of Arnold et al (1997). They questioned Australian truck drivers about how tired they were feeling and how many hours they had driven or expected to. Over two thirds of drivers reported driving for over 14 hours in a 24 hour period, and just over half of drivers thought they had driven for over 14 hours and also done other non-driving work. Around 12% of drivers reported having fewer than 4 hours sleep on one or more working days. Whilst some drivers thought that fatigue was a problem for them, the drivers considered that it was much more of a problem for other drivers. When asked what they thought contributed to fatigue, 70% of managers of truck companies believed that long working hours was a major cause, and 40% of drivers agreed with this. Other reported causes of fatigue included lack of sleep and inexperience and the non-driving work they also had to do e.g., loading the truck.

A quasi-experimental field study by Meijman (1997) utilized objective measures of fatigue with a sample of bus drivers and driving examiners in The Netherlands. The researchers noted that after seven hours of work and sleep loss (an early start), information processing broke down.

This was interpreted as a serious sign of mental fatigue. Performance could no longer be protected by extra effort on the part of the individual.

Williamson et al (1996) collected various data (both subjective and objective) on the fatigue of Australian truck drivers and found that fatigue increased across all trips taken (which averaged 12 hours). They considered the pre-trip level of fatigue was important in determining fatigue at work.

4.3.1 When does fatigue 'set in'?

Individual differences and circumstances and the task someone is doing will contribute to how quickly an individual will become fatigued. However, some researchers have discussed whether there are generic 'cut-off' points for fatigue.

Park et al, (1991) concluded that, from their study, working 60 hours a week was a useful cut-off point for assessing cumulative fatigue in their sample. Konz (1998a) suggests prolonged overtime of over 12 hours per day should be avoided. Spurgeon et al (1997) seem to suggest that weekly hours exceeding 50 could lead to occupational stress.

The existence of working time regulations suggests that there can be cut-off points for when fatigue may be dangerous. In the USA, the transport industry has rules e.g., for truck drivers, driving is limited to 10 hours per day, followed by 8 hours of rest, and a minimum of 60 hours in a 7-day period (Federal Highway Administration reported in Lewis, 1999). The Federal Aviation Administration limits aircraft pilot hours to 100 each month (also reported in Lewis, 1999). The Working Time Directive for the UK is relevant here too: A minimum daily rest period of 11 hours is recommended.

Whilst we could tentatively conclude, based on various regulations and studies, that around 10-12 hours of work a day may be the maximum an individual can work without becoming fatigued, in their comprehensive review of the literature, Spurgeon et al (1997) conclude that there is (as at 1997) not enough data to determine exactly how many hours people should be required to work to remain healthy and safe.

For a comprehensive review of the various guidelines and models for rest times to combat various types of fatigue (for example, muscular, cardio-vascular and mental), please refer to Konz (1998b).

4.4 WHY DO LONG HOURS LEAD TO FATIGUE?

The role of stress as the mechanism connecting long hours and various outcomes has been touched upon in section 2.4. What could fatigue contribute?

Fatigue is the result of putting in effort (working) for long hours without sufficient rest. Konz (1998b) asserts that the purpose of resting time is to overcome fatigue, and that fatigue increases exponentially with time. This kind of concept was the focus of a study conducted by Van der Hulst and Geurts (2001). Researchers used the Effort-Recovery Model as their theoretical perspective (Mejiman and Mulder, 1998, cited in Van der Hulst and Geurts, 2001). This model hypothesises that any costs associated with effort (i.e., working) will be stabilised if there is sufficient recovery time (either in the working day, or after work). If there is insufficient recovery time (e.g., due to long work hours) then eventually fatigue will accumulate and affect well-being and health outcomes. So, fatigue seems to be the main cause of associated ill health.

They further note that job rewards appear to be the key moderator to the long hours and psychological health relationship.

Jansen et al (2002) wonder whether the need for recovery after a day's work should be considered as a precursor of prolonged fatigue. They suggest longitudinal research is needed to then associate this need for recovery ultimately with psychological distress. They also speculate whether the outcome of prolonged fatigue is lowered resistance to daily workload which therefore increases the need for recovery after work.

For Meijman (1997) the prolonged mental effort that is associated with serious mental fatigue adversely affects well-being and health by sustained activation of physiological stress reactions systems.

4.4.1 Lack of sleep

Lack of sleep as a result of long working hours is also thought to contribute to fatigue (e.g., Arnold et al, 1997 and Williamson et al, 1996). For example, a study done in the US and Canada looked at the sleep of long haul truck drivers (Mitler, Miller, Lipsitz, Walsh and Wylie, 1997). Objective measures of sleep and drowsiness were taken during the night and whilst driving. The authors concluded that the drivers had less sleep (sleep averaged around 5 hours per night) than required for being alert on the job.

Evidence from doctors who have traditionally worked long hours and have been deprived of sleep is not conclusive, although there have been links between the hours doctors keep to performance and health problems (Rosa, 1995). Wellens (2001) also cites evidence for the long hours - loss of sleep - fatigue relationship in his review.

4.5 CONCLUSION

The available evidence seems to support a link between long hours and fatigue. Studies have examined different jobs and populations from different countries and have used both subjective and objective measures of fatigue.

Studies have assessed fatigue both directly and indirectly, although those directly assessing fatigue as an outcome measure associated with long hours are not that plentiful.

There is not yet a general consensus on how many hours need to be worked before fatigue occurs.

5 PSYCHOLOGICAL HEALTH AND STRESS

5.1 SUMMARY

- Stress and psychological health outcomes have been defined and measured in a variety of ways.
- **In general, the evidence points to an association between working long hours and stress and other negative psychological health outcomes.**
- Individual factors such as the way an individual thinks about their job and the amount of control they have over their work patterns will mediate the long hours – stress/psychological health relationship.
- Other work-related variables will also be associated with stress.

5.2 DEFINITIONS

Like fatigue, psychological health and stress have been defined in a variety of ways. With some psychological health outcomes such as clinical anxiety and depression, there are standard criteria for assessing individuals. Other mental health effects such as 'stress' are more ambiguous. HSE acknowledges the difficulty in defining or labeling 'stress', but nevertheless feels it is useful to define stress thus:

> *"the adverse reaction people have to excessive pressure or other types of demand placed on them."*

Various measures have been used to measure stress and other mental health problems in the literature. Kodz et al (2001) note how the use of the different measures for stress and other mental health outcomes means that it is difficult to compare results and may be a reason for the equivocal nature of the evidence.

5.3 EVIDENCE FOR MENTAL HEALTH EFFECTS (INCLUDING STRESS) FROM GENERAL REVIEWS

Compared to the literature on fatigue, it seems that psychological health as one outcome of long working hours has received considerable attention. However, Spurgeon et al (1997) note that there is a shortage of studies that focus solely on mental health outcomes.

In their meta-analytic review, Sparks et al (1997) analyse studies that have used various measures of stress or mental health as outcome measures. Measures used included depression, role strain, poor sleep, irritability/tension, problems with relationships, anxiety, frustration, mood symptoms and general mental stress amongst other things. These diverse, yet related measures, indicate the different ways that stress can be defined. They conclude that there is a small but significant correlation between increased hours of work and poor psychological health symptoms. The psychological health measures used in the studies were diverse, and long hours did not seem to have a greater impact on one particular measure.

Spurgeon et al (1997) report on studies looking at mental health outcomes of music therapists, bus drivers and accountants using standard measures of stress (e.g., Oppenheim, 1987, Duffy and McGoldrick, 1990, and Daniels and Guppy, 1995). Long hours were associated with poor mental health outcomes (measured in various ways) in all studies with the exception of the music therapists. However, long hours were measured as just one of several different potential

sources of stress. For example, in the study on British accountants (Daniels and Guppy, 1995), 'professional and administrative' stressors and 'nuisance' stressors were key dimensions of stress as well as the quantitative work overload stressors that include long hours. Because of this variety of stressors, Spurgeon et al (1997) caution that long hours must be viewed in relation to other factors. They ultimately conclude that there is some evidence to support the view that weekly hours exceeding 50 are associated with increased occupational stress.

Kodz et al (2001) note that there seems to be evidence to support an association between working hours/patterns and poorer mental health outcomes, but whether it is actual long hours that causes the relationship is hard to assess.

These larger reviews appear to agree that there is some link between working long hours and psychological health outcomes (including stress).

5.3.1 Stress measured by associative measures

It is of interest to take a closer look at some different studies and the ways they have measured stress or other psychological health outcomes.

Some studies indirectly measure stress through assessment of behaviours associated with 'coping' with stress e.g., smoking or drug taking.

For example, Raggatt (1991) investigated work stress among a sample of Australian long distance coach drivers. The drivers completed a postal questionnaire. Raggatt found that long driving hours (50 hours or more per week) were the best predictor of maladaptive behaviour such as stimulant use. Maladaptive behaviours then predicted stress. Interestingly, there is the possibility of response bias in this study, as it might not have been socially desirable to admit to stimulant use.

Maruyama and Morimoto (1996) surveyed around 6,500 Japanese male managers. They found that managers who worked long hours (not specifically defined, although over half of the sample worked more than 10 hours per day) perceived greater stress. Daily long hours were significantly related to poor lifestyle habits such as drinking and smoking.

These studies appear to provide tentative support for a link between long hours and stress observed through the maladaptive behaviours, although many of the studies were based on self-reporting. Kodz et al (2001) however concluded that drinking and smoking are equivocal evidence for stress (as a result of long working hours).

5.3.2 Self-reported stress

Some studies have measured stress by using subjective self-report measures (e.g., Bliese and Halverson, 1996; Sorensen et al, 1985; Houston and Allt, 1997; Galambos and Walters, 1992; Cooper et al, 1982; Maruyama and Morimoto, 1996, Kirkaldy et al, 1997).

For example, Bliese and Halveson (1996) surveyed 7,382 army personnel and found that there was a significant relationship between long hours and lower well-being.

Kirkaldy et al (1997) surveyed 2,500 medical and dental practitioners in Germany. The majority of this sample were female. Results suggested that those physicians working over 48 hours per week reported higher levels of job-related stress than those working less than 48 hours per week.

Whilst most of the self-report stress research points to a relationship between increasing stress and longer work hours, one study has not supported this finding. Houston and Allt (1997) looked and psychological distress and error making among junior house officers in the UK (n = 30). Almost the whole sample worked excessively long hours (for example, a mean of 78 hours per week), which may have affected results in that there were not many participants working shorter hours for comparison. However, the authors found that hours of work did not correlate significantly with health or error measurements, although there is the possibility that errors and health may not have been reported accurately.

In a self-report survey conducted by the Chartered Institute of Personnel Development (2001) on UK workers working more than 48 hours a week, over half of respondents reported 'mental exhaustion' as a health problem, and around 40% reported feeling unable to cope at work. Around 20% said they were anxious, depressed or had 'bad nerves'.

5.3.3 Other measures of psychological health

Depression has been measured in relation to long hours.

Shields (2000) looked at longitudinal data from a Canadian survey and concluded that, amongst other findings, women who worked long hours were more likely to develop depression compared to their colleagues working standard hours.

Proctor et al (1996) conducted a study on automotive workers and found evidence to support a link between the number of consecutive days worked and the number of overtime hours worked and increased feelings of depression, fatigue and confusion.

Kodz et al (2001) looked at studies such as Glass and Fujimoto (1994) and Galambos and Walters (1992) [both reviewed in Appendix 1] that examine depression. They found some evidence for an association between depression and longer working hours, and conflicting evidence for whether women or men were more affected. Mediating factors included job satisfaction and role strain.

5.4 MECHANISMS INVOLVED AND MEDIATING FACTORS

Whilst it appears that there is a general relationship between long hours and poor psychological health and stress, several authors have noted that mediating factors probably play an important role in the relationship.

Kodz et al (2001) observe how some studies have noted that long hours alone do not necessarily lead to stress, but that long hours can contribute to stress-related problems in conjunction with other factors such as poor job control, personality etc.

For example, a study by Van der Hulst and Geurts (2001) on a sample of workers from the Dutch postal service found that voluntary overtime (even a limited number of hours) was associated with adverse mental health (measured by a burnout inventory and psychosomatic health complaints inventory), but only for low reward situations. (Low reward means people scored low on a scale measuring their feelings about job and career opportunities, and satisfaction with salary). As long as there is a balance between the effort put into work and the rewards received, overtime is not necessarily associated with poor mental health.

Individual preferences are crucial in whether long hours are related to stress, as individuals may react very differently to working long hours depending on circumstances and their individual traits and perceptions. This was recognised in the study by Bliese and Halverson (1996) where

individual choice over long hours was thought to have a large impact on the long hours well-being relationship.

In a review not specifically related to long hours, Kawakami and Haratani (1999) examined the Japanese literature on job stress and health among Japanese workers. They include studies that used various measures of stress, and ultimately concluded that the impact of overtime and quantitative job demands were moderate, other factors such as skill use, and job control had a greater impact on stress.

Firth-Cozens and Moss (1998) discuss doctors' long hours, stress and teamwork and conclude that there is little evidence to associate stress or depression and hours of work. They note that the relationship is complex and that loss of sleep and quality of sleep is often the problem, rather than long hours per se. They also argue that good supportive teamwork is the key to reducing the stress felt by doctors. However, loss of sleep is often associated with long working hours, therefore the link between long hours and stress may be indirect.

Interestingly, Spurgeon et al, (1997) report on a study that highlights the importance of considering all aspects of the work environment and task. They report that Haugland (1996) did a small-scale study on academics and found that stress decreased during overtime work. This was because the participants reported that there were less disruptions and demands on their time during overtime work, so they could get their tasks efficiently done.

5.5 CONCLUSION

Working long hours does seem to be associated with stress and poorer psychological health outcomes.

Studies have measured stress and psychological health by associative measures such as smoking, by self-report and by looking at depression and this affects how easy it is to compare studies.

Individual differences and other factors such as job rewards and choice are likely to play a large role in mediating the long working hours – stress relationship.

6 PHYSICAL HEALTH

6.1 SUMMARY

- There appears to be a link between working long hours and cardiovascular disorder but several factors (e.g. existing medical conditions or insufficient sleep) may mediate this link.
- **A new issue of "ideal hours" may be emerging in this area, whereby longer *and* shorter hours may increase the risk of myocardial infarction.**
- There appears to be evidence linking working long hours with poor lifestyle behaviours and other physical health problems, such as lowered immunity and diabetes mellitus.
- **From the available evidence, there is sufficient reason to be concerned about a possible link between long hours and physical health outcomes, especially for hours exceeding 48-50 per week.**
- However, samples were not very diverse, as much research seems to focus on men in Japan.

Many studies have found varying associations between long hours and physical health.

6.2 CARDIOVASCULAR DISORDER

Cardiovascular disorder and coronary heart disease (CHD) is an area that has received substantial investigation (Spurgeon et al, 1997). Russek and Zohman (1958) reported that 46% of a coronary group (coronary patients under the age of 40) had, for a prolonged period, worked more than 60 hours a week and Buell and Breslow (1960) found a higher incidence of CHD in men who worked more than 48 hours a week. Furthermore, Hinkle et al (1968) found that men working full time and attending night school, therefore suggesting long hours, had a greater incidence of cardiovascular death risk.

However, such studies were conducted a long time ago and several reviewers in this area have stressed that there is little up-to-date, systematic or large-scale research and that much more is needed to prove a link with long hours and health (Kodz et al, 2001). Therefore, it is important to consider whether the link between long hours and cardiovascular disorder identified above still holds. For example, Sorenson et al (1985) reported no association between working hours and risk factors of CHD.

However, studies have been carried out in Japan where *'karoshi'* has received much attention. Karoshi refers to a syndrome of cardiovascular attacks such as strokes, myocardial infarction or acute cardiac failure and it is widely thought that the long hours culture of the Japanese is a major contributory factor (Spurgeon et al, 1997).

Uehata (1991) studied over 200 karoshi victims and found that two-thirds of the victims had been working 60 or more hours per week and more than 50 hours overtime per month prior to the attacks. Uehata concluded that long hours might be considered to be an acute stressor that could trigger fatal attacks. As Spurgeon et al (1997) argue, however, this suggests that long hours may only heighten the chances of cardiovascular problems where other risk factors exist. Indeed, Kodz et al (2001) reported that over half of the victims in Uehata's study had existing medical conditions and almost a third experienced other stress factors such as increased workload. On the other hand, Sokejima and Kagamimori (1998) reported a significant

increased risk of myocardial infarction in Japanese men when daily work hours were above 11 hours and when all other risks were controlled for.

Despite such positive studies, Harrington (2001) reported that the published studies concerning Karoshi are no more than case series and therefore lack epidemiological rigor. Also, Sokejima and Kagamimori (1998) reported that working both longer (11 hours or more) or shorter (7 hours or less) days increased the risk of myocardial infarction compared to working 7-9 hours per day. This suggests a new issue of what is the "ideal" length of time to be working.

6.3 MECHANISMS INVOLVED

Spurgeon et al (1997) reported that it is generally assumed that long working hours are a major source of occupational stress. They go on to suggest that the mechanisms underlying the association between stress (and therefore long hours) and coronary heart disease are related to multiple and sustained increases in heart rate and blood pressure. However, they also recognise that individual differences in responses to stress may exist. The association between stress and long hours was considered in an earlier section of this review.

A more recent study (Liu et al, 2002) studied 260 Japanese working men and found a twofold increased risk of acute myocardial infarction (AMI) for those working 61 hours or more per week as compared to fewer than 40 hours per week. These researchers suggested similar biological explanations for such a relationship, reporting that overtime work increases blood pressure and heart rate, which induces cardiac symptoms such as chest pain. This study has been highlighted in a BBC news Internet report, suggesting the high profile nature of the link between long hours and physical health (http://news.bbc.co.uk/1/hi/health/2118117.stm).

However, these researchers also reported that insufficient sleep might increase AMI risk. This suggests difficulty in determining exactly which factors lead to an increased risk of AMI. Also, the researchers suggested that having an AMI might influence patients' perception or recall of work and sleep before the onset of the AMI, meaning that caution must be taken when interpreting such findings.

Despite these limitations, the Whitehall II study (Head, Martikainen, Kumari, Kuper and Marmot, 2002) cited that high job demands was associated with CHD and angina. But do high job demands actually mean longer work hours? It may be that people will work longer hours to deal with higher job demands but this link was not explicitly investigated. However, high job demands may be a mechanism by which long working hours leads to heart problems. Alternatively, stress associated with job demands may be a mechanism linking long hours and physical health problems.

6.3.1 Poor Lifestyle Habits

Poor lifestyle habits may act as a mechanism linking long hours with cardiovascular disorder or they may become a physical health problem in themselves (Sparks et al,1997).

For example, Westman et al (1985) studied 870 male members of a kibbutz in Israel and found a positive relationship between hours of work and smoking intensity. In addition, Maruyama and Morimoto (1996) reported a higher percentage of smokers and frequent drinkers in Japanese foremen who worked long hours. However, these studies only included males and they used subjective self-report methodology.

Shields (2000) reported various links between long hours and unhealthy lifestyles. For example, changing from standard to long hours was associated with increased smoking, higher

alcohol consumption, decreases in physical activity levels, and unhealthy weight gain. Similarly, Maruyama and Morimoto (1996) found that long hours workers were less likely to take physical exercise and attend to their nutritional balance. This is supported by the Whitehall II study finding (Head et al, 2002) that high job demands predicted obesity in men and women. However, job demands do not necessarily translate into long working hours.

However, Steptoe et al (1998) cited different evidence for maladaptive health behaviours. They found that only women increased smoking in response to longer working hours and that there was no systematic association between alcohol consumption and long hours. Furthermore, they pointed out that there are difficulties in establishing links with lifestyle habits such as smoking and drinking because such behaviours may exist before the change in working hours. Also, there may be a multitude of other factors, not related to long hours, which could cause the onset of such negative lifestyle behaviours (e.g. social norms or enjoyment).

Nevertheless, as these factors (e.g. smoking, alcohol consumption, diet, exercise) have been linked to ill-health (e.g. CHD), it is important to consider the effects of long hours on maladaptive health behaviours, as well as considering poor lifestyle habits as mechanisms by which long hours and cardiovascular problems are related.

6.4 OTHER PHYSICAL HEALTH EFFECTS

There are also a few other physical health effects that may occur as a result of working long hours. For example, Starrin, Larsson, Brenner, Levi and Petterson (1990) reported increased suicide rates during periods of increased overtime. Also, a survey of people working over 48 hours a week, conducted by the CIPD (2001), showed that common reported problems included chronic headaches and irritable bowel problems. Furthermore, Yasuda et al (2001) reported that long hours might have negative effects on an individual's immunity, by lowering the percentage of CD56+ cells. This study focused on Japanese men in a specific technology development company.

Kawakami, Araki, Takatsuka, Shimizu and Ishibashi (1999) studied a large sample of men from a Japanese electrical company and found that those who worked more than 50 hours of overtime a month had a much higher risk of diabetes mellitus. Similarly, the Whitehall II study (Head et al, 2002) reported some association of diabetes with higher job demands, which are likely to necessitate long hours. However, conclusions are not clear as to whether the association is with long working hours and there appears to be some gender differences in the risk of diabetes from job demands. Such mediating factors are considered further in the limitations section of this review.

6.5 CONCLUSION

From the inconsistency of various research findings and the various problems inherent in some studies, it seems reasonable to suggest that the effect of overtime or long hours on physical health has been less extensively studied than is required and that more larger scale studies are needed to prove such associations. In addition, samples used in the studies reviewed here were not very diverse (i.e. men in Japan) and further research on more diverse samples may be required.

However, Kodz et al (1997) provide an explanation to critics who consider that the evidence on the association of long working hours and physical health is lacking, suggesting that the lack of unequivocal evidence may also be due to those suffering ill health leaving the workforce or reducing their hours as a result of their ill health.

Nevertheless, as Spurgeon et al (1997) conclude, it is agreed that current evidence is sufficient to raise concerns about a possible link between long hours and physical health outcomes, including cardiovascular disease, especially for hours exceeding 48 to 50 a week.

7 SAFETY AND ACCIDENTS

7.1 SUMMARY

- There appears to be a link between working long hours and the likelihood of work-related accidents, especially for certain occupations.
- Several factors, however, may mediate the link between long hours and accidents (e.g. age, sleep, fatigue, experience, lack of training etc).
- Also, such links may be limited by the problems of underreporting and response bias.
- **There seems to be cause for concern about the relationship between long hours and safety/accidents but some areas remain to be explored.**

Working long hours may have an impact on individual safety in terms of increased likelihood of work-related accidents. This is thought to stem from the fact that fatigue, as a result of long working hours, may affect behaviours such as maintenance of attention and risk taking. Indeed, Wellens (2001) noted that fatigue caused by long working hours has been cited in previous man-made disasters, such as Chernobyl or the Exxon Valdez oil spill. However, this again raises the question of whether it is long hours per se or fatigue that leads to adverse effects.

Safety may also be addressed in terms of the prolonged exposure to toxic chemicals in certain working environments. Research on this issue has concentrated on standard working hours, rather than assessing the impact of extended hours (Spurgeon et al, 1997), and so it is difficult to make any conclusions regarding this aspect of safety. Interestingly however, a recent paper (Kenny, Hurley and Warren, 2002) looking at pneumoconiosis (a dust-related lung disease) noted how an increase in the working hours of miners has raised concerns of a potential upturn in the risk of contracting pneumoconiosis.

7.2 ACCIDENTS

Some evidence for the effects of long hours on safety and accident involvement does exist, however, particularly for medical and driving occupations.

7.2.1 Medical Occupations

Kirkaldy et al (1997) found that, for a large sample of medical practitioners in Germany, there was a positive correlation between long working hours and accidents, both at the workplace and when travelling to and from work. Also, when doctors were analysed separately, they were 5 times more likely to have an accident during house visits if hours were longer (over 48 hours per week). Other evidence comes from veterinary surgeons. Trimpop et al (2000) found that veterinary surgeons in Germany who worked over 48 hours were twice as likely to report driving accidents during work hours. However, gender, age and longer working hours combined to increase the number of accidents, suggesting that there is a complex interaction of individual differences and a need for working hours to be considered with other variables.

7.2.2 Driving Occupations

Many research studies have assessed the impact of long hours on drivers' accidents. McCartt et al (2000), for example, surveyed long distance truck drivers and found that more arduous work schedules and more hours of work (i.e. driving for more than 10 consecutive hours) were among

the key determinants of sleep-related incidents. However, this did not mean that many accidents occurred; simply that accident risk may have been increased by drivers falling asleep at the wheel. Furthermore, other factors were reported as being involved in sleep related incidents (e.g. more experienced drivers, shorter and poorer quality sleep, sleep disorder, tendency for drowsiness), which suggests that long hours may not be the sole influence on accident occurrence.

Nevertheless, Lin, Jovanis and Yang (1994) did report that total driving time had a greater effect on crash risk among truck drivers than either driving experience or time of day. Also, Moore and Moore (1996) reviewed a range of research studies and reported that accident risk tends to increase with driving time, with the largest increases around 8 hours and with no increased risk until after 4 or 5 hours of driving. It is also interesting to note that these authors are not aware of studies, examining driving hours beyond 11 or 12 hours, which suggests that this is an under researched area. However, Arnold et al (1997) reported that 38% of truck drivers in Australia exceed 14 hours driving but this did not seem to be linked to any safety or accident data.

Moore and Moore (1996) also noted that many factors associated with long working hours need to be addressed, such as drug taking, sleep deprivation and poor coping with the stress of long hours. For example, the National Transportation Safety Board (1995) concluded that the most critical factors in predicting fatigue-related accidents are the duration of the most recent sleep period, the amount of sleep in the past 24 hours, and split sleep patterns. This indicates that it is sleep and rest that is important in driving accidents rather than long hours per se.

Similarly, in a study of taxi drivers in Australia, Dalziel and Soames-Job (1996) suggested that other factors might be involved in the long hours and accidents relationship. For example, they suggest that greater driver experience may mean that taxi drivers suffer less from the effects of fatigue as a result of long hours and also that:

> *"...a lack of driving-related stimulation may be crucial to fatigue accidents rather than merely the number of hours of driving."*

However, it was also found that working hours were often considerable (67% driving at least 50 hours per week and 50% working 60 hours or more a week when additional work was included) and that higher average total break times were significantly related to reduced accidents. Therefore, long working hours do appear to have a significant part to play.

Research has also looked at bus or coach drivers. Meijman (1997) studied male bus drivers and driving examiners and concluded that as preceding work time increased, mental processing efficiency and attention decreased. It was speculated that the prolonged mental effort that has to be exercised during long periods of driving might adversely affect well-being and health by sustaining the activation of physiological stress reactions systems. In another study, examining 93 male Australian long distance coach drivers, Raggatt (1991) found that long driving hours of 50 or more per week was the best predictor of maladaptive behaviours, such as stimulant use and sleep disturbance, which could then have an impact on stress outcomes. However, such research does not appear to have examined whether such mental effort, maladaptive behaviours, or stress translate into compromised safety or increased accident involvement.

Finally, an article in Safety Reports (August 2000) reported that over 70% of train drivers fear a rise in the rate of signals passed at danger (SPADs) and therefore a rise in rail incidents or accidents. One reason they cited for this concern was long shifts, suggesting that working long hours is seen as an important factor in the occurrence of accidents.

7.2.3 Other Occupations

Ong et al (1982) found a relationship between long working hours (i.e. 11.5 hours per day) and severe hand injuries in Hong Kong manual workers. However, a range of other factors were identified by Ong et al (1982) that need to be considered when accounting for the prevalence of hand injuries, such as lack of training and supervision, inexperience and time of day. Therefore, the authors concluded that the relationship between hours worked and accidents was unclear.

Hanecke, Tiedemann, Nachreiner and Grzech-Sukalo (1998) studied a wide variety of occupations in Germany, from office work to mining and steel industries, and reported an exponentially increasing accident risk beyond the 8th or 9th hour at work, suggesting that the length of working hours does impact on accidents in a variety of professions. However, many occupations were included in the same study and no complete national statistics on the length of the working day in Germany were available. Therefore, information had to be estimated from exposure models and such results should be considered with caution.

In a study involving extremely long working hours, Lusa, Häkkänen, Luukkonen and Viikari-Juntura (2002) examined the prevalence of occupational accidents amongst Finnish firefighters who were working during a strike. They found that working more than 70 hours per week increased the risk of occupational accidents almost four-fold compared with a weekly working week of 50 hours or fewer. However, the fire-fighters were working shifts and were also working under extreme and exceptional conditions, which means that results may not be that relevant to 'normal' working life. Also, the reduction in personnel was also associated with the reported accidents.

7.3 CONCLUSION

There clearly appears to be reason for concern about the relationship between long working hours and safety and accidents, particularly for certain occupations. Research in this area does include quite a diverse range of samples, although most concentrates on driving occupations. However, it is known that such evidence, derived from surveys, may be limited by underreporting of accidents, whereby people will take a more positive view of themselves and not report risks to safety, and response bias, whereby non-respondents are more likely to have had accidents (Kodz et al, 2001). Also, many factors such as lack of training and inexperience may also contribute to accidents.

Therefore, it is generally agreed with Spurgeon et al (1997) that to date *"... many other questions remain to be explored ..."*. The relationship between long hours and accidents is complex and possibly involves many other factors.

8 PERFORMANCE

8.1 SUMMARY

- Performance can be measured directly or indirectly.
- **Most of the available evidence tentatively supports a link between longer working hours and lowered performance but this relationship is complex and not conclusive.**
- It appears that rest breaks may help to improve productivity and performance.
- Several factors may mediate or limit the long working hours - performance link. For example, sleep loss, fatigue, motivation, nature of the task and self-reported surveys.

Pierce, Newstrom, Dunham and Barber (1989) suggested that there are only a few hours a day where employees enjoy their peak period and perform at optimal levels. Therefore, having employees work longer hours should increase the amount of time they are working at sub-optimal levels.

However, Spurgeon et al (1997, p. 367) reported that *"... there have been few systematic investigations of performance effects ..."*. Nevertheless, some evidence can be cited.

8.2 PERFORMANCE EFFECTS

It is evident from various studies that performance can be measured either **directly** in terms of productivity outcomes or **indirectly** in terms of speed and accuracy tests that approximate work tasks or in terms of surveys.

8.2.1 Direct performance effects

Kodz et al (2001) noted two main methods of measuring productivity. The first is in terms of an input - output ratio (e.g. output per unit of labour) and the second is as a percentage of full capacity (e.g. 950 out of 1000 units is 95% capacity). However, in some of the studies that follow it is not always clear what measure of productivity has been used.

Early recorded studies of working hours and performance, from the beginning of the 20th century, focused on direct measures, such as productivity (Abbe, 1901, Vernon, 1920). Such studies discovered that reductions in daily or weekly hours resulted in gradual increases in production. For example, Abbe (1901) reported a 3% rise in production over a year when daily hours were reduced from nine to eight. However, Mather (1894, cited in Spurgeon et al, 1997) conducted a study in the late 19th century and found that reductions in weekly working hours from 53 to 48 had no effect on production levels. Surprisingly, Spurgeon et al (1997) argue that such early research provides the most reliable information in terms of scientific method and attention to detail.

However, Vernon (1920) highlighted some limitations of productivity research, which may question the reliability of such early research. For example, factors, such as practice effects, workers exerting extra effort at the end of a day, or whether a procedure is under machine or human control, may influence performance and efficiency outcomes; workers may be voluntarily limiting their output levels and not working to the best of their ability for whatever reason; and certain results for daily or hourly output variations came from different workers and different jobs. All such issues may limit the accuracy of research findings. Furthermore,

Vernon (1920) reported that the best hours of work could only really be ascertained from prolonged observation and experiment. This implies that this is something that was missing from the early research and therefore that the scientific method and attention to detail that Spurgeon et al (1997) refer to may not have been as reliable as first thought.

Alluisi and Morgan (1982) reported a major investigation from the United States that replicated the early research, and found a general trend for longer hours to be associated with lower productivity. They found that the optimum hours were the standard five day, 40 hour week. However, it was recognised early on that such a relationship could be affected by a range of factors, such as type of work, worker control or motivation. Such mediating factors are considered in the limitations section of this review.

Baltes, Briggs, Huff, Wright and Neuman (1999) looked at the effects of compressed workweek schedules (i.e. the work week is compressed into fewer than 5 days by increasing the number of daily hours), which imply long working "daily" hours. They found that supervisor rated performance showed a positive increase while the more objective measure of productivity showed no performance increase, which indicates conflicting views on whether performance is affected by long hours. Shepard and Clifton (2000) noted that findings of performance increases in early studies coincided with significant reductions in the working week and the rising working hours of more recent years probably explain why performance increases may now be less evident. Furthermore, the fact that compressed workweeks mean that employees have extra days off, may negate any effects of long daily hours and explain the conflicting performance results.

Shepard and Clifton (2000) also studied data from 18 manufacturing industries within the United States covering the period 1956 to 1991 and found that use of overtime hours lowered average productivity (output per worker hour) for almost all of the industries in the sample. Specifically, they reported a significant productivity decline of 2 to 4 percent for a 10 percent increase in overtime and the petroleum and chemical industries showed the largest effects.

8.2.2 Indirect performance effects

More recently there has been a shift towards measuring performance through various tests and work task simulations, designed to involve skills that are essential to particular work tasks (e.g. attention).

Proctor et al (1996) studied the effect of overtime work on the cognitive function of automotive workers and showed that increased overtime was significantly associated with impaired performance on several tests of attention and executive function. Furthermore, the authors found that working 8 hours of overtime predicted increased numbers of errors on a vocabulary test and 19% longer response times on a card sorting test. However, Spurgeon and Harrington (1989) and Kodz et al (2001) noted that it is not clear whether performance results in tests and simulations such as these can be generalised to the actual workplace.

Spurgeon and Harrington (1989) conducted a review of the literature on the work performance and health of junior doctors. They concluded that lower levels of performance on various tasks were found, but it seemed to be mainly related to the effect of sleep loss rather than actual long hours. They also noted the complex relation between long hours and impaired performance, including the possible influence of factors such as the nature and complexity of the task, motivation or individual susceptibility. Finally, they concluded that research might combine long hours with shift work schedules and therefore the long hours - performance link may be inconclusive (e.g. Proctor et al (1996) included shift workers).

In a study of a different occupational group, Stead and Fletcher (1997, cited in Kodz et al, 2001) found that the workload and long working hours of managers were associated with impaired cognitive processing and decision-making.

Evidence from survey research also suggests a general belief that long working hours is detrimental to managerial performance. For example, a survey by the Institute of Management (Worrall and Cooper, 1999) found that 68% of managers felt that their long working hours were having an adverse effect on their productivity. In addition, a US poll cited in Jeunesse (1998, cited in Kodz et al, 2001) showed that 62% of managers agreed that shorter working hours gives workers more incentive to be productive.

A survey of 2,452 junior doctors in the UK by Wilkinson et al (1975) found that over a third reported that always or often their working hours were so long they impaired their performance ability. However, it was commented that such self-report surveys, such as this and the ones above, might be unreliable as the self-assessment of alertness and performance is likely to become more problematic as the individual works longer and becomes sleepier (Gander et al, 2000).

8.2.3 Effects of rest breaks

Vernon (1920) found that productivity was further enhanced when 10-minute rest breaks were introduced in the mornings and afternoons. This finding was supported by a much more recent study (Okogbaa and Shell, 1986) which indicated that total output was 6% better when rest breaks were scheduled into the day.

8.3 MECHANISMS INVOLVED

As mentioned in the fatigue section of this review, performance may actually be the outcome effect of working long hours with fatigue as the linking mechanism. Indeed, a survey conducted by the CIPD (2001) on UK workers working more than 48 hours a week noted that over a third of those who were surveyed said that they had made errors at work as a result of fatigue caused by working long hours.

However, no comparison was made with individuals who did not work over 48 hours, which makes it difficult to draw any firm conclusions about the impact of these long hours on such performance.

Furthermore, Proctor et al (1996) suggested that the relationship between long hours and performance could be explained by the fact that fatigue, possibly resulting from long hours, is a stressor and excessive stressors will lead to decreased performance. However, they also suggest that certain moderate levels of stressors will increase arousal and therefore effective performance. This is generally known as the "inverted-U hypothesis".

Shepard and Clifton (2000) also cited some mechanisms by which long hours may influence performance. They noted that the length of the workweek possibly influences productivity through effects on individual motivation, effort and satisfaction, physical well-being, stress and fatigue, and absenteeism. Also, Kodz et al (2001) mentioned that the reduction of "unproductive time" that may occur from reducing working hours may lead to the perception that shorter hours are related to productivity gains. Therefore, similar to the other effects that have been discussed so far in this review, the relationship between long working hours and performance appears to be quite complex, with many possible mechanisms and mediators.

8.4 CONCLUSION

It seems that the relationship between working hours and performance, either measured directly through productivity outcomes or indirectly through performance tests or surveys, is clearly complex and nowhere near conclusive. Healy (2000) reported that such a relationship requires further research.

There are limitations to most methods of performance research and many factors may mediate the relationship (e.g. deterioration in performance due to long hours is often coupled with sleep disruption), which according to Kodz et al (2001, p. 111):

> *"... makes it difficult to scientifically prove that long hours lead to lower levels of performance."*

9 WORK-LIFE BALANCE

9.1 SUMMARY

- The concept of Work-Life Balance involves, to a large extent, the length and pattern of working hours.
- **The literature suggests that working long hours impacts negatively on home and family life.**
- Other factors, such as the amount of control an employee has over their working hours, may mediate the negative long hours - work-life balance relationship.
- Compressed workweeks (one work-life balance practice) tend to be associated with positive outcomes, such as increased job satisfaction.

Work-Life Balance (WLB) is very much a 'buzz' concept at the present time. Many different organisations and sectors of society seem to be advocating it as 'a good thing'. But what exactly is Work-Life Balance?

9.2 DEFINITION OF WORK-LIFE BALANCE (WLB)

Kodz et al (2001) found that for some people WLB concerned flexibility of schedules, whereas for others it was a reduction in working hours. Dow-Clarke (2002) also found different definitions of WLB in her focus group research. Whilst she found no common definition of work-life balance within a selection of Canadian employees, WLB was defined with reference to, amongst other things, family life, income and the life cycle. Interestingly, all focus groups talked about WLB in relation to work hours: for example, WLB involves being able to decline overtime offers.

So, for the purposes of this review we can assume that WLB does refer, at least in some part, to working hours that are sufficiently short to ensure an individuals' desired balance between work and family or home life is achieved and maintained.

The Department of Trade and Industry (DTI) is currently leading the UK Government campaign on WLB, launching the DTI Work-Life Balance Campaign in 2000. They are putting forward the business case for WLB and showing employers how they can implement various WLB options. For the DTI, WLB seems to be about flexible working arrangements and flexible benefits. In their booklet 'Work-Life Balance: The Business Case' (2001, DTI, downloaded from internet www.dti.gov.uk/work-lifebalance) the DTI highlight many WLB practices. These include flexi-time, staggered hours, time off in lieu, compressed working weeks, 'with shift' working, shift swapping, self-rostering, annual hours, job sharing, working from home. This list highlights how broad WLB is.

The common term in use in the UK seems to be Work-Life Balance. Within the academic research there are a variety of terms that describe a similar concept. For example, studies have examined work-to-nonwork conflict (Wallace, 1999), interrole conflict (O'Driscoll et al, 1992) and work-family conflict (Fox & Dwyer, 1999, Major et al, 2001). These terms have been included in the review's concept of WLB.

As the present review focuses on long working hours, and as the WLB literature is fairly large, this section concentrates on two aspects of WLB:

1) The effects of working long hours on WLB, and

2) The effects of certain WLB practices that are directly concerned with the length of hours that people work. Specifically, looking at practices such as compressed working weeks, whereby employees may, on certain days work 'longer' than the average 8 hours may shed some more light on the relationship between long hours and various outcomes.

9.3 THE EFFECTS OF WORKING LONG HOURS ON WORK-LIFE BALANCE

Kodz et al (2001) note how most research that addresses the effects of long hours on personal and family factors seems to concentrate on attitudinal surveys or case study type research. They note that this may be because measuring the impact of work on home life is very difficult and it is hard to examine direct causal links. Looking at this type of attitudinal research, they conclude that long hours workers tend to feel that they are not happy with the amount of time they devote to work and how it impacts on their family and home life. Spurgeon et al (1997) assert that the 'social effects' of long hours (e.g., family, home and leisure life) have not been systematically investigated, despite many passing references to them.

These types of attitudinal surveys are reported in the media and also in peer reviewed journals. For example, recently in the national media a telephone survey of 508 employees carried out by Continental Research on behalf of DTI and Management Today (reported at www.dti.gov.uk/work-lifebalance/press300802.html) found that twice as many employees would rather work shorter hours than win the lottery and 72% of 'highly stressed' workers do not have access to any formal flexible working practices.

Research supported by the Joseph Rountree Foundation and conducted by the National Centre for Social Research in 2001 (La Valle, Arthur, Millward, Scott and Claydon, 2002) involved a telephone survey of over 1,000 mothers and 40 follow-up interviews with mothers and fathers. It explored the impact of atypical work on family life. Nearly a third of fathers worked long hours (over 48 hours a week). Working long hours was associated with disruption to family activities and atypical work (for example, working at the weekend or evenings) was associated with dissatisfaction with the amount of time mothers were able to spend with their children and with dissatisfaction with the amount of time spent as a couple. Also, long hours (of both parents) were associated with less involvement with and disruption to children's activities.

An interim report by Robert Taylor on the Working in Britain in 2000 survey (part of the Economic and Social Research Council Future of Work programme) summarises some of the survey findings. The survey was conducted in 2000 by the London School of Economics and the Policy Studies Institute. It involved in-depth interviews with 2,466 employees doing various jobs. One of the relevant key findings is that around three quarters of employees in various job types (for example, higher level professionals and managers, technicians and supervisors and semi and unskilled manual) are not satisfied with the hours they work (with hours, we assume, being perceived as too long).

A selection of relevant studies are reviewed and presented in the Summary table that are mostly academic/peer reviewed (e.g., Major et al, 2001; Parasuraman, Purohit, Godshalk and Beutell, 1996; O'Driscoll et al, 1992; Fox & Dwyer, 1999; Galambos & Walters, 1992; Glass & Fujimoto, 1994; Wallace, 1999; Barnett et al, 1999). All the studies involve self-reports, and all associate working long hours with increases in some sort of work-life conflict.

9.3.1 Moderating factors and other variables

It does seem that in general working long hours is associated with poorer work-life balance. However, not surprisingly, the conclusions are not that straightforward. Whilst long hours were associated with conflict between work and home life, other 'stressors' such as quantity of workload, work variability and frequency of stressful events (e.g., Fox and Dwyer, 1999) were also related to work-family conflict. In a way, the stressors that are identified and associated with poor WLB are almost dependent on what is measured in that particular study.

In addition, many authors note how factors such as control and choice over number of work hours (e.g., Wallace, 1999, Barnett et al, 1999) or the impact of the work hours on others in the family (e.g., Galambos & Walters, 1992), can moderate any effects of long hours on WLB. This latter study highlights the complex nature of the work hours – WLB relationship. Ninety-six dual earner couples from a city in Canada completed postal questionnaires that measured various facets of work life, role strain and depression and anxiety. Galambos and Walters found that working long hours for husbands and wives was associated with stress and role strain respectively. Interestingly, they also found that long working hours of wives were associated with anxiety and depression in husbands.

In her review of the literature, Wallace (1999) notes that research has found that work is allowed to invade one's family life more than the reverse (i.e., family life invading work).

One particular limitation that should be considered is that the definitions of long hours are not always explicit within these studies. For example, whilst the average working hours of the lawyers in the study of Wallace (1999) was 50 for men and 45.6 for women, the average for the Canadian couples in the study by Galambos and Walters (1992) was 42 for men and 30.9 for women. The concept of 'long' hours was often relative to the sample in that study. In some studies, the length of working hours is not stated.

9.4 THE EFFECTS OF WLB PRACTICES THAT MANIPULATE WORKING HOURS

Another aspect of WLB that is of interest is what effect changes in working patterns and hours have had on WLB and other outcomes. This review touches on a few studies that have assessed compressed workweeks.

There is an increasing amount of research being done on the impact of different facets of flexible working on the lives of employees. 'New ways of working' are starting to be systematically investigated by researchers from all over the world. Reviewing all of these studies is well beyond the scope of this review but the following may be of interest to the current topic:

Baltes et al (1999) recently conducted a meta-analysis of studies that have evaluated flex-time and compressed workweek schedules. The process of meta-analysis has been described elsewhere in this review. Baltes and colleagues were strict with regard to the studies that they included in their analysis: studies had to involve pre-post control-experimental or normative experimental comparison. These types of studies allow us to be reasonably confident that any effects observed are due to the changes of the schedule under investigation.

Compressed work weeks generally refer to a schedule whereby normal weekly working hours (e.g., 40 hours) are compressed into 4 or fewer days. This means that although the weekly working hours are not particularly long, the daily hours can average around 10, which is quite a

long working day. The results of their meta-analysis suggested that compressed workweeks positively affected performance (as rated by supervisors), job satisfaction and satisfaction with work schedule. They did not affect productivity of absenteeism. The positive effects of compressed workweek schedules did not diminish over time.

Looking at an example of a study that looked at the effects of a shorter workweek, Ivancevich (1974) compared two groups of employees working at a US manufacturing company. One group was working a 4 day week of 10 hours per day, whilst the controls were working 40 hours over 5 days. Both groups completed a questionnaire at various points in time. Ivancevich found that people working the shorter workweek (therefore, longer days) reported higher job satisfaction than the controls, and there was a small but significant improvement in perceived anxiety-stress and some measures of job performance. There was no effect on absenteeism.

9.5 CONCLUSION

In conclusion the literature suggests that working long hours is perceived to impact negatively on various aspects of home life, but that many different factors can moderate this relationship. The research base is also, perhaps necessarily, based on self-report measures and attitudinal surveys.

Compressed workweeks (one WLB practice) tend to be associated with positive effects such as increases in job satisfaction and performance.

10 CONCLUSIONS AND RECOMMENDATIONS

There is an increasing body of literature that is starting to examine the effects that working for long hours has on an individual's health and safety. Whilst the volume of evidence on the subject is increasing, it is not as well researched as shift working, for example. However, some conclusions can be drawn.

10.1 THE RESEARCH BASE

The evidence reviewed in this report does raise some causes for concern with regard to the negative effects on health and safety of working long hours. However, at this stage, the research base is not sufficiently robust to make any firm assertions that working for long hours definitely causes various negative effects. The limitations of the research have been discussed in detail in Section 3 of this review, but some key limitations are presented below.

10.1.1 Limitations

Some limitations are inherent to the topic of study. Many of the concepts, such as fatigue, work-life balance and stress are very personal to the individual. What makes one person stressed will not make another person stressed. Therefore, a lot of the research uses self-report. The problem with self-report data is that we cannot be sure that the variables under consideration (stress for example) are the same across all studies or individuals within studies. Generalising findings can be problematic. Also associated with using self-reports is the problem that study participants may not recall accurately.

Many of the studies are based on questionnaire completion. When this is not mandatory within a work group, the sample studied will be self-selected. This can mean a possible bias within the sample, for example, people may be more likely to complete a questionnaire about health effects of long hours if they feel they have health problems related to long hours. However, many authors do attempt to ensure their sample is as representative as possible of the population under consideration.

Causation needs to be further investigated. Our conclusions are based, in the main, on results from studies that have noted an association between long hours and various factors, but not explicitly investigated whether long hours causes these effects. In reality, what is likely is that there will be multiple causality for many of the effects, such that long hours is amongst factors such as lack of control and choice at work, work overload, poor lifestyle behaviours, for example that impact on health, well-being and safety.

Furthermore, there is a lack of consensus as to what constitutes long hours. Shift work also contaminates the long working hours studies.

Some methodological limitations are starting to be addressed.

- Prospective or longitudinal studies are necessary to trace whether long hours are amongst the factors causing poor health, well-being or performance. There are a few of these within the research base, but more are required.
- In general, diverse industries are being studied from around the world, with both males and females in the sample. However, there is perhaps a lack of studies from the UK.
- There has been some use of objective measurements of variables under consideration.

10.1.2 Mechanisms involved

The ways in which working long hours could lead to negative effects on health and safety is not yet entirely clear. It seems likely that long hours can either act as a stressor, which in turn leads to negative consequences, or alternatively long hours leads to fatigue, which in turn leads to negative consequences. It is likely that poor quality or lack of sleep that is associated with long working hours may also have an impact. Within the shiftwork literature there is evidence for cumulative sleep debt having a large impact on observed performance and safety effects (Folkard, 1996).

10.1.3 Mediating factors

Whilst researchers have associated working long hours with various effects, the relationships will be complex and will be mediated by the following factors:

- Individual factors (gender, age, personality)
- Choice and control over work hours and rest breaks
- Type of job/occupation/task
- Type of work environment or culture.

These have not been thoroughly investigated in this review.

10.2 MAIN CONCLUSIONS FROM THE LITERATURE

One of the aims of the review was to ascertain whether any studies have found that reducing working hours leads to health and safety improvements. This can only be inferred from the conclusions below, as no studies that we reviewed systematically reduced hours and compared the effects to long working hours.

10.2.1 Long hours and fatigue

The literature suggests that there is an association between working long hours and fatigue. The strongest link is with long hours and subjective reports of fatigue, although some studies that have used more objective measurements of fatigue have also found a link. Fatigue has been defined in different ways within the literature. Section 4 of the review concentrates on studies that measured fatigue as an end in itself. However, fatigue can also be measured indirectly by looking at performance. Evidence from the literature on accidents and performance (reviewed in sections 7 and 8) also suggests that long hours are related to fatigue.

10.2.2 Long hours and stress and psychological health

There is some evidence that working long hours can lead to stress or mental ill health, although this is somewhat equivocal. Stress has been measured in a variety or ways, which has most likely influenced the lack of consensus within the literature. Working long hours is probably associated with stress, but so are many other work and non-work factors. The key is perhaps to ascertain why an individual is working long hours in the first place as the way an individual thinks about their job and the amount of control they have over their job will mediate the long hours – stress/psychological health relationship.

10.2.3 Physical health

There is sufficient evidence for us to be concerned about the potentially negative effects of working long hours on physical health. The strongest evidence probably concerns the links with cardiovascular disorder, though this evidence stems mostly from Japanese men. There is also evidence for a link between long hours and maladaptive health behaviours such as smoking, which can in turn increase the risk of some health problems. However, there are so many other factors that can affect health that long working hours is likely to be just one of many.

10.2.4 Safety and accidents

Investigating the impact of various factors on accidents and safety is an inherently difficult area, with many factors often combining to result in an accident and problems with retrospective analysis. For this reason, the evidence is not conclusive. However, there does seem to be cause for concern for a link between long hours and accidents, particularly within the driving occupations. It is likely that fatigue associated with working long hours will have a strong impact on safety and accidents.

10.2.5 Performance

The evidence is far from conclusive with regard to the performance effects of working long hours. The studies are relatively robust in that performance is often measured both subjectively and objectively. What could perhaps be said about the literature is that it supports the evidence for a link between working long hours and fatigue, in that performance is often used as an indirect measure of fatigue.

10.2.6 Work-life balance

There is strong evidence that people perceive that working long hours leads to poor work-life balance. However, the evidence is based on self-report measures. Control over when an individual works is very important to the extent to which working long hours will impact on home and family life, with those people who can control how long they work perceiving less of a negative impact on work-life balance.

10.3 AREAS WHERE RESEARCH IS LACKING

The research base would benefit from further work in a number of areas that at present have received little or no attention. They include the following:

a) **Commuting time.** Few studies seem to include commuting time as part of their definition of working time. There was no study that explicitly assessed the impact of commuting time on health and safety. With the increasing distances that individuals are required to travel to and from (and during) work, it would be beneficial to look at this area.

b) **Longitudinal studies.** More longitudinal studies are required. This would help with further investigating the causal relationships between health and safety and long hours. In addition, the cumulative effects of long working hours may be important to consider, especially as overtime can vary over the year. More research would help to ascertain whether there is a maximum period that an employee can sustain overtime work for and would help to assess both the cumulative and the acute effects of working for long daily, weekly, monthly and yearly hours.

c) **Less researched occupations and ways of working.** There appears to be a lack of studies that have examined long hours in relation to certain jobs, for example, home working, tele-working (for example, call centre working) and nursing.

d) **"Ideal hours" and new ways of working.** There is some evidence that working both longer and shorter hours than preferred can lead to negative outcomes. This finding merits further attention. Furthermore, the effects that 'new ways of working' such as flexi-time and compressed workweeks have on the length of hours worked and health and safety outcomes would also be of interest.

e) **Mechanisms involved.** Further detail is needed on the exact mechanisms involved in the long working hours – health and safety relationship. Is it stress? Is it fatigue? How important is loss of sleep?

10.4 RECOMMENDATIONS

This review has highlighted a number of limitations of the existing research which means any conclusions about the relationship between long working hours and work-life balance, accidents and health and safety outcomes can only be tentative. Further research is therefore essential if the continuing trend of working longer and longer hours in the UK continues.

1) Further methodologically robust research is needed on the relationship between long working hours and health and safety outcomes. Research should aim for the following:
    - Longitudinal or prospective
    - Control for more mediating variables
    - Large scale
    - Use both objective and subjective measures
    - Involve UK samples.

2) Studies on less researched occupational groups would be helpful, for example, on tele-working, nursing, manual labour.

3) Further research should aim to investigate whether 48 hours a week is the appropriate 'cut off' for the maximum length of time an individual should work. It could also further investigate the acute effects of long hours (for example after a long day) and the cumulative effects (for example, after weekly or monthly long hours).

4) Good quality studies that look at the effects of reducing working hours would shed more light on the impact of long working hours on health and safety. Could data from France, where a working week of 35 hours has recently been adopted, help?

5) Further specific literature reviews could be conducted in many of the areas touched upon in this review. For example:
    - New ways of working and new Work-life Balance practices and their effects on hours of work and health and safety
    - Further investigation of the literature on driving should be reviewed (the body of research is growing, especially due to public concern about fatigue and driving in the light of the Great Heck crash).

6) The role of loss of or inhibited sleep on health and safety outcomes should be considered in more detail.

11 REFERENCES

Abbe, E. (1901)
IN J Goldmark (1912) Fatigue and efficiency: A study in industry.
New York: Russell Sage Foundation.

Alluisi, E.A. and Morgan, B.B. (1982)
Temporal factors in human performance and productivity. IN E. Alluisi & E. Fleishman (eds) Human Performance and productivity: Stress performance effectiveness (vol 3), pp 165-247.
New Jersey: Lawrence Erlbaum Associates.

Anonymous.
Train drivers fear rise in rail accidents.
Safety Reports, Aug 2000, No 8, 2.

Arnold, P.K., Hartley, L.R., Corry, A., Hochstadt, D., Penna, F., and Feyer, A.M. (1997)
Hours of work and perceptions of fatigue among truck drivers.
Accident Analysis and Prevention, 29 (4), 471-477.

Baltes, B.B., Briggs, T.E., Huff, J.W., Wright, J.A., and Neuman, G.A. (1999)
Flexible and compressed workweek schedules: A meta-analysis of their effects on work-related criteria.
Journal of Applied Psychology, 84 (4), 496-513.

Barnett, R.C., Gareis, K.C., and Brennan, R.T. (1999)
Fit as a mediator of the relationship between work hours and burnout.
Journal of Occupational Health Psychology, 4 (4), 307-317.

BBC News Online Network (viewed 14/8/2002)
World: Americans work longest hours.
http://news.bbc.co.uk/1/hi/world/439595.stm

Beull, P. and Breslow, L. (1960)
Mortality from coronary heart disease in Californian men who work long hours.
Journal of Chron. Dis., 11, 615-26.

Bliese, P.D. and Halverson, R.R. (1996)
Individual and nomothetic models of job stress: An examination of work hours, cohesion and well-being.
Journal of Applied social Psychology, 26, 1171-1189.

Calvasina, E.J. and Boxx, W.R. (1975)
Efficiency of workers on the four-day workweek.
Academy of Management Journal, 18, 604-610.

Chartered Institute of Personnel Development (2001)
Married to the Job.
Occupational Safety and Health, 31 (7), Jul, 16-17.

Clapp, S., Benjamin, K., and Sreenivasan, B. (in press)
An Evaluation of the Sensitivity of the Critical Flicker Fusion (CFF) Test to the Neurobehavioural Effects of Alcohol.
HSL Report WPS/02/12.

Clark, A. (1996)
Job satisfaction in Britain.
British Journal of Industrial Relations, 34, No 2, 189-217.

Cooper C.L., Davidson, M.A., and Robinson, P. (1982)
Stress in the Police Service.
Journal of Occupational Medicine, 24 (1), 30-6.

Dalton, D.R. and Mesch, D.J. (1990)
The impact of flexible scheduling on employee attendance and turnover.
Administrative Science Quarterly, 35, 370-387.

Dalziel, J.R., and Soames-Job, R.F. (1996)
Fatigue and Taxi Drivers: An examination of factors associated with motor vehicle accidents. Proceedings of the 2nd International Conference on Fatigue and Transportation: Engineering, Enforcement and Education Solutions, Fremantle, Western Australia, Feb 11-16.

Daniels K. and Guppy, A. (1995)
Stress, social support and psychological well-being in British accountants.
Work and Stress, 9, 432-47.

Defrank, R.S., Konopaske, R. and Ivancevich, J.M. (2000)
Executive travel stress: perils of the road warrior.
Academy of Management Executive, 14 (2), May, 58-71.

Department of Trade and Industry (DTI) (2001) (viewed on Internet 8/1/2003).
Work Life Balance: The Business Case.
www.dti.gov.uk/work-lifebalance/publications.html

Department of Trade and Industry (DTI) Work Life Balance Campaign Press Release 30 August 2002 (viewed 8/1/2003).
UK workers struggle to balance work and quality of life as long hours and stress take hold.
http://www.dti.gov.uk/work-lifebalance/press300802.html.

Dex, S., Clark, A. and Taylor, M. (1995)
Household Labour Supply: Department of Employment Research Series 43.
University of Essex: ESRC Research Centre on Micro-social change.

Dow-Clarke, R.A. (2002)
Work-life balance in an industrial setting: focus on advocacy.
AAOHN Journal, 50 (2), Feb, 67-74.

Dowie, R. (1989)
Patterns of hospital medical staffing: Interim report - junior doctor hours.
British Postgraduate Medical Federation. London: HMSO.

Duffy, C.A., and McGoldrick, A.E. (1990)
Stress and the bus driver in the UK transport industry.
Work and Stress, 4, 17-27.

Firth-Cozens, J., and Moss, F. (1998)
Hours, sleep, teamwork and stress.
British Medical Journal, 317, no 7169, 14 Nov, 1335-1336.

Folkard, S. (1996)
Body Rhythms and Shiftwork (chapter). IN P. Warr (ed) Psychology at Work (4th Edition).
London: Penguin Books.

Fox, M.L. and Dwyer, D.J. (1999)
An investigation of the effects of time and involvement in the relationship between stressors and work-family conflict.
Journal of Occupational Health Psychology, 4, 164-174.

Galambos, N.L. and Walters, B.J. (1992)
Work hours, schedule inflexibility and stress in dual-earner spouses.
Canadian Journal of Behavioural Science, 24(3), 290-302.

Gander, P.H., Merry, A. and Miller, N.M. (2000)
Hours of work and fatigue related error.
Anaesthesia and Intensive care, 28 (2), 178-183.

Glass, J. and Fujimoto, T. (1994)
Housework, paid work and depression among husbands and wives.
Journal of Health and Social Behaviour, 35, June, 179-191.

Hagihara, A., Tarumi, K., Morimoto, K. (1998)
Type A and type B behaviours and factors related to job satisfaction among male white collar workers.
Environmental Health and Preventive Medicine, 2, 139-44.

Hanecke, K., Tiedemann, S., Nachreiner, F., and Grzech-Sukalo, H. (1998)
Accident risk as a function of hour at work and time of day as determined from accident data and exposure models for the German working population.
Scandinavian Journal of Work Environment Health, 24, 43-48.

Harrington, J. M. (1978)
Shiftwork and health: A critical review of the literature.
Health and Safety Executive. HM Stationery Office, London.

Harrington, J.M. (2001)
Health effects of shift work and extended hours of work.
Occupational and Environmental Medicine, 58, 68-72.

Head, J., Martikainen, P., Kumari, M., Kuper, H., and Marmot, M. (2002)
Work environment, alcohol consumption and ill-health. The Whitehall II study. (HSE CRR 422/2002).

Healy, E. (2000) (viewed on Internet).
The shift to long working hours: A social and political crisis in the making.
People and Place, 8 (1), 38-51.

Hills, P. and Keenan, M. (2000)
Evaluation of the HSE's shiftwork research portfolio.
PREST (Policy Research in Engineering, Science and Technology), The University of Manchester.

Hinkle, L.E., Whitney, L.H., Lehman, E.W., Dunn J., Benjamin, B., King, R., Plakun, A. and Flehinger, B. (1968)
Occupation, education and coronary heart disease.
Science, 161, 238-246.

Houston, D. and Allt, S. (1997)
Psychological Distress and error making among junior house officers.
British Journal of Health Psychology, 2, 141-151.

Iskra-Golec, I., Folkard, S., Marek, T., and Noworol, C. (1996)
Health, well-being and burnout of ICU nurses on 12 and 8h shifts.
Work and Stress, 10 (3), 251-256.

Ivancevich, J.M. (1974)
Effects of the shorter workweek on selected satisfaction and performance measures.
Journal of Applied Psychology, 59 (6), 717-721.

Jamal, M. (1986)
Moonlighting: Personal, social and organizational consequences.
Human Relations. 39, 977-990.

Jansen, N.W.H., Kant, I., and Van Den Brandt, P.A. (2002)
Need for Recovery in the working Population: Description and Associations with Fatigue and Psychological Distress.
International Journal of Behavioural Medicine, 9(4), 322-340.

Kawakami, N., Araki, S., Haratani, T., Hemmi, T. (1993)
Relations of work stress to alcohol use and drinking problems in male and female employees of a computer factory in Japan.
Environmental Research, 62, 314-24.

Kawakami, N., Araki, S., Takatsuka, N. Shimizu, H. and Ishibashi, H. (1999)
Overtime, psychosocial working conditions and occurrence of non-insulin-dependent diabetes mellitus in Japanese men.
Journal of Epidemiological Community Health, 53, 359-363.

Kawakami, N., and Haratani, T. (1999)
Epidemiology of job stress and health in Japan: Review of current evidence and future direction.
Industrial Health, 37, 174-186.

Kenny, L. C., Hurley, F. and Warren, N. D (2002)
Estimation of the Risk of Contracting Pneumoconiosis in the UK Coal Mining Industry.
Annals of Occupational Hygiene, 46, Supplement 1, 257-260

Kirkaldy, B., Trimpop, R. and Cooper, C. (1997)
Working hours, job stress, work satisfaction and accident rates among medical practitioners and allied personnel.
International Journal of Stress Management, 4 (2) 79-87.

Kodz, J., Lain, D., Sheppard, E., Davis, S., Bates, P., and Cummings, J. (2001)
Working long hours: A review of literature and secondary data analysis (draft interim report).
Brighton: Institute for Employment Studies.
Konz, S. (1998a)
Work/rest: part I - Guidelines for the practitioner.
International Journal of Industrial Ergonomics, 22, 67-71.

Konz, S. (1998b)
Work/Rest: Part II - The scientific basis (knowledge base) for the guide.
International Journal of Industrial Ergonomics, 22, 73-99.

La Valle, I., Arthur, S., Millward, C., Scott, J., and Clayden, M. (2002)
Happy Families? Atypical work and its influence on family life.
The Policy Press as part of the Family and Work Series (ISBN 1 861 34 481 3).

Lewis, D. (1999)
All work and no sleep: is fatigue waking up the transportation industry.
Safety and Health, 159 (3), Mar, 44-48.

Lin, TD, Jovanis, PP and Yang, CZ (1994)
Time of day models of motor carrier accident risk. IN Transportation Research Record 1467 Safety and Human Performance: Traffic and Roadway Accident Analysis and Traffic Records Research.
National Academy Press: Washington DC.

Liu, Y., Tanaka, H., and The Fukuoka Heart Study Group (2002)
Overtime work, insufficient sleep, and risk of non-fatal acute myocardial infarction in Japanese men.
Occupational and Environmental Medicine, 59, 447-451.

Lusa, S., Hakkanen, M., Luukkonen, R., and Viikari-Juntura, E. (2002)
Perceived physical work capacity, stress, sleep disturbance and occupational accidents among firefighters working during a strike.
Work and Stress, 16 (3), 264-274.

Major, V.S., Klein, K.J., and Ehrhart, M.G. (2001)
Work time, work interference with family and psychological distress.
Journal of Applied Psychology, 87 (3), 427-436.

Maruyama, S. and Morimoto, K. (1996)
Effects of long hours on lifestyle, stress and quality of life among intermediate Japanese managers.
Scandinavian Journal of Work Environment Health, 22 (Oct), 353-359.

McCartt, A.T., Rohrbaugh, J.W., Hammer, M.C, and Fuller, S.Z. (2000)
Factors associated with falling asleep at the wheel among long-distance truck drivers. Accident Analysis and Prevention, 32, 493-504.

Meijman, T.F. (1997)
Mental fatigue and the efficiency of information processing in relation to work times. International Journal of Industrial Ergonomics, 20, 31-38.

Mitler, M.M., Miller, J.C., Lipsitz, J.J., Walsh, J.K., and Wylie, C.D. (1997)
The sleep of long-haul truck drivers.
New England Journal of Medicine, 337 (11), 755-761.

Moore, B., and Moore, J. (1996)
Prescriptive driving hours: the credibility gap.
Proceedings of the 2nd International Conference on Fatigue and Transportation: Engineering, Enforcement and Education Solutions, Fremantle, Western Australia, February 11-16, 545-560.

National Transportation Safety Board (1995)
Factors that affect fatigue in heavy truck accidents. Volume 1 Analysis.
Safety study NTSB/SS-95/01 (January), Washington DC.

O'Driscoll, M.P., Ugen D.R., and Hildreth K. (1992)
Time devoted to job and off-job activities, interrole conflict and affective experiences. Journal of Applied Psychology, 77, 272-279.

Okogbaa, O.G. and Shell, R.L. (1986)
The measurement of knowledge worker fatigue.
IIE Transactions, 335-42.

Ong, S.G., Fung, S.C., Chow, S.P. and Kleevans, J.W.L. (1982)
A study of major factors associated with several occupational hand injury in Hong Kong island.
Journal of society of Occupational medicine, 32, 82-8.

Ono, Y., Watanabe, S., Kaneko, S., Matsumoto, K., and Miyako, M. (1991)
Working hours and fatigue of Japanese flight attendants.
Journal of Human Ergology, 20, 155-164.

Oppenheim, L. (1987)
Factors related to occupational stress or burnout among music therapists.
Journal of Music Therapy, 24, 97-106.

Parasuraman, S., Purohit, Y.S., Godshalk, V.M., and Beutell, N.J. (1996)
Work and family variables, entrepreneurial career success, and psychological well-being.
Journal of Vocational Behaviour, 48, 275-300.

Park, J., Kim, Y., Chung, H.K. and Hisanaga, N. (2001).
Long working hours and subjective fatigue symptoms.
Industrial Health, 39, 250-254.

Pierce, J.L., Newstrom, J.W., Dunham, R.B. and Barber, A.E. (1989)
Alternative work schedules.
Needham Heights, MA: Allyn and Bacon.

Proctor, S.P., White, R.F., Robins, T.G., Echeverria, D., and Rocskay, A.Z. (1996)
Effect of overtime work on cognitive function in automotive workers.
Scandinavian Journal of Work Environment and Health, 22, 124-132.

Raggatt, R.T. (1991)
Work stress among long-distance coach drivers: A survey and correlational study.
Journal of Organizational Behaviour, 12, 565-579.

Rogers, A.S., Spencer, M.B. & Stone B.M. (1999)
Validation and development of a method for assessing the risks arising from mental fatigue.
(HSE CRR 254/1999).

Rosa, R.R. (1995)
Extended workshifts and excessive fatigue.
Journal of Sleep Research, 4, Suppl. 2, 51-56.

Russek, H.I. and Zohman, B.L. (1958)
Relative significance of heredity, diet and occupational stress in coronary heart disease of young adults.
American Journal of Medicine, 325, 266-75.

Shepard, E., and Clifton, T. (2000)
Are longer hours reducing productivity in manufacturing.
International Journal of Manpower, 21 (7), 540-552.

Shields, M. (2000)
Long working hours and health.
Perspectives (Spring 2000) Statistics Canada, Catalogue No. 75-001-XPE (viewed on www.statcan.ca/english/indepth/75-001/archive/2000/pear2000012001s1a06.pdf)
Adapted from an article in Health Reports (Statistics Canada, Catalogue No. 82-003-XPB), 11 (2), Autumn 1999, 33-48.

Shimomitsu, T. and Levi, L. (1992)
Recent working life changes in Japan.
European Journal of Public Health, 2, 76-96.

Sokejima, S. and Kagaminnori, S. (1998)
Working hours as a risk factor for acute myocardial infarction in Japan: Case control study.
British Medical Journal, 317, 775-80.

Sorenson, G., Pirie, P., Folsom, A., Luepker, R., Jacobs, D. and Gillum, R. (1985)
Sex differences in the relationship between work and health. The Minnesota heart survey.
Journal of Health and Social Behaviour, 26, 379-94.

Sparks, K., Cooper, C., Fried, Y. and Shirom, A. (1997)
The effects of hours of work on health: A meta-analytic review.
Journal of Occupational and Organizational Psychology, 70, 391-408.

Spector, P.E., Dwyer, D.J. and Jex, S.M. (1988)
Relation of job stressors to affective health and performance outcomes: A comparison of multiple data sources.
Journal of Applied Psychology, 73, 11-19.

Spurgeon, A. and Harrington, J.M. (1989)
Work performance and health of junior hospital doctors: A review of the literature.
Work and Stress, 3, No 2, 117-128.

Spurgeon, A., Harrington, J.M. and Cooper, C.L. (1997).
Health and safety problems associated with long working hours: a review of the current position.
Occupational and Environmental Medicine, 54, 367-375.

Starrin, B., Larsson, G., Brenner, S., Levi, L. and Petterson, I. (1990)
Structural changes, ill-health and mortality in Sweden, 1963-1983. A macroaggregated study.
International Journal of Health Services, 20(1), 27-42.
Steptoe, A., Wardle, J., Lipsey Z., Mills, R., Oliver, G., Jarvis, M., and Kirschbaum, C. (1998)
Longitudinal study of workload and variations in psychological well-being, cortisol, smoking and alcohol consumption.
Annals of Behavioural Medicine, 20 (2), 84-91.

Taylor, R. (2000)
Britain's world of work – Myths and Realities.
Economic and Social Research Council, Future of Work Programme Series.

Trimpop, R., Kirkcaldy, B., Athanasou, J., and Cooper, C. (2000)
Individual differences in working hours, work perceptions and accident rates in veterinary surgeries.
Work and Stress, 14 (2), 181-188.

Uehata, T. (1991)
Long working hours and ocupational stress-related cardiovascular attacks among middle-aged workers in Japan.
Journal of Human Ergology, 20, 147-153.

Van Der Hulst, M., and Geurts, S. (2001)
Associations between overtime and psychological health in high and low reward jobs.
Work and Stress, 15 (3), 227-240.

Vernon, H.M. (1920)
Industrial Efficiency and Fatigue. IN E.L. Collis (ed) The Industrial Clinic (p. 51-74).
London: Bale and Danielsson.

Wallace, J.E. (1999)
Work to non-work conflict among married male and female lawyers.
Journal of Organizational Behaviour, 20, 797-816.

Wantabe, S., Torii, J., Shinkai, S., and Wantabe, T. (1993)
Relationships between health status and working conditions and personalities among VDT workers.
Environmental Research, 61, 258-265.

Wellens, B. (2001)
A review of the literature on the combined effects of noise and working hours. IN M.A. Hanson (ed). Contemporary Ergonomics (p. 185-190).
London: Taylor and Francis.

Westman, M., Eden, D. and Shirom, A. (1985)
Job stress, cigarette smoking and cessation: The conditioning effects of peer support.
Social Science and Medicine, 20, 637-644.

Wilkinson, R.T., Tyler, P.D. and Varey, C.A. (1975)
Duty hours of young hospital doctors: Effects on the quality of work.
Journal of Occupational Psychology, 48, 219-229.

Williamson, A.M., Feyer, A.M. and Friswell, R. (1996)
The impact of work practices on fatigue in long distance truck drivers.
Accident Analysis and Prevention, 28 (6), 709-719.

Worrall, L. and Cooper, C. (1999)
Quality of Working Life: 1999 survey of managers' changing experiences.
London: Institute of Management.

Yasuda, A., Iwasaki, K., Sasaki, T., Oka, T., and Hisanaga, N. (2001)
Lower percentage of CD56+ cells associated with long working hours.
Industrial Health. 39, 221-223.

12 APPENDIX 1 – SUMMARY TABLE OF KEY STUDIES

The following table summarises the methodology, sample, relevant findings and conclusions and limitations of a range of key studies on long working hours. The list of studies is by no means exhaustive. It is intended to highlight some of the methodological issues associated with the research base.

Study	Methodology	Key Findings/Conclusions	Limitations
Arnold et al (1997) Hours of work, and perceptions of fatigue among truck drivers.	• Survey of heavy truck driving companies and drivers in Australia. • Using interviews and standardised questionnaire, asked about driving and non-driving work schedules, sleep obtained in last week and fatigue related experiences. • During a 7-day period 1249 truck drivers were invited and 638 (60.9%) agreed to the interview. • Interviews were collected at 6 service areas chosen to provide a sample of drivers from each major long distance transport route. • 84 out of 88 management representatives of transport companies were also interviewed. They included a spread of large, medium and small city and country organisations.	• In a 24-hour period 38% drivers exceed 14 hours driving and 51% exceed 14 hours driving plus other work. • 12% drivers reported fewer than 4 hours sleep on 1 or more days in the preceding week. 20% had fewer than 6 hours sleep. • Drivers and companies reported fatigue as a problem for other drivers. 60% of drivers and 88% of companies thought fatigue was not a problem for themselves and 10% drivers and 1% companies thought fatigue was a problem for themselves. • There were also differences between drivers and companies about the causes of fatigue and how to manage it (e.g. 70% companies and 40% drivers thought long hours was the main contributor and half of companies and a third of drivers thought lack of sleep was a cause).	× Definition of fatigue not provided to participants. × Results consist of some retrospective reports, which may be inaccurate. × Not causal. × Results were more descriptive and generally used percentages. × More study on causes of fatigue and strategies to manage fatigue needed as drivers and companies differ in perceptions. Agreement on multi-faceted causes required.

Study	Methodology	Key Findings/Conclusions	Limitations
Baltes et al (1999) Flexible and compressed workweek schedules: a meta-analysis of their effects on work-related criteria	• N = 39 sub-studies which have evaluated flextime schedules or compressed work weeks. • Studies had to include a pre-post control-experimental or normative experimental comparison. • A meta-analysis was performed on the studies, with the following outcome criteria being of interest: productivity, performance, absenteeism, job satisfaction and satisfaction with schedule. • The compressed workweek data are of most relevance as individuals work (on average) 10 or more hours a day.	• From the analysis, compressed workweek schedules positively affected performance (as rated by supervisors), job satisfaction, and satisfaction with work schedule. • Compressed workweeks did not affect productivity or absenteeism. • Positive effects of compressed workweeks did not diminish over time.	× Unknown variables may have affected the size of effect. × The authors note that, with all studies, the patterns that are seen are context dependent.
Barnett et al (1999) Fit as a mediator of the relationship between work hours and burnout	• N = 141 married physicians with employed spouses in US (116 female). The sample was non-random. • Each spouse and physician completed a written questionnaire and a face-to-face interview. • Items included measures of fit (a subjective assessment of the degree to which each spouse has optimised her or his work schedule and needs of themselves and their family), and burnout.	• Physicians (who were self-defined as working reduced hours) worked on average 33.5 hours a week (males) and 29.4 hours (females). • 38% reported working more than their preferred number of hours. • Data supported the mediation hypothesis – if work hours were different (in length or arrangement) than the physician and their partner prefer, they are more likely to experience more disengagement, distraction and alienation at work. The relationship between number of work hours and burnout depends on the extent to which a work schedule meets the needs of the worker or family.	× Majority of sample were female. Unsure of whether gender differences exist. × Cross-sectional, therefore cannot establish causality. × There may be multiple mediators (i.e., not just fit).

Study	Methodology	Key Findings/Conclusions	Limitations
Bliese & Halverson (1996) Individual and nomothetic models of job stress: an examination of work hours, cohesion, and well-being	• N = 7,382 army personnel from 99 different US Army companies, stationed in Europe and the US. • Completed a questionnaire containing items on: psychological well-being, work hours (per day), and vertical and horizontal cohesion (reflects the quality of relationships within groups). Data were analysed at the individual and group level.	• The mean work hours per day were 11.3. • There was a significant relationship between work hours and well-being (longer hours relates to lower well-being). • The work hours-well-being relationship is best modelled from the group level (as opposed to the individual level). The authors believe that individual choice is likely to have a large impact on the work hours-well-being relationship. Are the work hours/requirements externally imposed?	× Only presents daily work hours, no specific assessment of weekly work hours. × Large sample size, but just from the Armed forces, therefore questionable ability to generalise findings. × Cross-sectional, self report data.
Buell & Breslow (1960) Mortality from coronary heart disease in California men who work long hours	• Mortality data from men whose deaths were attributed to heart disease (N= 22,176), and the Census data related to occupational work hours were compared to see if there was a relationship between hours worked and coronary heart disease (CHD). • Data from the Census that rated the physical activity involved in an occupation was also examined.	• There appears to be an excess of CHD mortality among men who are 'light workers', in non-farm occupations and who work more than 48 hours a week. • The strongest evidence is for men who are aged 25-44. It is postulated that long hours (also called 'stress') may be associated with certain types of CHD, and not necessarily that which affects older men. • Farmers/farm labourers were not as affected, even though many work long hours.	× No *causal* link can be established from these data. × No consideration of other influencing factors e.g., family histories, work and non-work triggers, 'type A' behaviour etc. × Some selection bias may be present – i.e., "Occupations which call for an excess of work hours may be actively sought be men with the appropriate dispositions for the work." (p 624) × No data gathered on working hours specifically relating to the dead men.

Study	Methodology	Key Findings/Conclusions	Limitations
Calvasina and Boxx (1975) Efficiency of workers on the four-day workweek	• N = 167 female factory workers in the US. • Productivity data (gathered via objective measurements of weekly output) was gathered from one year before the introduction of a four-day workweek, and for 12 months after the change. • Weekly hours were 40 before the change and 38 after (therefore not long, but averaged to 9.5 hours per day).	• Change from the five-day week to the four-day week did not materially affect productivity. Variability in worker performance was also unaffected. • "In instances where labourers are not engaged in heavy physical work, the four-day workweek does not reduce labor productivity and may in fact increase it. This conclusion, however, does not constitute an unqualified endorsement of the four-day workweek. On the other hand, it does refute the hypothesis that workers will become so fatigued on a four-day workweek schedule that their productivity will suffer." (p. 610)	× No measurement of factors such as job satisfaction etc that could moderate effects. × Relatively short time scale of study. × Specific population studied. × No information on health and safety measures.
Clark (1996) Job satisfaction in Britain	• N = 5000 British employees. Data taken from the British Household Panel Survey, which is a random sample of the households in Britain. • No further information about methodology available. • Items included job satisfaction, health, household demographics, work, values and finances etc.	• Men, workers in their thirties, well educated, working in a larger organisation and working longer hours was associated with lower levels of job satisfaction.	× Cross-sectional design. × Self-report measures taken. × Not a great deal of detail presented about what constitutes longer hours.
Cooper et al (1982) Stress in the UK police service	• N = 191 police officers (15 female) in a UK police force. • Initial interviews were conducted to help develop a questionnaire, which the police officers then completed. • Items included measurements of physical health (Type A behaviour), mental health and sources of work stress (98 items using a six-point Likert-type rating scale).	• The 98 items factored out into 9 factors. When the sample was split into the different management levels, significant correlations were found between some factors and the different levels of management. • A major source of stress across all management levels was that the work of the police was inhibited by outside and bureaucratic obstacles. • Junior and middle management police officers found that work overload was a large stressor. This stems from factors such as lack of manpower and associated work hour increases.	× Self-reported study × No information in paper about what constitutes long hours. × Factors on which statistics in the report are based do not include every item in questionnaire. As a result, 'long hours' is not specifically mentioned in any of the factors (only items such as 'shift work' and 'The fact that I have too much work to do' are mentioned within the factors).

Study	Methodology	Key Findings/Conclusions	Limitations
Dalton & Mesch (1990) The impact of flexible scheduling on employee attendance and turnover	• N = between 137-134 in experimental group, and 135-140 in control group. • Non-technical white-collar workers at an American public utility. • Naturally occurring field experiment using interrupted time series design with multiple (monthly) time-interval pre-test measures, intervention removal with a control group. • Figures for attendance and turnover were obtained from organisational records. • The 'intervention' was the advent of flexible scheduling, where employees work 8 hours a day, with flexible start, lunch and finish times. • Long hours were not measured.	• Reductions in employee absenteeism for the group of workers who experienced the flexi-time. No such changes were evident in the control group. • The flexible scheduling had no effect on the control group. • Interesting discussion about why the flexible scheduling programme was abandoned in the organisation.	× Possibility that reduction in absenteeism was due to another factor, but use of a control group mitigates this possibility somewhat. × The intervention lasted for one year, which may not have been long enough to see any turnover effects. × No information on <u>who</u> was absent, just how many were absent, which might be interesting.
Dalziel and Soames Job (1996) Fatigue and taxi drivers: An examination of factors associated with motor vehicle accidents	• 42 male metropolitan taxi drivers from Sydney, Australia. • Completed a detailed questionnaire on a variety of fatigue-related and job-related variables across a two-year period. • Accident details were obtained and verified using company insurance records. • Directional hypotheses: 1. A negative correlation was expected between total break time and number of accidents. 2. Accidents were expected to occur more towards the end of shifts due to increased fatigue from prolonged driving.	• 67% of taxi drivers drove at least 50 hours per week and 50% worked 60 or more hours a week including non-driving work. • Higher average total break times were significantly related to reduced accident involvement (sig negative correlation). • The expectation that drivers become more tired and may have more accidents towards the end of the shift was not confirmed – possibly due to the constantly changing stimuli they experience. • Suggested that lack of driving-related stimulation may be crucial to fatigue accidents rather than merely number of hours driving.	× Small, all male sample. × Only showed correlation, not cause and effect. × More research needed to explore the possibility of a personality/motivation causal factor. × Did not control for traffic density at different times of the day. × Optimism bias was present when considering driving abilities (i.e. considered themselves above average compared to most taxi drivers – except for the fatigue question "ability to drive safely while very tired." × Under-reporting in accident records may complicate the use of company records to verify accident involvement.

Study	Methodology	Key Findings/Conclusions	Limitations
Daniels & Guppy (1995) Stress, social support and psychological well-being in British accountants	• N = 399 British accountants (16% female) completed a postal questionnaire. • Items included sources of stress [as derived from previously conducted semi-structured interviews], measures of social support and psychological well-being.	• Key dimensions of stress include: • Quantitative overload stressors; • Professional/administrative stressors; • Nuisance stressors. • Intensity of quantitative overload stressors included items dealing with workload such as 'working long hours', and was related to psychological well-being in the sample.	× Self-reported study × No definition of what long hours is. × Always the possibility of non-measurement of stressors with a questionnaire with pre-defined items.
Dex et al (1995) Household Labour Supply	• Uses data available from a large-scale survey - British Household Panel Study (BHPS). • Household divisions of hours based on cross sectional data from Wave 1 of BHPS in 1991. • This report consists of a sample of 9912 respondents who completed the full interview. • Information was obtained on individual circumstances, household information, labour force participation, and weekly working hours.	• There was a positive relationship between physical health of males and females and number of hours of work. • Very long hours of work may have bad effects on couples mental health. • Addition of overtime hours, second jobs and travel to work time makes a sizeable addition to weekly working hours. • Couples hours of work were found to be correlated with, among other factors, their ages, education, physical and mental health, attitudes, employment statuses, pay etc.	× Cross sectional data. × Results were not causative – relationships only seemed to appear from cross-tabulations and only used descriptive frequencies and percentages. × Many relationships were mentioned for demographic and household characteristics but far fewer for actual health and safety factors. × Only provides overview of labour force participation and working hours – there were not many specific significant findings. × Some relationships between hours of work and individual characteristics were not replicated when examining households.

Study	Methodology	Key Findings/Conclusions	Limitations
Dow-Clarke (2002) Work-life balance in an industrial setting	• N = 45 employees working for a large employer in an industrial setting in Canada (27 women). • Five focus groups were held, where open-ended questions were asked about work-life balance and how the employer could support it.	• No common definition of work-life balance was recorded. • All groups talked about work-life balance in relation to work hours, for example, being able to decline overtime offers. • With regard to stressors, all groups mentioned workload. Other stressors included long work hours (although what constitutes long hours were not reported). • Hours of work were often thought to impact on work-life-balance. People who had flexible hours or a partial schedule felt their life was more in balance. • People thought that there was a pressure to work excessive hours and make family life secondary if they are to get on in the company.	× As this was a qualitative study, no attempts were made to infer causality or predict relationships among variables. × Problems with generalising findings as one specific company studied.
Dowie (1989) Patterns of hospital medical staffing interim report: Junior doctors hours	• N = 405 junior doctors in the UK. • Completed a 7-day diary that asked them to record various details about the hours they worked and the type of work they did. Interviews were also conducted.	• 51% of doctors had been on duty at the weekend as well as during the week. • The average weekly hours on duty was 90. • The average number of hours of work was 58. • The longest period of 'rest' was 6 hours on average on weeknights.	
Duffy & McGoldrick (1990) Stress and the bus driver in the UK transport industry	• 376 male bus drivers completed a postal questionnaire. They worked in the UK for a bus operating company. • Initial interviews were held with 32 drivers to help design the questionnaire. • Questionnaire items included biographical information, general health, psychological well-being and mental health, job satisfaction and sources of work stress.	• Areas of concern for bus drivers related to health and home concerns; problems intrinsic to the job; lack of involvement and support during organisational changes; fear of assault. • 64% of the sample variance could be explained by 'health and home-related problems' (such as family problems because of long hours, problems unwinding at home, sleeping problems). Many drivers experienced work overload, which spilled into their home life. • The bus drivers had lower levels of job satisfaction compared to a norm group.	× Subjective self-report study. × Male only sample. × No specific measurement of what constitutes 'long hours'.

Study	Methodology	Key Findings/Conclusions	Limitations
Fox & Dwyer (1999) An investigation of the effects of time and involvement in the relationship between stressors and work-family conflict	• N = 113 registered female nurses employed in the US. • Questionnaires were sent to the nurses, and contained items looking at the following: work stressors, work time involvement (emotional involvement in work and time spent at work, including commuting time), family time and involvement, inter-domain conflict (work-family conflict, and family-work conflict).	• Various work and family stressors were related to inter-domain conflict. • For example, work time interacted with family stressors to affect family-work conflict, and time spent in work affected work-family conflict. • The role of time and energy in inter-domain conflict involves complex interactions.	× Quite small sample size. × All female, one occupation sample, therefore difficult to generalise findings. × Self-report measures, therefore, difficult to know if family stressors reported were valid. × Cross-sectional nature of study.
Galambos & Walters (1992) Work-hours, schedule inflexibility, and stress in dual-earner spouses	• N = 96 dual-earner couples from a city in Canada. • Completed postal questionnaires containing items addressing the following: work hours, work schedule inflexibility (the extent to which a job constrains home activities), role strain (negative feelings associated with accomplishing family and work obligations), depression and anxiety.	• Mean hours worked for women per week = 30.9 (with 8.3% working 40+ hours), and for men = mean 42 hrs, 21.9% 40+ hours. • Husbands' schedule inflexibility and long work hours were associated with stress in husbands. • Long work hours of wives were associated with anxiety and depression in husbands. • Wives' schedule inflexibility and long hours were associated with role strain, but not anxiety or depression.	× Not excessively long hours worked by sample (nevertheless, hours do have negative consequences). × Cross-sectional study. × Self-report measures.

Study	Methodology	Key Findings/Conclusions	Limitations
Gander et al (2000) Hours of work and fatigue-related error: A survey of New Zealand anaesthetists	• Nationwide survey (70% response) of 301full time anaesthetists (44 trainees, 183 specialists, 9 "others") in New Zealand. • A 3-page questionnaire elicited information on practising status, demographic variables, work hours, safety perceptions and fatigue-related errors. • The average working week of anaesthetists in this study exceeded the 48 hours dictated by the Working Time Directive.	• In the 6 months prior to the survey, 35% of trainees and 50% of specialists had worked at least 1 shift exceeding 16 hours. 65% of trainees and 32% of specialists had worked over 72 hours in a 7-day period. • 50% trainees and 27% specialists said their average working week exceeded what they could do while maintaining patient safety. • 63% trainees and 40% specialists said their weekly hours exceeded what they could do while maintaining personal well-being. • Fatigue-related errors were reported by 86% of respondents, with 32% recalling errors in the preceding six months. • Older more experienced anaesthetists were less likely to report a fatigue-related error than younger less experienced ones.	× Small sample of trainees. × Restricted to full time anaesthetists. × Subjective data (e.g. differences in personal definitions of error and safe working hours). × No information was collected on the types of errors recalled or how many errors actually harmed patients - people may be more likely to recall severe errors! × No information was collected on how many fatigue-related errors were recalled so no conclusions can be drawn about error rates.
Glass & Fujimoto (1994) Housework, paid work, and depression among husbands and wives	• N = 3,846 (1,867 husbands and 1,979 wives) who were part of the National Survey of Families and Households (1987, USA). • Representative sample from randomly selected households. • Interviews and self-administered questionnaires were completed, addressing the following factors: depression, demographic characteristics, work hours (including a second job) and job characteristics.	• "…paid employment is associated with reduced depression among both husbands and wives until work hours exceed an upper threshold." (p. 179) • The upper threshold appears to be around 46 hours a week. • Time spent doing housework is associated with increased depression for all.	× Under representation of couples who have heavy child care responsibilities, therefore housework may not reflect this aspect. × Limited measures of job characteristics that affect depression e.g., job autonomy. × Cross-sectional study. × Self-report study. × Shift-work was included.

Study	Methodology	Key Findings/Conclusions	Limitations
Hagihara et al (1998) Type A and Type B behaviors and factors related to job satisfaction among male white-collar workers	• N = 657 Japanese administrative workers. • Questionnaires (not anonymous) were completed by subjects and returned when attending a company health check up. • Items measured Type A personality and the working environment. Questions about the working environment were based on opinions of occupational health nurses, personnel staff and literature. NB, Type A personality defined as competitive, feeling a sense of time urgency, persistent, hard driving, achievement-oriented and involved in work activities. • Commuting time was included in working hours.	• The nature of predictors for job satisfaction varied with the behaviour/personality type of the subject (either Type A, B or A/B). • Working more than 10 hours a day was a predictor of job satisfaction among Type A subjects. • Working fewer than 10 hours a day was a predictor of job satisfaction among Type B subjects.	× Cross sectional design. × Single item used to measure job satisfaction. × Hard to determine any directional association between working environment and job satisfaction.
Hanecke et al (1998) Accident risk as a function of hour at work and time of day as determined from accident data and exposure models for the German working population	• Data on more than 1.2 million accidents for the year 1994 were provided, listed according to time of day and hour at work. • Information on how long each day and at what time of day people work is not available in Germany so different exposure models were constructed on the results of 2 independent surveys on problems of work hours in Germany (the first in 1992 included 5000 respondents and the second in 1993 used 2577 respondents).	• An exponentially increasing accident risk was observed beyond the 9th hour at work. • A highly significant interaction effect was found for hour at work by time of day. • Accident risk at different hours of work varied according to starting time of day (e.g. with later starting times accident risk increased beyond the 8th hour at work). • Accident risk also differed at time of the day depending on the hour at work (e.g. whether a 2nd hr or 10th hr of a shift). • There are clear time-related effects on occupational accident risk.	× Exposure models only provide estimations – there is a need for recording and providing adequate data bases or developing more adequate exposure models for these sorts of analyses. × Exposure models "assumed" to be representative and valid. × Results included a wide variety of occupations with different accident risks (e.g. from office work to steel industries) so how accurate is the accident risk estimation? × Many confounding variables could not be controlled for (e.g. type and amount of work and presence of supervisory personnel), which may obscure some distinct effects.

Study	Methodology	Key Findings/Conclusions	Limitations
Hinkle et al (1968) Occupation, education and coronary heart disease (CHD)	• 5-year prospective survey of occupation, education and Coronary Heart Disease (CHD) carried out on 270,000 men employed by Bell System in the United States during 1963-65. • Survey of morbidity and mortality, coded from the International Classification of Diseases. • Social and demographic information, such as age, education, occupation category and level, date of employment and past career were obtained.	• Men with the highest levels of management as a group do not have a higher risk of CHD than men at lower levels. • There is no evidence that men who have high levels of responsibility or who have been promoted rapidly, frequently or recently have any added risk of CHD. • Men transferred to new departments or companies have no greater risk of CHD. • Men who enter the organisation with a college degree have a lower attack rate, death rate and disability rate for CHD at every age, all parts of the country and in all organisation departments. • Difference in risk was explained by possible biological, social and economic background differences, which may take the form of eating and smoking habits, rather than organisational experiences.	× All American male sample. × Old study. × Explanations given are quite speculative and do not necessarily explain the observed differences in CHD. × Other biological factors, such as genetic differences, may be important and were not considered. × Important not to over-generalise from these observations as other countries, settings, cultures and times may have different consequences.
Houston & Allt (1997) Psychological distress and error making among junior house officers	• N = 30 graduates of medicine/junior house officers from the UK (13 males). • They completed two postal questionnaires, one before they started their first job, and the other 8 weeks later. • Items included the General Health Questionnaire, Cognitive Failures Questionnaire, and Medical Errors Questionnaire. Working hours and other details were also noted.	• Average hours of work (in their first job) ranged from 56 – 87 per week, mean = 73.4. Hours worked in the previous week to completing the questionnaire ranged from 56-120, mean = 78). • Hours of work did not correlate significantly with health or error measurements. They did not predict change in the health or error measurements either.	× Whilst it appears that hours of work are not simply associated with error making or health, the number of hours worked by the vast majority of the sample was very long. There are not many in the sample who worked shorter more 'normal' hours to compare with. × Relatively small sample size. × Self-report data.

Study	Methodology	Key Findings/Conclusions	Limitations
Iskra-Golec et al (1996) Health, well-being and burnout of ICU nurses on 12- and 8-hr shifts	• Nurses working in Intensive Care Units (ICU) in Poland, N = 96 who work 12hr shifts, and N = 30 who work 8hr shifts, completed the Standard Shiftwork Index (Barton et al, 1990). • Items included various measures of stress such as sleep disturbance, job satisfaction and psychological health. • Groups were matched. No subjects had children or were over 35 years old. No information on gender.	• 12hr shift nurses, (when compared to 8 hr workers), experienced more chronic fatigue, cognitive anxiety, sleep disturbance and emotional exhaustion. • 12hr nurses showed worse health, burnout and well-being measures. • The duration of a shift seemed to have no impact on job satisfaction. • It appears that the problems associated with 12hr shifts may be a result of the duration of the shift.	× Subjective, self report study. × Cross sectional. × Concerns shift workers.
Ivancevich (1974) Effects of the shorter workweek on selected satisfaction and performance measures	• N = 104 subjects who were experiencing a 4 day, 40 hour week (10 hours a day), and a control group of 106 subjects working 40 hours over 5 days. • The two groups worked at different sites in the same US manufacturing company. • A questionnaire was administered during the working hours before the change in work scheduling, 3 months after the change and 12 months after. • Items included various measures of job satisfaction and anxiety-stress. Unexcused absence rate was collected, and performance was rated on various scales by a supervisor.	• Subjects working the shorter workweek reported higher job satisfaction in general than the control group (although not for all facets). • There was a small significant improvement in perceived anxiety-stress for the experimental group. • There were no significant changes for either group with regard to absences. • There was significant improvement for some measures of job performance for the experimental group compared to controls.	× Difficult to generalise as study only looked at one company. × The study time (13 months) may have been too short to capture some of the effects of a shorter workweek (and therefore longer work days). × Hawthorne Effect may be operating as only one division of the company experienced the change in work hours. × Moderators such as fatigue, attitudes, and job pace were not addressed.

Study	Methodology	Key Findings/Conclusions	Limitations
Jamal (1986) Moonlighting: personal, social and organizational consequences	• N = 285 blue collar workers in a Canadian manufacturing organisation (82% male), and N = 252 Canadian male fire fighters. • Questionnaires were distributed and contained items on the following: moonlighting status (i.e., whether the subject did a second job which brought in money), organisational commitment, job performance (based on supervisor ratings), absenteeism, anticipated turnover, social participation, job satisfaction, social support, occupational stress and health problems. • There was no measure of number of hours spent working.	• Non-moonlighters are not better off compared to moonlighters with regard to physical health, job stress, social support, absenteeism, anticipated turnover and job performance. • For blue-collar workers, moonlighters showed higher job satisfaction. • For the fire fighters, moonlighters showed lower organisational commitment.	× No indication of how many hours the moonlighters worked per day or per week. × There may be a selection bias in that only people who enjoy and can cope with doing two jobs continue to moonlight, and those who are badly affected stop. × Problems with generalising (i.e., not the general population studied). × Possibility of shift working subjects.
Jansen et al (2002) Need for recovery in the working population: description and associations with fatigue and psychological distress	• N = 12, 095 adults working in 45 different companies in the Netherlands (part of the Maastricht Cohort Study). • Completed postal questionnaires including the following measures: Need for Recovery, Checklist Individual Strength (prolonged fatigue), General Health Questionnaire (GHQ-12), demographic and health factors, work-related factors.	• Some degree of need for recovery was found in the whole sample. • Some degree of fatigue was found in all the sample. • Need for recovery from work was higher in men, higher age groups, people who reported a long-term disease, high psychological job demands, low decision latitude. • Need for recovery, fatigue and psychological distress represent different underlying concepts. • The authors suggest that need for recovery could be a good measure for the short term effects of working time arrangements. • They also speculate that need for recovery could represent the more acute effects of a day at work, and fatigue represents the longer term effects. Fatigue could also lower resistance to work load and therefore increase the need for recovery.	× No data on number of hours worked. × Cross-sectional study × Possibility of selection bias – non-respondents were somewhat less likely to report fatigue complaints, sick leave etc.

Study	Methodology	Key Findings/Conclusions	Limitations
Kawakami et al (1993) Relations of work stress to alcohol use and drinking problems in male and female employees of a computer factory in Japan	• N = 1298 (255 females) working in a computer factory in Japan. • Completed a postal questionnaire containing the following measures: psychosocial work stressors (including overtime), rotating shift, various measures of alcohol consumption, and depressive symptoms.	• For males, overtime and lack of intrinsic work rewards were factors in heavy and problem drinking. • For females, the factor was ambiguity about job future. • The results suggested that effects of these stressors were not mediated by depressive symptoms. • Average monthly overtime of males = 42 hrs, of females = 11 hours.	× Lack of information about what the average weekly working hours was for subjects, therefore difficult to determine whether 'long hours' were worked. × Shift workers were included in analysis. × Cross-sectional study design inhibits inferences of causality. × Self-report measures used.
Kawakami et al (1999) Overtime, psychosocial working conditions, and occurrence of non-insulin dependent diabetes mellitus in Japanese men	• An eight-year prospective cohort study. • N = 2194 male respondents working in a Japanese electrical company. • Subjects completed mailed questionnaires including items on working hours and patterns and psychosocial working conditions (e.g., single items to assess work overload, decision latitude, and social support). They also had interviews with nurses to assess medical conditions. • All subjects had annual medical screening that included a test for diabetes. • In 1992 (after 8 years) subjects completed a questionnaire to assess family history of diabetes.	• "Those who worked more than 50 hours overtime per month had 3.7 times higher risk of NIDDM [Non-insulin dependent diabetes mellitus]. • Those who experienced the use of new technology had a higher risk of NIDDM than those who did not. • … Avoiding chronic long overtime and reducing distress caused by the new technology may be important for the prevention of NIDDM." (p. 361)	× For methodological reasons, some subjects may have had NIDDM and not been identified at baseline. × The company studied was going through change at the time of the study that may have affected results. × Items on the questionnaires may have been too simple to measure complex psychological responses that may have occurred. × Small number of subjects (34) tested positive for NIDDM in 1992. × Shift workers were included in the sample. Their patterns of work changed during the study period.

Study	Methodology	Key Findings/Conclusions	Limitations
Kirkaldy et al (1997) Working hours, job stress, work satisfaction, and accident rates among medical practitioners and allied personnel	• Mailed 8000 questionnaires to randomly selected medical and dental practitioners in Germany – part of an anonymous survey addressing determinants of job-related accidents. • The first 2500 completed questionnaires to arrive within the 3-month deadline were included in the study. • There were 86.9% females and 13.1% males, age range 15-86 yrs. • Only 7% of women were medical doctors and 93% were auxiliary personnel. More men (87.5%) were owners of medical practices. The proportion of doctors to other personnel was 1:5.7.	• Mean weekly hours were 47.69 for doctors and 31.97 for auxiliary personnel. • 45.6% doctors worked over 48 weekly hours while only 0.3% auxiliary staff did. • Number of dependent children, distance from work, working hours, job-related stress, working climate, and gender were powerful predictors of work-related accidents or driving accidents. • Physicians working over 48 hours per week reported significantly more driving accidents (but not work-related accidents) and higher levels of job-related stress than those working fewer than 48 hours per week. • Working hours can adversely affect accident rates and employers should consider flexible working arrangements to accommodate different needs of workers.	× Disproportionately more females than males. × But most females were auxiliary personnel and the proportion of doctors to other staff was low. × Only correlational. × May have confounding effects of occupational status, looking at both medical and auxiliary personnel. × Reliance on a general factor of job-related stress, rather than distinguishing components of stress. × Some of the variables were quite subjective – e.g. "perceived" job stress. × Self report questionnaires.
La Valle et al (2002) Happy Families? Atypical work and its influence on family life	• N = 1,165 working mothers who completed a telephone survey and N = 40 parents who did an in-depth interview (24 mothers and 16 fathers). • Questions covered areas such as: work patterns and reasons for them, family characteristics, parents' attitudes towards use of time, what influence work patterns has on family life and views on what kinds of policies would help reconcile work and family life.	There were many findings from this study. Some of the most relevant are mentioned below: • 30% of fathers worked over 48 hours a week, this was particularly common in the managerial and professional job category. • Atypical work was common among families. There was substantial choice among the professional group over when they could work. • Mothers tended to structure their work hours around their families. • Atypical work disrupted family activities. • Long hours were identified as a 'key pressure point' for families, and something that affected fathers in particular.	× Self-report study × Primarily cross-sectional

Study	Methodology	Key Findings/Conclusions	Limitations
Lin et al (1994) Time of day models of motor carrier accident risk.	• Time dependent logistic regression models formulated to assess the safety of motor carrier operations using estimates of the probability of having an accident at time t subject to surviving until that time. • 3 models were tested – time main effects (driving time) / time independent effects (experience) / time dependent effects (time of day). • Models were tested using a data set on accidents and non-accidents from actual trucking company operations. • Total number of observations used for modelling is 1,924 cases - 694 accidents and 1,230 non-accidents.	• Driving time had the strongest direct effect on accident risk. Risk increases significantly after the 4th hour by 50% until the 7th/8th/9th hour where there was further 80-130% increase in risk. • Drivers with more than 10 years driving experience retained low accident risk. All other categories had significantly higher risk. The highest risk category for experience was 1-5 years driving experience. • Driving at 4-6pm had a 60% greater accident risk. Daytime driving (especially 10-12) had low accident risk. Other significant times of the day with a 40% greater accident risk were midnight to 2am / 6-8am / and 8-10pm. • Rest breaks, especially taken before 6th/7th driving hour appeared to lower accident risk. • Time of day and driver hours interact to increase accident risk.	× Data specific to national truckload firm so may not typify trucking industry as a whole. × There can be difficulties with coding time of day (e.g. rest breaks may cause non-linearities). × Joint study of time of day and driving time is complicated because driving time may cross more than one time of day interval. This approach in this research is rough and could result in some loss of information and bias in estimation. × Accidents were deliberately over sampled relative to actual occurrence in order to handle the data more efficiently. × Basic model assumes probability of accident determined entirely by driving time but other factors may affect accidents. × Additional factors such as traffic volume or road class are not considered and are needed to improve the understanding of time related effects.
Liu et al (2002) Overtime work, insufficient sleep, and risk of non-fatal acute myocardial infarction in Japanese men	• Case-control study in Japan. Cases were 260 working men aged 40-79 admitted to hospitals with acute myocardial infarction (AMI) during 1996-98. Controls were 445 men free from AMI matched for age and residence. • Questionnaire based interview elicited details of work-related factors (including working hours), lifestyle factors and medical/family history before AMI in cases and before interview in controls.	• Cases worked longer and slept less. • Longer working hours were related to increased risks of AMI, with a twofold increased risk for overtime work (weekly hours ⩾61) compared with work hours ⩽ 40. • Short time sleep (daily hours of sleep ⩽5) and frequent lack of sleep (2 or more days/weeks with <5 hours of sleep) were also associated with a two to threefold increased risk of AMI. • Overtime work and insufficient sleep may be related to increased risk of AMI, independent of other coronary risk factors.	× Included working men only. × Based only on non-fatal AMI and so generalisation of findings may be limited. × Did not consider quality of sleep. × Having an AMI may have influenced patients' perception or recall of work and sleep before the onset of the AMI. × Selection bias should be considered, as those working longer may be reluctant to participate in the study.

Study	Methodology	Key Findings/Conclusions	Limitations
Lusa et al (2002) Perceived physical work capacity, stress, sleep disturbance and occupational accidents among fire-fighters during a strike.	• N = 543 male fire-fighters in Finland still working during a strike. • Questionnaires were distributed by fire-chiefs to 71 fire brigades. • Items covered: work and organisational factors such as personnel in crew, weekly working time, individual and lifestyle variables, perceived physical work capacity, stress, sleep disturbance and occupational accidents.	• The survey took place in extra-ordinary circumstances, with much reduced personnel, and much greater than normal work time. • 19% of fire-fighters worked for between 51-69 hours a week, 43% worked between 10 – 100 and 11% worked over 100 hours per week. • Two thirds of workers reported feeling only a little or not at all stressed. • Sleep disturbance was reported when hours exceeded 50 per week. • Those working more than 70 hours a week were three times more risk of having sleep disturbance compared to those working less than 50 hours. • When weekly working hours were 70+, the risk of occupational accidents was almost 4 times greater compared to those working less than 50 hours. • Decreased number of personnel in shift and crew was also associated with sleep disturbance and accidents.	× Fire-fighters were working under extreme and unusual conditions. × Excessive hours were worked by most of the sample. × Shift working was included. × Cross-sectional and self-report study. × Single item measure for stress. × Very specific circumstances for the sample therefore may not be too generalisable.
Major et al (2001) Work time, work interference with family and psychological distress	• N = 513 staff at American Fortune 500 company. • Completed written questionnaire surveys covering following items: career identity salience, work overload, organisational norms, perceived financial need, non-job responsibilities, parental demands, schedule inflexibility, work time, time base work interference with family, psychological distress and various control variables.	• "Long work hours are associated with increased work-family conflict and, at least indirectly, with psychological distress. " (p433) • There are strong relationships between work interference with family and work overload and organisational expectations for time spent at work.	× Self-report study × Cross-sectional

Study	Methodology	Key Findings/Conclusions	Limitations
Maruyama and Morimoto (1996) Effects of long work hours on life-style, stress and quality of life among intermediate Japanese managers.	• Cross sectional investigation using survey/questionnaire methodology. • Sample of intermediate level male managers – 3870 division/section heads and 2666 foremen. • Questionnaire given to 110 firms in Japan. • Questionnaire on daily work hours, lifestyle habits and subjective stress and quality of life.	• Prevalence of working over 10 hours per day was 69.7% of division/section heads and 53.2% of foremen. • Managers and foremen with long hours perceived greater stress and lower quality of life. • Long daily hours were also significantly associated to poor lifestyle habits, such as smoking and drinking and less sleep or exercise. • Shortening daily hours was more effective than having longer holidays for improving mental and physical health.	× All male sample. × Subjective questions resulting in only perceptions of stress and quality of life. × Further evaluations are required to assess the reliability and validity of the subjective stress and quality of life questions. × Could not evaluate long-term effects on health. × Lower quality of life may be more accepted in Japanese culture. × Stress may not be caused solely by long hours. × Indirect effects of long hours on health through lifestyle habits need to be clarified.
McCartt et al (2000) Factors associated with falling asleep at the wheel among long distance truck drivers	• N = 593 randomly selected truck drivers. • Drivers were interviewed whilst they stopped at rest areas or for routine safety inspections. • Items in the interview covered: self-reports of having fallen asleep at the wheel, demographics, work schedules, violations of federal hours, sleepiness.	• 25.4% of drivers had fallen asleep at the wheel in the past year. • The 6 underlying factors which predict falling asleep at the wheel were greater daytime sleepiness, shorter/poorer sleep on road, symptoms of sleep disorder, more arduous schedules with more hours of work and fewer off duty, older more experienced drivers, greater tendency to night-time drowsiness and not having been alerted by driver rumble strips. • Counter-measures should be put in place to limit drivers' work hours and enable drivers to get adequate rest.	× Self-report data × Not causative × Possibility that other variables were not captured e.g., 'rule breaking personality' or stress.

Study	Methodology	Key Findings/Conclusions	Limitations
Meijman (1997) Mental fatigue and the efficiency of information processing in relation to work times	• N = 18 male bus drivers and N = 30 male driving examiners in The Netherlands. • Mental fatigue was measured by use of a memory search task that was performed at various periods after working and after work of different intensity. • Mental effort was measured using heart rhythm signal. • Subjective fatigue was also recorded.	• As preceding work time increased, mental processing efficiency degraded. • With an early morning start and 7 hours of work, reaction time was relatively normal but test results suggested subjects did not pay as much attention and missed certain signals. This could be interpreted as serious indication of mental fatigue. • The authors speculate that the prolonged mental effort that had to be exercised may adversely affect well-being and health by sustained activation of physiological stress reactions systems.	× Small sample size × All male sample × Lack of control group
Mitler et al (1997) The sleep of long-haul truck drivers	• N = 80 male truck drivers in USA and Canada doing two different types of schedules. • Round-the-clock electrophysiologic and performance monitoring were carried out (e.g., tracking movement of the eyes and snoring response).	• Drivers averaged 4.78 hours of sleep per day (3.83 hours if drivers worked the night shift, 5.38 if they worked in the day). • Drivers worked for between 10 hours driving in the day, to 13 hours at night. • 56% of drivers had one six minute period of drowsiness while driving. • The authors conclude that the drivers obtained less sleep than required for alertness on the job.	× Shift working drivers were included in the sample, which may affect purely 'long hours' results. × Estimations of drivers 'ideal' sleep amounts were derived from subjective self-reports. × Relatively small sample size, and no possibility to study each driver on all schedules.
O'Driscoll et al (1992) Time devoted to job and off-job activities, interrole conflict and affective experiences	• N = 120 employed people from the general population of Michigan, USA. • They completed a postal survey that included measures of demands on their time at work and off-work (not just family/parental roles), job and off-job interference (how much demands of one sphere interfered with the other), job satisfaction, off-job satisfaction, organisational commitment and psychological strain.	• The more time that people devoted to their jobs, the greater the perceived interference with their off-job activities. • This relationship did not hold for the time people devoted to their off-work activities – the more time spent in off-work activities, the lesser the role interference and psychological strain. • Job satisfaction was a mediator for how people reacted.	× Cross sectional study × Based on self-report measures (there is no way of knowing how long individuals did actually spend at work). × Average reported hours at work was 44 hours per week. This isn't particularly long. No further information on length of working hours.

Study	Methodology	Key Findings/Conclusions	Limitations
Okogbaa and Shell (1986) The measurement of knowledge worker fatigue	• Laboratory experiment to determine relationships between worker performance and fatigue. • Randomly selected participants from a group of male junior level engineering university student volunteers (average age 21.8 yrs). • Two conditions (rest/no rest) and six experimental modes using cognitive and abstract tasks. Each experiment session lasted 5 hours. • Performance measures were work output, heart rate and brain wave activity and task measures were reading words per minute, abstract problems solved per minute and percentage of correct responses for comprehension and accuracy.	• Results supported the notion of performance deterioration due to mental fatigue. • There was a significant difference between output for rest and no rest task conditions. • The total mental work output with rest breaks was superior (6% more) to the tasks without breaks. This means that the group without rest breaks produced 6% less than the group with rest breaks. • The index of mental fatigue (MFI) was lower for those tasks with rest breaks. • Differences between individual output performance was not significant, consistent with the fact that participants were from identical populations and had comparable ability.	× All male engineering sample. × Sample size not reported. × Study became a compulsory assignment for the students – would this affect the effort made? × The use of both cognitive and abstract task types and the differences between them means that a single unit of measurement could not be used to describe combined output (an approach to overcome this problem was made though). × Using both cognitive and abstract tasks may complicate findings, as the rate of performance decrement may be faster for a reading task than for an arithmetic/logical task. × More work needed on heart rate as a function of time to examine the relationship between task duration, work output and fatigue.
Ong et al (1982) A study of major factors associated with severe occupational hand injury in Hong Kong Island	• Retrospective study of 383 cases of severe occupational hand injury (i.e. those that required a consultant in hand surgery) in Hong Kong between September 1979 and October 1980. • There were 379 males and 4 females from a wide range of occupations, from sea fishing to factory workers. • All participants were interviewed in hospital wards using a pre-designed questionnaire, related to five areas: personal data, job description, description of accident, work environment, and personal habits.	• 46% of the victims worked for 10 or more hours each day, 14% worked 12 or more hours and 30% also worked overtime. • Two groups of workers were found more vulnerable to occupational hand injury – machine operators with less than 1 year of experience and new immigrants from China. • Inadequacy of training in safety supervision and in the use of safety devices; long working hours; and the male sex were factors associated with over 50% of total injuries. • Poor machine design, adverse work environment and personal risk factors were associated with only small proportions of occupational injury.	× Retrospective study may be inaccurate. × Males far outnumbered females. × Some participants had arrived from China less than 2 years before the study and many could not speak or express themselves adequately in Cantonese, which may have affected understandings during the interview. × Relationships of variables, such as long hours and hand injury, were not causative. × Further research on the variables included is needed (e.g. was machine design not related to hand injury because the design was good?)

Study	Methodology	Key Findings/Conclusions	Limitations
Ono et al (1991) Working hour and fatigue of Japanese Flight Attendants (FA)	• Two surveys conducted on female flight attendants. a) N = 211 female FA rated their fatigue on a 5 point scale at 9 time points each day on a 4 day duty period. The FA worked on long international flights (hours of flights were taken from schedules). b) N = 3,111 female FA completed a questionnaire logging working times and fatigue symptoms. The FA worked on domestic flights.	• Factors causing serious FA fatigue on long international flights include nighttime and early morning work, long flight hours (e.g., 9 or more hours), large time difference. • Factors causing fatigue on domestic flights include showing up early in the morning and debriefing late at night and highly irregular schedule. • Factors contributing significantly to higher fatigue included flight hours, frequent landings and late finish times.	× Female only study × Subjective rating of fatigue × Factors such as crossing time zones and working at night will contaminate purely 'long hours' fatigue effects.
Oppenheim (1987) Factors related to occupational stress or burnout among music therapists	• N = 239 music therapists from the US (87% female). • Completed a postal questionnaire that measured job stress or 'burnout' and various demographic variables.	• There was no relationship between any predictor variable (including hours worked) and any of the burnout scales. • Number of hours worked per week varied widely, with 6.7% reporting 50+ hours a week, and 63.6% reporting 40 – 49 hours per week.	× Cross-sectional study. × Self-report measures used.
Parasuraman et al (1996) Work and family variables, entrepreneurial career success, and psychological well-being	• N = 111 male and female (53% male) entrepreneurs who were attending a business class at university. • Completed a survey covering the following variables: autonomy, schedule inflexibility, work-role overload, job involvement, parental demands, social support, family involvement, time commitment to work [includes commuting time and time spent at working at home], work-to-family conflict and family-to-work conflict, family satisfaction and control variables.	• The modal time commitment was 50 – 59 hours for men and 40-49 hours for women. • Many relationships were found, the most relevant to this review being that: • Male subjects devoted more time to work and less time to family than women did. • Work-role overload and schedule inflexibility were associated with increased time commitment to work. • Time commitment to work was related to work-family conflict. • Work-to-family conflict related to life stress. • Time commitment to work plays a mediating role with regard to the effects of gender work characteristics and role demands.	× Cross-sectional study. × Self-report. × Single item scales used.

Study	Methodology	Key Findings/Conclusions	Limitations

Park et al (2001)
 	
Long working hours and subjective fatigue symptoms
	• Field survey of 238 men working in 3 electronic manufacturing companies in South Korea.
	• Self-report questionnaires concerning:
	  • Working hours
	  • Health conditions
	  • Fatigue (measured using the Japanese subjective fatigue questionnaire)
		• The men were divided into 3 groups working:
		1) fewer than 60 hours per week
		2) more than 60 and fewer than 70 hours
		3) more than 70 hours per week
		• The rate of complaints of subjective fatigue, before going to work, tended to be higher for groups 2) and 3) compared to group 1). This difference was not as strong for complaints of fatigue whilst on duty.
		• There were positive correlations between weekly working hours and various stress measures.
		• The amount of sleep was negatively correlated with job stress and fatigue.
		• "… the questionnaire on the subjective fatigue complaints is a good screening tool for early detection of cumulative fatigue due to chronic job stress such as long working hours." (p. 250)
			× Self report measures
			× Most of the study subjects tended to work long hours (over 48 hours a week) and not get very much sleep.
			× Fatigue not 'objectively' measured
			× Uniquely male sample
			× Cross-sectional design
			× Sample engaged in one 'type' of job (not physical work).

Proctor et al (1996) Effect of overtime on cognitive function in automotive workers	• N = 248 (35.6% female) workers from an American automotive plant. • Subjects completed medical and occupational history questionnaires and did several neuropsychological tests. • Data about overtime hours (greater than 8 hours a day or 5 days a week) and number of hours worked were gathered from company records.	• Mean overtime hours worked by those who had done overtime was 11 • Increased overtime was significantly associated with impaired attention of various neuropsychological tests that measure attention and executive function. • Increased feelings of fatigue, depression and confusion were also associated with increased overtime.	× Subjects were shift workers, but only those on morning (6am start) or afternoon (23.00 finish) were included in the study. The authors tested for shift effects and found no significant interaction between shift worked, length of time at work and subsequent performance on tests. × Cross sectional design. × Possibility that other factors e.g., type A behaviour or other work stressors may have some impact on cognitive function, but these were not measured.

Study	Methodology	Key Findings/Conclusions	Limitations
Raggatt (1991) Work stress among long-distance coach drivers: a survey and correlational study	• 93 Australian male distance coach drivers. • Postal questionnaire was used containing the following measures: work experience survey (including weekly driving hours, maladaptive behaviours such as pill taking, medical history), health and stress symptom checklist and life events inventory.	• Long driving hours (50 hours or more per week) was the best predictor of maladaptive behaviour, such as stimulant use, and sleep disturbance. • Maladaptive behaviours then predicted stress outcomes.	× Possibility of response bias (e.g., social desirability). × Self-selection of sample. × Only correlational, therefore causation can only be hypothesised. × Cross-sectional nature of design.
Russek and Zohman (1958) Relative significance of heredity, diet and occupational stress in coronary heart disease of young adults	• Analysis of 100 young adult coronary heart disease (CHD) patients between 25 and 40 years and a similar group of 100 healthy unmatched control subjects. • Of the coronary patients all but 3 were men and approximately two thirds of the group were over 35. • Evaluations and interviews were conducted in succeeding months following the attacks. • Information was obtained on health history, habits, diet, hereditary influences, sources of tension and events preceding clinical symptoms.	• 67% of patients compared to 40% of controls had a history of CHD. • 91% of the coronary group had been under unusual occupational stress for varying periods compared to 20% of controls. • 46% patients had weekly hours $\geqslant 60$. • 26% of patients were obese compared with 20% of controls, 58% of patients had regular exercise compared to 60% controls and 90% of patients and 62% of controls regularly used tobacco. • Three major predisposing factors influence the onset and progression of CHD in young adults – heredity, diet and stress. At least 2 of these factors were present in 95% of patients and 12% of controls.	× Old study × Predominantly male sample. × Unmatched control group. × Variables considered in retrospect × For a true evaluation of occupational effects account must be taken of deviation from usual hours, other occupations and extra activities. × It is not always clear what factors are important (e.g. smoking or lack of exercise are often a by-product of occupational stress, which questions exactly what factors predispose CHD). × Other predisposing factors may be important.

Study	Methodology	Key Findings/Conclusions	Limitations
Shepard and Clifton (2000) Are longer hours reducing productivity in manufacturing?	• Aggregate panel data in Economic Production Function Model. • Data from 18 manufacturing industries within the US economy from 1956-1991. • Independent variable – overtime. • Dependent variables – value added per total hours worked and output per worker hour.	• Weekly hours ranged from 36 (leather goods) to 42.7 (stone/clay/glass). Overtime hours ranged from 1.3 to 4.7. • 11 of the 18 industries averaged over 40 hours per week. • Use of overtime hours lowers average productivity for almost all industries as measured by output per worker hour. • Majority of industries showed a significant productivity decline of 2.4% for 10% increase in overtime. Petroleum and chemicals industries had the largest effects. • Paper products and transport equipment were not significant and seemed immune to the effect.	× Technology/work differences in different industries may account for productivity. × Other factors may affect productivity (e.g. mandatory/voluntary overtime; incentives; demographics). These were not assessed. × Study required for the dynamics of hours in individual industries – aggregate data does not allow these answers. × Aggregate data may cover other findings. For example, data by industry show considerable variation from the aggregate. × Specific patterns of trends (e.g. over 40 hours per week and increased overtime) cannot predict which industry will experience productivity effects.
Sokejima and Kagamimori (1998) Working hours as a risk factor for acute myocardial infarction in Japan: case-control study	• Case control study set in university / general hospitals and workplace medical examinations in Japan. • Cases were 195 men aged 30-69 years who were in hospital for acute myocardial infarction (AMI) between 1990 and 1993. • Controls were 331 men aged 31-72 years who were free of heart disease and who matched the cases on age and occupation. • Participants completed a self-administered questionnaire about work hours and psychosocial working conditions. It asked for mean work hours per day for 2 months prior to AMI/study and the shortest and longest months. • Outcome measures were odds ratios for AMI in relation to previous daily work hours as well as changes in mean work hours.	• Conducted pilot study on 125 cases and controls and found a significant relation between hours and myocardial infarction. • The shortest mean daily work hours were significantly fewer for cases. • Long working days (over 11 hours) **and** short working days (fewer than 7 hours) were associated with a three times increased risk of AMI compared to working 7-9 hours per day. • There was no appreciable change to this relationship when it was adjusted for established risk and psychosocial factors. • AMI risk increased when there was over three hours increase to daily hours than when there was only up to one hour increase in daily hours. *Conclusions:* • There is a U-shaped relationship between mean work hours and the risk of AMI. • The risk of AMI increases with greater increase in mean daily work hours.	× All male sample. × Self-administered questionnaire. × Data limited to non-fatal myocardial infarction. × There may be recall bias – after the AMI cases may negatively misinterpret working hours or they may have negative feelings about their working hours and their AMI. × Preponderance of managers and officials (51%) with few manual workers (12%). Therefore, there may be socio-economic biases. × Further study required to clarify the mechanism of the U-shaped association. × Controls were not selected from the same worksite as the cases.

Study	Methodology	Key Findings/Conclusions	Limitations
Sorensen et al (1985) Sex Differences in the Relationship Between Work and Health: The Minnesota Heart Survey	• 1,379 men and 1,133 women were surveyed as part of the Minnesota heart survey. • Data collection included a home interview, medical examination and a self-administered survey to assess Type A behaviour patterns. • Items also included self-reports of cigarette smoking and physical exercise.	• Men work significantly more hours than women. 47% of men work 40+ hours/week, 16% of women work 40+ hours/week. • Women report more stress symptoms. • Stress symptoms increase with increasing work hours and deadlines, more so for men. Work pressures such as long hours can also intensify Type A behaviours. • Long work hours and time concerns have deleterious consequences for smoking and physical activity behaviours (risk factors for CHD). Some work experiences and other risk factors (e.g., cholesterol levels) do not show a strong relationship. • Work experiences, especially work hours, may contribute to risk of heart disease indirectly by their impact on health behaviours.	× Cross-sectional data, therefore difficult to infer causality and direction of causality. × Can't assess any long-term exposure to stressors on risk of CHD. × Used subjective recollections of work hours/environment that may not be reliable.
Spector et al (1988) Relation of job stressors to affective health, and performance outcomes: a comparison of multiple data sources	• N = 156 female secretaries from a university in the US and their supervisors. • Questionnaire surveys were completed by secretaries and supervisors and returned mainly via the internal mail. • Items included measures of stressors (e.g., ambiguity, workload which included number of hours worked at university and at a second job), outcome measures such as absenteeism, anxiety and satisfaction.	• Subjects worked an average of 38.3 hours a week. • Total hours worked was significantly correlated with anxiety, satisfaction and intent to quit. • Number of hours worked, autonomy, workload, job satisfaction and number of people worked for showed convergent and discriminant validity. • The hypothesis that both outcomes and environment cause subordinate reports of stressors was supported. • Results suggest that long hours could produce a negative affective response that has a physiological basis, but which does not lead to illness or physical symptoms.	× Long hours were not generally worked by the sample. × Does try and look at causality and different sources of information on stressors. × Cross-sectional study. × Possibility of some response bias by supervisors?

Study	Methodology	Key Findings/Conclusions	Limitations
Starrin et al (1990) Structural changes, ill-health, and mortality in Sweden, 1963-1983: A macroaggregated study	• Exploratory time series analysis performed on selected indicators of structural change, health behaviour and ill-health in Sweden in the years 1963-1983. • Data taken from Swedish registers covering social change and suicide/mortality/sick leave statistics. • Men and women aged 45-64. • Both synchronic (nonlagged) and asynchronic (lagged) analyses were made.	• Decreasing levels of employment and increasing overtime work were two main contributory factors for higher suicide rates. • Increases in alcohol sales, unemployment length, and number applying for work per available job is associated with increases in cardiovascular mortality in men. • Decreasing overtime and industrial unemployment and increasing alcohol sales and unemployment length is correlated with an increase in cirrhosis mortality in men. • For women, job competition appears to be a significant factor in the above associations. • For men and women, sale of alcohol is positively associated to, and unemployment is negatively related to, sick leave.	× Fairly small sample (years 1963-1983). × Does not specify numbers of males and females and other demographic data. × Restricted age group × The appropriateness of time lag analyses has been questioned, unless an explicit model and theoretical argument that motivates the analysis can be given. × Synchronic and asynchronic models can produce different results, which may cause problems when drawing conclusions. × Many questions still need answers.
Steptoe et al (1998) Longitudinal study of workload and variations in psychological well-being, cortisol, smoking and alcohol consumption	• Sample of 71 workers (44 women, 27 men) in the retail industry (mainly sales) in London. • Measures on workload (indexed by paid work hours), psychological well-being, cortisol, smoking and alcohol consumption were obtained on four occasions over a six-month period. Assessments were ranked according to hours of work over the past 7 days. • Job strain and job social support were evaluated as potential moderators of responses. • It was hypothesised that psychological well-being would deteriorate and smoking/alcohol consumption would increase under high workload (i.e. work hours).	• Paid work hours ranged from 32.6 to 48.0 hours per week (average 39.5 hours) with no difference between men and women. • Variation in paid work hours was not associated with psychological well-being or salivary cortisol. • Female (not male) smokers consumed more cigarettes during long work hours. • Men, but not women, with poor social supports consumed more alcohol as work hours lengthened. • Changes in health behaviour were small. Therefore, data indicates that health behaviours are affected only to a limited extent by variations in workload. In general, working men and women may tolerate wide variations in workload with few adverse effects on psychological well-being and health behaviours.	× Interaction of workload/alcohol/social support should be interpreted with caution as it was not predicted and the subgroups were small. × Other factors, such as emotional trauma, can be more potent triggers of alcohol use etc. × The workforce may have been well adapted to their occupations so results cannot be generalised to jobs involving greater uncertainty. × There was a prohibition on smoking and drinking at work, which may have restricted some variations from emerging. × Study was carried out in a large city; different effects may emerge from smaller areas or other cultural settings. × Participants were assessed at different times of the day.

Study	Methodology	Key Findings/Conclusions	Limitations
Trimpop et al (2000) Individual differences in working hours, work perceptions and accident rates in veterinary surgeries.	• Cross sectional questionnaire / survey study. • Large random sample of 778 vets and auxiliary personnel taken from veterinary practices in Germany. • Looked at accident rates at work and in the car. Survey asked for details of hours worked, number of car and work accidents, and demographic information. • Used Occupational Stress / Work Climate and Satisfaction at Work scales. • Total sample – 58% females/42% males, vets 64% and auxiliary personnel 36%. Average age 39 years (range 16-74).	• Mean hours worked for the entire sample was 44 hours per week. For vets the average was 51.5 hours and for auxiliary personnel the average was 33.4 hours. • Work related injuries and accidents during the previous 12 months were significantly related to individual differences in stress and job satisfaction. • Vets working over 48 hours per week had significantly more driving accidents when visiting clients (not commuting). • Increased age and longer hours combined to increase off site accidents by 10 times. • Hours and stress related to accident behaviours. • Hours of work cause concern but need to be considered with other variables (individual differences, demographics, work situations).	× Other issues need to be explored (e.g. time of day, rest breaks, type of work, task importance). × Sampling response bias - due to non-responding results may under-report involvement in accidents. × Reliance on self-report data – accident reporting may be inaccurate. × Cross sectional studies do not establish causal relationships.
Uehata, T (1991) Long working hours and occupational stress-related cardiovascular attacks among middle-aged workers in Japan	• Retrospective case studies of 196 males and 7 females who suffered *Karoshi* (fatal attacks by overload). • Compensation was being claimed by families/colleagues of the victims. • Families and colleagues were interviewed and responses were checked using company and medical records. • Interviews covered sources of work stress, working hours, lifestyle and medical histories.	• Two thirds of cases were working 'long hours' e.g., +60 per week, more than 50 hrs of overtime per month or more than half of their holidays before their attack. • Other stressors accompanied hours: career problems, changes of workplace, night work. • Over half of cases had complaints linked to cardiovascular attacks e.g., diabetes mellitus. • Around 60% of male cases smoked. • Various triggers (in 24 hrs before attack) included emotional anxiety, workload increase. Conclusions: • Karoshi can be mainly triggered by long working hours. • Working styles (inc long hours) aggravated lifestyle habits and minor work-related troubles/events, led to cardiovascular attacks.	× Retrospective study (not a random sample) × Possible bias from interviewees [and interviewer?] (being interviewed as part of compensation claim process), although some objective confirmation of answers sought. × Some shift workers in sample

Study	Methodology	Key Findings/Conclusions	Limitations
Van der Hulst & Geurts (2001) Associations between overtime and psychological health in high and low reward jobs	• N = 535 Dutch postal service employees (5.2% women). • Completed a self-report questionnaire including measures looking at amount of overtime done, job rewards and a burnout inventory.	• Overtime was associated with higher scores on negative work-home/home-work interface. • People working overtime but having high job rewards suffer no more psychological health complaints than those working with high job rewards but no overtime. • Low rewards are associated with increased risk of psychological health problems. Overtime by itself is not associated with increase risk. • The authors conclude that moderately long working weeks (fewer than 50 hours) are not associated with adverse psychological health, even if there is a high pressure to work overtime, as long as job rewards are high.	× There are no norm scores for the home-work/work-home interface scale. × Possibly a 'healthy worker' effect? × Cross-sectional study × Possible influence of job or job type on psychological health, and not just long hours. × Subjective measures. × Measures were dichotomised, which could mean than rich data was lost.
Vernon (1920) Industrial Efficiency and Fatigue	• Observations were made at a large fuse factory during the early part of the 20th century. • Records were taken of hours of work and output of various groups of workers. For example, a group of 100 women engaged in turning aluminium fuse bodies week by week for a period of 13 and a half months or a group of men charging a blast furnace over a five-month period. • Investigations into daily output and hourly output variations were also recorded.	• When weekly hours for the women group was reduced from 66.2 to 54.8 hours per week, total output was 11% greater. When weekly hours were reduced further to 45.6 hours total output was 9% greater. • Daily output variations showed that as weekly work hours increased (from 52.5 to 63) maximum output was found sooner in the week (i.e. Tuesday rather than Saturday). • When working hours for the men group was examined, output before and after a break was found to increase in the first and second full hour of work and then fell off considerably. After the break saw the greatest output figures. • For the women group the morning spell continually improved, with output in the last hour being 21% greater than the first hour. This suggests that output fall off from fatigue is unlikely and increase in efficiency due to practice may be important.	× A fall in output does not necessarily imply the existence of fatigue; people may be voluntarily limiting their output and not working to the best of their ability. × Other factors than fatigue may affect efficiency, e.g. practice, and may render results difficult to interpret. × The best hours of work can only really be ascertained from prolonged observation and experiment. × The results for daily/hourly output variations came from different workers and different jobs, which may limit the accuracy of the findings. × Psychological factors, such as exerting extra effort at the end of a day, may mask any fatigue effects. × Improvements may not necessarily apply to all industries and may depend on the extent to which a procedure is under machinery or human control.

Study	Methodology	Key Findings/Conclusions	Limitations
Wallace (1999) Work-to-nonwork conflict among married male and female lawyers	• N = 338 lawyers in Western Canada (53% male). • Completed a postal questionnaire. • Items measured work-to-nonwork conflict (work impinging on non work activities and life), work involvement (including average number of hours worked per week), work role stressors (concerning workload), work context and control variables (e.g., partner's work status).	• Work overload was the only common determinant for work-to-non-work conflict for both males and females. • The actual number of hours worked was not important in influencing how subjects felt about work-to-non-work conflict. (Average hours worked per week for men = 50.04, for women = 45.6). • Authors suggest that control over work scheduling may be the key which means that working long hours may not automatically lead to work-to-non-work conflict.	× Cross-sectional design limits inferences. × May be difficult to generalise to other professions. × Possibility that other factors which were not measured may relate to and moderate work-to-non-work conflict.
Wantabe et al (1993) Relationships between health status and working conditions and personalities among VDT workers	• N = 486 (female = 68) local government workers who work with visual display terminals (VDT) in Japan. • Interviews were carried out using a questionnaire. Items measured biological information, life history, working conditions, subjective symptoms associated with VDT use, depression and attitudes towards computers.	• Mean weekly working hours were significantly different for Type A (51 hrs/week) and Non-Type A subjects (47.7 hrs/week). • The mean weekly working hours for those who were classed as depressed was much longer than any of the other groups (61 hours/week). • Subjects who were anxious about using computers had a higher history of duodenal ulcer. • Other factors such as high quotas, poor work relationships and monotonous work are also linked to depression.	× Difficult to separate out causal linkages e.g., do people who are Type A have a tendency towards depression, regardless of the number of hours that are worked? × Self-report measures used.
Westman et al (1985) Job stress, cigarette smoking and cessation: the conditioning effects of peer support	• N= 870 male members of kibbutzim in Israel. • Completed a self-report questionnaire during a medical examination (as part of a prospective study). • Items included various measures of job stressor (e.g., role overload, work addiction) and working hours and smoking behaviour, mostly in closed question, five point response scale format.	• Hours of work (amongst other variables) were positively associated with smoking intensity. • Hours of work (amongst other variables) were negatively associated with smoking cessation. • The effect of social support and working hours was additive. People working fewer than 8 hours a day with high support = average 17 cigarettes/day. Working more than 8 hours with low support = 22 cigarettes. • Little support for stress-support interaction.	× Self report study × Subjects did not work as 'long' hours as defined by other studies. Around 6% of this sample were working 11 hours a day or longer, with 60% working up to 8 hours a day. × Smoking as indirect measure of stress may be unreliable as there are probably various reasons that people smoke e.g., social norms, enjoy the experience etc.

Study	Methodology	Key Findings/Conclusions	Limitations

Wilkinson et al (1975)
 	
Duty hours of young hospital doctors: Effects on the quality of work
	• A postal questionnaire was sent to junior and senior House Officers in England, Scotland and Wales (June 1973). N = 2452.
	• Items included 'Do you think that your hours of duty are so long as to impair you ability to work with adequate efficiency?" (responses were along a 5 point scale), and items concerning how many hours had been worked in the previous 24 hours.
		• In response to the long hours question, doctors responded:
		  • Always = 3.3%
		  • Often = 34.0%
		  • Occasionally = 47.6%
		  • Rarely 12.2%
		  • Never = 2.9%
		• Average of 21 hours of work or on call, and 6 hours sleep in preceding 24 hours.
			× Self-report study, with subjective responses.
			× Possibility of bias from respondents.
			× Working with 'adequate efficiency' can be interpreted in various ways.

Williamson et al (1996) The impact of work practices on fatigue in long distance truck drivers	• N = 27 male truck drivers in Australia. • They completed three trips between Sydney and Melbourne: a relay (where they exchanged loads with another driver at the midpoint of their journey and then returned), a working hours regulated one-way trip and a fully flexible (no regulation) one-way trip. • Various measures of fatigue were taken including subjective, physiological and performance. Biographical and other data (e.g., hours of sleep before trip) were also recorded.	• The trips averaged around 12 hours, with around 2 breaks taken in each trip. • Fatigue increased across all trips. • Drivers only got an average of around 6 hours sleep preceding the trip (not always at night). • None of the trip regimes appeared to help combat fatigue. • The pre-trip level of fatigue appears to be important in determining fatigue whilst at work.	× Small sample size. × May be difficult to generalise due to specific population studied.

Study	Methodology	Key Findings/Conclusions	Limitations
Worrall and Cooper (1999) The quality of working life. 1999 survey of managers changing experiences.	• Third in a series of five surveys to explore the impact of recent trends in organisational change and labour market on managers experiences of UK work life. • Fieldwork conducted in March 1999. The Institute of Management member database was used as a sampling frame. • Self-completion questionnaires were sent to the same panel of 5,000 members to see how views and experiences had changed in that year. If members were no longer there replacements were made with the same demographic characteristics. • In this 1999 survey there were 1,213 valid responses (24%).	Work hours results included: • One third of respondents were regularly working 51 hours or more per week. • 19% managers worked fewer than 40 hours per week / 10% work over 60 hours and 49% work 41-50 hours. • 26% at CEO/MD level worked over 60 hours but only 3% of junior managers did. • 49% often or always work in the evening and 32% work at weekends. • There were various reasons why working long hours is acceptable: 58% said because they take work seriously / 80% said to meet deadlines / 58% said employer expects it / and 58% said time was needed to think and plan. • 76% managers worked over contract hours. • Working hours may have adverse effects on health / morale / productivity / social lives / and relationships with partners/children. • Recommends that creating an environment that recognises both home and work life is preferable to gain commitment and productivity.	× Panel tends to over represent managers at more senior levels. This may cause inaccuracies as there may be massive differences in attitudes, behaviours and experiences within different organisational levels. × Self report data. × Many other changes in society may affect survey results. × Only survey descriptive data – no causal conclusions could be made.
Yasuda et al (2001) Lower percentage of CD56+ cells associated with long working hours	• Cross sectional study using biological blood collection and questionnaire methodology. • Sample was 142 Japanese men from a technology development company. • Blood samples were collected in the annual workplace medical health checks and lymphocyte cells were measured. • Participants also completed a questionnaire regarding work/sleep/health and lifestyle. • Weekly work hours definition included commuting time.	• The percentage of CD56+ cells were significantly inversely correlated with work and sleep hours. • A lower CD56+ cell percentage (not number of cells) was associated with higher weekly work hours and lower daily sleep hours. • Such cells therefore may serve as prognostic markers for monitoring the effects of long work hours on the immune system.	× Only shows correlation, not causal effects. × All male sample. × Fairly small sample size. × Cross sectional study. × Restricted to one type of work company.