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An update of the literature on age and employment

ERG/09/33

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EXECUTIVE SUMMARY

Demographic trends indicate that the make up of the labour force in the UK (and other developed countries) is changing. Older workers are becoming more prevalent in the workforce, there are fewer new workers joining the labour force and older workers are continuing to retire early (Hotopp, 2005, 2007). These changes to the labour force could lead to labour and skills shortages in the future and have implications for the economy in terms of the age dependency ratio (Khan, 2009).

The research in this area suggests that employers can have stereotyped views of the abilities and attitudes of older workers, which can both positively or negatively, influence the retention and recruitment of older individuals (Ilmarinen, 2006; McNair et al, 2007). A previous report by Benjamin and Wilson (2005) considered some of the common stereotypes about older workers and provided evidence and arguments aimed at dispelling inaccurate perceptions about older adults. The Department for Work and Pensions (DWP) and the Health and Safety Executive (HSE) commissioned a report to review and update the Benjamin and Wilson (2005) report. The aim was to revisit the literature on age and employment which was published at the time of the Benjamin and Wilson review as well as to consider relevant literature published since (2005-2009). This updated review looks at the evidence for age-related effects on employment in the same areas addressed in the Benjamin and Wilson (2005) report. In addition the report considers trends, gender, and sector specific issues. The same definition of "older worker" is used in this review as was used by Benjamin and Wilson (2005), which is workers over the age of 50.

Main Findings

Health and life expectancy trends

In the UK, there were 20.7 million people 50 years or older in 2007, which is a 50% increase since 1951. This increase in older age groups is projected to continue. Similarly, the percentage of people employed in 2009 who are of Statutory Pension Age (SPA) or older has increased from 8% to 12%. Life expectancy has risen between 2000 and 2005 and is projected to continue rising. It is suggested that men at 65 could now expect to live a further 12.8 years in good or fairly good health and women could live for a further 14.5 years. Lifestyle behaviours, such as healthy eating, smoking, alcohol consumption and levels of physical exercise, have a major impact on the health of an individual and with respect to this there is evidence that health of all age groups, including older people, is improving. Common diseases such as high blood pressure have shown a reduction in most age groups in the past few years and the proportion of people with cardiovascular diseases has remained stable. However, diabetes has shown an increase in prevalence, almost doubling in adults between 1994-2006. Obesity levels have also increased markedly since 1994 but there are indications that the trend may now be flattening out.

Age and productivity

The conclusion of this review is that there is no consistent evidence that older workers are generally less productive than younger workers which is in agreement with the earlier Benjamin and Wilson (2005) review. Most reviews and studies of work performance have not established a relationship between decreased job performance with increasing age and conclude that job performance is generally the same across all age groups. It is concluded that when abilities match job requirements and when experience is taken into account, there is little difference between the performance of older and younger workers. Where some studies into the relationship between age and productivity show mixed results, this may be because of

differences in the nature of the job and the measure of performance used. It is suggested that performance does not necessarily decline with age because most jobs do not require employees to work at full capacity; strategies, skills and experience can be utilised to compensate for functional declines; and there is great variability in functional capabilities between individuals. Knowledge and experience have been found to compensate for age-related declines in a wide range of fields and it is suggested that practice and skills and professional expertise, developed over many years of practice and experience, can compensate for potential negative impact of declines in performance. As well as there being little evidence that performance of core skills declines with age, there appears to be evidence that other aspects of performance such as good timekeeping, helping co-workers, better anger management and people skills increase with age. Some studies have also shown that older workers perform better in terms of accuracy and output consistency.

Age and ill health

There is strong evidence that work is generally good for physical and mental health and well-being for people of all age groups and that not being in work is associated with poor physical and mental health and well-being (Waddell and Burton, 2006). There appears to be consistent evidence that ageing does generally bring an increase in the prevalence of musculoskeletal disorders (MSDs) and cardiovascular disease. However, it is important to note that a decline in health and physical capacity does not necessarily indicate an associated decline in job performance. Studies have shown that the majority of workers reporting ill health or a decline in physical capacity, remain in work. The evidence suggests that age-related changes in ill health generally do not result in impairment or incapacity and therefore have a minimal affect on productivity. In fact, the evidence strongly suggests that work is generally good for physical and mental health and well-being of healthy people, many disabled people and most people with common health problems (Waddell and Burton, 2006). This applies equally to older workers as to their younger colleagues.

The increase in the prevalence of some common health problems and MSDs with age is part of the normal ageing process and happens to people whether they are working or not. There is no conclusive evidence that age by itself is a risk factor for work-related MSDs or ill health. In other words, it is not the age of the worker that is the issue, but that the work or workplace is demanding more of a worker than the worker is capable of giving. Other factors such as work demands, psychosocial and socioecomomic factors may have a greater influence on the risk of developing work-related ill health than age. For mental health problems the findings generally suggest that the prevalence of depression decreases with increasing age. Symptoms of work-related stress and burnout appear to increase with age but peek at 50-55 years old and then decrease with older age. Women may be more likely to report work-related stress than men possibly due to the demands of their work, having multiple roles outside work and generally being more ready to admit to stress.

Age and cognitive capacity

There is evidence that cognitive performance does not generally show any marked decrease until after the age of 70. It is suggested that this is because cognitive skills such as intelligence, knowledge, language and complex problem solving are resistant to age-related declines and are likely to increase with age until 60 years of age. However, there appears to be considerable laboratory based evidence to support the theory that some specific cognitive abilities decline with age. These cognitive skills include working memory, reasoning, attention and processing speed. Where declines in cognitive abilities such as working memory and reaction time do occur, there is evidence that performance of tasks is unlikely to be affected because of the ability of an individual to compensate for these declines with experience, education, high

motivation, better judgement and job knowledge. Neuroimaging research has consistently demonstrated differing patterns of brain activation for older and younger adults performing the same task to similar levels of performance. This has led to a generally accepted compensation or scaffolding hypothesis suggesting that the brain of older adults can reorganise and recruit additional parts of the brain to support performance to counter deterioration in brain structures. Where there is evidence of age-related declines specific cognitive abilities, there is little evidence to suggest that work performance declines with age.

Age and physical strength and endurance

Although there is evidence that both muscle strength and aerobic capacity decline progressively with age, there is little evidence that these declines generally have an adverse effect on performance. It is suggested that muscle strength declines between 30 and 65 years of age but that this decline is unlikely to be noticeable until after the age of 65. There is some evidence that older workers may have lower muscle strength but longer endurance times suggesting that they could perform lighter tasks for longer than younger workers. Aerobic capacity also appears to decline progressively after the age of 30 with accelerated declines after the age of 70. It appears that older workers are more likely to have a higher need for recovery from physically demanding work than younger workers. There is considerable agreement in the literature reviewed here that age related declines in physical capacity do not normally adversely affect job performance. This may be because very few jobs require high aerobic and muscular strength demands to be maintained over a long period of time. Alternatively, work performance may be unaffected by declines in physical capacity because older workers are able to adapt their environment and employ mechanically efficient techniques to compensate for physical declines. There is also agreement in the literature that physical capacity varies greatly between individuals and that declines in physical capacity can be delayed and minimised (although not prevented) with regular exercise in leisure time.

Age and sensory abilities

There is clear evidence that visual and auditory acuity generally deteriorate with age. Whilst there are individual differences in the rates and extent of these declines, declines have been shown to be widespread in older adults. However, these declines can generally by compensated for by the individual procuring personal aids such as spectacles or a hearing aid, or by adaptations to the environment such as improved lighting, reduced glare or reduced background noise.

Age and adaptation to change

Benjamin and Wilson (2005) in their review of the literature, conclude that older workers can adapt to change and this current review supports that conclusion. Whilst some studies advocate that older workers may be initially reluctant, or have difficulty, adapting to workplace changes, no evidence was identified to propose that older workers are not capable of adaptation. A number of reasons for reluctance or difficulties in adapting have been suggested which may be overcome with support, training and education. The evidence suggests that whilst older adults are capable of learning, the speed of learning tends to slow with age. Given additional time and practice, there is strong evidence that older workers can generally achieve a good standard in learning and performing new skills. The training time and ease of learning for older workers may be improved if the training is tailored towards the learning styles of older adults such as self paced learning, learning with age peers, additional assistance from trainers and more practice time.

Age and levels of sickness absence

Sickness absence is a complex issue. It is influenced by a number of different factors including personal, social and organisational issues. It can be measured by both frequency and duration of absence. Figures from the Labour Force Survey indicate that self-reported sickness absence rates for all employees have generally declined since 2000 and have been stable between 2006-2008 with 2.5% of employees having at least one days sickness absence in the reference week. The figures show that women have more sickness absence than men and that sickness absence rates are higher in the public service than in the private sector. The Labour Force Survey figures also indicate that younger workers under the age of 35 have a higher rate of sickness absence (2.6%) than older workers (2.4% for 50-SPA age group). However, these figures only consider frequency of sickness absence and not duration. As suggested by Benjamin and Wilson (2005), generally the balance of the evidence shows that older workers do not have a greater sickness absence pattern than younger workers. Generally the empirical evidence suggests that older workers have less short-term sickness absence than younger workers. Some studies suggest that older workers take more long-term sickness absence than younger workers. However, there is some contradiction in the evidence for this. The lack of consistent evidence may be due to differences in sickness absence patterns with regard to health, occupation or industry.

Age and accident rates in the workplace

There appears to be little conclusive evidence that older workers have an increased risk of occupational accidents than younger workers. This is the same conclusion that the earlier review by Benjamin and Wilson (2005) proposes. The evidence suggests two patterns in the relationship between age and occupational accidents. Firstly, that older workers are generally less likely than younger workers to have occupational accidents, and secondly that accidents involving older workers are likely to result in more serious injuries, permanent disabilities or death than for younger workers (Robertson and Tracy, 1998). However, differing rates of non-fatal injury between older and younger workers can be largely explained by industry and occupational profiles of the working populations in those groups. When workplace injury rates are adjusted for other factors such as occupation, age was found not to have a statistically significant influence on the risk of workplace injury. The most important and dominating factor contributing to the risk of workplace injury is occupation. There is some evidence to suggest that older workers may experience more slips, trips and falls than younger workers. In addition, the recovery period following an injury may be longer for older workers although this is not consistently found. The evidence suggests that women workers have a substantially lower rate of injuries than men and this rate does not appear to increase with age. Analysis of accident and injury data suggests that new workers who have been in a job less than four months and part-time workers of all ages may have a higher risk of work-related, reportable injuries than those working full time hours. The inconsistencies in the evidence may be due to the differences in the relationship between age and accidents within different industries, types of job and job tenure and also due to the healthy worker effect.

Workplace accommodations

In additions to lifestyle behaviours and personal interventions which an individual can take up in order to mitigate functional impairments, there are also simple and effective accommodations that an employer can take to identify where employees are experiencing difficulties and to adjust the work organisation or work environment to remove or reduce these difficulties. These accommodations can include changes to the organisation of work such as giving the employee the opportunity to work flexible hours, part time hours or have a phased retirement plan. The work itself can be adjusted such as moving to supervisory or training roles if the work is

proving too physically demanding. Also, the work environment itself can be adjusted, for example, reducing glare, improved workstation layout, providing power tools, lighter equipment, or more suitable display screen equipment. Often these accommodations are simple to introduce and cost effective, allowing the valuable experience and skills of older workers to be retained in the organisation

Conclusions

The findings of this review on the effects of ageing and employability are that there is little evidence that chronological age is a strong determinant of health, cognitive or physical abilities, sickness absence, work-related injuries or productivity. This supports the findings reached by Benjamin and Wilson (2005) in their earlier review. Where there is evidence of age-related declines, the consensus of opinion is that overall these declines do not generally have an adverse affect on performance or productivity. There is general agreement in the literature that work is generally good for physical and mental health and well-being of people of all ages including people with common health problems. The findings of this review suggest that older workers do not need to be treated any differently to younger workers as long as employers are aware that there may be a reduction in some physical and mental capabilities with age and that these can be identified on an individual basis and suitable accommodations put in place.

KEY POINTS

Health and life expectancy trends

- There were 20.7 million people in the UK of 50 years or older in 2007, which is a 50% increase since 1951.
- The percentage of people employed in 2009 who are SPA or older has increased from 8% to 12%.
- Life expectancy has risen between 2000 and 2005 and is projected to continue rising.
- There is evidence that health of all age groups, including older people, is increasing due to changes in lifestyle behaviours.
- Common diseases such as high blood pressure have shown a reduction in most age groups in the past few years and the proportion of people with cardiovascular diseases has remained stable.
- Diabetes has shown an increase in prevalence, almost doubling in adults between 1994-2006.
- Obesity levels have also increased markedly but may now be levelling out.

Age and productivity

- There is no consistent evidence that older workers are generally less productive than younger workers.
- The evidence suggests that job performance is generally the same across all age groups.
- Some studies have shown that older workers perform better in terms of accuracy and output consistency.
- Productivity does not necessarily decline with age probably because most jobs do not require employees to work at full physical and mental capacity.
- Where age-related functional declines do occur in older workers, strategies, skills and experience can be utilised to compensate enabling productivity levels to be maintained.
- There is great individual variability in capabilities of older adults making generalisations unreliable.

Age and ill health

- There appears to be consistent evidence that ageing does generally bring an increase in the prevalence of MSDs and cardiovascular disease as part of the normal ageing process **BUT**
- The existence of illnesses does not necessarily hinder the employee at work and may have only minimal effects on productivity.
- General health and life expectancy and disability free life expectancy are improving in the UK due to increases in education and healthy lifestyles.
- For mental health problems generally prevalence of depression appears to decrease with age while work-related stress appears to increase with age but peeks at 50-55 years old.
- Work demands, and psychosocial factors may have a greater influence on the risk of developing work-related ill health than age.
- There is also some evidence that older adults lead healthier lifestyles than younger adults.
- There is strong evidence that work is generally good for both physical and mental health and well-being in contrast to the poor physical and mental health associated with not working.

Age and cognitive capacity

- There is evidence that cognitive performance does not generally show any marked decrease until after the age of 70.
- Cognitive skills such as intelligence, knowledge, language and complex problem solving are resistant to age-related declines and are likely to increase with age until 60 years of age.

- There appears to be laboratory based evidence that some specific cognitive abilities, such as working memory, reasoning, attention and processing speed, do show declines with age.
- Where cognitive declines do occur, there is evidence that performance is unaffected because of the ability to compensate with experience, education, high motivation, better judgement and job knowledge.

Age and physical strength and endurance

- Muscle strength declines between 30 and 65 years of age but that this decline is unlikely to be noticeable until after the age of 65.
- Aerobic capacity appears to decline progressively after the age of 30 with accelerated declines after the age of 70.
- Age related declines in physical capacity do not normally adversely affect job performance.
- Physical capacity varies greatly between individuals.
- Declines in physical capacity can be delayed and minimised with regular exercise in leisure time.

Age and sensory abilities

- There is clear evidence that visual and auditory acuity generally deteriorate with age.
- There are individual differences in the rates and extent of these declines.
- These declines can generally by compensated for through simple personal aids, such as spectacles or hearing aids, or adaptations to the environment.

Age and adaptation to change

- Older workers may be initially reluctant adapting to workplace changes but there is no evidence that older workers are not capable of adaptation.
- Reluctance or difficulties in adapting may be overcome with support, training and education.
- Whilst, the speed of learning tends to slow with age, there is strong evidence that older workers can generally achieve a good standard in learning and performing new skills.
- Training time and ease of learning for older workers may be improved if the training is tailored towards the learning styles of older adults.

Age and levels of sickness absence

- The balance of the evidence shows that older workers do not have a greater sickness absence than younger workers.
- The Labour Force Survey figures indicate that younger workers have a higher rate of sickness absence than older workers when duration of absence is not considered.
- Differing rates of non-fatal injury between older and younger workers may be largely explained by industry and occupation.
- When workplace injury rates are adjusted for other factors such as occupation, age was found not to have a significant influence on the risk of workplace injury.
- The most important and dominating factor contributing to the risk of workplace injury is occupation.
- There is a lack of conclusive evidence as to whether older workers take more long term sickness absence than younger workers.

Age and accident rates in the workplace

- There is little conclusive evidence that older workers have an increased risk of occupational accidents than younger workers.
- The evidence suggests that accidents involving older workers are likely to result in more serious injuries, permanent disabilities or death than for younger workers.

- The evidence suggests that women workers have lower rate of injuries than men and this rate does not appear to increase with age.

1 INTRODUCTION

Demographic trends indicate that the make up of the labour force in the UK (and other developed countries) is changing. Older workers are becoming more prevalent in the workforce, there are fewer new workers joining the labour force and older workers are continuing to retire early (Hotopp, 2005, 2007). These changes to the labour force could lead to labour and skills shortages in the future and have implications for the economy in terms of the age dependency ratio (Khan, 2009).

In 2004, the Age Partnership Group (APG) and the Department for Work and Pensions (DWP) commissioned a report to provide information towards ongoing development work on older workers in the labour market as part of the Be Ready (BR) campaign. This campaign aimed to raise employers' awareness of, and ability to adopt, flexible employment and retirement opportunities in order to increase the recruitment, retention and training of older workers prior to the implementation of age legislation. Employers can have stereotyped views of the abilities and attitudes of older workers, which can both positively or negatively, influence the retention and recruitment of older individuals. At the time of the original report the Employment Equality (Age) Regulations 2006 that would have given employees protection against discrimination on the grounds of age had not yet been introduced. The report by Benjamin and Wilson (2005) considered some of the common stereotypes about older workers and provided evidence and arguments that aimed to dispel inaccurate perceptions about older adults and demonstrate that health and safety cannot be used as an "excuse" to justify the exclusion of older workers from the workplace.

In 2009, the Department for Work and Pensions (DWP) and the Health and Safety Executive (HSE) commissioned a report to review and update the Benjamin and Wilson (2005) report. The aim was to revisit the literature on age, health and employment which was published at the time of the Benjamin and Wilson review as well as to consider relevant literature published since. This updated review looks at the evidence for age-related effects in health and employability in the same areas addressed in the Benjamin and Wilson (2005) report. These areas are:

- Productivity – including work ability, work design and organisation, and speed and quality
- Health – including physical and mental health issues
- Cognitive capacity – including memory, attention and speed of information processing
- Physical strength and endurance – including muscular and aerobic capacity, fatigue and recovery
- Sensory abilities – vision and hearing
- Adaptation to change – including resistance and motivation for change
- Sickness absence – short and long term absence levels and influencing factors
- Accidents and injuries – work-related accident and injury rates and risk factors

In addition the report considers trends, gender, and sector specific issues. The review also discusses workplace design, adaptations and accommodations that are recommended in the literature to address age-related limitations if these occur.

The same definition of "older worker" is used in this review as was used by Benjamin and Wilson (2005), which is workers over the age of 50.

2 METHOD

The report used information and data taken from a variety of sources, for example statistics from the Office of National Statistics, published journal articles and reports. In addition to the references contained in the Benjamin and Wilson (2005) report, other relevant published research articles and sources of information were identified through a search of a number of databases (Web of Science, ASSIA, OSHROM, Ergonomics Abstracts, STN, DA, MEDLINE) using a number of keywords (Ageing, Aging, Age, Older, Worker, Age-related).

Two researchers independently reviewed the identified abstracts in order to minimise bias in the selection of the articles, and a joint decision was made on those to include in the review. Similarly, two researchers analysed independently the retrieved full papers to minimise bias and ensure the reliability of the study.

3 GENERAL TRENDS

3.1 *TRENDS AND STATISTICS*

3.1.1 Older workers

In the UK, there were 20.7 million people 50 years or older in 2007, which is a 50% increase since 1951 when the figure was 13.8 million (Khan, 2009). This increase in older age groups is projected to continue as shown in Figure 1.

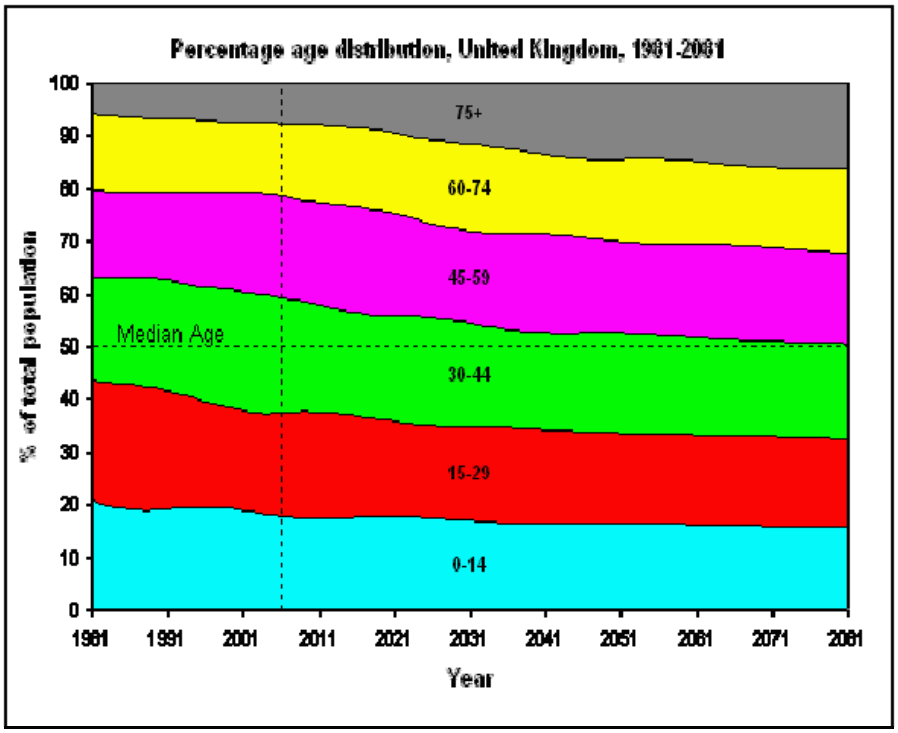


Figure 1 Actual and projected age distribution, 1981-2081 (ONS, 2008)

Not surprisingly in the light of this, the number of older workers in the labour market has also increased. Within EU15 it is estimated that by 2025 the proportion of 50-64 year old workers will double in size compared to workers under the age of 25 (Griffiths *et al*., 2009). The employment rate for older workers in the UK has increased between 1992 and 2008 as shown in Figure 2. The employment rate for people aged 50 or over has increased by 7.4% compared to 3.2% for all workers (Khan, 2009). In the UK in 2009, 72% of men and 71% of women aged between 50 and SPA were employed compared with 66% of men and 59% of women in this age group employed in 1992. Similarly, the percentage of people employed in 2009 who are SPA or older has increased from 8% to 12% (ONS, 2009a). This growth in older workers as the population ages is not restricted to the UK or Europe but it a global phenomenon.

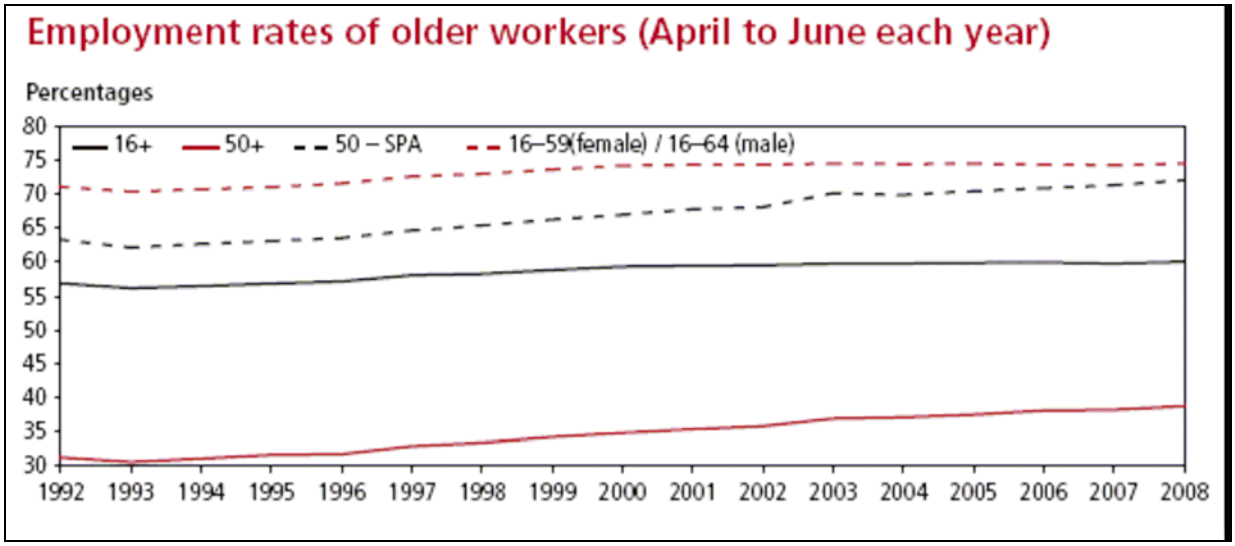


Figure 2 Employment rates for older workers from 1992-2008. (Source: Labour Force Survey, Khan, 2009)

There is not an equal representation of older workers across occupations. Older workers (over 50) are over-represented in process, plant and machine operatives, skilled trades and administrative work and under represented in technical and professional occupations, and in sales and customer service as shown in Figure 3 (Khan, 2009). Workers older than State Pension Age (SPA), tend to be concentrated in local, low skilled jobs, irrespective of their former level of skill (McNair *et al.*, 2007).

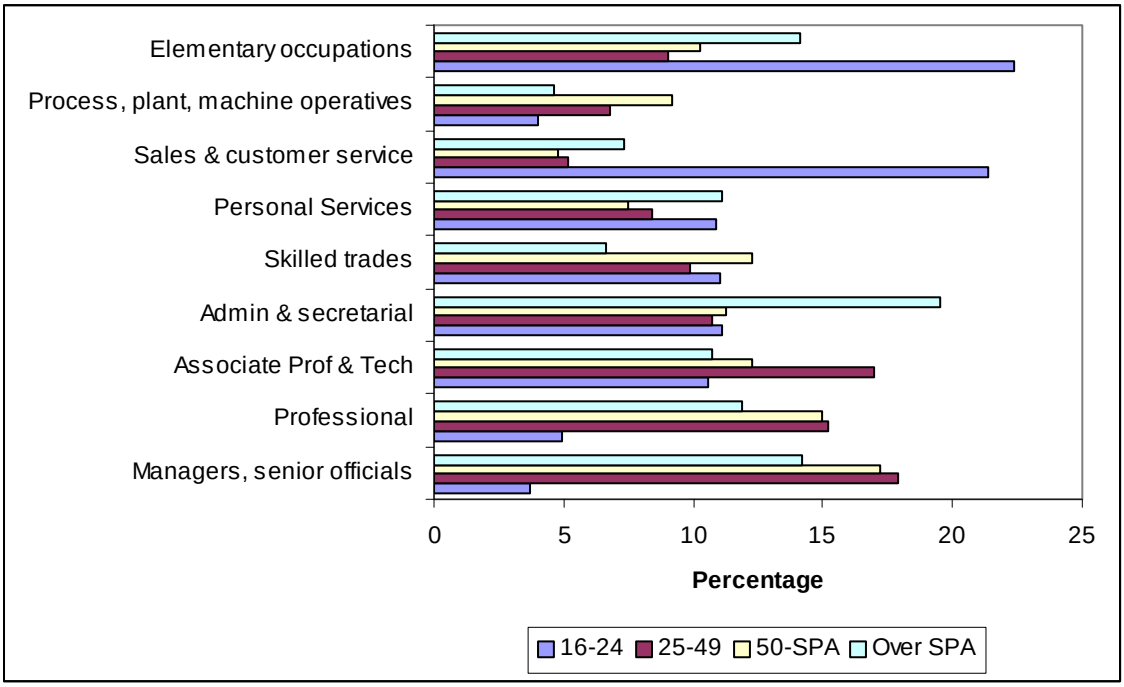


Figure 3 Workforce by occupation and age in GB 2009 (Source: Labour Force Survey 2nd quarter 2009, DWP, 2009)

The distribution of older workers across industries indicates only small differences with the greatest difference in the distribution, hotel and retail sector (Figure 4). Older workers are more likely to work part time than younger workers (Hotopp, 2007; Granville and Evandrou, 2008) and also more likely to be self-employed. Figures for the UK show that 18% of older workers (aged 50 or older) are self-employed compared to 12% of those in the 25-49 age group (Khan, 2009).

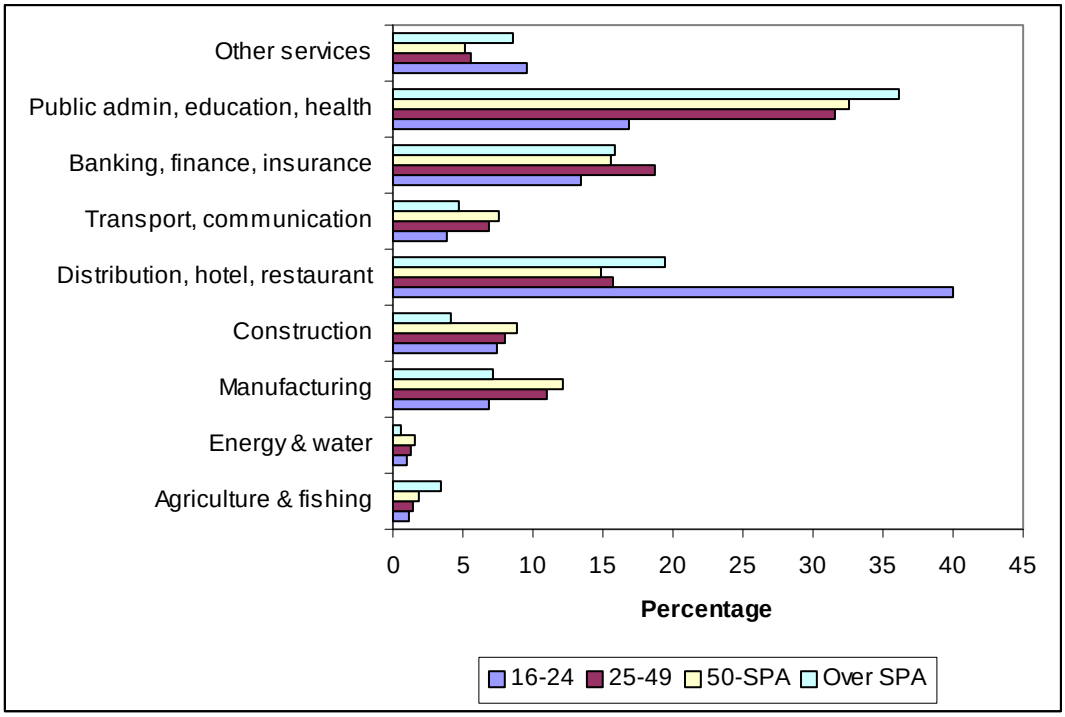


Figure 4 Workforce by industry and age in Great Britain (Source: Labour Force Survey 2nd quarter 2009, DWP, 2009)

3.1.2 Health and life expectancy trends

Life expectancy has risen between 2000 and 2005 and is projected to continue rising as shown in Figure 5 (ONS, 2008). Figures for 2005, suggest that men at 65 could expect to live a further 12.8 years in good or fairly good health and women could live for a further 14.5 years (ONS, 2008). Disability free life expectancy (DFLE) is a measure of functional health and measures the proportion of life expected without limiting disability or illness (Dunnell, 2008). Like life expectancy, DFLE has also risen between 2000 and 2005, with men at 65 expecting to live a further 10.1 years free of disability and long standing illness, and women, 10.6 years (ONS, 2008).

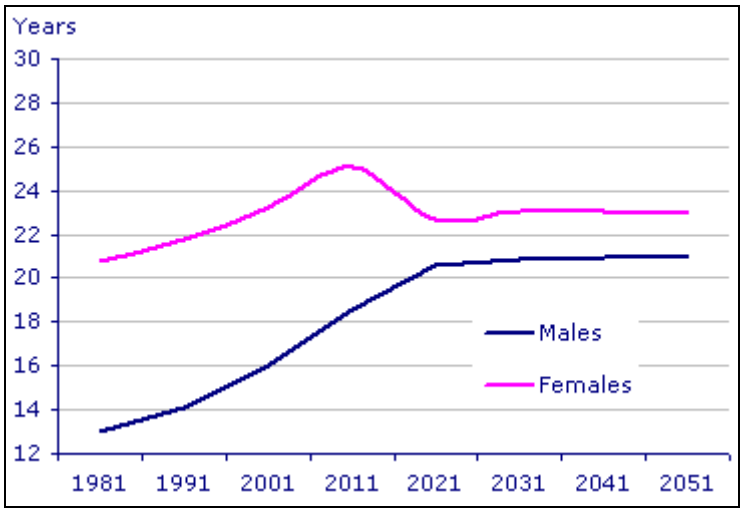


Figure 5 Projected life expectancy at State Pension Age by gender 1981-2051 (ONS, 2008)

It is clear that lifestyle behaviours have a major impact on the health of an individual. This includes lifestyle choices such as healthy eating, smoking, alcohol consumption and levels of physical exercise (NHS, 2008). There is evidence that the health of all age groups, including older people, is increasing. The latest Health Survey for England (NHS, 2009) shows that the number of people smoking has declined from 28% of men and 26% of women in 1993 to 24% of men and 20% of women in 2008. Older people smoke less than those in younger age groups. For example, in 2008, 28% of the 35-44 age group smoked compared to 21% of the 45-54 age group, 17% of the 55-54 age groups and just 13% of people 65-74 (NHS, 2009). The same survey indicates that the trend is for more people to consume a healthy diet with a significant increase between 2001 and 2007, in the proportion of people consuming more than five portions of fruit and vegetables a day. The highest proportion of people consuming a healthy diet was found in the older age groups with 34% of people in the 55-64 age group consuming five portions of fruit and vegetables a day in 2008 compared to 27% of the 25-34 and 35-44 age groups (NHS, 2009). Further indications of improving health are shown by an increase in the proportion of people meeting the recommended levels of physical activity in a week (30 minutes or more of vigorous or moderate activity five times a week). In 2008 42% of men and 31% of women achieved this level of physical activity compared to 32% of men and 21% of women in 1997 (NHS, 2009). Whilst across all age groups there has not been a significant decrease in the numbers of people drinking more than the recommended units of alcohol per week, older age groups are less likely to drink heavily (ie. more than twice the recommended limit on at least one day a week) (NHS, 2009).

Trends in the prevalence of common diseases such as high blood pressure have shown a reduction in most age groups in the past few years and the proportion of people with cardiovascular diseases has remained stable. Diabetes has shown an increase in prevalence, almost doubling from 2.4% of all adults in 1994 to 4.9% in 2006 (NHS, 2009). This may reflect the marked increase in obesity levels with 24% of men and 25% of women considered obese in 2008 compared to 13% of men and 16% of women in 1993. However, the Health Survey for England (NHS, 2009) points out that the increase in obesity levels has slowed in the last few years and there are indications that the trend may be flattening out. For people over 65 especially, there is a current improvement in health due to improved access to healthcare, screening, health advice and public health initiatives (Crawford *et al*., 2009).

3.1.3 Early exit/retirement

Older workers are exiting the labour force early in great numbers in many European countries and policies are being developed to encourage workers to delay retirement (Alavania and Burdorf, 2008). In the UK increasing the participation of older people in the labour market is a central policy issue (Dini, 2009). There has been an increase in the employment rate for men and women aged 50 or over to SPA between 1992 and 2008 (Dini, 2009). This is shown in Figures 6 and 7.

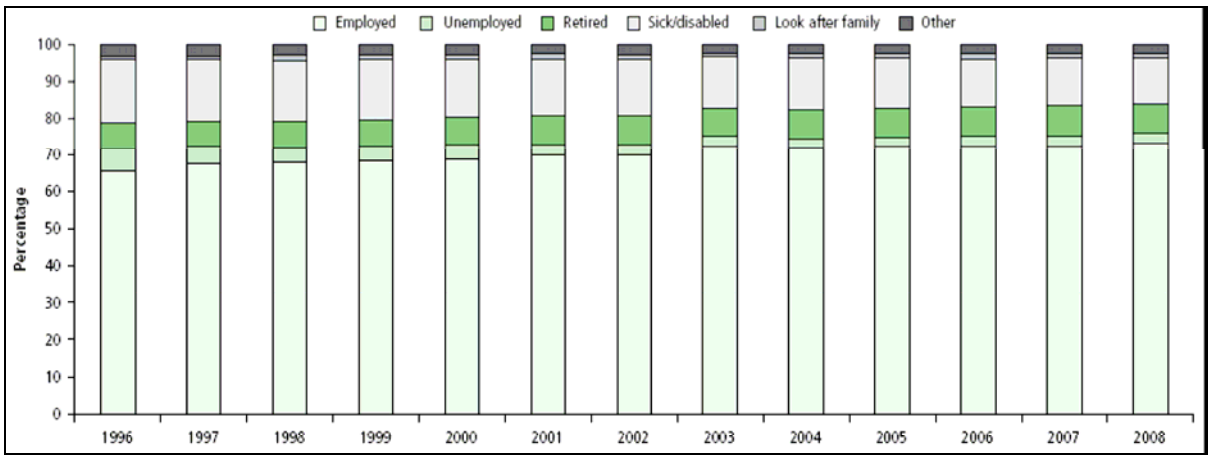


Figure 6 Percentage of men aged 50-64 by economic activity status UK, 1996-2008 (Source: Labour Force Survey, Dini, 2009)

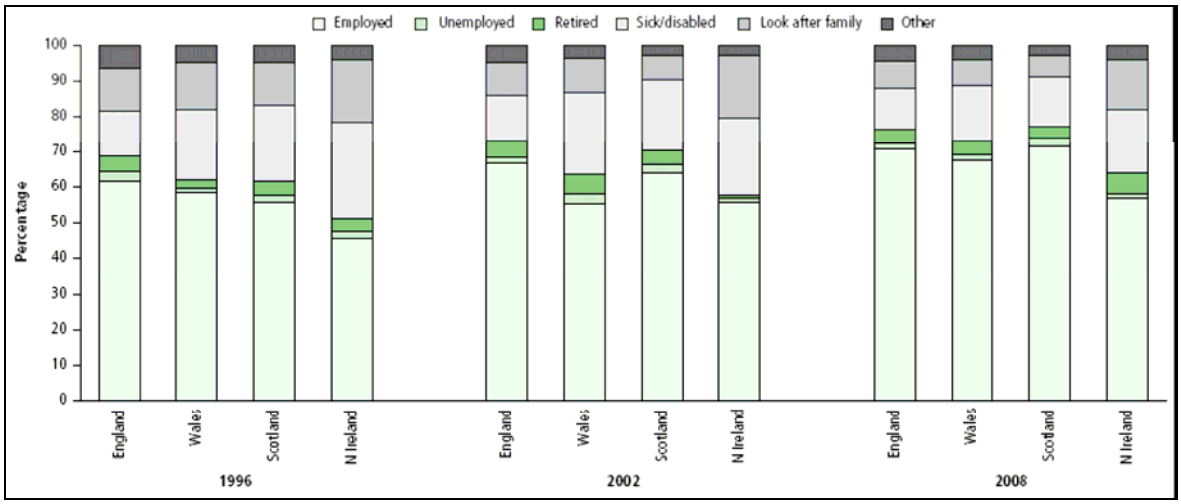


Figure 7 Percentage of women aged 50-59 by economic activity status UK, 1996-2008 (Source: Labour Force Survey, Dini, 2009)

The most common reason given for leaving the workforce before SPA is ill health or disability (Philipson and Smith, 2005; Hotopp, 2007). However, there are a number of other factors such as family and caring responsibilities, lack of opportunities at work, flexible and part time working, and financial security (Philipson and Smith, 2005).

3.1.4 Qualifications/Education

Due to cohort effects, there has been an increase in the proportion of people aged 50 and older in the UK with higher education qualifications whilst the proportion of this age group without

GCSE qualifications has fallen (Dini, 2009). In the last 12 years the percentage of people aged 50 to SPA holding a degree or equivalent has increased from 10% to 28% and the percentage of people in this age group without qualifications has decreased from 50% to 19% (Dini, 2009). Across all age groups, employment rates are higher for people with higher education levels which suggest that well educated older workers will be more likely to remain in the labour force for longer (Hotopp, 2005; Rix, 2006; Yilkoski *et al.*, 2006).

3.1.5 Women

Women make up nearly half (47.8%) of all people in the UK aged 16 to SPA. For all people in the UK who are over SPA, there is a higher percentage of women (62.7%) than men (DWP, 2009). The female employment rate is 70% and increasing. Recent figures show that there are 1.5 million female workers between 45-65 years of age and 113,000 who are 65 years or older employed in the UK (Doyal and Payne, 2006). Women workers are more likely than men to work part time (see Figure 8), are concentrated in certain employment areas (such as administration, personal services and sales/customer service), are more likely to be in low status jobs and to have lower earnings than male workers (Doyal and Payne, 2006; Shearn, 2005). It is also suggested that female workers between the ages of 45 to 65 are the most likely age group to be combining care roles at home and employment (Doyal and Payne, 2006).

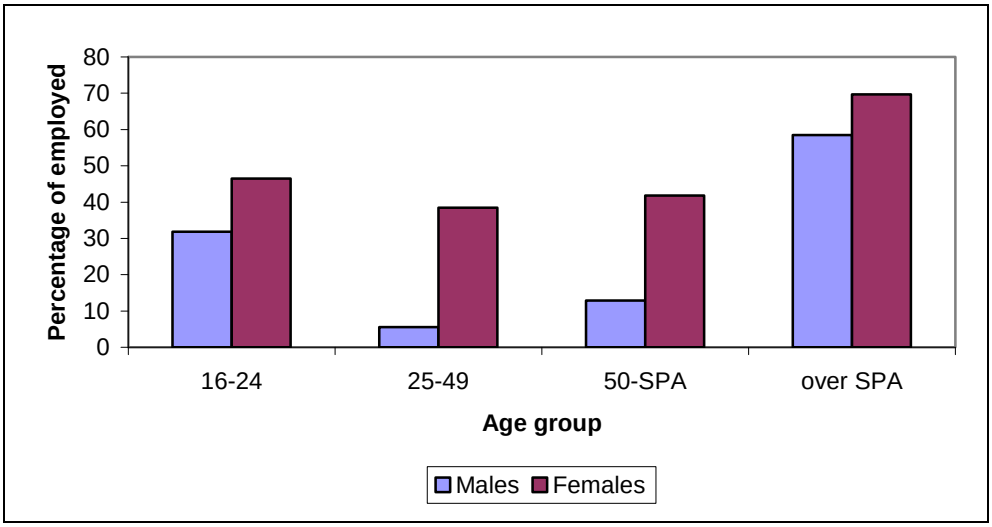


Figure 8 Percentage of age band employed working part time by gender in 2009 (Source: Labour Force Survey, 2nd quarter 2009, DWP, 2009)

3.1.6 Changing work environment

The work environment is changing towards increased internationalisation and competition, new technology, increased flexibility and new organisational practices (Koukoulaki, 2009). For example, outsourcing, downsizing, lean production and the use of temporary and contract labour are becoming increasingly common and are likely to continue to influence the work environment in the future. In addition, new information and communication technologies, the ageing workforce, increased immigration and a more flexible labour market are changing the work environment (Koukoulaki, 2009). One of the most striking changes in the organisation of work in recent years has been the increase in part time employment (Shearn, 2005). In 2008 25.5% of employed people were working part time hours compared to 23.6% in 1992 and it is suggested that this increase is driven by more men working part time (Khan, 2009). There is also a trend towards self-employment and temporary or fixed term sub contracts (Shearn, 2005;

Granville and Evandrou, 2008). The increased flexibility in the labour market and the continued progress of new information and communications technology suggest that life-long learning may need to be promoted in order to address the need for a better educated and trained workforce with flexible and adaptable skills (Koukoulaki, 2009).

The UK has seen a significant move away from jobs in manufacturing towards work in service industries (Clancy, 2009). Since the 1970s, the manufacturing industry has declined whilst the service sector has seen an increase in jobs from 61% in 1978 to 83% in 2008. Jobs in finance and business have more than doubled and there have been large increases in public administration, health, education, distribution and the hotel and catering sector (Clancy, 2009). Employment rates within the transport and construction industries have remained relatively stable in contrast to manufacturing and the service sectors (Shearn, 2005). It is suggested that the move away from traditional manufacturing work which involved physically demanding work, alongside the increase in the service sector and new e-commerce business involving order picking and distribution, will change the nature of work to low force but highly repetitive activities which will impact on an ageing workforce (Marras *et al.*, 2009). In the USA the proportion of jobs requiring heavy and/or frequent lifting has fallen from 20% in the 1950s to less than 8% by 1996 but while jobs are now less physically demanding, it is suggested that work intensification has resulted in an increase in mental stress (Rix, 2006).

3.2 SUMMARY

In the UK, there were 20.7 million people 50 years or older in 2007, which is a 50% increase since 1951. This increase in older age groups is projected to continue. Similarly, the percentage of people employed in 2009 who are SPA or older has increased from 8% to 12%. Life expectancy has risen between 2000 and 2005 and is projected to continue rising. It is suggested that men at 65 could now expect to live a further 12.8 years in good or fairly good health and women could live for a further 14.5 years. Lifestyle behaviours, such as healthy eating, smoking, alcohol consumption and levels of physical exercise, have a major impact on the health of an individual and with respect to this there is evidence that health of all age groups, including older people, is increasing. Common diseases such as high blood pressure have shown a reduction in most age groups in the past few years and the proportion of people with cardiovascular diseases has remained stable. However, diabetes has shown an increase in prevalence, almost doubling in adults between 1994-2006. Obesity levels have also increased markedly since 1994 but there are indications that the trend may now be flattening out. Older workers are exiting the labour force early in great numbers in many European countries and the most common reason given for leaving the workforce before SPA is ill health or disability. Women make up nearly half of the 16 to SPA labour force in the UK and nearly two thirds of the SPA and older labour force. Women workers are more likely than men to work part time, are concentrated in certain employment areas, are more likely to be in low status and low paid work, and are most likely to be combining work and care roles. The UK has seen a significant move away from jobs in manufacturing towards work in service industries. The trend is towards a more flexible labour market with an increase in part time employment, self-employment and temporary or fixed term sub contracts.

4 AGE AND PRODUCTIVITY

4.1 KEY POINTS

- There is no consistent evidence that older workers are generally less productive than younger workers
- The evidence suggests that job performance is generally the same across all age groups
- Some studies have shown that older workers perform better in terms of accuracy and output consistency
- Productivity does not necessarily decline with age probably because most jobs do not require employees to work at full physical and mental capacity
- Where age-related functional declines do occur in older workers, strategies, skills and experience can be utilised to compensate enabling productivity levels to be maintained
- There is great individual variability in capabilities of older adults making generalisations unreliable.

4.2 RELATIONSHIP BETWEEN AGE AND PRODUCTIVITY

There is no consistent evidence that older workers are generally less productive than younger workers. As is discussed later, whilst studies indicate that age-related changes in cognitive and physical function are inevitable, these changes do not invariably lead to reduced capacity or work productivity (Silverstein, 2008).

4.2.1 Evidence of no age-related decreases in productivity

Most reviews and studies of work performance have not established a relationship between decreased job performance with increasing age (Walman and Avolio, 1986; McEvoy and Cascio, 1989; Avolio *et al.,* 1990; Silverstein, 2008). Griffiths (1997) in her review, concludes that most reviews and meta-analyses on this issue suggest that there is little consistency in the relationship between ageing and work performance. Rhodes (1983) carried out a review of 25 empirical studies, which looked at the age/performance relationship and concludes that job performance was the same across all age groups in two thirds of the studies where experience was controlled. She suggests that performance is probably dependent on the nature of the job and the measure of performance used. McEvoy and Cascio (1989) and Warr (1994) reviewed around 100 studies and both reviews conclude that there is no significant difference between the job performance of older and younger workers. More recent reviews and studies support the earlier findings of the lack of a strong relationship between ageing and performance. For example, Charness (2008), in his meta-analysis of performance and ageing, found that age is only a moderate predictor of performance in most laboratory tests. Similarly, Feinsod and Davenport (2006) suggest that most studies find no significant relationship between productivity and age. Core task performance was found to be largely unrelated with age by Ng and Feldman (2008) in their meta-analysis of job performance.

Whilst the consensus appears to be that there is no strong relationship between age and performance, some reviews and studies have found some evidence of performance deteriorating with age. These results have usually been found in studying situations where jobs place a very high demand on cognitive or physical functions and where experience and expertise do not play a major part in the tasks (Chan *et al.,* 2000; Kanfer and Ackerman, 2004; Silverstein, 2008).

For example, performance decreases with age were identified in occupations where there are exceptionally high cognitive demands such as for Air Traffic Controllers (Silverstein 2008). Some studies suggest that there will be a decrease in productivity in jobs with a high physical demand and that performance will decrease more quickly in occupations with high physical workload and lower job control (Shephard, 2000a; Costa and Sartori, 2007). However, this has not been supported by other studies. For example, Parkhouse and Gall (2004) found that older powerline workers could perform all essential job tasks as well as other age groups with only minor exceptions. Some studies looking at work involving manual dexterity and time/motion measures suggest that productivity declines between 30-40 years of age, although even in fast paced tasks, it is suggested that communication and decision-making skills can often make up for declines in manual dexterity (Feinsod and Davenport, 2006). In a review of the literature on MSDs and ageing, Okunribido and Wynn (2009) concluded that studies generally agree that as we age we are not able to perform to the same level as when we are younger, but that there is evidence that work performance in most jobs does not decline before the late 60s.

Silverstein (2008) suggests that there may be a number of reasons for the lack of relationship between ageing and productivity. Firstly, most jobs do not require full capacity although older workers are more likely to be working closer to their physical limits. Secondly, studies have found large inter-individual variations in declines in physical and cognitive capacities for older adults compared to younger adults which illustrates the important point that each individual ages at a different rate and is affected (unaffected) in very different ways. Thirdly, older workers are often able to employ strategies, skills, experience and expertise to compensate for any age-related declines (Silverstein, 2008). Ng and Feldman (2008) suggest that the reason for the lack of a consistent and strong relationship between age and job performance is that research has focussed on core task activities rather than looking at the much broader range of behaviours that comprise job performance.

Role of experience on age and performance

Some studies appear to show that older workers are able to compensate for physical declines and maintain performance levels. Some older, but still valid, studies illustrate this ability to compensate for age-related declines. Salthouse's (1984) study of typists found that older typists performed as fast as younger typists possibly because they compensated by looking further ahead and processing larger sections of material than the younger typists. Taylor (1975) examined the influence of age on decision-making performance for 23-57 year old line managers in a manufacturing company. Taylor (1975) found that whilst older managers tended to take longer to make decisions they were able to diagnose the value of information more accurately than younger managers, although this was influenced by decision making experience. Feinsod and Davenport (2006) suggest that no significant relationship between age and productivity is found possibly because knowledge and experience can compensate at least partially for age-related declines in cognitive function in a wide range of fields. Similarly, Sturman (2003) in a meta-analysis, found that experience becomes more predictive of job performance in highly complex jobs suggesting that older workers may be able to compensate to some degree for any cognitive declines to maintain performance. It is suggested that practice and skills can offset the slow down of mental functions and that professional expertise, developed over many years of practice and experience, can compensate for potential negative impact of declines in performance (Kowalski-Trakofler *et al.*, 2005; Ng and Feldman, 2008; Peeters and Emmerik, 2008).

Some studies have shown that older workers perform better in terms of accuracy and output consistency (Robertson and Tracy, 1998). Other reviews have concluded that when abilities match job requirements and when experience is taken into account, there is little difference

between the performance of older and younger workers (McEvoy and Cascio, 1989; Rhodes, 1983; Waldman and Avolio, 1986).

Many of the laboratory based studies which demonstrate physical and cognitive declines are not replicated in real work situations. This may be because people are able to select work as they age to match their capabilities, that laboratory tests are artificial and may measure very specific abilities which are not relevant to real work tasks, and that experience plays a more important part in real work activities than in laboratory tests (Silverstein, 2008). Costa and Satori (2007) make the point that ageing also means professional growth in terms of strategic ability, shrewdness, wisdom and experience. In addition, performance may not decline with age because of a healthy survivor effect where those continuing to work into older age tend to be those who are still able to perform the roles as those whose performance has declined have opted to leave or move to other, less demanding roles (Silverstein, 2008).

Individual differences

Individual difference is considered to be a key factor for researchers in explaining some of the inconsistencies in age and performance studies (Silverstein, 2008). In a review of the literature on ageing and functional decline, it is suggested that the effects of the ageing process have been over-estimated and that any declines in performance are highly individual (Berlin, 2006). Charness (2008) reports that early research found that older adults were more heterogeneous in level of functioning than younger adults as well as individuals showing greater variability in their own performance in repeated tests. High levels of individual variability in physical, mental and social conditions have been observed in older age groups. This variability is likely to make it more difficult to generalise (Costa and Sartori, 2007). For example, in studies with fire fighters, wide individual variations in task performance were found with more than six fold difference in performance both between and within age groups (Sluiter, 2006).

4.3 OTHER ASPECTS OF PERFORMANCE

4.3.1 Organisational behaviours

The majority of the age and performance studies attempt to measure only the core tasks of a job. However, there are a number of job behaviours which, alongside core task activities, can significantly affect organisational productivity by shaping the culture and environment in which the core tasks take place. It is suggested that looking at a much broader range of job performance behaviours may help to clarify the complex relationship between age and performance (Ng and Feldman, 2008).

In their expanded meta-analysis of job performance, Ng and Feldman (2008) looked at ten dimensions of job performance in 380 empirical studies of age and performance. These ten dimensions were:

1. Core task performance
2. Creativity
3. Performance in training
4. Organisational citizen behaviours (eg. compliance with norms, not complaining about trivial matters, helping co-workers)
5. Safety performance
6. General counterproductive work behaviours (eg. working on personal matters rather than assigned tasks, neglecting supervisor instructions, stealing, repeating rumours and gossip, using unprofessional language)

Plus four specific counterproductive work behaviours:

7. Workplace aggression
8. On the job substance abuse

9. Tardiness
10. Absenteeism

The results of Ng and Feldman's meta-analysis indicated that age was only minimally related to core task job performance and creativity, and slightly negatively related to performance in training. This finding that performance is largely unrelated to age supports similar findings in other reviews (McEvoy and Cascio, 1989; Sturman, 2003; Silverstein, 2008). Ng and Feldman (2008) also found that for the other performance dimensions relating to organisational citizen behaviours, and general and specific counterproductive work behaviours, age was strongly associated. For example, older workers tended to demonstrate more organisational citizen behaviours than younger workers. This is supported by Harris and Higgins (2006) who found that older workers demonstrated good time keeping, consistent performance throughout the working day and were more likely to participate in organisational citizenship behaviour. These are qualities associated with efficiency and effectiveness of an organisation (Harris and Higgins, 2006). Counterproductive work behaviours were found to be significantly and negatively associated with age in the Ng and Feldman (2008) meta-analysis. For example, it appears that older workers engage in less workplace aggression, substance abuse and tardiness. This is supported by the finding that older workers tend to demonstrate better anger and stress management, greater empathy and good people skills and customer service (Harris and Higgins, 2006).

Older workers may also be able to share expertise with younger workers and provide positive role models for others (Harris and Higgins, 2006). Older workers are often perceived by employers to be more reliable, committed and productive than younger workers and studies suggest that this is justified. It is suggested that if employers can retain workers as they age, they will benefit from increased employee reliability, commitment and dedication; decreased turnover and absenteeism; and the diversity of knowledge, expertise and skills (Harris and Higgins, 2006).

4.4 OTHER FACTORS

It is suggested that factors other than age can play an important part in functional and performance decline. These factors include loss of autonomy, decreased social support and other psychological factors as well as physical factors and pre-existing resources (Berlin, 2006).

4.5 PROBLEMS WITH STUDIES

Performance or productivity is difficult to measure, not least because of the substantial variability in individual performance of older workers. It is not sufficient to just look at quantity or speed as a measure of productivity. Productivity encompasses a number of factors including quality, quantity, absenteeism and turnover. Performance measures used in studies include output indices, performance ratings, accuracy rates, rate of academic publications or important discoveries (Rhodes, 1983). Some of these performance measures suffer from reliability and validity weaknesses such as performance ratings made by supervisors or managers which may reflect the age bias of the rater (Rhodes, 1983; Robertson and Tracy, 1998). Shephard (2000a) points out that just measuring quantity will penalise older workers as their accumulated experience and judgement will tend to enhance the quality of their contribution. Ng and Feldman (2008) suggest that whereas earlier research has focussed on the negative relationship between age and performance, more recently researchers have started to look at the ways in which age can facilitate task performance or how performance declines can be avoided through accommodations and interventions. It is suggested that this positive focus should be continued in future research.

As most of the studies examining performance and age are cross-sectional (in that they compare age groups at one point in time), a healthy survivor effect may be a confounding factor. The healthy survivor effect may bias the findings in that those people who continue to work into older age tend to be those who are still able to perform the roles whereas those whose performance has declined will have opted to leave or move to other, less demanding roles (Silverstein, 2008).

4.6 SUMMARY

The conclusion of this review is that there is no consistent evidence that older workers are generally less productive than younger workers. This is in agreement with the earlier Benjamin and Wilson (2005) review. Most reviews and studies of work performance have not established a relationship between decreased job performance with increasing age and conclude that job performance is generally the same across all age groups. It is concluded that when abilities match job requirements and when experience is taken into account, there is little difference between the performance of older and younger workers. Where some studies into the relationship between age and productivity show mixed results, this may be because of differences in the nature of the job and the measure of performance used. It is suggested that performance does not necessarily decline with age because most jobs do not require employees to work at full capacity; strategies, skills and experience can be utilised to compensate for functional declines; and there is great variability in functional capabilities between individuals. Knowledge and experience have been found to compensate for age-related declines in a wide range of fields and it is suggested that practice and skills and professional expertise, developed over many years of practice and experience, can compensate for potential negative impact of declines in performance. As well as there being little evidence that performance of core skills declines with age, there appears to be evidence that other aspects of performance such as good timekeeping, helping co-workers, better anger management and people skills increase with age. Some studies have also shown that older workers perform better in terms of accuracy and output consistency.

5 AGE AND ILL HEALTH

5.1 KEY POINTS

- There appears to be consistent evidence that ageing does generally bring an increase in the prevalence of MSDs and cardiovascular disease as part of the normal ageing process **BUT**

- The existence of illnesses does not necessarily hinder the employee at work and may have only minimal effects on productivity.

- General health and life expectancy and disability free life expectancy are improving in the UK due to increases in education and healthy lifestyles

- For mental health problems generally prevalence of depression appears to decrease with age while work-related stress appears to increase with age but peeks at 50-55 years old.

- Work demands, and psychosocial factors may have a greater influence on the risk of developing work-related ill health than age.

- There is also some evidence that older adults lead healthier lifestyles than younger adults.

- There is strong evidence that work is generally good for both physical and mental health and well-being in contrast to the poor physical and mental health associated with not working.

5.2 HEALTH

The World Health Organization (WHO) defines health as a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity. This has been seen as an unrealistic goal as few people reach this ideal state of health at any point during a lifetime. Therefore the definition was redefined by WHO as functional health, which is where all people should be able to enjoy a health status that allows them to participate in normal, socially and economically productive and satisfying life (Ylikoski et al 2006).

Both physical and mental health conditions can reduce an individual's functional health. There is a widespread view that ageing leads to an increase in the risk of developing disorders and diseases and health issues are the most common reason for leaving the work force before Statutory Pension Age (SPA) (Philipson and Smith, 2005; Hotopp, 2007). Figures from a recent Labour Force Survey illustrate that as workers get older they are more likely to experience a long term health problem. Figure 9 shows that over a third of older workers aged 55 to 59 reported having a long term health problem whilst just under half older male workers and two fifths of women in the 65 to 69 age group report long term health problems (ONS, 2008). This illustrates that older workers are continuing to be able to participate in the workforce despite having long term health or disability problems. There is a consensus in expert opinion across multiple disciplines that, where possible, people who experience sickness and disability should remain in work or return to work as soon as possible as working helps to improve quality of life and well-being (Waddell and Burton, 2006).

The latest health and injury statistics available from the Health and Safety Executive (HSE) show that musculoskeletal disorders (MSDs) and stress are the most commonly reported types of illness in the UK (HSE, 2009), as shown in Figure 10. The most common health problems affecting people's ability, or wish to stay in work, are similar for both older men and women (60

years and older) and relate to the heart, blood pressure and circulatory system; upper and lower limbs, back and neck; and respiratory problems as shown in Table 1 (ONS 2008).

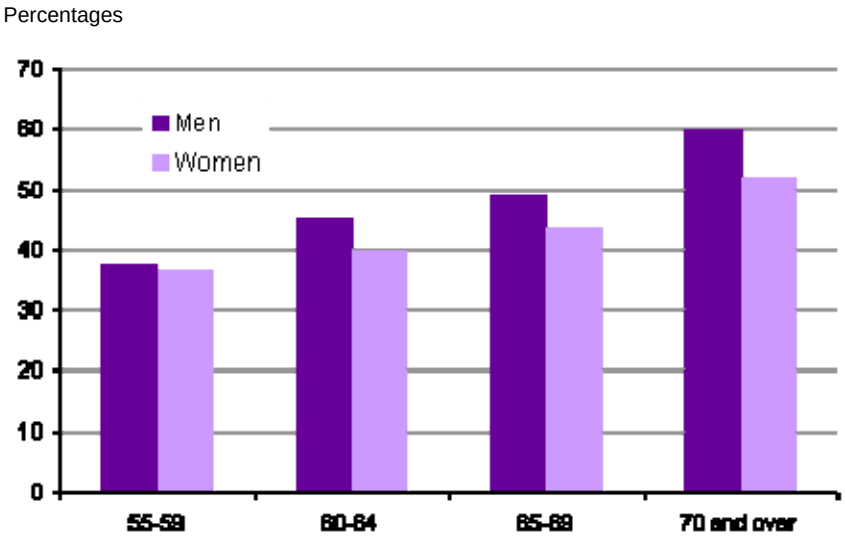


Figure 9 Proportion of employed population who report having a long term health problem or disability: by age and gender, April-June 2008 Labour Force Survey (ONS, 2008)

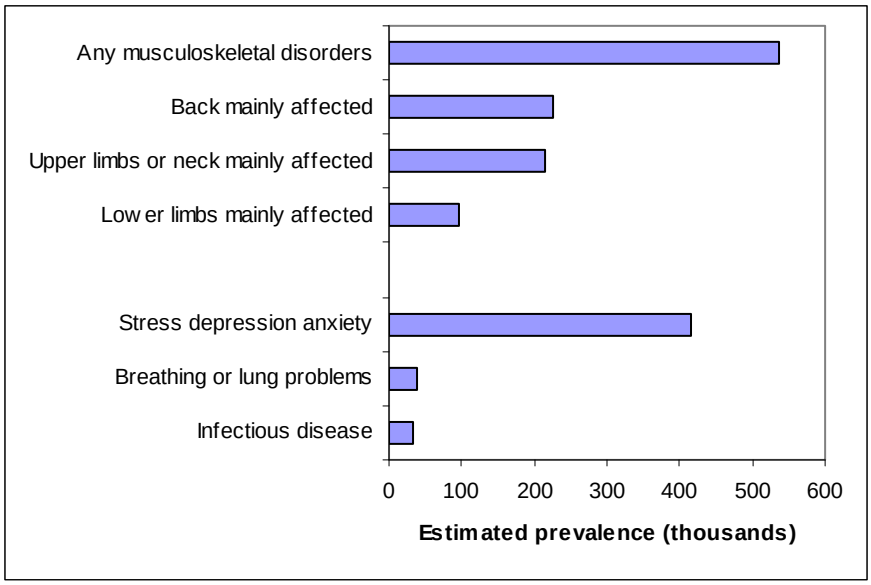


Figure 10 Estimated prevalence of self-reported work-related illness, by type of illness, for people working in the 12 months, 2008/09. (Source: Labour Force Survey, HSE 2009)

Table 1 Proportion of population (60 years or older) with a health problem or disability that limits the kind of work that they can do, by main health problem, age and gender, April-June 2008 (Source: Labour Force Survey, ONS, 2008)

						(Percentages)
	60-64		***65-69***		***70 and over***	
	Men	***Women***	***Men***	***Women***	***Men***	***Women***
Heart, blood pressure, circulation	21	10	27	14	25	7
Back or neck	16	21	13	12	7	15
Legs or feet	16	19	15	18	11	18
Chest,breathing problems	10	6	7	13	7	--
Arms or hands	7	15	10	15	6	17
Diabetes	6	4	5	5	11	13

(Excludes communal establishments. Not seasonally adjusted)

There is strong evidence showing that work is generally good for both physical and mental health and well-being (Waddell and Burton, 2006). In contrast, the same comprehensive review of the evidence into whether work is good for health, concludes that not working is associated with poor physical and mental health (Waddell and Burton, 2006).

5.3 HEALTH AND PERFORMANCE

It is important to note that declines in an individual's health does not necessarily indicate associated declines in their job performance (Peeters and Emmerik, 2008). There can be a number of possible reasons for this. Firstly, an individual may have the ability to compensate for any declines in health. Secondly, people are highly individual and no two people experience the same ageing process. Thirdly, age is not the only factor associated with health changes. The fourth reason suggested is that any health declines experienced may not be relevant for specific job performance in many occupations and lastly, where the decline is relevant to a specific job, accommodations can often be made relatively easily (Peeters and Emmerik, 2008). An illustration of this is results of a study by Pransky *et al.* (2005). Despite finding that older workers (55 years and older) reported more pre-existing illnesses and more severe injuries than younger workers (under 55), Pransky *et al*. (2005) did not find any significant differences in work functioning for older workers following an injury. The authors suggest that this may be because the presence of illness and infirmity does not necessarily interfere with work functioning. Other studies have also noted that the majority of workers reporting ill health, discomfort and pain remain in work (Cassou *et al.* 2002; Welch *et al.*, 2008). Ilmarinen (2005) points out that the question of whether an employee's long term illness, injury or disorder results in a hindrance to their work is a more important question than the existence of a health issue. For example in the 2003 Finnish work and health interview study, 62% of men and women in the 55-64 age group did not feel that their diagnosed long term illness or disability hindered their current work (Ilmarinen, 2005). Robertson and Tracy (1998) in their literature review of age, health and work, conclude that in general, the productive potential of the majority of older workers remains high and that age related changes in health have a minimum effect on productivity.

5.4 HEALTH AND LIFE EXPECTANCY

As discussed earlier, life expectancy continues to rise and both men and women over the age of 65 could expect to live a further 12.8 years men and 14.5 years for women in good or fairly good health (ONS, 2008). .

Lifestyle behaviours such as smoking, alcohol consumption, healthy diet and physical exercise have a major influence on health and are considered to be important risk factors for many illnesses and conditions (NHS, 2008). Benjamin and Wilson (2005) suggest that general health and life expectancy is likely to continue to improve in the UK due to increases in education and healthy lifestyles as evidenced by the reduction in cigarette smoking, an increase in the proportion of people consuming more than 5 portions of fruit and vegetables a day, and an increase in the proportion of people achieving the recommended level of physical exercise. Smoking (of tobacco products) is generally considered to be the biggest single factor to reducing health and life expectancy as it is the prime cause of lung cancer and a major contributor to heart disease (ONS, 2008). As discussed earlier, the proportion of people of all ages who are regular smokers has significantly declined and is likely to continue to do so although smaller declines are seen in adults from households classified as routine and manual in socio-economic background (ONS, 2008). This illustrates that socio-economic background is likely to have a major effect on health, probably larger than the effect of age.

Statistics on increasing obesity levels give some cause for concern for continued improvements in general health and life expectancy. Obese and overweight individuals are at greater risk of developing cardiovascular diseases such as heart disease or stroke, diabetes, MSDs (especially in older age) and some cancers (ONS, 2008). Overweight and obesity levels have increased with 24% of men and 25% of women considered obese in 2008 compared to 13% of men and 16% of women in 1993 (NHS, 2009). Mean Body Mass Index (BMI) which is used as a measure of obesity, is generally higher in older age groups for both men and women (NHS, 2009). Obesity is increasing in most populations with around 3-4% per year rise in people 65 years and over who are obese (Christensen *et al*., 2009). It is suggested that obesity increases problems of health, reduces the chances of recovery and increases the risk of death (Christensen *et al*., 2009). However, recent obesity figures suggest that the trend towards increasing obesity rates may levelling out (NHS, 2009).

In their review, Benjamin and Wilson (2005) suggest that there is evidence that, in some aspects of health and lifestyle, older adults may be healthier than younger adults. This is supported by statistics for eating 5 or more portions of fruit and vegetables a day where a higher proportion of the 45-74 age groups reported eating this diet than younger age groups, and for alcohol consumption where a lower proportion of the over 55 age groups exceeded the recommended number of daily units of alcohol on one day the previous week (NHS, 2009). In another review on the ageing population, it is suggested that continued improvements in the health of older workers is likely to depend on public health efforts to combat smoking, obesity, low levels of physical exercise, poor diets, excess alcohol consumption, as well as social aspects such as improved living conditions (Christensen *et al*., 2009).

5.5 ILL HEALTH

5.5.1 Prevalence of ill health

In the adult population among all age groups, health problems such as MSDs, cardio-respiratory conditions and mild or moderate mental health problems are the most common and account for around two-thirds of sickness absence, long term incapacity and early retirement (Waddell and Burton, 2006). The evidence suggests that these already common health problems become more prevalent with age as part of the normal and inevitable ageing process and that they are common for both working and non-working people (Okunribido and Wynn, 2009; Hotopp, 2007; Waddell and Burton, 2006). It is important to note that whilst people commonly report experiencing these health problems, there is limited evidence of impairment or incapacity resulting from these. As Waddell and Burton (2006) conclude “these are essentially whole

people, their health conditions are potentially remediable, and long-term incapacity is not inevitable" (p3).

Ilmarinen (2001) suggests that prevalence and incidence rates of diseases increase greatly with age and estimates that at least 33% - 66% of the population over the age of 50 have at least one diagnosed chronic disease (Ilmarinen, 1994). Adams *et al.* (1999) suggests that chronic health conditions occur more often in people over the age of 45 with the highest rates for conditions concerning arthritis, sinusitis, orthopaedic impairment and high blood pressure. HSE figures for work-related ill health suggest that older workers are more likely to report work- related ill health than younger workers as shown in Figure 11 (HSE, 2009a).

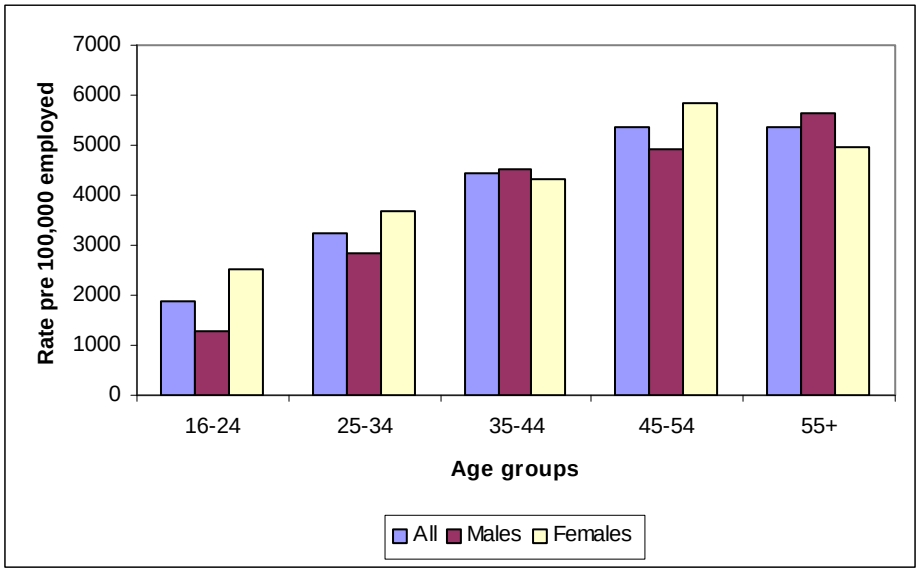


Figure 11 Estimated prevalence of self-reported illness caused or made worse by work, age and gender for people working in last 12 months, 2007/08. (Source: Labour Force Survey Table WRIAGE1W12 2007/08, HSE, 2009a)

Dixon (2003), looking at the UK National Statistics Retirement Survey, suggests that the risk of poor health rises with age, as the onset of health problems was the reason for retirement in one third of a sample of people retiring before the state pension age. Several studies have demonstrated that health problems contribute to people leaving the labour force before the usual retirement age. In one European cross-sectional study of 50-64 year olds, it was found that perceived poor health was strongly associated with non-participation in the labour force and depression, stroke, diabetes and MSDs were strongly related to early retirement from the labour force (Alavania and Burdorf, 2008). However, this study also points out that whilst health may determine participation in the workforce, there are other factors which also affect participation. These other factors include social-demographic variables such as education, gender and lifestyle.

Several studies suggest that the most common forms of ill health among ageing workers are MSDs and cardiovascular diseases (Ilmarinen, 1994). In a Finnish 11-year longitudinal study of municipal workers cardiovascular disease appeared to become more prevalent with ageing. The results of this study showed that more than 25% of women and 39% of men suffered from cardiovascular disease after the age of 55, (Ilmarinen, 2005).

Despite the evidence that ill health becomes more common with increasing age, there is mixed evidence that older workers report declines in health or perceive their health to be poor (Waddell and Burton, 2006). For example, in the Finnish longitudinal study of ageing workers,

the process of ageing was accompanied by the symptoms of various diseases but the participants reported that their health was good and improved. This study found that 42% of participants diagnosed with a disease in 1992 reported being in good health. This study linked improvements in health and performance with improved supervisor attitude, a decrease in repetitive tasks and increased leisure time exercise (Tuomi *et al*., 1997 in Waddell and Burton, 2006).

Ill health prevalence and female workers

It has been suggested that women are genetically more susceptible than men to some chronic diseases such as arthritis, other autoimmune diseases and osteoporosis (Doyal and Payne, 2006). However, the effect of a woman's health on her employment performance will vary dramatically depending on factors other than age, such as income, physical and psychological status, domestic circumstances, working conditions, class and ethnicity (Doyal and Payne, 2006).

5.6 PSYCHOLOGICAL SYMPTOMS AND MENTAL HEALTH PROBLEMS

In the UK, health and safety statistics from the Labour Force Survey (LFS) indicate that stress, depression and anxiety were the second most commonly reported group of work-related illnesses in 2008/09 (Figure 10)(HSE, 2009). Whilst MSDs were the most commonly reported illness, more working days were lost due to stress, depression and anxiety (HSE, 2009). This indicates that mental health problems are as much of an issue as MSDs and other physical ill health conditions for employers. Whilst mild or moderate psychological and emotional symptoms are very common in the working population across all age groups, most of the time people cope with these symptoms without health care or sickness absence from work (Waddell and Burton, 2006). There is also evidence that continuing to work is associated with increased psychological well-being and that the any adverse effects of work on mental health may be outweighed by the beneficial effects of work on well being and the likely adverse effects of long term sickness absence or leaving the workforce (Griffiths *et al.*, 2009: Waddell and Burton, 2006).

Generally, the evidence suggests that work-related stress, anxiety and depression decreases after the age of 55. The most recently published Labour Force Survey data shows that younger workers (34 or younger) report less anxiety, stress and depression than workers 35-54 years old, but workers 55 years and older report lower levels (Figure 12). It is noted that this may be because there are low numbers reporting in the 60 and over age group (Griffiths *et al.*, 2009). In their recent review of the evidence on ageing and work-related stress Griffiths *et al.*, 2009) report that several large scale studies support the statistics in suggesting that work-related stress increases with age, peaking at 50-55 years and then decreasing towards retirement.

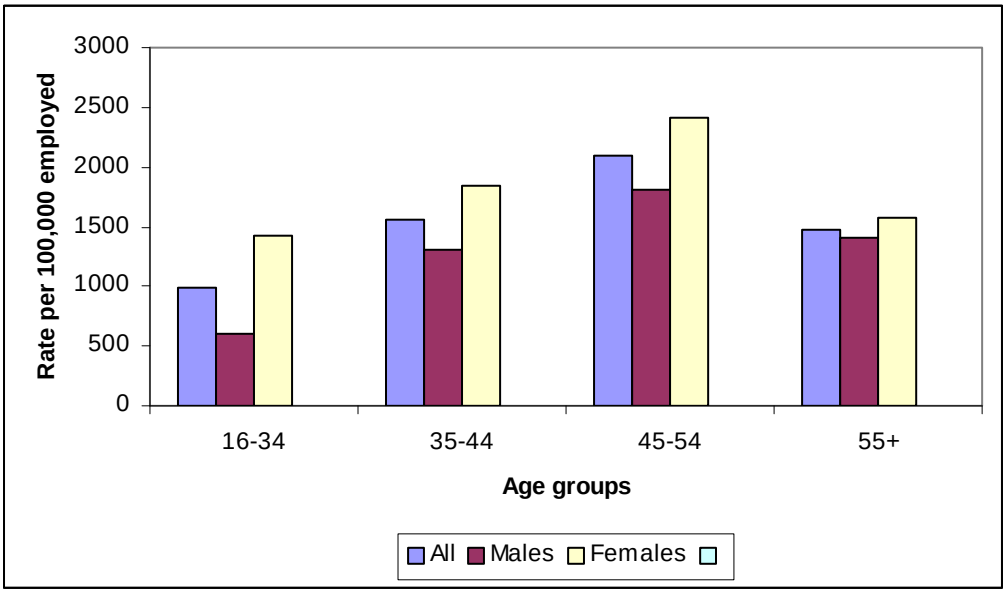


Figure 12 Estimated prevalence rate of self-reported stress, depression or anxiety caused or made worse by work, by age and gender, for people working in the last 12 months (Source: Labour Force Survey Table STRAGE1W12 2007/08, HSE, 2009a)

Whilst the evidence generally suggests that work-related stress, anxiety and depression do not increase with age after 50-55 years old, some studies have found that either there is no difference or a curvilinear relationship between age and work-related mental health problems, with the incidence of anxiety and depression peaking at age 50 (Griffiths *et al*., 2009).

Considering depression and serious mental health problems, separately to stress and burnout, Peeters and Emmerik (2008), in their review, suggest that the empirical results on age differences in are contradictory. For example, one meta-analysis found some small age associated increases in negative feelings in older workers, another study found a U shaped relationships between age and depression (with the highest rates among young adults and people over 75), and still another study found that middle aged adults had low rates of depression. A Finnish longitudinal study found that serious depression was more common in women than men across all age groups but that it became less common with age (Ilmarinen, 2005).

Some similar contradictions are found for the relationship between stress and burnout and age. In the longitudinal 11-year follow up Finnish study, symptoms of stress increased by 18-26% with age (Ilmarinen, 2005). In contrast, a Dutch longitudinal study found no difference between measures of burnout for workers over 50 years old and workers under 35 (De Lange *et al.*, 2006 in Peeters and Emmerik, 2008). One study of nurses aged over 50 found that increasing age was positively correlated to mental health and suggests that this may be because older nurses have reached more enjoyable career positions and dissatisfied nurses will have left the profession (Letvak, 2005). Similarly, age was positively associated with emotional well being and social functioning in a study of men employed in construction and industrial work (Sorensen *et al*., 2008). There is some suggestion that a healthy survivor bias may be present in these cross-sectional studies as those with mental health problems or dissatisfaction with work may have left the workforce early and those remaining may view their mental health more positively (Griffiths *et al*., 2009).

Whilst the general conclusion is that work-related stress, anxiety and depression only increase with age until the age of 50-55 but then decrease in workers over this age, there is some contradictory evidence. This probably reflects the complexity of the relationship between age

and mental health issues. Peeters and Emmerik (2008) conclude that the relationship between age and mental health is complicated, as personality, contextual and social-demographic variables and their interactions also need to be considered.

5.6.1 Stress and female workers

One review has concluded that women workers are more likely than men to report work-related psychological stress (Doyal and Payne, 2006). This may be because women are more likely to be in work roles with caring responsibilities and customer service jobs which have been shown to be factors associated with work-related stress. In addition more women than men have caring and domestic responsibilities at home (Doyal and Payne, 2006). Another review suggests that there is reasonably consistent evidence that older women in the 45-54 age group report more stress than older men (Griffiths *et al.,* 2009). One possible explanation put forward for the increased reports of work-related stress in women is that it is as a result of the demands of multiple roles (carers, domestic responsibilities), and/or as a result of women occupying roles characterised by lower status and less control than men (Griffiths *et al.,* 2009). However, the authors of this review make the point that the findings of increased work-related stress in women may be skewed by women being more ready to report stress than men (Griffiths *et al*., 2009). Similarly, as previously mentioned, Imarinen (2005) found that serious depression was more common in women than men across all age groups but that it became less common with age.

Griffiths *et al* (2009) conclude that stress is one factor affecting older worker's decision to leave the workforce, alongside dissatisfaction with work, long working hours and demanding working practices. In addition data suggests that older workers who are off work for a long period of time because of mental ill health, are likely to leave the workforce (Griffiths *et al*., 2009).

5.7 AGE AND MSDS

5.7.1 Prevalence/incidence of MSDs

As previously discussed, MSDs are currently the most commonly reported illness types currently in the UK with around 538,000 cases reported in 2008/09 as shown in Figure 10 (HSE, 2009). However, MSDs do not automatically preclude physical work or necessarily mean that work will exacerbate the condition (Waddell and Burton, 2006). In a recent review of the literature on ageing and MSDs, Okunribido and Wynn (2009) concluded that observations indicate that the prevalence of MSDs is higher among older workers than younger workers. However, having a MSD does not necessarily impact on work capacity. Most people with MSDs are able to carry on working even when they are experiencing symptoms (Waddell and Burton, 2006). The statistics show a general trend towards lower incidence of MSDs with the 2008/09 incidence rates for self-reported MSDs significantly lower than the rates for 2001/02. Also, a recent review suggests that in comparison to proceeding age cohorts, baby boomers (born 1946-66) have fewer MSDs (Christensen *et al*., 2009).

In general, studies have found an increase in the prevalence of MSDs among older workers (Holmstrom and Engholm, 2003; Ilmarinen, 2002). This probably reflects the normal ageing process. Several studies have concluded that the increased prevalence in MSDs with ageing is most pronounced in workers involved in physically demanding jobs (Holmstrom and Engholm, 2003; Nurminen, 1997; Ilmarinen, 2002; Virokannas *et al*, 1999; Arndt *et al.,* 2005, Welch *et al.* 2008; Laudau *et al*., 2008). More information on this is provided in Appendix A.

It is suggested that the high reported prevalence of MSDs for older workers, and the significant associations between age and health in study results, may simply be reflecting the fact that many of the MSD conditions of older workers are an inevitable and normal part of the ageing

process (Okunribido and Wynn, 2009; Hotopp, 2007). Some adverse working conditions contribute to the development of MSDs independently of age, and psychosocial factors also have a role to play (Hotopp, 2007).

5.7.2 MSD prevalence in female workers

Doyal and Payne (2006), in their review, report that a number of studies have shown that women in general and older women in particular, are more likely to have MSDs. The most common disorders are repetitive injuries, upper limb disorders, back pain and carpal tunnel syndrome. This review suggests that the incidence, and sometimes the severity, of MSDs increases with age in women. The authors suggest that the prevalence of MSDs in older women may be partly due to the type of work that women tend to be employed in. For example, women are often employed in cleaning, factory work, retail sales and hairdressing. Whilst this type of work is often seen as light manual work, it is usually physically demanding with many tasks involving the moving of heavy loads, sustained static muscular effort, working in awkward postures and short-cycle repetitive movements (Doyal and Payne, 2006). The physically demanding nature of the work is likely to increase the risk of MSDs.

5.8 AGE AS RISK FACTOR FOR ILL HEALTH

A review of health and ageing suggests that the effects of ageing on health and the ability to work are not straight forward, and concludes that there is little conclusive evidence that older workers are more likely to have their health affected by work than younger workers (Hotopp, 2007). Whilst older workers are more likely to have medical conditions, the evidence indicates that older age is not necessarily associated with bodily pain, general health, vitality, missed work or work limitations (Welch *et al.*, 2008).

Looking at the findings from studies on the association between age and health, it appears that there is not consistent and conclusive evidence that is an independent risk factor for work-related ill health. In other words, age by itself does not increase the risk of developing work-related health problems. Other factors such as high physical workload and psychosocial factors may have more influence on health than age alone. For example, physical work conditions have been found to be a strong determinant of general health in the Wisconsin Longitudinal Study. The authors concluded that general health deteriorated significantly, and the number of health complaints increased dramatically, for those employed in physically demanding work, indicating the long-term adverse effect of high physical workload, repetitive work, low autonomy and high work pressure on health (Hoonakker *et al.*, 2006).

Support for the view that age in itself does not increase the probability of an individual developing a work-related health problem can also be found in the analysis of patterns of work-related ill health. This analysis indicates that older workers are not more likely to report work-related ill-health in all industry, occupation and working hours groups (Hotopp, 2007) as shown in Figures 13-15.

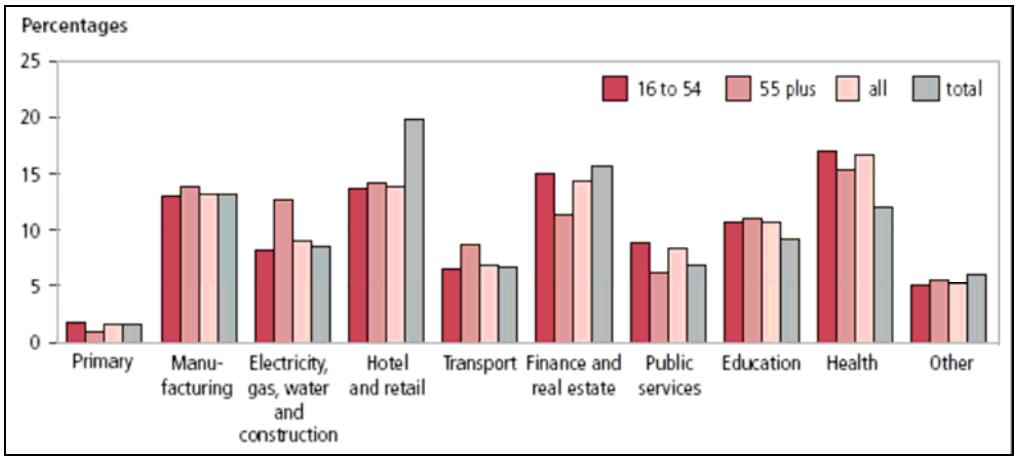


Figure 13 Employees' illness caused or made worse by work. By age and industrial sector, compared to all employees, 2004/05 (Source: Hotopp, 2007)

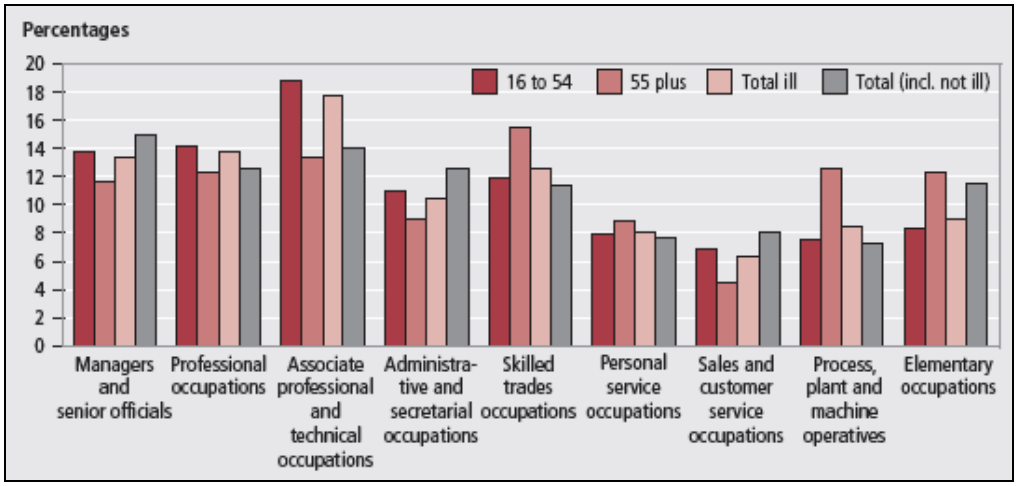


Figure 14 Employees' illness caused or made worse by work. By age and occupation, compared to all employees, 2004/05 (Source: Hotopp, 2007)

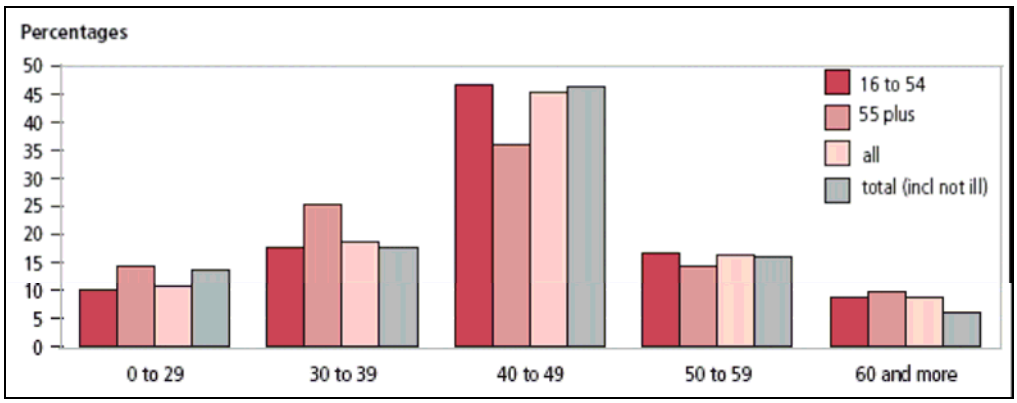


Figure 15 Employees' illness caused or made worse by work. Over hours worked, compared to all employees, 2004/05 (Source: Hotopp, 2007)

5.8.1 Age as a risk factor for MSDs

Older people, whether they are working or not, are more likely to develop MSDs as part of the normal and inevitable ageing process. However, there is no conclusive evidence that age by itself is a risk factor for older workers developing MSDs due to work (Okunribido and Wynn, 2009). Research reviewed by Okunribido and Wynn's (2009) found the key determinant of whether any worker suffered an injury or MSD was how well adjusted the physical work was to the worker's capacity. It is not the age of the worker that is the issue, but that the work or workplace is demanding more of a worker than the worker is capable of giving. Where the physical demands of the work exceed the capabilities of a young worker, he or she will be as susceptible to acquiring a work-related MSD as an older worker with the same capabilities. The Okunribido and Wynn (2009) review suggests that, irrespective of age, the risk of developing MSDs depends on the difference between the demands of work and the worker's functional capacity. Factors that have been shown to increase the risk of work-related MSDs relate to adverse working conditions, including physically demanding work, repetitive work under time constraints, working in awkward postures and high job demands (Okunribido and Wynn, 2009). These factors, and others, should be the criteria used to determine suitability for a specific job, rather than chronological age (Okunribido and Wynn, 2009). It is important to note that functional capability varies enormously between individuals and a healthy and physically fit 60 year old may have much greater functional capabilities than a 30 year old and may, therefore be at less risk of developing a work-related MSD than the younger worker. More information on this can be found in Appendix A.

5.9 HEALTH AND OCCUPATIONS

Health and safety statistics for 2008/09 show that the health and social work, public administration, and transport and communications sectors had the highest levels of self-reported work-related illness and the occupations with most illness were personal service, and associate professional/technical roles (HSE 2009) as shown in Figure 16.

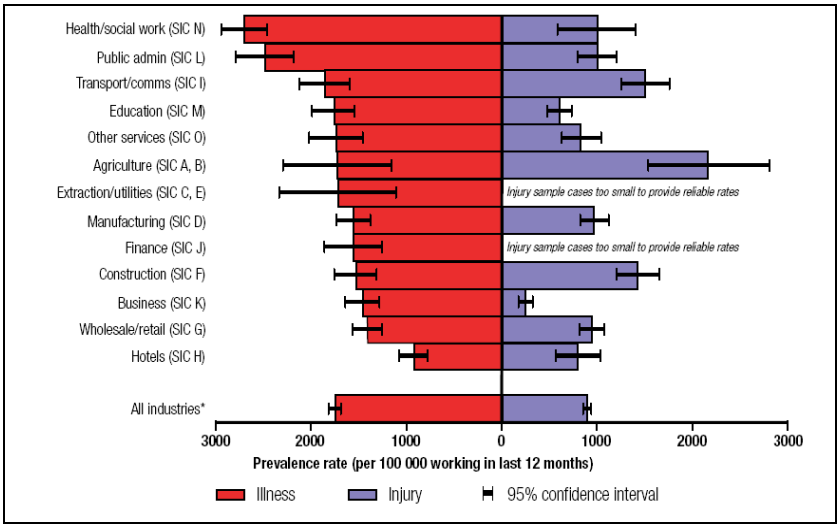


Figure 16 Estimated incidence rates of self-reported work-related illness and reportable non-fatal injury, by industry, for people working in the last 12 months, 3 year average 2006/07 – 2008/09 (Source: Labour Force Survey, HSE, 2009)

5.9.1 Shift work

It is commonly suggested that older workers are less able to cope with the demands of shift working than younger workers. Shift work and night work interfere with sleep patterns which may in turn effect work performance and family/social life and in the long term may affect health. It has been suggested that between the ages of 40-50 workers may experience decreasing work performance and health (Costa and Sartori, 2007). This study of Italian workers in the health care, chemical and construction sectors measured work ability scores and found that age-related health deterioration was more pronounced in shift workers over the age of 55 than in day workers because of chronic fatigue and sleep problems (Costa and Sartori, 2007). However, statistically significant differences were not found between day and shift workers when comparing the same occupation (nursing). This study also found that women shift workers show a decrease in work ability at an earlier age than men, compared to day workers and it is suggested that this may be due to care commitments hindering strategies for coping with shift work. For example, the study found that nurses with small children managed, on average, one and a half hours less sleep after a night shift than their colleagues without small children (Costa and Sartori, 2007). However other studies did not support this finding. For example, a study of hospital workers in Italy did not find a link between age, shift work including night shifts, and poor health (Conway *et al*., 2008). This may be because of the large differences between older individuals and their ability to cope with shift work and because of the healthy worker effect where older workers who have difficulties with shift work tend to leave or transfer to day work.

A recent review of the ageing literature concludes that the suggestion that shift work is bad for the health of older workers is not supported by the evidence (Griffiths *et al.*, 2009). This review concludes that it is likely that the cumulative effect of the number of years spent working shifts is more important than age in predicting ill health effects. However, two reviews suggest that older workers do not adjust to some shift patterns as well as younger workers (Griffiths *et al.*, 2009; Peeters and Emmerik, 2008). Kowalski-Trakofler *et al*. (2005) in their review, suggest that older workers working shifts would benefit from an increased number of breaks during the shift to counter increased fatigue. They also suggest that older workers have fewer problems with morning shifts than younger shift workers. Some studies have shown that older workers rate themselves as less tired in a morning shift than younger workers whilst there was no difference in the tiredness rating between younger and older workers in night shifts (Harma and Illmarinen, 1999). This is because the ageing process tends to lead to changes in circadian rhythm towards diurnal type where people feel more active in the morning (Akerstedt and Torsvall, 1981).

5.9.2 Construction

Studies have found that workers carrying out physically demanding construction work have a higher prevalence of health problems, especially MSDs. A study of construction workers in Germany found a U shaped association between MSDs and age where the highest relative risk was amongst youngest and older age groups (Arndt *et al*.,2005). Another cross-sectional study found significant levels of MSDs and medical conditions among 40-59 year old construction workers (Welch *et al*., 2008).

It is suggested that age-related musculoskeletal changes such as reduced joint dexterity which reduces manoeuvrability, posture and grip; and reduced muscular endurance and strength, are particularly pertinent to physically demanding work such as construction (Leaviss *et al*., 2008). Leaviss *et al*. (2008) report that it is well documented that construction workers are at greater risk of health disorders than workers in other industries due to the physically demanding nature of the work. Whilst conditions have improved in construction in the last decade workers are

still exposed to hard physical labour (Arndt et al). Leaviss *et al.* (2008) points out that some studies suggest that construction work is not suitable for the ageing worker but it is important to note that accommodations can be introduced to enable older construction workers to remain in work. These include the provision of more power tools and handling equipment, and utilising skills and experience in safety, supervisory or training roles (Leaviss *et al.*, 2008).

5.9.3 Healthcare

It is estimated that there are 145,000 nurses over the age of 50 working in National Health Service in the UK. A review suggests that it is likely that the cumulative exposure to psychological and physical aspects of nursing work may combine with the process of ageing to lead to an increased prevalence of many health problems (Doyal and Payne, 2006). In a survey of nurses over 50 years of age, it was found that over one third experienced job related health problems, most commonly back pain anxiety and depression. However the survey found that nurses with higher psychosocial ratings (job satisfaction, high job control, lower job demands) experienced increased physical health. This study found that increasing age was positively correlated to mental health and suggests that this may be because older nurses have reached more enjoyable career positions and dissatisfied nurses will have left the profession (Letvak, 2005).

5.9.4 Cleaning occupations

A literature review of cleaning work suggests that there are approximately 3 million full or part time cleaners in the EU with 800,000 in the UK. The majority of these (80%) are female and most are older women. Work is low paid, involves little education or skill and has low social status and low social support (Kumar and Kumar, 2008). This review found that the level of physical work, static muscle loads, awkward (bending and twisting) postures, repetitive hand/arm movements using high force are risk factors for MSDs and that older females are more likely to experience physical discomfort performing sustained heavy work (Kumar and Kumar, 2008). One Danish study of 1166 cleaners found that in a period of twelve months 63% reported neck discomfort, 63% reported shoulder problems, 36% reported low back pain, 27% reported elbow joint stiffness and 46% reported wrist problems (Nielsen, 1995 in Kumar and Kumar, 2008).

5.10 OTHER FACTORS INFLUENCING HEALTH

As Benjamin and Wilson (2005) suggests, age is just one of the factors that may influence an individual's health, and other factors may have greater influence. For example, the substantial relationship between socioeconomic status and health is well documented and UK national statistics indicate that people living in the most deprived areas have lower life expectancy and spend twice the number of years in poor health compared to those in the least deprived areas (Bajekal, 2005). The WHO describes the sensitivity of health to the social environment as "remarkable" and lists a number of social determinants of health including social and economic circumstances, stress, birth and childhood, deprivation, work, unemployment, social support, addiction (alcohol, drugs, tobacco), diet, and transport (Wilkinson and Marmot, 2003).

5.11 SUMMARY

There appears to be consistent evidence that ageing does generally bring an increase in the prevalence of MSDs and cardiovascular disease. However, it is important to note that a decline in health does not necessarily indicate an associated decline in job performance. Studies have shown that the majority of workers reporting ill health, remain in work. The evidence suggests that age-related changes in ill health generally do not result in impairment or incapacity and therefore have minimal affect on productivity. In fact, there is strong evidence showing that

work is generally good for both physical and mental health and well-being in contrast to the poor physical and mental health associated with not working. The increase in the prevalence of some common health problems and MSDs with age is part of the normal ageing process and happens to people whether they are working or not. There is no conclusive evidence that age by itself is a risk factor for work-related MSDs or ill health. In other words, it is not the age of the worker that is the issue, but that the work or workplace is demanding more of a worker than the worker is capable of giving. Other factors such as work demands, psychosocial and socioecomomic factors may have a greater influence on the risk of developing work-related ill health than age.

For mental health problems the findings generally suggest that the prevalence of depression decreases with increasing age. Symptoms of work-related stress and burnout appear to increase with age but peek at 50-55 years old and then decrease with older age. Women may be more likely to report work-related stress than men possibly due to the demands of their work, having multiple roles outside work and generally being more ready to admit to stress.

Generally, health is improving among the population as a whole as illustrated by increases in life expectancy and changes in lifestyle behaviours such as declines in smoking and increase in healthy eating and levels of physical exercise. There is evidence that in some aspects of health and lifestyle such as smoking, alcohol consumption and a healthy diet, older workers may be healthier than younger workers.

6 AGE AND COGNITIVE CAPACITY

6.1 KEY POINTS

- There is evidence that cognitive performance does not generally show any marked decrease until after the age of 70.

- Cognitive skills such as intelligence, knowledge, language and complex problem solving are resistant to age-related declines and are likely to increase with age until 60 years of age.

- There appears to be laboratory based evidence that some specific cognitive abilities, such as working memory, reasoning, attention and processing speed, do show declines with age.

- Where cognitive declines do occur, there is evidence that performance is unaffected because of the ability to compensate with experience, education, high motivation, better judgement and job knowledge.

6.2 COGNITIVE SYSTEM

The cognitive system is one part of the human information processing system and is responsible for processing the data received by the senses and the memory (Ilmarinen, 2002). As such the cognitive system is seen as crucial for work performance. The pattern of cognitive decline appear to be complex with evidence that some but not all cognitive skills decline with age.

6.3 AGE-RESISTANT AND DECLINING COGNITIVE SKILLS

There is evidence that some knowledge based cognitive skills, such as language, knowledge and intelligence are resistant to age-related declines. Cognitive abilities such as orientation, language and verbal fluency have been found to be resistant to the effects of ageing (Ardila *et al.*,.2000). Horn (1991) found that visualising and auditory capabilities increase during the ages of 30-40 before decreasing gradually, and that knowledge, long term memory retrieval and mathematical/quantitative capabilities increase into the 60s before decline begins. Ilmarinen (2001) suggests that control of use of language and complex problem processing ability improve with age. Peeters and Emmerik (2008), in their review of ageing, suggest that intelligence does not show declines with age but remains stable on average until 80 years of age. Robertson and Tracy (1998) in their review of the literature of age, health and work concluded that there is general agreement in the literature that processing speed declines greater than processing power, and that different cognitive abilities deteriorate at different rates. They also make the point that there does not appear to be a marked decrease in cognitive performance until after the age of 70. The cognitive abilities such as intelligence, knowledge, language and complex problem solving, which the evidence suggests do not appear to decline until after the ages of 70-80, are likely to be the abilities that are most important to the successful performance of the majority of work tasks. This may explain why significant performance declines are not generally found in older workers in comparison to their younger colleagues.

There is substantial evidence that some but not all cognitive abilities decline with age (Sharit and Czaja, 1994). This is suggested both by behavioural and neuroscience research (Park *et al.*, 2001). Three recent literature reviews of cognitive ageing are consistent in their conclusion that there is a clear age-related gradual decline in cognitive functions such as processing speed, attention, perception, working memory and long term memory starting when people are in their 20s (Dennis and Cabeza, 2008; Park and Reuter-Lorenz, 2009; Dennis and Cabeza, 2008; Salthouse, 2009). Similar declines were found in both longitudinal and cross-sectional studies

(Park and Reuter-Lorenz 2009). There is some evidence that age-related cognitive declines, for example in processing speed and memory, accelerate in people over 60 (Salthouse 2009).

Working memory is considered to be particularly important for cognitive performance and learning, as it affects reasoning and problem solving (Park *et al.,* 2001; Salthouse, 2000; Tomporowski, 2003). Deficits in working memory were more pronounced when associated with the processing of new or complex information or unfamiliar context (Sharit and Czaja, 1994). An age-related increase in cognitive processing and reaction time is well documented (Moyers and Coleman, 2004; Salthouse, 2000, 2004; Shimamura *et al.,* 1995). Attention and perception is generally considered to decline with age especially in tasks where attention is divided (Craik and McDowd, 1987, Park *et al.,* 2001) although there is some inconsistency in this (Sharit and Czaja, 1994). Working under severe time constraints and pressures is reported to be difficult for older workers (Gaudart, 2000; Moyers and Coleman, 2004). More information on this is provided in Appendix A.

6.4 BEHAVOURAL COMPENSATION FOR COGNITIVE DECLINES

There is some evidence that where declines in cognitive abilities such as working memory and reaction time do occur, performance of tasks is likely to be unaffected because of the individual's ability to compensate for these with experience, education, high motivation, better judgement and job knowledge (Ilmarinen, 2001; Li *et al.* 2003; Shimamura *et al.,* 1995, Smith *et al.,* 1994; Salthouse and Maurer, 1996; Moyers and Coleman, 2004). Examples of possible compensation include Salthouse's (1984) study of typists which found that older typists performed as fast as younger typists despite being slower in separate perceptual-motor tests. The suggestion is that the older typists compensated for slower speeds by looking further ahead and processing larger sections of material than the younger typists. Also, in a study of bus drivers, 60-64 year old drivers were found to have fewer accidents than other age category drivers despite evidence of decreased visual acuity and reaction time with increased age. The author of this study suggests that the judgement and patience of older workers compensated for any decline in reaction time (Shephard, 2000a). Rabbitt (1997) conducted experiments where older adults practised a range of tasks over a long period of time. She found that older adults were able to improve their performance in even quite demanding tasks with practice and that the gains achieved through practice were greater than the performance declines associated with age or lower intellectual ability. These findings suggest that age-related declines in performance can be mitigated by practice (Rabbitt, 1997).

6.5 NEUROSCIENCE PERSPECTIVES OF AGE AND COGNITION

6.5.1 Ageing and changes brain structure

Neuroscience perspectives on cognition and ageing agree that the ageing process in the brain involves a series of changes to the structure of the brain, including shrinking in both white and grey brain matter, synaptic degeneration, blood flow reduction and neurochemical alterations (Cabeza *et al.,* 2002; Park and Gutehess, 2006; Dennis and Cabeza, 2008; Park and Reuter-Lorenz, 2009).

Evidence from neuroimaging techniques suggest that the cognitive function in older adults does not decline but differs from that of younger adults. The evidence for this comes from neuroimaging techniques where brain images of high performing older adults carrying out cognitive tasks have shown a different pattern of brain activation from similar performing younger adults. In younger adults the pattern of activation in restricted to specific parts of the brain whereas high performing older adults show a pattern of over-activation in other parts of the brain (Reuter-Lorenz, 2002). It is suggested that this allows older adults to perform cognitive functions as accurately as younger adults but at the expense of slower reaction times.

This over-activation brain pattern in older adults is referred to as the compensation or scaffolding theory where the brain compensates for deficits by recruiting other parts of the brain to maintain high cognitive performance (Cabeza *et al.*, 2002; Reuter-Lorenz, 2002; Park and Reuter-Lorenz, 2009). It is suggested that the brain engages in a continual reorganisation process to support cognitive functions by strengthening existing neural connections, forming new connections and disuse of weak or faulty connections (Park and Reuter-Lorenz, 2009). Whilst there seems to be strong support for the compensation hypothesis, more research is needed to clarify the interpretation of over-activation and to establish the relationship between cognitive performance, brain activation patterns and longitudinal changes (Park *et al.*, 2001; Reuter-Lorenz and Lustig, 2005; Dennis and Cabeza, 2008). More information on this is provided in Appendix A.

6.6 COGNITIVE DECLINE AND JOB PERFORMANCE

Whilst there is evidence that some specific cognitive abilities decline with age, there is little evidence to suggest that work performance declines with age. Griffiths (1997) makes the point that many of the cognitive behavioural studies, which show a decline in some cognitive abilities with age, were laboratory or population studies, which tested specific cognitive abilities in isolation, and this does not reflect the cognitive requirements of most work tasks. Rhodes (1983) suggests that despite numerous findings that age related performance declines in laboratory tests of cognitive abilities, there is little evidence to imply that job performance declines with age. Park and Reuter-Lorenz (2009) conclude that whilst there are decline in brain structure with age, direct relationships between this decline and cognitive performance are not always observed or if they are observed, they are small.

Salthouse (2004) puts forward a number of possible explanations for this discrepancy between the evidence of cognitive declines in laboratory or population studies and the lack of or lesser declines in work performance. These explanations include: that cognitive ability is only one factor contributing to performance; that few situations require maximum cognitive performance; that humans tend to modify their environment and activities to reduce cognitive demands; and that experience and knowledge reduces the need for novel problem solving.

Limitations with some of the studies may account for the inconsistencies and debate over age-related cognitive decline. Importantly, it has been suggested that there is a substantial variability in cognitive performance among older adults so that average performance of older age groups is a less accurate measure of individual performance (Robertson and Tracy, 1998; Sharit and Czaja, 1994).

6.7 COGNITIVE PERFORMANCE AND OCCUPATIONS

6.7.1 Driving

Driving is a complex task which relies on the successful performance of several cognitive abilities including the need to perceive and process visual cues quickly in order to deliver quick, accurate motor responses. The complexity of a driving task is likely to increase in high traffic situations, unfamiliar routes or poor driving conditions. Because of the obvious safety implications of declines in driving performance, driving has been the focus of several studies examining whether there is an association between age-related cognitive declines in reaction time and driving tasks (Makishita and Matsunaga, 2008; Popkin *et al.*, 2008).

Previous driving and cognitive performance studies have suggested that a driver's ability declines with age in response to driver distraction such as using a mobile phone (Hancock *et al.*, 2003. Makishita and Matsunaga's (2008) study of driving performance also found a significant association between reaction time and age when drivers were asked to perform mental

calculations whilst driving in a simulator. However, this study also found large individual differences in reaction times in the older age group (61-64 years) which suggests that the speed of cognitive performance decline varies considerably among older drivers. A study of truck drivers in the USA found that age was significantly related to deteriorations in speed and accuracy in performing complex tasks with slower response times for drivers 65 years old or older compared to those under 50 years old (Popkin *et al*., 2008). However, in contrast, in another study of young and older drivers completing cognitive tests whilst driving, no age-related performance deficits were observed (Horrey *et al.,* 2009). Similarly, in a study of 60-64 year old bus drivers, it was found that this age group had fewer accidents than drivers in any other age category possibly because judgement and patience compensated for declines in reaction time (Shephard, 2000a).

Whilst there does seem to be some evidence that reaction times of older drivers decline with age in complex situations, the large individual variations in reaction time found by some studies, and the lack of age-related performance deficits found in other studies, suggest that the relationship between age, cognitive declines and driving tasks is not straightforward.

6.8 SUMMARY

There is evidence that cognitive performance does not generally show any marked decrease until after the age of 70. It is suggested that this is because cognitive skills such as intelligence, knowledge, language and complex problem solving are resistant to age-related declines and are likely to increase with age until 60 years of age. However, there appears to be considerable laboratory based evidence to support the theory that some specific cognitive abilities decline with age. These cognitive skills include working memory, reasoning, attention and processing speed. Where declines in cognitive abilities such as working memory and reaction time do occur, there is evidence that performance of tasks is unlikely to be affected because of the ability of an individual to compensate for these declines with experience, education, high motivation, better judgement and job knowledge. Neuroimaging research has consistently demonstrated differing patterns of brain activation for older and younger adults performing the same task to similar levels of performance. This has led to a generally accepted compensation or scaffolding hypothesis suggesting that the brain of older adults can reorganise and recruit additional parts of the brain to support performance to counter deterioration in brain structures. Where there is evidence of age-related declines specific cognitive abilities, there is little evidence to suggest that work performance declines with age.

7 AGE, PHYSICAL STRENGTH AND ENDURANCE

7.1 KEY POINTS

- Muscle strength declines between 30 and 65 years of age but that this decline is unlikely to be noticeable until after the age of 65.
- Aerobic capacity appears to decline progressively after the age of 30 with accelerated declines after the age of 70.
- Age related declines in physical capacity do not normally adversely affect job performance.
- Physical capacity varies greatly between individuals.
- Declines in physical capacity can be delayed and minimised with regular exercise in leisure time.

7.2 PHYSICAL CAPACITY

Physical strength is delivered by the musculoskeletal system of the body and endurance by the cardiovascular system. It is generally accepted in the ageing literature that ageing is associated with a decline in physical capacity where an older person is not able to perform at the same level as when they were younger (Griffiths, 1997; Ilmarinen, 2001; Savinainen *et al.*, 2004, Okunribido and Wynn, 2009). Kenny *et al.*, (2008) reviewed the literature on ageing and physical capacity. The authors concluded that, while a great deal of variation exists, there appeared to be an average decline of physical capacity of 20% between the ages of 40 and 60 years due to decreases in both aerobic and muscular capacity.

7.3 CARDIOVASCULAR SYSTEM AND AGEING

The capacity of the cardiovascular system generally starts to decline with age (Ilmarinen, 2001; Schibye *et al.*, 2001). Data from the Baltimore Longitudinal study of ageing suggests that there is an age-related decrease in aerobic capacity and that this decrease is non-linear, increasing progressively each decade. For example, the maximum rate of oxygen uptake (peak VO_{2max}) decreased by 3-6% for people in their 30s and 40s but declined by more than 20% after the age of 70 (Ades and Toth, 2005). Goldspink (2005) also concludes that aerobic capabilities of the heart and muscles decline with age. In one review of the literature, it is suggested that age related declines in peak VO_{2max} occur at around 30 years of age but puts the average rate of decline after 30 at 5-15% per decade. Similar non-linear declines were found in longitudinal studies with accelerated rates of decline of 20% per decade after the age of 70 (Kenny *et al.*, 2008). This review also found that there were different, less steep declines for females than males. Studies suggest that aerobic power declines progressively over working life so that 65 year olds have around 50% the aerobic power of 25 year olds which may suggest a corresponding decrease in productivity (Ilmarinen, 2002; Shephard, 2000a).

In practice, few jobs require high aerobic demand over a long period of time. Therefore, it is unlikely that job performance is greatly affected by a decline in a worker's aerobic power, and any decline may be compensated for by experience and mechanical efficiency (Shephard, 2000a). It should also be noted that there are large individual differences in aerobic capacity and performance. In a review of age and functional ability in fire fighters, aerobic capacity of fire fighters was generally found to decrease with age, however very large individual differences in task performance were found (over six fold differences between and within age groups) (Sluiter and Frings-Dresen, 2007).

7.4 PHYSICAL ACTIVITY

Ilmarinen (2001) established a clear decline of maximal oxygen consumption with age among both men and women after the age of 30. However, he noted large individual differences, which suggest that cardiovascular capacity is strongly dependent on aerobic exercise. This suggests that age-related declines in endurance can be eliminated with aerobic exercise during work or leisure. Ades and Toth (2005) also found that physically active individuals have higher aerobic capacity than less active individuals at all ages (Ades and Toth, 2005). It appears that individuals who start with higher aerobic capacity and continue with high levels of physical activity throughout their lives, maintain a greater level of fitness throughout the ageing process. Therefore, a fit 60 year old could have better aerobic capacity than an unfit 30 year old. However, irrespective of physical activity levels, aerobic fitness does, inevitably, decline with age which suggests that physical activity delays rather than prevents age-related declines in physical capacity (Ades and Toth, 2005; Goldspink, 2005).

Despite this delaying rather than prevention role of physical activity, it is clear that there are benefits to regular exercise taken over a number of years. Individuals participating in regular exercise were found to possess larger cardiac and skeletal muscle reserves, retain more control over circadian rhythms, experience fewer health problems and reduced risk of work-related injury (Goldspink, 2005; Kenny *et al.*, 2008). What remains less certain is the benefits gained by increased levels of activity later in life and the minimum level of activity required to guarantee physiological measurable benefits (Goldspink, 2005). An appropriate mix of endurance and resistance based exercises is most likely to have the widest range of benefits in countering age-related declines in physical capacity (Goldspink, 2005). Results of one study into physical capacity suggest that older workers who participate in a moderate amount (up to 3 hours weekly) of sport had better physical capacity performance than those who were inactive (Hamberg-van Reenen and van der Beek, 2009). However, it is not entirely clear that physical activity or fitness has a positive effect on performance. In one study of men working in construction and industrial work, no relationship was found between physical fitness and work performance (Sorensen *et al*., 2008).

7.5 MUSCULOSKELETAL SYSTEM AND AGEING

7.5.1 Muscle capacity

Muscle capacity has been shown to be an important determinant of functional capacity as it maintains the ability to sit, stand, walk, climb stairs, perform repeated movements, and lift and carry loads for extended periods of time (Ades and Toth, 2005; Kenny *et al.*, 2008).

Studies of age-related muscle capacity have found mixed results but generally it is suggested that there is a decrease in muscle capacity between the ages of 25-70 due to an increase in the proportion of body fat, loss of muscle fibres and bone loss (Hamberg-van Reenen and van der Beek, 2009; Kenny *et al.*, 2008). Whilst up to a 25% decline in muscle capacity may be seen between 30-65 years, most decline takes place after 45 years and may not be noticeable until after the age of 65 (Aoyagi and Shephard, 1992; Kenny *et al.*, 2008). It is estimated that the maximum capacity of a 65 year old is, on average, 75-80% of that individual's maximum lifetime capacity (Hamberg-van Reenen and van der Beek, 2009). Studies also suggest that muscle strength in the upper body declines more than lower body (Kenny *et al.*, 2008). A study examining differences in static muscle capacity between older (55-65) and younger (18-25) adults found that the older participants had lower muscle strength but longer endurance time and development of fatigue (Yassierli *et al.*, 2007). This suggests that whilst older workers may not

have the capacity for very physically demanding tasks, they may be able to perform lighter tasks for longer than younger workers (Yassierli *et al.*, 2007).

Studies of workers employed in physically demanding occupations have generally not found significant age-related declines in muscle capacity. For example, static lifting performance was found to be independent of age in a review of the work ability and age of fire fighters. It is suggested that this may be because fire fighters tend to be relatively fit and healthy compared to other groups of workers (Sluiter and Frings-Dresen, 2007). In their study of waste collectors Schibye *et al.* (2001), found no decrease in muscle strength with respect to age with the exception of hand grip for waste collectors and a reduction in muscle strength for hand grip and shoulder strength between old and young workers in the control groups. Similarly, Gall and Parkhouse (2004) studied the physically demanding work of powerline technicians and found relatively little decline in muscle capacity in older workers. Only hand grip and one handed pull down capacity were reduced and there was no decrease in older worker's ability to perform essential job tasks.

7.6 RECOVERY

One large UK cross sectional study found that older workers (50 years old or older) are more likely to have a higher need for recovery from physically and psychologically demanding work than younger workers. It was noted that psychologically demanding work was a stronger risk factor than physically demanding work. This suggests that it is important that physical and psychological demands of work are assessed and controlled for, especially with older workers (Devereux and Rydstedt, 2009). Similar results were found in another study where workers 45 years or older were found to have a significantly higher risk for need for recovery than workers under 45 years of age (Kiss *et al.*, 2008). This study also found that female subjects had a significantly higher need for recovery than men (Kiss *et al.*, 2008).

7.7 EXERCISE AND THE TRAINING EFFECT

The Benjamin and Wilson (2005) review concludes that exercise and a healthy lifestyle can improve physical capacity. This is supported by Ilmarinen (2001) who suggests that regular physical exercise can keep physical capacity nearly unchanged for people between 45-65 years of age. What is unclear is how much physical exercise is needed to prevent a decline in physical strength and endurance. Shephard (2000b) suggests that a healthy lifestyle and gentle exercise, as encouraged through a wellness programme, can help to maximise residual physical capacity. However, as discussed above, physical exercise cannot reverse the effects of ageing on functional capacity, although older adults participating in high levels and intensity of exercise can realise substantial gains in muscle strength, aerobic power and flexibility.

Some studies suggest that physically demanding work produces a training effect where older workers employed in this work will maintain their physical capacity. However, this training effect was not consistently found. A high physical workload does not appear to have a long-lasting training effect on muscular strength or physical capacity of older workers (Hamberg-van Reenen and van der Beek 2009, Kang *et al.*, 2007, Savinainen *et al.*, 2004). Although some studies did find that heavy manual work maintained physical capacity especially for upper limbs (Gall and Parkhouse, 2004; Torgen *et al.*, 1999). It has been suggested that where training effects have not been found, this may be because the physical demands of the work activities studied have been below the "training threshold" (Schibye *et al.*, 2001). The intensity, frequency and duration of the activity may not be sufficient to induce general training effects although task specific improvements or maintenance of functional capacity may be achieved (Kenny *et al.*, 2008).

7.8 OTHER FACTORS

Some caution is advised against placing too much importance on biological factors alone as measures of functional capacity. This is because functional capacity is also dependent on psychological factors and it raises the question as to whether a drop in aerobic capacity translates into a proportionate drop in functional performance (Ades and Toth, 2005). Similarly, it is suggested that physical abilities and age-related changes are influenced by genetics, lifestyle and the working environment (Kenny *et al*., 2008). There is great variability in individual performance of older workers, which makes it difficult to generalise.

7.9 PROBLEMS WITH STUDIES

Caution is needed when extrapolating from laboratory tests of physical capacity to the work place because the healthy worker effect may be present (Shephard, 2000a). For example, people with musculoskeletal or cardiovascular complaints will be excluded from laboratory tests (Gall and Parkhouse, 2004) or, in workplace studies, only healthy older workers are likely to remain in jobs as those unable to cope with the physical job demands would have retired or changed to less demanding roles. In addition, the tests for physical performance may not adequately capture job performance (Robertson and Tracy, 1998).

7.10 SUMMARY

Although there is evidence that both muscle strength and aerobic capacity decline progressively with age, there is little evidence that these declines generally have an adverse effect on performance. It is suggested that muscle strength declines between 30 and 65 years of age but that this decline is unlikely to be noticeable until after the age of 65. There is some evidence that older workers may have lower muscle strength but longer endurance times suggesting that they could perform lighter tasks for longer than younger workers. Aerobic capacity also appears to decline progressively after the age of 30 with accelerated declines after the age of 70. It appears that older workers are more likely to have a higher need for recovery from physically demanding work than younger workers. There is considerable agreement in the literature reviewed here that age related declines in physical capacity do not normally adversely affect job performance. This may be because very few jobs require high aerobic and muscular strength demands to be maintained over a long period of time. Alternatively, work performance may be unaffected by declines in physical capacity because older workers are able to adapt their environment and employ mechanically efficient techniques to compensate for physical declines. There is also agreement in the literature that physical capacity varies greatly between individuals and that declines in physical capacity can be delayed and minimised (although not prevented) with regular exercise in leisure time. The evidence as to whether physically demanding work itself produces a training effect and maintains physical capacity is less equivocal.

8 AGE AND SENSORY ABILITIES

8.1 KEY POINTS

- There is clear evidence that visual and auditory acuity generally deteriorate with age.
- There are individual differences in the rates and extent of these declines.
- These declines can generally by compensated for through simple personal aids, such as spectacles or hearing aids, or adaptations to the environment.

8.2 SENSORY ABILITIES

Sensory abilities refer to the five senses of sight, hearing, touch, smell and taste. Of these, sight and hearing are the most critical for job performance. It is generally accepted that these senses decline with increasing age and can affect job performance. Although, as with other aspects of functional abilities and ageing, individual differences do exist, it is acknowledged that declines in age-related vision, hearing and touch are widespread (Robertson and Tracy, 1998).

8.3 VISION

Visual impairments are more common with increasing age. Visual changes with age include a reduction in the range of accommodation, loss in contrast sensitivity, decreases in dark adaptation, decline in colour discrimination and increased susceptibility to glare (Moyers and Coleman, 2004; Leaviss *et al*., 2008; Reischl, 2007). In addition, a decrease in depth perception in older people can lead to trips and falls (Mahan and Chikamoto, 2006). Peripheral vision also tends to decline with age (Roge and Pebayle, 2009). As well as deteriorations in vision, the prevalence of diseases such as cataracts, glaucoma and macular degeneration, increase with age (Mahan and Chikamoto, 2006).

These changes to vision may affect close, detailed work such as quality checking (Chan *et al.*, 2000) or driving (Shephard, 2000a). Whilst visual acuity is known to decline with age this may not necessary negatively affect job performance, as accommodations can often be made to the task or environment as discussed below. Age-related visual declines may not affect performance because other factors associated with older, more experienced workers may act to compensate for sensory declines. For example, in a study of 60-64 year old bus drivers, it was found that this age group had fewer accidents than drivers in any other age category possibly because judgement and patience compensated for declines in reaction time or vision (Shephard, 2000a).

Visual impairments can often by easily adjusted for and most individuals will independently procure ophthalmic aids such as spectacles and contact lenses to eliminate the impairment. Similarly, eye diseases such as cataracts are frequently corrected with surgical treatment.

8.3.1 Driving

As previously discussed, peripheral vision tends to decline with age leading to the effect of tunnel vision. This tunnel vision is particularly relevant for drivers. One study of the visual field during simulated driving tasks found that the ability to detect signals in the peripheral field of vision when driving deteriorates with age and is not compensated for by experience in driving (Roge and Pebayle 2009). In contrast to this is Shephard's (2000a) study of older bus drivers which suggests judgement and patience can compensate for visual declines.

8.4 HEARING

Presbycusis (age related hearing loss) is more common in older people than young adults. It is thought to begin after the age of 35 but becomes more pronounced with advancing age and is experienced by most older adults (Irwin, 2000; Robertson and Tracy, 1998; Mahan and Chikamoto, 2006). Hearing loss can include a loss of sensitivity to high frequency tones, difficulty understanding speech, problems localising sounds, and increased sensitivity to loud noises. This can cause safety concerns, for example if there is difficulty hearing safety alarms, understanding verbal instructions and may also result in vertigo and balance problems which could lead to falls (Charness and Bosman, 1994; Mahan and Chikamoto 2006, Leaviss et al 2008, Reischl 2007). The deterioration of hearing with age can be aggravated by working in noisy environments and the communication difficulties that a loss of hearing can lead to may have occupational safety implications and may lead to social isolation (Chan *et al.,* 2000). Robertson and Tracy (1998) point out that these age-related changes to hearing are often gradual and that any impairments as a result of these changes, are relatively minor. Hearing impairments can often be compensated for by the individual being fitted with a hearing aid.

8.5 SENSORY DECLINES WITH AGE AND PERFORMANCE

Both visual and auditory senses are known to deteriorate with age and a marked deterioration may also affect working abilities (Griffiths, 1997). Concerns have been expressed that declines in the sensory system with age could compromise safety (Moyers and Coleman, 2004; Shephard, 2000a). Zwerling *et al.* (1998) found that older workers with impaired hearing or sight had increased risks of occupational injuries. Age-related deterioration in vision or hearing is often cited as factors increasing the risk of occupational injuries in older workers (Zuhosky *et al.,* 2007). However, visual and hearing impairments can often be easily reduced or eliminated if the individual takes steps to procure spectacles, contact lenses or a hearing aid.

8.6 SUMMARY

There is clear evidence that visual and auditory acuity generally deteriorate with age. Whilst there are individual differences in the rates and extent of these declines, declines have been shown to be widespread in older adults. However, these declines can generally by compensated for by the individual procuring personal aids such as spectacles or a hearing aid, or by adaptations to the environment such as improved lighting, reduced glare or reduced background noise.

9 AGE AND ADAPTATION TO CHANGE AND LEARNING

9.1 KEY POINTS

- Older workers may be initially reluctant adapting to workplace changes but there is no evidence that older workers are not capable of adaptation.

- Reluctance or difficulties in adapting may be overcome with support, training and education.

- Whilst, the speed of learning tends to slow with age, there is strong evidence that older workers can generally achieve a good standard in learning and performing new skills

- Training time and ease of learning for older workers may be improved if the training is tailored towards the learning styles of older adults.

9.2 ABILITY TO ADAPT AND LEARN

Critical reviews of the literature on age and learning suggest that the current evidence does not support the theory that older people are unable to learn new information or adapt to change (Parsons *et al.,* 1991; Benjamin and Wilson, 2005; Chan *et al.,* 2000; Robertson and Tracy, 1998; Yeatts *et al.,* 2000). A survey of 2400 UK workers using computers concluded that older workers do not have particular difficulties in adapting to a computerised work environment (Borghans and Weel, 2002). In a study of manually selecting items on a computer screen using a computer mouse or a light pen, older adults performed more slowly that younger adults but proved to be extremely adaptable. Older adults became just as efficient with the use of the unfamiliar light pen as they were with the computer mouse after only 30 minutes use (Berlin, 2006). A much older study which looked at retraining tram drivers as bus drivers found that 63% of 61-67 year old drivers successfully passed the course and mastered this complex and demanding skill within 6 weeks (Shooter *et al.,* 1956) despite possible lower motivation to do so due to being close to retirement age (Rabbitt, 1997).

Some studies have suggested that older workers may be unwilling or have difficulty adapting to changes in the workplace, such as new work patterns (Griffiths, 1997). Ilmarinen (1994) indicates that older workers have some limitations in adapting to changes at work and Fossum *et al.* (1986) highlight that it may be difficult for older workers to deviate from previously successful routines. A number of explanations have been proposed regarding why older workers may have a resistance to, or difficulty in, adapting to change. Yeatts *et al.* (2000) implies older workers may be reluctant to admit that their skills are rusty, may be concerned that they will be unable to learn new methods or may have no motivation to take on more responsibility following job enrichment redesign. Research into resistance to change intimates that a fear that job changes will result in loss of status or privileges may be relevant for older workers (Fossum *et al.,* 1986; Kanfer and Ackerman, 2004).

There is compelling evidence that older adults learn new skills more slowly than younger adults (Tomporowski, 2003). Several studies have shown that older people require more time than younger people to learn such skills as computer text editing but were able to learn and achieve the necessary level of proficiency (Elias *et al.,* 1987; Sharit and Czaja, 1994). Shooter *et al.* (1956) found that the number of tram drivers successfully completing a bus driving retraining course in 3 weeks declined steadily after the age of 40 and was particularly marked after the age of 50. However, when they had an additional 1-3 weeks of training the majority of drivers passed the course. This suggests that excluding older workers from training courses is

unjustified as, although older people may take a little longer, a good standard of performance in new skills can be achieved and the lower turnover for older workers is likely to offset the cost of additional training (Rabbitt, 1997).

9.3 MOTIVATION TO ADAPT AND LEARN

Ilmarinen (2001) advocates that, whilst the speed of learning may slow with age, the ability to learn is not age dependent and that strong motivation to learn can compensate for a slower learning speed. Robertson and Tracy (1998) in their review of age, health and work, suggest that changes to learning are likely to be small and more related to motivation, attention, perception, health and learning context than to age-related learning capacity. However, there is a theory that older adults may be less motivated to initiate and persist in learning new skills. The evidence for this lack of motivation to learn appears inconsistent. Some studies advise that older adults experience low self efficacy when asked to learn new skills (Sharit and Czaja, 1994; Welch and West, 1995) whereas other studies have found high motivation and self efficacy to learn new tasks (Tomporowski, 2003), although the use of highly educated retired academics in the latter study may have been a confounding factor.

Maurer *et al.* (2003) proposes that the existence of negative stereotyping about older worker's motivation can become a self-fulfilling prophecy with older workers believing that they cannot learn so not participating in learning opportunities. In addition, studies of the attitudes of managers and supervisors to older workers have found common beliefs that older workers are unwilling to undergo training, are difficult to train and have less development potential (Maurer, *et al.,* 2003; Taylor and Walker, 1998). This may lead to older workers not being offered training opportunities (Taylor and Urwin, 2001).

9.4 LEARNING TECHNIQUES

Whilst it is generally accepted that older workers learn new tasks and information slower than younger adults (Ilmarinen, 2001; Tomporowski, 2003; Sharit and Czaja, 1994), it is acknowledged that older workers can generally learn new skills given the additional time. It is suggested that older people learn in a different way to younger people and therefore require different training and learning methods (Chan *et al.,* 2000). Yeatts *et al.* (2000) suggest that older workers learn best when they can learn at their own pace, learn with their age peers, and when any anxieties they have about the learning process have been addressed. Other studies have shown that older workers require both more time, more trainer intervention, shorter training sessions and more practice time to learn new skills (Elias *et al.,* 1987; Sharit and Czaja, 1994).

9.5 LEARNING AND JOB PERFORMANCE

Productivity in some jobs is dependent on knowledge that is acquired prior to entry to the labour market or early in the career. Data from the Organisation for Economic Co-operation and Development (OECD) suggests that few workers over the age of 25 acquire further formal qualifications (Dixon, 2003). The risk in this situation is that older workers' knowledge from the initial formal education will become dated and this may result in declining productivity or innovation unless they can learn new skills and knowledge (Dixon, 2003). However, one argument put forward against this, is that a mature labour force will posses higher than average levels of work experience, which may have a positive effect on productivity. In addition, Dixon (2003) points out that whilst formal qualifications are rarely acquired after the age of 25, participation rates in job related training do not decline significantly. This suggests that older workers are not significantly more reluctant to undertake training than younger workers (Dixon, 2003).

9.6 SUMMARY

Benjamin and Wilson (2005) in their review of the literature, conclude that older workers can adapt to change and this current review supports that conclusion. Whilst some studies advocate that older workers may be initially reluctant, or have difficulty, adapting to workplace changes, no evidence was identified to propose that older workers are not capable of adaptation. A number of reasons for reluctance or difficulties in adapting have been suggested which may be overcome with support, training and education. The evidence suggests that whilst older adults are capable of learning, the speed of learning tends to slow with age. Given additional time and practice, there is strong evidence that older workers can generally achieve a good standard in learning and performing new skills. The training time and ease of learning for older workers may be improved if the training is tailored towards the learning styles of older adults such as self paced learning, learning with age peers, additional assistance from trainers and more practice time.

10 AGE AND LEVELS OF SICKNESS ABSENCE

10.1 KEY POINTS

- The balance of the evidence shows that older workers do not have a greater sickness absence than younger workers.
- The Labour Force Survey figures indicate that younger workers have a higher rate of sickness absence than older workers when duration of absence is not considered.
- Differing rates of non-fatal injury between older and younger workers may be largely explained by industry and occupation.
- When workplace injury rates are adjusted for other factors such as occupation, age was found not to have a significant influence on the risk of workplace injury.
- The most important and dominating factor contributing to the risk of workplace injury is occupation.
- There is a lack of conclusive evidence as to whether older workers take more long term sickness absence than younger workers.

10.2 DEFINITIONS OF SICKNESS ABSENCE

Sickness absence is a complex issue. The decision for an employee to take sickness absence can be influenced by a number of different factors including personal, social and organisational factors (Barham and Leonard, 2002). It can be measured by both frequency and duration of absence and by employee, employer and statutory reporting. In addition, two types of sickness absence are discussed in the literature. Short-term sickness absence refers to absences of short duration, usually less than one week. Long-term sickness absence usually refers to absence longer than a week in duration, which is usually certified by a medical professional. Long-term absences are often referred to as unavoidable or involuntary because they usually relate to more serious injuries whereas short-term absences are associated with minor ailments. Short-term absences are sometimes referred to as voluntary or avoidable absences, which assumes some form of choice on the part of the employee, and possibly some form of motivational or personal reason for the absence (Thomson *et al.*, 2000).

10.3 SICKNESS ABSENCE TRENDS AND STATISTICS

The Labour Force Survey data shows that the sickness absence rate for all employees declined between 2001-2006 and has remained stable from 2006-2008 with around 2.5% of employees having had at least one day's absence in the survey reference week because of sickness or injury as shown in Figure 17 (Leaker, 2008).

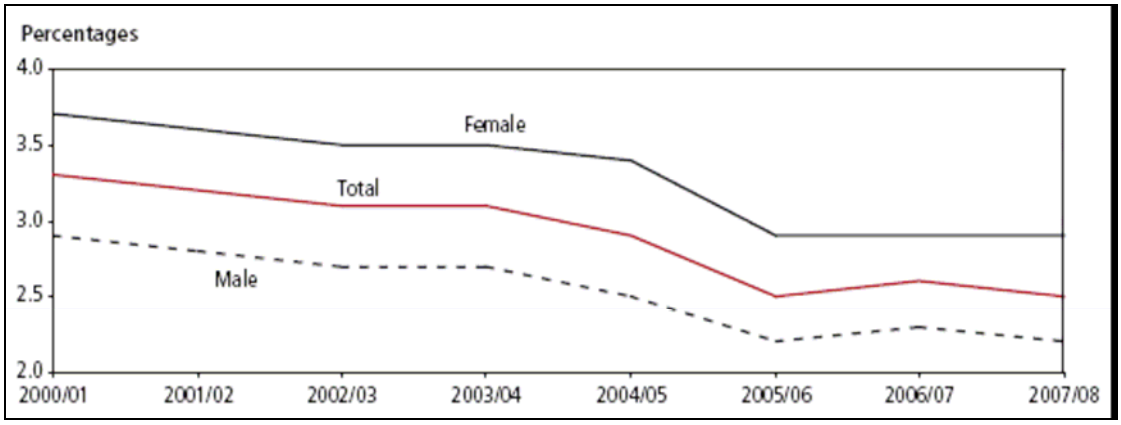


Figure 17 Sickness absence rates of working age employees (July to June each period), 2000/01 – 2007/08. (Source: ONS Labour Force Survey, Leaker, 2008)

The Labour Force Survey figures for sickness absence for 2008 estimate that around 5.8 million working days were lost due to illness or injury which equates to around 1.5% of the total scheduled working days in the July 2007 to June 2008 period (Leaker, 2008). The Confederation of British Industry estimated that the cost of this absence to the UK economy was around £19.9 billion (Leaker, 2008). The figures indicate that women had a greater sickness absence rate (2.9%) than men (2.2%) and that sickness absence rates are higher in the public service (2.9%) than in the private sector (2.4%) (Leaker, 2008).

Since 2000, the trend has been for a reduction in the estimated days off work due to self-reported work-related illness or workplace injuries (Figure 18). The reduction is around 27% (HSE, 2009).

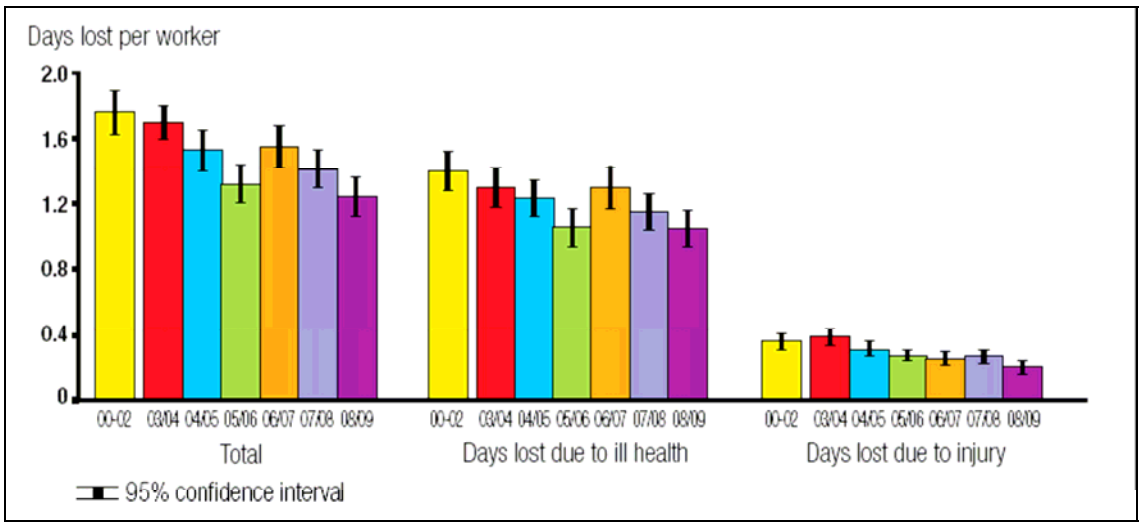
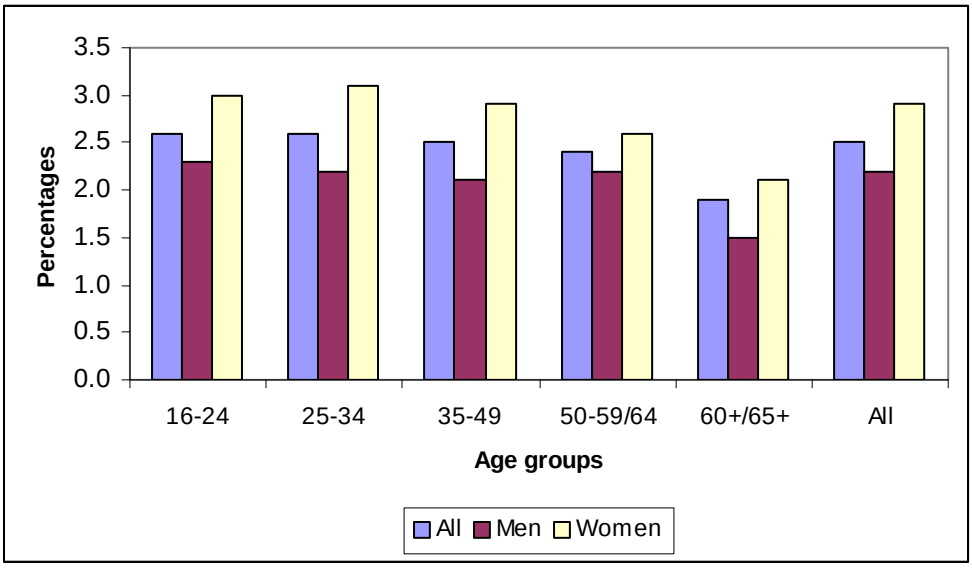


Figure 18 Estimated working days lost per worker due to work-related ill health and workplace injuries (Source: Labour Force Survey, HSE 2009)

10.4 FINDINGS FOR SHORT AND LONG-TERM ABSENCES

Short-term absence accounts for 80% of episodes of absence when frequency is measured. However, long-term absence accounts for 40% of the loss of total working time when duration

is considered (Barham and Leonard, 2002). Sickness absence statistics for the UK from the Labour Force Survey, indicate that younger workers are more likely to take sickness absence that older employees with 16-24 year olds and 25-35 year olds having an absence rate of 2.6% compared to 2.5% for 35-49 year olds and 2.4% for 50-SPA age group as shown in Figure 19 (Leaker, 2008). However, these figures do not consider the duration of the sickness absence episode (Leaker, 2008).



Proportion of employees who were absent from work for at least one day in the reference week.

Not seasonally adjusted

Figure 19 Sickness absence rates by age and gender 12 months ending June 2008 (Source: ONS Labour Force Survey, 2007/08, ONS, 2009b)

Generally the empirical evidence suggests that older workers have less short-term absenteeism than younger workers but more long-term absenteeism (Griffiths, 1997; Arola *et al.*, 2003). Harris and Higgins (2006) in their review of early retirement, suggest that whilst levels of short-term or non-certified absence are lower for older workers, they tend to be more prone to longer term or certified sick leave and often leave the labour force as a result of chronic health complaints. This finding is not entirely consistent, as contrasting results were found in one review of the evidence on safety and occupational accidents reports. This review of the results of the 2005 European Working Conditions Survey found that the 45-54 age group had the highest occurrence of absenteeism (24.6%) and the largest number of days off per absence (Koukoulaki, 2009).

Some studies and reviews of the evidence suggest that the relationship between age and absenteeism is inconsistent or more complex than described above. Thomson *et al.* (2000) suggests that this negative relationship between age and absence frequency is not consistent in studies. In their study of local government staff in the UK they found that, like previous studies, older workers had fewer spells of absence for non-certified (minor) illnesses but that the findings were more complex for certified (more serious, longer) absences. For example, they found that whilst age was negatively related to longer illnesses for physically demanding roles this was not the case for administrative workers or those who had worked in physically demanding roles for long periods of time. Peek-Asa *et al.* (2004) studied material handlers in

the USA and found that although older workers had lower injury rates (for low back injuries) they had a higher average number of days sickness absence per injury, which suggests that the cost to the employer may be similar for older and younger workers. Ng and Feldman (2008), in their meta-analysis of job performance, divided studies up by year of publication to see whether the age-performance relationship was affected by changes in the work environment over 30 years. They found that the negative relationship between age and general absence became stronger in studies published after 2000. The authors suggest that this may be because of improved health in older workers where the average 60 year old today may be in much better health and physical condition than a 60 year old 20 years ago (Ng and Feldman, 2008).

One study found that the prevalence of health problems increased with age and that blue collar workers had more sickness absence days than white collar workers (Taimela *et al.*, 2007). This study found that when self-reported health problems and occupational grade were accounted for, age was not associated with the total number of sickness absence days and that older workers were less likely to stay out of work than younger workers (Taimela *et al.*, 2007).

Robertson and Tracy (1998) and Rhodes (1983) in their reviews of the literature advocate that the evidence for age and absenteeism is inconclusive and that there is essentially no logical age-absence pattern for certified/involuntary and uncertified/voluntary absences.

10.4.1 Sickness absence and women workers

Sickness absence figures in the UK indicate that women are generally more likely to take sickness absence than men in all age groups (Leaker, 2008; Barham and Leonard, 2002). For example, current Labour Force Survey figures indicate that 2.9% of female employees were absent from work because of sickness or illness compared with 2.2 % of men. The highest rate of sickness absence for women was found in the 25-34 age group as shown in Figure 19 (Leaker, 2008). Looking at sickness absence rates by household composition suggests that the highest rates are associated with women living alone. However, women living alone also have a high rate of limiting long standing illness which may explain the high rate of sickness absence (Barham and Leonard, 2002). Statistical modelling analysis of sickness absence figures suggests that, after controlling for other factors, women are 22% more likely to be absent in a reference week than men (Leaker, 2008). In contrast, one study of sickness absence with 1300 employees in one company did not find that women took more sickness absence than men (Taimela *et al*., 2007).

10.5 OTHER FACTORS INFLUENCING SICKNESS ABSENCE

Many factors other than older age have been found to be likely to influence sickness absence. Statistical modelling analysis of sickness absence figures suggests that, after controlling for other factors, there is a significant relationship between an increased likelihood of sickness absence and the following characteristics: female workers in comparison to men; public sector workers compared to private sector; black/black British ethnic group compared to white; long working hours (over 45 hours per week) compared to part-time (less than 16 hours); employees aged 16-24 compared to 50-59/64; disabled employees compared to non-disabled; personal service workers compared with professional occupations; and working for large organisations (over 500 employees) compared to small employers (less than 25 employees) (Leaker, 2008).

Sickness absence figures indicate that people with poorer health are more likely to be absent from work (Barham and Leonard, 2002). Analysis of sickness absence figures, controlling for other factors, suggests that workers who classify themselves as disabled are 2.5 times more likely to be absent than those who are not disabled (Leaker, 2008). Similarly, higher sickness absence was found among those reporting health problems and poorer work ability regardless of age, gender or occupation (Taimela *et al.*, 2007).

The Whitehall II study (a longitudinal study of 10,000 London civil servants aged between 35 and 44) identified a number of risk factors for high rates of sickness absence including health related behaviours (smoking, alcohol), work characteristics (low levels of control, variety, skills use; work pace; support), low levels of job satisfaction and adverse circumstances outside work (Barham and Leonard, 2002, p184).

10.6 PROBLEMS WITH STUDIES

Some of the inconsistencies in findings between studies may reflect the multifactorial nature of sickness absence such as the physically demanding nature of the work, the length of employment and team working (Rhodes, 1983, Thomson *et al.*, 2000). Problems associated with the quality of the data and the definitions and measurements of sickness absence (Barham and Leonard, 2002; Thomson *et al.*, 2000) add to the difficulty in interpreting the evidence on sickness absence.

10.7 SUMMARY

Sickness absence is a complex issue. It is influenced by a number of different factors including personal, social and organisational issues. It can be measured by both frequency and duration of absence. Figures from the Labour Force Survey indicate that self-reported sickness absence rates for all employees have generally declined since 2000 and have been stable between 2006-2008 with 2.5% of employees having at least one days sickness absence in the reference week. The figures show that women have more sickness absence than men and that sickness absence rates are higher in the public service than in the private sector. The Labour Force Survey figures also indicate that younger workers under the age of 35 have a higher rate of sickness absence (2.6%) than older workers (2.4% for 50-SPA age group). However, these figures only consider frequency of sickness absence and not duration. As suggested by Benjamin and Wilson (2005), generally the balance of the evidence shows that older workers do not have a greater sickness absence pattern than younger workers. Generally the empirical evidence suggests that older workers have less short-term sickness absence that younger workers. Some studies suggest that older workers take more long-term sickness absence that younger workers. However, there is some contradiction in the evidence for this. The lack of consistent evidence may be due to differences in sickness absence patterns with regard to health, occupation or industry.

11 AGE AND ACCIDENT RATES IN THE WORKPLACE

11.1 KEY POINTS

- There is little conclusive evidence that older workers have an increased risk of occupational accidents than younger workers.
- The evidence suggests that accidents involving older workers are likely to result in more serious injuries, permanent disabilities or death than for younger workers.
- The evidence suggests that women workers have lower rate of injuries than men and this rate does not appear to increase with age.

11.2 TRENDS AND STATISTICS

The UK HSE accident and injury statistics show that 180 workers were killed at work and 131,000 workers suffered work-related injuries reported under the Reporting of Injuries, Diseases and Dangerous Occurrences Regulations (RIDDOR) in the 12 month period 2008-2009 (HSE, 2009). There is a general downward trend for injuries at work as shown in Figures 20 and 21 (HSE 2009). The RIDDOR figures indicate a 19% fall in major injuries between 1999/2000 and 2008/09, and a 28% fall for over-3-day injuries in the same period although most of the decrease occurred in the early part of the period and rates have remained relatively stable over the last five years (HSE 2009)

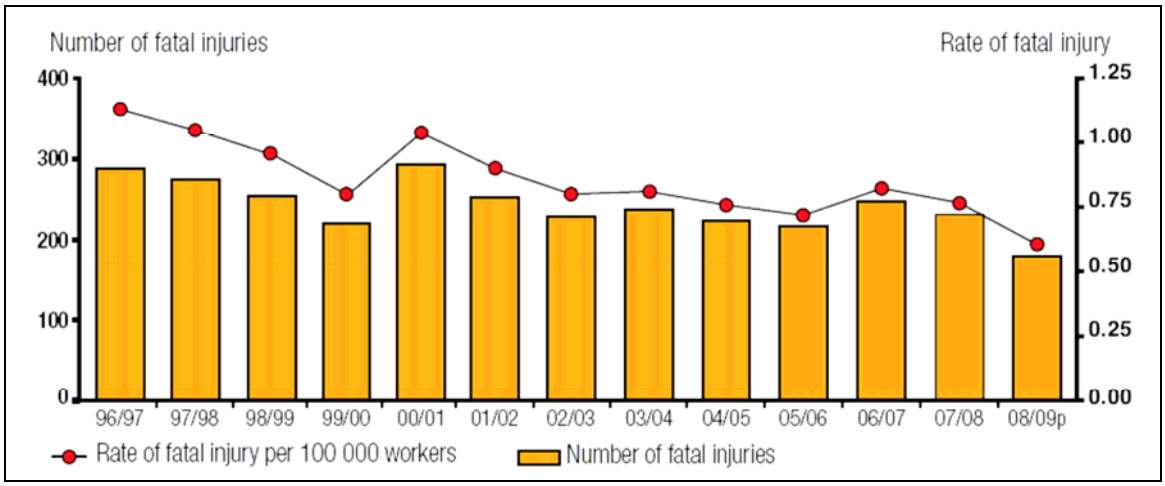


Figure 20 Number and rate of fatal injuries to workers (Source: RIDDOR, HSE 2009)

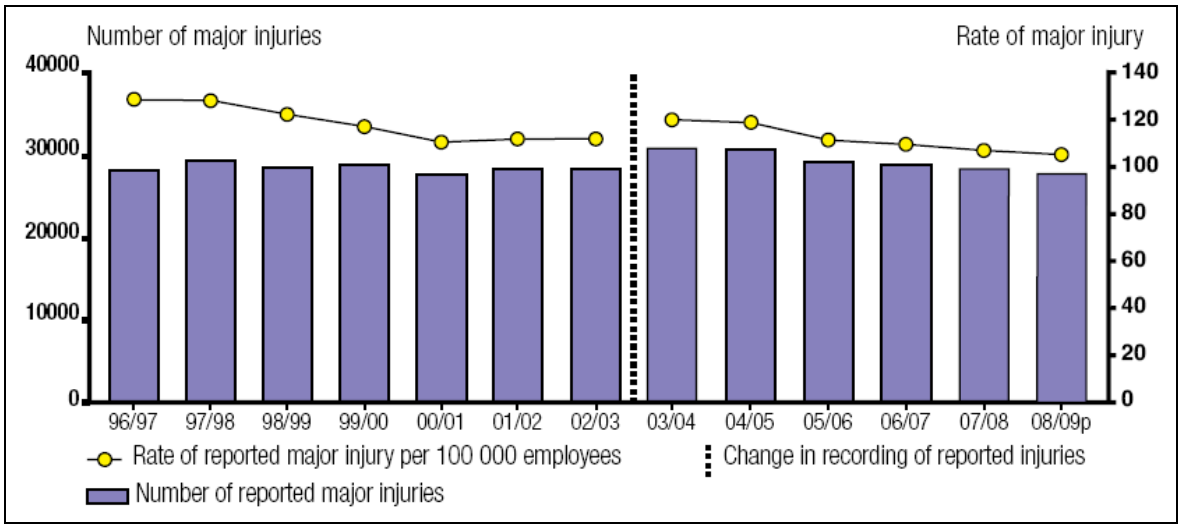


Figure 21 Number and rate of reported major injuries to employees (Source: RIDDOR, HSE 2009)

The Labour Force Survey estimated there were 246,000 reportable injuries in this same period (HSE, 2009). The statistics show that the underlying trend for work-related fatal injuries has been downward, with a statistically significant decrease over the last 5 years from the 2008/09 figures. The trend for major injuries, and injuries causing more than 3 days absence, has been stable over the past 5 years although self-reported work-related injury figures from the Labour Force Survey show a slight decline (HSE, 2009).

The UK statistics show that the industry sectors with the highest levels of work-related injuries were transport and communication, agriculture, and construction with agriculture and construction having the highest number of fatal injuries. Skilled trades, process plant and machinery operatives, and elementary roles were the occupations with the highest levels of work-related injuries as shown in Figures 16 and 22 (HSE, 2009). Slip and trip accidents at work remain a major cause of work-related injuries accounting for over a third of major injuries and a quarter of over 3 day absence injuries. Manual handling is also the cause of many work-related injuries with two fifths of over 3 day absence attributed to handling, lifting and carrying activities (HSE, 2009).

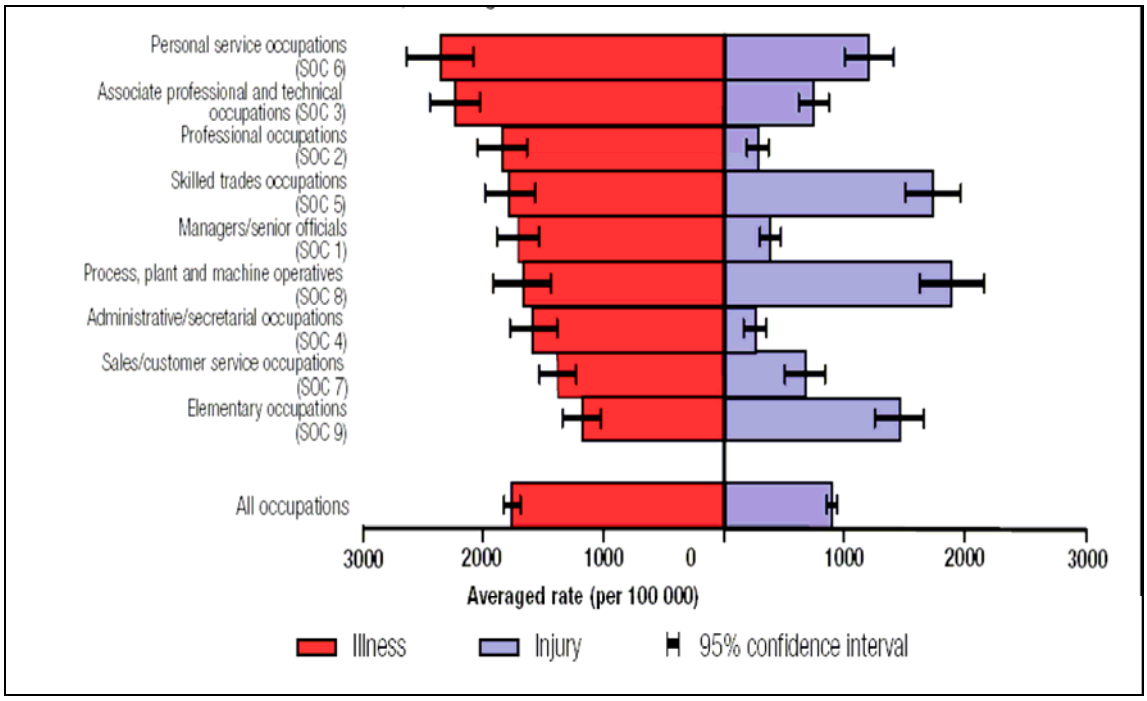


Figure 22 Estimated incidence rates of self-reported work-related illness and reportable non-fatal injury, by occupation, for people working in the last 12 months, average 2006/07 – 2008/09 (Source: Labour Force Survey, HSE 2009)

11.3 ACCIDENTS AND INJURY RATES

Incidence rates of non-fatal injuries to workers from the Labour Force Survey indicate that workers in the 16-24 age group have the highest rate (1220 per 100,000 workers) with the second highest rate for the 45-54 age group (HSE, 2009) as shown in Figure 23.

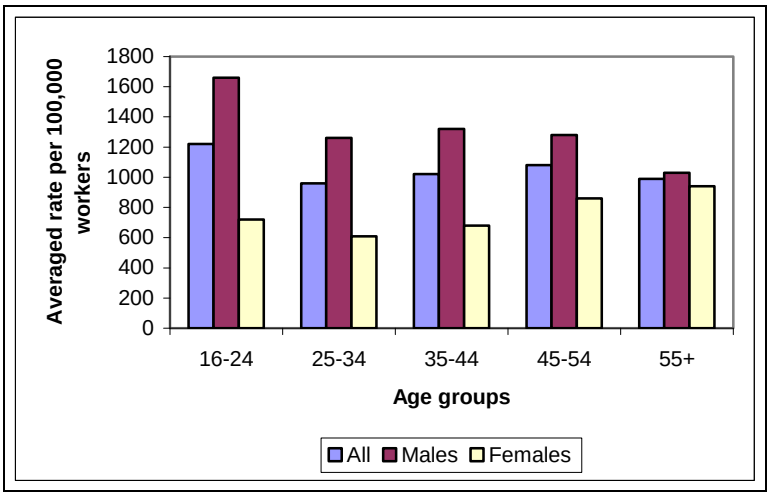


Figure 23 Estimated incidence rates of reportable, non-fatal injury to workers by age and gender, averaged 2005/06 – 2007/08 (Source: Labour Force Survey, INJAGE1_3YR, HSE 2009a)

Davies and Jones (2005) looked at workplace injury rates using Labour Force Survey data for from 1986-2004. They found the highest rate of workplace injuries amongst workers in the 20-34 age group with the injury rate declining in older age groups. However, research by the Institute of Employment Research has shown that differing rates of non-fatal injury between older and younger workers is largely explained by the industry and occupational profiles of the working populations in those groups. (Davies and Jones, 2005). This study analysed the Labour Force Survey workplace injury data by various characteristics of the workforce such as age, gender, occupation and working hours in order to estimate the separate influence of these factors on the risk of workplace injury. For age, this analysis found that whilst younger workers (16-19) were the least likely to report experiencing a workplace injury, when adjusted for other factors age was found not to have a statistically significant influence on the risk of workplace injury (Davies and Jones, 2005). Not surprisingly, the Davies and Jones (2005) study found that the most important and dominating factor contributing to the risk of workplace injury is occupation, with construction labourers; metal, wood and construction trades; vehicle trades; agriculture and animal care occupations; and stores/warehouse keepers as the five most hazardous occupational categories.

The relationship between age and occupational injuries appears controversial and other studies have produced inconsistent findings. One comprehensive review of the literature, looking at whether younger workers suffer more injuries than older workers, considered 63 studies of non-fatal injuries and 45 studies of fatal injuries (Salminen, 2004). This review found that 56% of non-fatal studies showed that young workers (under 25 years old) had a higher injury rate than workers 25 years old or older with 17% of studies showing lower injury rates and 27% showing no difference. For fatal injuries, 64% of the studies showed lower fatality rates for younger workers than for workers 25 years or older with 16% of studies showing a lower fatality rate and 20% showing no difference. In summary this review suggests that younger workers (under 25 years old) have a higher risk of occupational injuries but a lower fatality rate than workers 25 years or older (Salminen, 2004). However it should be noted that for this review only two age groups of workers were discussed with younger workers defined as those less than 25 years of age and all other age groups considered to be older workers. The findings of Salminen's (2004) review that workers under 25 years old have a higher risk of non-fatal injuries but a lower fatality rate than workers 25 years or older is broadly in line with some other reviews (Chan *et al.*, 2000; Robertson and Tracy, 1998). The variation in the results are likely to be due to differences by industry, occupation and experience (Robertson and Tracy, 1998; Koukoulaki, 2009).

11.3.1 Fatalities and serious injuries

Provisional RIDDOR figures for 2008/09 show an increased incidence rate of fatal injuries with age, especially for the over 65 age group (Figure 24). However, it is important to note that this is likely to be due to the over representation of workers over SPA in occupations such as agriculture which are known to be hazardous and have a high rate of fatal injuries (5.7 deaths per 100,000 worker in 2008/09) (HSE, 2009b). Similarly the low rate of fatal injuries for female workers reflect the fact that far few women are employed in the high risk industries.

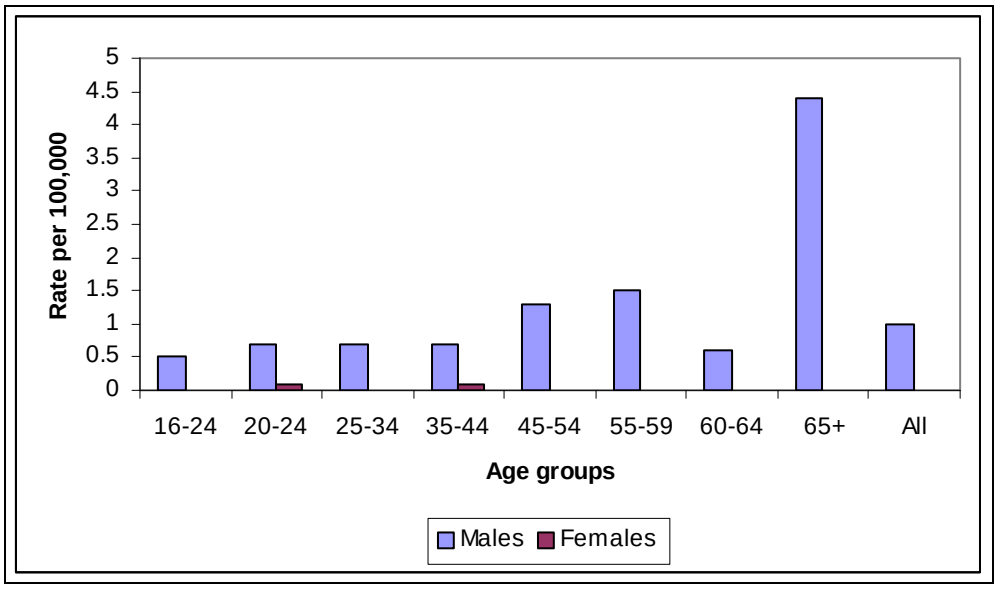


Figure 24 Fatal injuries incidence rates to employees by age and gender 2008/09 (provisional). (Source: RIDDOR, AGEGEN1, AGEGEN2, HSE 2009a)

Some studies suggest that older workers suffer a higher rate of fatal accidents than younger workers (Kowalski-Trakofler *et al.,* 2005). Kisner and Pratt (1999) looked at occupational fatality figures for 1980-91, which showed that workers aged 65, or over had three times the rate of occupational fatalities compared to workers in the 16-64 age group. It is suggested that this may be due to an increased risk of complications and infections following injuries to workers over 64. There is some inconsistency in results of fatal accident and age studies. For example, a study of fatal occupational injuries in Taiwan found that young males had the highest rate fatal injuries (Lin *et al.,* 2008).

Layne and Pollack (2004) studied fall injuries for workers over the age of 54. They found that older workers had a lower overall risk of injury compared to younger workers but that they were significantly more likely to incur more serious injuries, such as fractures, as a result of slips, trips or falls. This may be because the bones of older people are more susceptible to fractures as a result of even minor trips or falls (Scot, 2002). Peek-Asa *et al.* (2004) studied material handlers and also concluded that older workers (over the age of 45) have more serious back injuries than younger workers and therefore are away from work for a longer period of time. Pransky *et al.* (2005) in their large population based study, also revealed that work absence was longer for older workers and they were more likely to die as a result of an occupational accident.

Some reviews of accidents suggest that, whilst the accident rate does not increase with age, the accidents that older workers have do tend to be more severe in comparison to younger workers and that the resulting injuries are often more costly to treat or compensate (Reischl, 2007). Similarly, other reviews suggest that older workers experience overall lower rates of non-fatal work-related injuries but whilst injury rates are generally low, the severity and impact of the injuries tends to increase with age (Kowalski-Trakofler *et al*., 2005; Silverstein, 2008).

11.4 DIFFERENCE IN TYPES OF ACCIDENT AND CAUSES

The literature suggests that the incidence of particular types of accidents vary with age. As previously mentioned, a greater proportion of injuries to older workers occur as a result of slips, trips and falls (Layne and Pollack, 2004), or accidents involving moving vehicles (Salminen, 1993). One reason proposed for the increased number of fall injuries for older workers is that they experience depressed autonomic reflexes which predisposes them to postural hypotension,

syncopal episodes which can lead to falls (Zuhosky *et al.,* 2007). However, whilst previous studies have suggested that workers over 45 years of age have a greater proportion of slip, trip and fall related injuries than younger workers, one study of older fire fighters did not find a significant difference in slip risks between older and younger fire fighters (Punakallio *et al.*, 2005).

It is suggested that younger workers have accidents associated with inexperience or a lack of caution, whilst older workers may have accidents where a decline in function (such as sensory abilities) is a contributory factor (Rhodes, 1983). Some studies have suggested that older workers with sensory impairments are particularly at risk of occupational injuries (Zwerling *et al.*, 1998; Moll van Charante and Mulder, 1990). However, Shephard (2000a) points out that older bus drivers had lower accident rates despite any slowing in reaction speed or deterioration in vision.

11.5 INDUSTRY DIFFERENCES

Injury rates for older workers vary with the industry as differences in the type of work carried out by older and younger workers may be a factor in the differences in injury rate. For example, mining and construction industries have been shown to have higher work-related injury rates for older workers (Zuhosky *et al.,* 2007; Arndt *et al.,* 2005; Paul *et al.*, 2005). In a study of manufacturing and manual materials handling work, the highest proportion of injury claims for MSDs were observed in the 25-34 and 35-54 age groups (Jones and Kumar, 2005). In contrast, Breslin and Smith (2005) found that elevated injury rates were observed for workers under 35 even when adjusted for job type and physical exertion. Other studies have found no statistical increased susceptibility for older or younger workers in poultry processing and data entry operators which are occupations know to have high rates of upper limb injuries from repetitive movements (Zuhosky *et al.*, 2007).

Interestingly, Ng and Feldman (2008), in their meta-analysis of job performance, divided studies up by year of publication to see whether the age-performance relationship was affected by changes in the work environment over 30 years. They found that the relationship between age and work injuries had changed significantly over the three decades with the relationship being less negative in more recent (post 2000) studies. It is suggested that this may be due to impact of the introduction of technology which reduces the level of physically demanding work and the improved awareness of occupational health issues leading to fewer injuries across all age groups (Ng and Feldman, 2008).

11.6 INJURY DURATION

Studies generally show a trend for longer periods of disability following occupational injuries in older workers and suggest that older workers sustain more serious injuries, take longer to recover and are less likely to return to work than younger workers (Zuhosky *et al.,* 2007; Reischl, 2007; Silverstein, 2008). Whilst not entirely consistent, the studies suggest that the median duration of sickness absence increases with age from 5 days in the under 25 age group, to 12 days for those 55 and older (Silverstein, 2008). Pransky *et al.* (2005) in their large population based study, also found that older workers (55 years and over) sustained more severe injuries than younger workers (under 55) but did not find a significant difference in the absence duration or outcomes for either age group.

Silverstein (2008) in his review of the literature suggests that the increase in duration of sickness absence with age may be due to two reasons. Firstly, that older workers tend to sustain more severe injuries such as fractures whereas younger workers sustain more sprains and strains. Secondly, for the same injuries or health conditions older workers experience more severe outcomes including longer recuperation time. However, this is not supported by all

studies. In a study of occupational injuries in Canada, Breslin and Smith (2005) found that, compared to older workers (35+ age groups), younger workers reported twice as many minor injuries such as burns, cuts, bites and bruises. Older workers reported more serious injuries such as dislocations, sprains and strains (Breslin and Smith (2005). Pransky et al (2005), in their study of injury outcomes did not find more severe outcomes for older workers and suggest that this may be due to a stronger workplace attachment. They conclude that for the majority of workers who return to work following an occupational injury, there does not appear to be an age-related difference in functioning and that older workers appeared to suffer fewer residual symptoms than younger workers.

11.7 NEW WORKERS

Data from the UK Labour Force Survey shows that new workers have the highest rate of injury. New joiners were found to be at increased risk of sustaining a workplace injury especially within the first four months. Davies and Jones (2005) estimated that those workers who had been in their current employment for less than one month were almost 400% more likely to have a workplace injury than an employee with twenty years or more experience in their current job (p57). It is suggested that this may be due to an initial learning period after which the accident rate tends to even out (HSE, 2000).

As previously mentioned, it is suggested that younger workers have accidents associated with inexperience or a lack of caution, whereas older workers may have accidents where a decline in function (such as sensory abilities) is a contributory factor (Rhodes, 1983). Some studies have found that workers new to the job have increased risk of an occupational injury across all age groups Breslin and Smith (2006) found injury claim rates for Canadian workers in the first month in a job were up to six times higher than those who had been in a job for more than a year. This study also found that the increased risk was more pronounced for older workers compared to younger workers and this may be important because more workers are moving from one job to another (Breslin and Smith, 2006). The same study also indicated that older workers with long tenure in jobs had lower injury rates which the authors suggest may be because older workers with more experience in the job are exposed to fewer hazards (possibly because hazardous tasks are assigned to younger workers) or are better at identifying and controlling hazards (Breslin and Smith, 2006).

11.8 SAFETY PERCEPTIONS

Some, studies have suggested that older workers have less occupational accidents because they tend to show a more responsible attitude to health and safety, engage in less risky behaviours, are the most compliant with safety procedures, and are better at identifying and controlling for hazards (Breslin and Smith, 2006; Harris and Higgins, 2006; Ng and Feldman, 2008; Gyekye and Salminen, 2009). This may lead to older workers having less serious accidents (for example, falls), in contrast to younger workers having more serious accidents such as machinery-related incidents (Harris and Higgins, 2006). Leaviss *et al.* (2008) suggests that, whilst there is a widely held belief that older workers' attitude to health and safety is less positive than younger workers, many empirical studies do not support this belief.

11.9 WOMEN AND OCCUPATIONAL ACCIDENTS/INJURIES

Analysis of the UK Labour Force Survey data indicates that rates of fatal and non-fatal injuries are substantially lower for women than for men even after controlling for the effects of occupation, hours of work and other job characteristics. Analysis of the figures for injuries to women by age group shows that there is no substantial variation in risk of injury between age groups (HSE, 2000; Davies and Jones, 2005).

One review suggests that women are less likely than men to suffer injuries as a result of a single incident but that the risk of injury increases with age. The most common age group for women to experience injury is the 45-54 age group and women in this age group are at particular risk of falls (Doyal and Payne, 2006). Male workers have been found to have a slightly higher risk of occupational injury than female workers (Lin *et al.*, 2008; Smith *et al.*, 2005). Whilst young men (24 or younger) showed the highest rate of fatal injuries, for women, older women (45 years and older) had the highest percentage of fatal occupational injuries (Lin *et al.*, 2008). It is suggested that more research is necessary to find out the reasons behind this (Lin *et al.*, 2008). USA injury statistics found that generally men suffer more work-related injuries than women but, unlike men, the overall injury rate for women did not decrease with age (Smith *et al.*, 2005).

11.10 OTHER FACTORS

In the UK, analysis of the UK Labour Force Survey data was carried out to explore the relative risks of injury by age, gender, job tenure, hours of work and other job characteristics (Davies and Jones, 2005). The effect of gender, age and job tenure (new workers) have been discussed above. By bringing injury rates to the same basis as an average 40 full time hours, analysis shows that part time workers have a substantially higher rate of all workplace and reportable injury than those working full time. Those employees working less than 10 hours per week were estimated to be 90% more likely to experience a workplace injury per hour worked than those working 40-45 hours per week (Davies and Jones, 2005). An earlier analysis gives a useful example of this where a study of railway signals passed at danger (SPADs) showed high rates for drivers working shorter hours and for drivers new into a shift (HSE, 2000).

11.11 PROBLEMS WITH STUDIES

Several of the studies and reviews in this area note that the results may be influenced by the healthy worker effect, where older workers who are more accident prone, or have serious disabilities as a result of occupational accidents, leave the workforce or transfer to less demanding or dangerous work (Cloutier and Champoux, 2000; Rhodes, 1983; Breslin and Smith, 2005). The remaining older workers may therefore be the ones who have more awareness and caution for health and safety issues or have developed protective measures with experience to mitigate the risks of accidents or injuries.

11.12 SUMMARY

There appears to be little conclusive evidence that older workers have an increased risk of occupational accidents than younger workers. This is the same conclusion that the earlier review by Benjamin and Wilson (2005) proposes. The evidence suggests two patterns in the relationship between age and occupational accidents. Firstly, that older workers are generally less likely than younger workers to have occupational accidents, and secondly that accidents involving older workers are likely to result in more serious injuries, permanent disabilities or death than for younger workers (Robertson and Tracy, 1998). However, differing rates of non-fatal injury between older and younger workers can be largely explained by industry and occupational profiles of the working populations in those groups. When workplace injury rates are adjusted for other factors such as occupation, age was found not to have a statistically significant influence on the risk of workplace injury. The most important and dominating factor contributing to the risk of workplace injury is occupation. There is some evidence to suggest that older workers may experience more slips, trips and falls than younger workers. In addition, the recovery period following an injury may be longer for older workers although this is not consistently found. The evidence suggests that women workers have a substantially lower rate of injuries than men and this rate does not appear to increase with age. Analysis of accident and

injury data suggests that new workers who have been in a job less than four months and part-time workers of all ages may have a higher risk of work-related, reportable injuries than those working full time hours. The inconsistencies in the evidence may be due to the differences in the relationship between age and accidents within different industries, types of job and job tenure and also due to the healthy worker effect.

12 WORK DESIGN AND ACCOMMODATIONS

In previous sections of this report, the actions and interventions that older workers can put in place on an individual basis to eliminate or reduce some age-related declines have been discussed. These include lifestyle behaviours such as keeping physically fit with the recommended level of leisure time exercise, eating a healthy diet, not smoking and avoiding being overweight or obese by keeping within normal body mass index measures. In addition, personal accommodations for age-related sensory impairments such as spectacles and/or hearing aids can be prescribed. In additions to these lifestyle behaviours and personal interventions which an individual can take up in order to mitigate functional impairments, there are also simple and effective steps that an employer can take to identify where employees are experiencing difficulties and to adjust the work organisation or work environment to remove or reduce these difficulties. These adjustments are referred to here as workplace accommodations. These can include changes to the organisation of work such as giving the employee the opportunity to work flexible hours, part time hours or have a phased retirement plan. The work itself can be adjusted such as moving to supervisory or training roles if the work is proving too physically demanding. Also, the work environment itself can be adjusted, for example, reducing glare, improved workstation layout, providing power tools, lighter equipment, or more suitable display screen equipment.

Employers are expected to make reasonably adjustments and accommodations to the work and/or the workplace of an employee who has a disability under the Disability Discrimination Act (1995). An employer has to take such steps as it is reasonable for it to do so to remove or adjust a work practice or physical feature of the premises which places the disabled person at a substantial disadvantage (DRC, 2004).

The evidence suggests that work is generally good for physical and mental health and well-being for all age-groups including those over 50 years old. The proviso for this is that the nature and quality of the work must be considered and that jobs should be safe and accommodating (Waddell and Burton, 2006). The authors of this review of work and health, suggest that there is "a broad consensus that work should accommodate the needs and demands of ageing workers" (p15). They suggest that matching work to the changing capabilities and needs of older workers may help them to remain healthy and safe at work and accommodations which may include physical ergonomics and work-organisational adjustments are important in enabling older workers to remain in the workforce (Waddell and Burton, 2006).

12.1 ACCOMMODATIONS

Physically demanding work

It is suggested that changes to work organisation and work design may promote job satisfaction and maintain health and productivity for older workers (Harris and Higgins, 2006). In physically demanding work, moving older workers who are experiencing difficulties to tasks that require less heavy physical work may be an option. Reducing heavy lifting and carrying tasks for older workers may help to maintain their health and productivity. It is suggested that older workers in physically demanding jobs could be allowed to use their skills and experience to train younger staff or supervise others (Harris and Higgins, 2006). In construction work it has been suggested that the provision of more power tools and handling equipment, and utilising the skills and experience of older workers in safety, supervisory or training roles, could be considered to reduce the physical demands of construction work (Leaviss *et al.*, 2008). Welch

et al. (2008) suggests that efforts to prolong the working career of construction workers should include accommodations to reduce the physical demands of the work, specific job accommodations following injury, and attention to any functional limitations.

It is suggested that age-related declines in physical capacity may make it increasingly difficult for older workers to perform physically demanding jobs such as manufacturing, construction, health care and emergency services occupations (Kenny *et al.*, 2008). Sluiter and Frings-Dresen (2007) in their review of fire fighters work ability, recommend that functional capacity and performance are assessed on an individual basis, rather than imposing a collective early retirement age, because of the large variations found in changes in physical capacity and health. If individual workers feel that their work is becoming too physically demanding for them to comfortable carry out, transferring them to work which is less physically demanding may be an option. It may be possible for the employer to use their experience in training and supervisory roles (Harris and Higgins, 2006).

Some studies involving performance in the construction industry have suggested that ergonomics interventions be used to reduce the physical demands of construction work. These accommodations include the use of power tools and manual handling equipment to reduce physical demands of work. Increased lighting and glare reduction may also help to lessen the effects of visual changes and a reduction in background noise and use of ear defenders is recommended for hearing difficulties (Leaviss *et al.*, 2008). These recommendations are not age specific and should improve working conditions and reduce physical demands for all workers. In the UK, manual handling regulations have gone some way already in encouraging employers to introduce power tools and manual handling equipment. Leaviss *et al.*'s (2008) study also made some age specific suggestions such as reorganisation of workload to utilise the skills and experience of older workers. It is suggested that any efforts to prolong the working career of construction workers should include reduction in physical demands of work, specific job accommodations after injury and special attention to functional limitations (Welch *et al.*, 2008).

Office based work

For office or computer based work, accommodations which might benefit older workers includes encouragement to take frequent breaks or micro-breaks (Harris and Higgins, 2006; Mahan and Chikamoto, 2006). Taking breaks has been shown to increase productivity rather than reduce it (Mahan and Chikamoto, 2006). It has also been suggested that providing older workers with ergonomics training to show how they can adjust and change their work environment can lead to a reduction in discomfort and enhanced performance (Mahan and Chikamoto, 2006). Simple accommodations to computer display screens can be made for age-related visual problems which are discussed later.

Work predominantly carried out by women

Doyal and Payne (2009) point out that men are often assumed to carry out the heavy physical work but many jobs predominantly carried out by women involve manual handling heavy loads, adopting awkward postures, high levels of static muscular effort and standing for long periods of time. Examples include health care work, cleaning, retail sales, factory work and work in the hairdressing and beauty sectors. The physically demands of this type of work need to be recognised and suitable accommodations may need to be provided. Any accommodations or workplace redesign needs to be suitable for female workers rather than just designed to accommodate average male employees to avoid exacerbating MSDs in women. Difficulties that

women experience in the workplace can be exacerbated when workstations (eg. desks, chairs, work benches) are designed for the average male employee (Doyal and Payne, 2009). For predominantly female professions such as nursing and other health care roles, one author looking at nursing in the USA, suggests accommodations to retain older workers should include minimum staffing levels, limits on overtime and the use of experienced nurses in education and training roles (Letvak, 2005). One study of cleaners found that physical conditioning exercises led to them experiencing less physical comfort (Hopsau *et al*., 2005 cited in Kumar and Kumar, 2008).

Healthcare work, especially nursing, often involves physically demanding tasks such as patient handling. Costa and Sartori (2007) observed a strong trend of decreasing work ability with increasing age in women in nursing. An American study of nursing work suggests that accommodations are needed to retain all nurses, not just older ones (Letvak, 2005). This study makes recommendations for minimum staffing levels and limits on mandatory overtime to try to provide nurses with improved work environments. Another recommendation is the use of experienced nurses in education and training roles (Letvak, 2005).

Shiftwork

There is no consistent evidence that shift working adversely affects the health of older workers and no support for avoiding shift work for all older workers (Griffiths *et al.*, 2009). However, there is limited evidence that some older workers may find it difficult to adjust to night and afternoon shifts (Griffiths *et al.*, 2009). Where individual workers report difficulties with shiftwork, it is suggested that a flexible and individually tailored approach is taken (Costa and Sartori, 2007). Where possible this should include a transfer to the individual worker's preferred shift pattern. This may include avoiding night shifts and transferring to early morning or day work. Other interventions, which may provide support to older workers having difficulty with shiftworking, include providing more opportunities for breaks; arranging more frequent health checks; and offering counselling and advice on sleep, diet, stress management and exercise (Costa and Sartori 2007; Griffiths *et al.*, 2009). Providing older workers with increased control over work and increased social support is recommended to reduce the common causes of stress and early exit from the labour force (Griffiths *et al*., 2009).

Flexible working

Some studies suggest that most people over the age of 60 would prefer to work part time than full time (Christensen *et al*., 2009). Providing the option of flexible working hours or part time hours would better accommodate the significant proportion of older workers with caring and domestic responsibilities and those who are managing their own long term health problems (Griffiths *et al*., 2009). Flexible working allows older workers to adjust their working hours to suit personal circumstances and non-work commitments which become increasingly important as people age (Harris and Higgins , 2006).

Workplace health promotion

Whilst workplace health promotion programmes are important for all workers, several studies have emphasised their importance for older workers to encourage healthy lifestyles, check for the early signs of illness such as cardiovascular disease and encourage physical fitness (Griffiths *et al.*, 2009; Kumar and Kumar, 2008). It is suggested that these health or wellness programmes could be important to increase physical capacity and work ability, prevent health deteriorations and to allow continued presence in the workforce (Gamperience *et al.*, 2008; Kumar and

Kumar, 2008). However, workplace health promotion programmes need to meet the needs of older women in particular and older workers in general (Doyal and Payne, 2006).

Sensory impairments

Personal aids are probably the most simple and effective means by which an individual with visual or hearing impairments can eliminate or reduce impairment. Individuals can arrange eye and/or hearing tests, and can be prescribed spectacles or hearing aids to counteract visual and and hearing impairments both in and outside work. In addition, employers can offer other simple and effective accommodations in the workplace to counter visual and hearing impairments. For visual impairments, this can include the provision of magnifying equipment to compensate for visual declines, installing window blinds to reduce glare, avoiding high contrasts, simplification of visual information, increasing size of visual detail (such as screen text size), and providing controls to enable lighting to be adjusted (Mahan and Chikamoto, 2006; Reischl, 2007; Charness and Bosman, 1994; Robertson and Tracy, 1998). Similarly, some improvements can be made to the working environment to reduce performance declines as a result of hearing impairments. These include restricting sound frequencies to 1000-2000 Hz range, minimising background noise and reverberation, increasing sound intensities to distinguish wanted sounds from background noise, and emphasising low frequency sounds (Charness and Bosman, 1994; Reischl, 2007).

Improving sickness absence

Several types of interventions have been recommended in the literature to reduce rates of sickness absence within organisations. These include ergonomics interventions to the work environment; changes to the organisation of work such as flexible hours, phased retirement, rehabilitation and return to work programmes; health promotion, training and skill development; and social support (Silverstein, 2008). One study to determine whether a wellness programme had an impact on employee health care costs and rates of absenteeism in the USA, found large reductions in employee absenteeism for those who participated in the program (Aldana *et al.*, 2005).

Injury prevention and rehabilitation

Providing rehabilitation for older workers who have been injured enhances the chances that they will return to work by improving flexibility, aerobic fitness and strength. In addition, it is suggested that education in fall prevention and manual handling may help to prevent further accidents and injuries (Zuhosky *et al.*, 2007). These measures apply to all workers of all ages.

12.2 IDENTIFYING THE NEED FOR ACCOMMODATIONS

To identify where interventions and accommodations can be put in place to improve the ability of a worker to carry out a job, it has been suggested that an. individual's capabilities should be assessed against the specific demands of the work. Where this individual assessment identifies gaps between the individual's resources and the job demands, these are the areas where interventions may be helpful to reduce the mismatch and improve the ability of the individual to carry out the work. (Ilmarinen, 2001; Harris and Higgins, 2006). Any accommodations should be made in consultation with the individual worker and should take into consideration their preferences (Harris and Higgins, 2006).

One study of ageing and workplace accommodations found that workers who thought of their functional limitations as part of the normal ageing process were less likely to believe that they needed accommodations to be made for them in the workplace. The same study also found that where the older worker did recognise that they had a need for some form of workplace accommodation and requested it from their employer, their needs were less likely to be met if they attributed their condition to ageing rather than to a disability (McMullin and Shuey, 2006). This suggests that functional limitations attributed to ageing rather than to a disability are less likely to be considered for accommodation by both employers and employees themselves and valuable older workers may be pushed out of the labour force because of a reluctance to recognise or declare their difficulties (McMullin and Shuey, 2006). This emphasises the need for employers to carry out individual assessments of all employees to try to identify difficulties and to put accommodations in place to reduce them.

12.3 SUMMARY

There are actions that individuals can take themselves to reduce the likelihood of experiencing common health problems or to mitigate their functional impairments should these arise. These include lifestyle behaviours (such as exercise, not smoking, healthy eating) and personal interventions (such as getting spectacles or a hearing aid). In addition, there are simple and effective accommodations that an employer can take to identify where employees are experiencing difficulties and to adjust the work organisation or work environment to remove or reduce these difficulties. These accommodations can include changes to the organisation of work such as giving the employee the opportunity to work flexible hours, part time hours or have a phased retirement plan. The work itself can be adjusted such as moving to supervisory or training roles if the work is proving too physically demanding. Also, the work environment itself can be adjusted, for example, reducing glare, improved workstation layout, providing power tools, lighter equipment, or more suitable display screen equipment. Often these accommodations are simple to introduce and cost effective, allowing the valuable experience and skills of older workers to be retained in the organisation (Schartz *et al.*, 2006). Many of these accommodations are likely to benefit workers of all ages, for example, the introduction of handling equipment to reduce the physical demands of a particular task.

Several authors acknowledge that more research is needed into how the workplace needs to be designed and work organised to meet the needs of older workers (Buckle *et al.*, 2008; Kumar and Kumar, 2008). In addition more evidence is called for on the business value of workplace accommodations (Schartz *et al.*, 2006).

13 CONCLUSIONS AND LIMITATIONS

13.1 CONCLUSIONS

The findings of this review on the effects of ageing on health and employability are that there is little evidence that chronological age is a strong determinant of health, cognitive or physical abilities, sickness absence, work-related injuries or productivity. This supports the findings reached by Benjamin and Wilson (2005) in their earlier review and is in agreement with the conclusion that where there does seem to be evidence of age-related declines, these do not generally have an adverse affect on performance or productivity.

It is important to note that there is strong evidence that work is generally good for physical and mental health and well-being for people of all age groups (Waddell and Burton, 2006). In contrast, the same review suggests that not being in work is associated with poor physical and mental health and well-being. Waddell and Burton (2006) conclude that "work is generally good for physical and mental health and well-being of healthy people, many disabled people and most people with common health problems. Work can be therapeutic for people with common health problems" (p36). This applies equally to older workers as to their younger colleagues.

Whilst there is evidence that the prevalence of common health problems does increase with age due to the normal and inevitable ageing process, this does not necessarily hinder work performance and is not a valid reason to exclude an individual from the workforce (Crawford *et al.*, 2009). Dame Carol Black's review, Working for a healthier tomorrow, states that is a fallacy that illness is incompatible with being at work and that individuals should only be at work if 100% fit (Black, 2008). The majority of common health problems are not associated with impairment and people with these health problems are essentially whole people, their health conditions are potentially treatable and long-term incapacity and exclusion from the workforce is not an inevitable consequence (Waddell and Burton, 2006). It should be remembered that age is only one factor that affects health. Socioeconomic and psychosocial factors, and lifestyle behaviours probably have a greater influence on health than age. For example, regular physical exercise, a healthy diet, not smoking or drinking alcohol heavily, and remaining at a normal weight will reduce the likelihood of developing common health problems at any age. The trend is for the UK population to become healthier. Life expectancy is increasing and we are likely to live longer and to have more years of good, disability free health in older age. More older people are able to continue to work beyond the current SPA and wish to do so.

There is no strong evidence that older workers are more likely to experience work-related ill health or injury than younger workers. Similarly, the balance of evidence does not suggest that older people take more sickness absence or are at increased risk of accidents at work. It is the match between work demands and the capabilities of the individual carrying out that job which will help maintain health and safety at work (Waddell and Burton, 2006; Okunribido and Wynn, 2009). If a worker's capabilities change then it is important that employers identify this and work with the individual worker to assess whether the demands of the work are still a good match for the changed capabilities. If there is a gap between the changed capabilities and the work, then the demands of the work may need to be adjusted to match the individual capabilities. However, this applies to workers of all ages. Older workers do not need to be treated any differently to younger workers as long as employers are aware that there may be some reduction in some physical and mental capabilities with age and these can be identified and suitable accommodations put in place on an individual basis. It should be noted that older workers may be less likely to acknowledge a need for accommodation than younger workers

experiencing the same functional limitation. Older workers may fear losing their jobs if they admit to experiencing difficulties. Employers need to facilitate a workplace climate which promotes good health and well-being for all employees, including older workers (Black, 2006).

It is important to be aware that individuals experience ageing in very different ways. There is enormous variation in individual functional capabilities and performance between older adults which makes it difficult to generalise and, as Benjamin and Wilson (2005) point out, makes it unlikely that any stereotype of older workers will be true for all workers. For example, a physically fit 60 year old is likely to be able to perform physically demanding work better and with less risk of work-related illness or injury than an unfit 30 year old.

Attitudes towards the employment of older workers appear to be changing and employers are beginning to see older workers as a valuable asset (Okunribido and Wynn, 2009). This may be because of labour shortages, demographic ageing (Shearn, 2005) and raised awareness of age discrimination issues through the introduction of recent legislation (Employment Equality (Age) Regulations 2006). However, to motivate older workers to remain in work employers need to pay attention to the physical working environment for older workers and the way they are managed (Buckle *et al.*, 2006). Dame Carol Black's review of the health of Britain's working age population suggests that employers need to provide healthy workplaces and good jobs which are designed to protect and promote the health and well-being of employees of all ages, and to provide support for people who have, or are at risk of developing, health conditions. This support may include adjusting or adapting work practices, patterns or job roles (Black, 2006).

There are actions that individuals can take themselves to reduce the likelihood of experiencing common health problems or to mitigate their functional impairments should these arise. These include lifestyle behaviours (such as exercise, not smoking, healthy eating) and personal interventions (such as getting spectacles or a hearing aid). In addition, there are simple and effective accommodations that an employer can take to identify where employees are experiencing difficulties and to adjust the work organisation or work environment to remove or reduce these difficulties. Often these accommodations are simple to introduce and cost effective, allowing the valuable experience and skills of older workers to be retained in the organisation. Many of these accommodations are likely to benefit workers of all ages, for example, the introduction of handling equipment to reduce the physical demands of a particular task. Several authors acknowledge that more research is needed into how the workplace needs to be designed and work organised to meet the needs of older workers (Buckle *et al.*, 2008; Kumar and Kumar, 2008).

13.2 LIMITATIONS

The large number of studies that have been conducted to try to identify the effects of ageing on health and work would suggest that the effects would be clear and unambiguous. However, the complexities of the ageing process, the variations in occupations, environmental and individual factors involved, alongside some methodological limitations with the research make it difficult to identify causal factors in the relationship (Rhodes, 1983).

The majority of the studies in this area are cross-sectional in design, taking measurements across age groups at one point in time. This type of study has limitations because any age-related effects identified may be due to cohort effects, which can be a threat to internal validity (Rhodes, 1983). In cross sectional studies, differences in experience, education and work values, for example, held by age groups may account for observed differences (McEvoy and Cascio, 1989). In order to counter these cohort effects, more longitudinal studies into ageing and functional abilities should be implemented.

Longitudinal studies counter these cohort effects as they involve taking measurements of the same group of subjects at different stages in their working lives. However, longitudinal studies tend to use small samples, which is further reduced due to high drop out rates towards the end of the study and especially in the older age groups. The use of small samples risks the sample becoming unrepresentative.

Another possible methodological limitation of many of the studies into age and functional abilities is the healthy worker or survivor effect. This is often a weakness of cross-sectional study designs where older age groups may only include workers who are still healthy and performing their work well because those who are unable to do the work leave, retire or transfer to lighter duties (Rhodes, 1983). This may mean that the sample is unrepresentative and the results may underestimate the effect of age on work (Griffiths, 1997).

Analysis of the results presents another potential problem with some of these studies. The majority of the studies use bivariate analysis. The focus on two variables means that other factors, such as experience or length of employment, cannot be controlled and may be confounding factors. Rhodes (1983) suggests that multivariate analysis should be considered for future research to control for the many confounding, individual factors. Another difficulty with some of the studies is the assumption of a linear relationship between age and the dependent variable. This may not be the case and some studies have identified ***u*** shaped or curved relationships. Non-significant correlations in some studies where linear relationships between age and performance are assumed may mask a curvilinear relationship (McEvoy and Cascio, 1989; Griffiths 1997).

13.3 SUMMARY

In conclusion, the findings of this review on the effects of ageing and employability are that there is little evidence that chronological age is a strong determinant of health, cognitive or physical abilities, sickness absence, work-related injuries or productivity. This supports the findings reached by Benjamin and Wilson (2005) in their earlier review. Where there is evidence of age-related declines, the consensus of opinion is that these declines do not generally have an adverse affect on performance or productivity. There is general agreement in the literature that work is generally good for physical and mental health and well-being of people of all ages including people with common health problems. The findings of this review suggest that older workers do not need to be treated any differently to younger workers as long as employers are aware that there may be a reduction in some physical and mental capabilities with age and that these can be identified on an individual basis and suitable accommodations put in place.

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15 APPENDIX A

15.1 PREVALENCE OF MUSCULOSKELETAL DISORDERS

A Swedish study of MSDs in construction workers, foremen and office workers found that the prevalence of MSDs among construction workers increased among those aged 55-59. Lower back disorder prevalence increased from 18% in the less than 24 year old group to 35% in those aged 55-59 (Holmstrom and Engholm, 2003). Ilmarinen (2002), reports that a Finnish follow up study found that the prevalence of MSDs increased in men from 35% to 49% and women from 38% to 53% from the ages of 51-62.

Several studies have concluded that the increased prevalence in MSDs with aging is most pronounced in workers involved in physically demanding jobs. Holmstrom and Engholm's (2003) study concluded that the prevalence of MSDs increased with age but the increase was more rapid in construction workers for neck, shoulder and knee complaints than for foremen and office workers (Holmstrom and Engholm, 2003). Similarly, a study of Finnish construction workers found a significant link between heavy work, ageing and the risk of sciatic pain from lower back injuries (Nurminen, 1997). Ilmarinen (2002) also reports that the increase in MSD prevalence with age, found in his study, was most pronounced among participants who stayed in the same occupation and who were exposed to physically demanding work. Virokannas *et al.* (1999) also found high levels of MSDs (62% of women and 57% of men) in workers over 55 years of age who were exposed to heavy physical work. Arndt *et al.* (2005) found that MSDs are the leading cause of disability and ill health at all ages but the proportion is greatly increased with age in construction workers (Arndt *et al.*, 2005). Welch *et al.* (2008) in their study of construction workers in USA found that 54% of 40-59 year old workers reported at least one MSD in previous 2 years and that many construction workers continue to work despite pain and work limitations. In a study with automotive workers, back problems occurred more frequently in workers aged 50 or over, even with low job demands, which appears to indicate long term cumulative effects. Also in unfavourable working conditions, head, neck and shoulder MSDs occurred more frequently in workers over 40 years old (Laudau *et al*., 2008).

15.2 AGE AS A RISK FACTOR FOR MSDS

Okunribido and Wynn's review looked at eight longitudinal and fourteen cross-sectional studies which reported risk factors for work-related MSD symptoms and injuries. For example, Peek-Asa *et al*. (2004) looked at acute low back injuries in manual material handlers and concluded that workers who were 55 years or older were no more likely to suffer from a work-related low back injury than younger workers under 45 years old. Cassou *et al.* (2002) carried out a longitudinal study with a large, representative sample of French workers from various occupations to study the effects of ageing and work-related factors as predictors of chronic neck and shoulder pain. This study found that repetitive work carried out under time constraints and high job demands were risk factors for this type of MSD, independent of age for both men and women. It is worth noting that, at the end of this 5 year study, the majority of the workers with chronic neck and shoulder pain still remained in work and coped with their MSD. Another longitudinal study of male construction workers in Germany found a U shaped association with MSDs where the highest relative risk was amongst youngest and older age groups (Arndt *et al*., 2005). In a cross-sectional study of automotive industry workers, analysis found that age had no attributable effects on physical health symptoms (Laudau *et al*., 2008).

15.3 COGNITION

Working memory is considered to be particularly important for cognitive performance and learning, as it affects reasoning and problem solving (Park *et al.,* 2001; Salthouse, 2000; Tomporowski, 2003). Deficits in working memory were more pronounced when associated with the processing of new or complex information or unfamiliar context (Sharit and Czaja, 1994). Horn (1991), in a review of the measurement of intellectual capabilities, suggests that cognitive abilities such as reasoning capabilities, immediate awareness processes, speed of apprehension, and quick decision-making decrease steadily from the early 20s onwards. This is supported by a number of other studies and reviews of the literature (Griffiths, 1997; Ilmarinen, 2001; Li *et al.,* 2003; Sharit and Czaja, 1994).

An age-related increase in cognitive processing and reaction time is well documented (Moyers and Coleman, 2004; Salthouse, 2000, 2004; Shimamura *et al.,* 1995) and has been seen to impact on performance in a variety of tasks including computer tasks (Czaja and Sharit, 1993). In tests on speed, reasoning, vocabulary and memory, Salthouse (2004) found relatively large negative effects for speed, reasoning and memory with average performance falling from 75th percentile for adults in their early 20s to 20th percentile for adults in their 70s with declines apparent before the age of 50. Tomporowski (2003) studied younger and older adults in three different cognitive tasks and found the choice times in the young adults to be significantly faster that the older adults.

Attention and perception is generally considered to decline with age especially in tasks where attention is divided (Craik and McDowd, 1987, Park *et al.,* 2001) although there is some inconsistency in this (Sharit and Czaja, 1994). Working under severe time constraints and pressures is reported to be difficult for older workers (Gaudart, 2000; Moyers and Coleman, 2004). Other studies have also found that older workers have less tolerance of tight time schedules and time pressures (Griffiths, 1997; Molinie and Volkoff, 1994).

Some researchers in the field of cognitive abilities make a distinction between crystallised and fluid abilities. Crystallised abilities are automatic, knowledge based, procedural abilities which demand little effort and increase with age and experience (Silverstein, 2008) whereas fluid abilities, such as abstract problem solving, are more conscious information processes relying on processing speed, spatial functions and connecting pieces of new information. Fluid abilities have been found to deteriorate with increasing age starting from the when people are in their 20s in contrast to crystallised abilities (Peeters and Emmerik, 2008; Charness, 2008).

This finding appears to be supported by the experience of older workers. One study, looking at the self-perceptions of older workers of the ageing process, found that some older workers felt that as they got older their ability to learn and recall information was declining (Buckle *et al*., 2008).

15.4 AGE-RESISTANT COGNITIVE SKILLS

There is evidence that some knowledge based cognitive skills, such as language, knowledge and intelligence are resistant to age-related declines. Ardila *et al.* (2000) studied the effects of education on cognitive decline during normal ageing and found different levels of decline in different abilities and that some cognitive abilities (such as orientation, language and verbal fluency) are resistant to the effects of ageing. Horn (1991) found a non-linear relationship in some cognitive abilities. He suggests that cognitive abilities, such as visualising and auditory capabilities, increase during the ages of 30-40 before decreasing gradually, and that knowledge, long term memory retrieval and mathematical/quantitative capabilities increase into the 60s

before decline begins. Peeters and Emmerik (2008), in their review of ageing, suggest that intelligence does not show declines with age but remains stable on average until 80- years of age.

Ilmarinen (2001) suggests that control of use of language and complex problem processing ability improve with age. Li *et al.* (2003) looked at ageing and performance of airline pilots and suggests that performance in decision making and other piloting skills does not differ significantly with age. Avolio and Waldman (1994) found that age generally accounted for a relatively small percentage of the variance in cognitive, perceptual and psychomotor abilities when experience, education and occupation were controlled for. In cognitive tests of vocabulary and verbal abilities, higher scores were achieved with increasing participant age to the mid to late 50s after which age scores remained stable or slightly declined which was interpreted as knowledge accumulating with age (Salthouse, 2004; Park and Reuter-Lorenz, 2009; Salthouse, 2009).

As previously reported, some researchers in the field of cognitive abilities make a distinction between crystallised and fluid abilities. Crystallised abilities are automatic, knowledge based, procedural abilities which demand little effort and increase with age and experience (Silverstein, 2008). It has been suggested that crystallised abilities show modest increases until individuals reach their 50s and 60s (Charness, 2008).

Robertson and Tracy (1998) in their review of the literature of age, health and work concluded that there is general agreement in the literature that processing speed declines greater than processing power, and that different cognitive abilities deteriorate at different rates. They also make the point that there does not appear to be a marked decrease in cognitive performance until after the age of 70.

15.4.1 Neuroimaging and brain activation

Benjamin and Wilson (2005) suggest that the cognitive function in older adults does not decline but differs from that of younger adults. The evidence for this comes from neuroimaging techniques where brain images of high performing older adults carrying out cognitive tasks have shown a different pattern of brain activation from similar performing younger adults. In younger adults the pattern of activation in restricted to specific parts of the brain whereas high performing older adults show a pattern of over-activation in other parts of the brain (Reuter-Lorenz, 2002). Neuroimaging data consistently finds two age-related differences in brain activity between younger and older brains (Dennis and Cabeza 2008, Park and Reuter-Lorenz, 2009). Firstly that there is an age-related shift in activations from posterior to frontal lobes, which suggest that older adults compensate for processing declines by recruiting other parts of the brain. It is suggested that this allows older adults to perform cognitive functions as accurately as younger adults but at the expense of slower reaction times. Secondly, in many studies, looking at a range of cognitive abilities, older adults showed a more bilateral pattern of brain activation than younger adults.

15.4.2 Neuroscience compensation hypothesis

One explanation, that had been put forward for this over-activation, is the compensation hypothesis where the brain compensates for deficits by recruiting other parts of the brain to maintain high cognitive performance (Cabeza *et al.,* 2002; Reuter-Lorenz, 2002). Other evidence for this comes from brain damage research where motor and language functions can recover after unilateral brain damage due to the recruitment of unaffected areas of the brain (Cabeza *et al.,* 2002). Park and Reuter-Lorenz suggest a Scaffolding Theory of Ageing and Cognition (STAC) where increases in activation with age is a sign of an adaptive brain that engages in compensatory scaffolding in response to declining neural structures. They suggest

that the brain engages in a continual reorganisation process to support cognitive functions by strengthening existing neural connections, forming new connections and disuse of weak or faulty connections (Park and Reuter-Lorenz, 2009).

However, whilst findings from studies by Cabeza *et al.* (2002), Reuter-Lorenz (2002) and Park and Reuter-Lorenz (2009) suggest strong support for the compensation hypothesis, some caution is called for as there may be other explanations for brain over-activation in high performing older adults. A dedifferentiation hypothesis is also suggested as a possible alternative explanation of the over-activation findings (Cabeza *et al.,* 2002; Park *et al.,* 2001; Reuter-Lorenz and Lustig, 2005). Dedifferentiation is where the brain ageing process reverses the early developmental trend towards specialisation of areas of the brain for specific functions. This activation of other parts of the brain may indicate inefficient cognitive processing and, whilst it could support cognitive performance in the short-term, it could be an indication of progressive pathology and a prediction of future declines (Reuter-Lorenz and Lustig, 2005). In addition, Park *et al.* (2001) point out that there may be technical difficulties in interpreting brain activations through neuroimaging as young and old adults may have different strengths of detectable signal and pathological changes in cerebral tissue could also affect activation detection.

The conclusion from the neuroscience perspective of cognition and ageing is that whilst there seems to be strong support for the compensation hypothesis, more research is needed to clarify the interpretation of over-activation and to establish the relationship between cognitive performance, brain activation patterns and longitudinal changes (Park *et al.,* 2001; Reuter-Lorenz and Lustig, 2005). A more recent review of the neuroscience evidence concludes that the available evidence tends to be more consistent with the view that brain over-activation patterns are attributable to compensation rather than dedifferentiation but acknowledges that further research is still required (Dennis and Cabeza, 2008).

Compensation may come at a cost as recruitment of contralateral hemispheres may reduce the brain's ability to perform efficiently (Dennis and Cabeza, 2008; Park and Reuter-Lorenz, 2009). In their review of cognition and neuroscience, Park and Gutehess (2006) support the compensation explanation for age-related changes in brain activation, concluding that the evidence suggests that the brain responds to the age-related declines by reorganising neural structures in response to sustained exposure to stimuli or repetitive events. They feel that the question that is unanswered is whether these neural changes occur automatically or whether they reflect individual's strategy differences which can be controlled or taught (Park and Gutehess, 2006). It is suggested that there may be limits to the ability of the brain to compensate for deterioration in later stages of the ageing process, so that the capacity of the brain for reorganisation is exceeded, leading to a loss of cognitive function (Park and Reuter-Lorenz, 2009). This compensation suggests that the brain workload may be greater for older adults even when they are performing at similar levels to younger adults which implies that they are at greater risk of excess workload (Charness, 2008). Park and Reuter-Lorenz (2009) suggest that loss of cognitive function may depend on individual differences in the extent of decline and the amount of scaffolding that can be recruited. In addition, they suggest that the readiness and efficiency of an individual's compensatory scaffolding may depend on other factors such as levels of physical fitness or cognitive stimulation, although there is no evidence for this as yet in human studies (Park and Reuter-Lorenz, 2009).