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IN-DEPTH REVIEW

The health safety and health promotion needs of older workers

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Aims To evaluate current research on the health, safety and health promotion needs of older workers by identifying age-related change, whether older workers need support and evidence of successful intervention in the workplace.

Methods Using a systematic review methodology, databases were searched identifying 180 publications. Each publication was reviewed and data were extracted. Evidence was assessed for quality using the three-star system.

Results The review identified that there are a number of age-related physical and psychological changes. However, these changes can be moderated by increased physical activity, intellectual activity and other lifestyle factors. Sensory abilities are also subject to change but some of these can be accommodated via equipment or workplace adjustments. In reviewing accident data, although older workers are at a reduced risk of accidents, they are more at risk of fatal accidents. Ill-health data identify that many chronic diseases can be controlled and adjustments put in place in the work environment. A number of intervention studies were identified but few were of high quality. The research suggests that occupational health intervention can reduce the risk of early retirement from the workplace; health promotion interventions are seen as positive by older workers but it is important to ensure equal access to all workers in such promotions.

Conclusions The review identified that there are still a large number of research gaps including the lack of longitudinal research; no further analysis on fatal accidents or understanding of the high prevalence of musculoskeletal disorders and stress and anxiety in older workers.

Key words Ageing; health; health promotion; older worker; occupation; safety.

Introduction

The UK population in July of 2007 was 60 975 000 and for the first time in the UK, the number of individuals over state pension age was larger than the number below 16 in the UK population [1]. The demographic changes are associated with increased longevity and a reduction in fertility rates and do bring a number of challenges to the UK. While it is positive that individuals are living longer, the economically active population (those aged 16–64 years) are going to reduce from 65 to 60% of the total population. This has led to predictions that the ratio of economically active individuals to pensioners that is currently 3.3 workers to pensioners will reduce to 2.9 by 2032.

Research has identified that good work is good for the individual when it is healthy and safe [2]. Thus, maintaining good health throughout working life is likely to benefit individuals both before and after retirement. This review aims to identify the health, safety and health promotion needs of older workers (those aged ≥50 years) by addressing the questions below.

1. What are the health, safety and health promotion needs of older workers and do these differ from the rest of the workforce?
2. How are those needs being addressed?
3. Data gaps.

Methods

The review was conducted using the method developed by the Centre for Reviews and Dissemination at the University of York [3]. The search strategy was developed and in total, 40 keywords or phrases were used to search 17 search databases and four web pages from 1990 onwards; a full breakdown of the strategy can be found in Crawford *et al.* [4].

Inclusion and exclusion criteria were developed within the search strategy. On completion of the searches, an initial screening process was carried out to compare titles and abstracts with the inclusion and exclusion criteria. For documents fitting the inclusion criteria, full papers were obtained and each paper reviewed and data extracted. At this stage, each paper was reviewed for quality and given a rating based on the three-star system. The system rates quality based on: *** strong evidence; ** moderate evidence; * limited or contradictory evidence; – no evidence. This method has been successfully used in a number of recent reviews [5,6].

Results

Search results

Initial searches identified 180 papers, which were stored with abstracts in RefWorks software [7]. On completion of reviewing and quality assessment, 59 papers were included within the review; 2 papers giving definitions within the review, 2 publications that could not be obtained in time and the exclusion of 119 papers. The following is a summary of the findings of the review.

Age-related change

To address the first question within the review, it was intended to identify changes in physical and mental capacities that were likely to have an impact on the individual at work. The focus on this was healthy age-related change. This information has been collated below and is presented in Tables 1–3.

Aerobic capacity

Aerobic capacity in adults has been found to decline in both males and females over working life [8,9,18–21]. Evidence for this is presented in Table 1. The decrease in capacity has been found to equate to a reduction by 10% for each decade of life and this has been consistent in both longitudinal and cross-sectional research. The age-related reduction in capacity is thought to be linked to the reduced ventilation rates, reduced maximal cardiac output and reduction in peak heart rates associated with ageing [9]. It is apparent that the reduction in aerobic capacity will have an impact on physical work, where machine-paced work set for younger workers may outstrip the capacity of older workers. However, the reports of fatigue from older workers are not frequent and Shephard [18] suggests that this is due to mitigating factors including experience relating to age and duration of working life and seniority allowing for selection of lighter tasks. Although aerobic capacity reduces with age, some maintenance of capacity can occur where an active lifestyle is preserved.

Anthropometry

There are a number of anthropometric changes associated with ageing. Increase in body mass index (BMI),

Table 1. Studies relating to change in physical capacity

Author	Study design, research type and quality	Research question	Information provided
Gall and Parkhouse [8]	Cross-sectional experimental study with three age groups, $N = 40$ (*)	Changes in physical capacity in heavy manual work	Reduced aerobic capacity in the older worker group aged >50 years. Increased body weight and lower stature in those aged >50 years
Savinainen *et al.* [19]	Longitudinal study, $N = 95$ (**)	What are the changes in physical capacity in middle-aged workers >18 years	Significant reduction in female aerobic capacity and a non-significant reduction in males. Significant increase in BMI, weight and reduction in stature as age increases
Savinainen *et al.* [20]	Longitudinal study, $N = 95$ (**)	What are the changes in physical capacity in middle-aged workers >18 years	Significant reduction in female aerobic capacity and a non-significant reduction in males. Significant increase in BMI, weight and reduction in stature as age increases
Savinainen *et al.* [21]	Longitudinal study, $N = 95$ (**)	What are the changes in physical capacity in middle-aged workers >18 years	Significant reduction in female aerobic capacity and a non-significant reduction in males. Significant increase in BMI, weight and reduction in stature as age increases
Shephard [18]	Review (**)	Age-related physical change and the need for objective assessment	Predictions of work output based on age-related change
Shephard [9]	Review (**)	Age and physical work capacity	Data on reduction in age-related aerobic capacity with suggested reasons why

Table 2. Studies relating to strength and endurance

Author	Study design, research type and quality	Research question	Information provided
Cassou *et al.* [23]	Longitudinal study of chronic neck and shoulder pain in France. Study of 18 695 individuals including interview and physical examination (**)	Work-related factors as predictors of chronic neck and shoulder pain	The prevalence and incidence of chronic neck and shoulder pain increases with age, independently of exposure to risky work factors
Devereux and Rydstedt [10]	Longitudinal survey of 3139 at baseline and 2091 at follow-up 15 months later (**)	Does the need for recovery increase with age	The analysis identified that need for recovery was greater in the oldest age group (50–69 years) compared to the youngest group (17–29). Need for recovery was associated with working >42 h/ week, high psychological demands and physically demanding work
de Zwart *et al.* [11]	Cross-sectional questionnaire survey of 44 486 employees in The Netherlands (**)	The effects of ageing and physically demanding work on musculoskeletal health complaints	An increase in the prevalence of musculoskeletal complaints with age
de Zwart *et al.* [22]	Review (**)	Physical workload and the ageing worker	Identified an average decline in muscular capacity of 10–25% at 65 years. This is not consistent and very variable dependent on BMI and leisure time activities
Gall and Parkhouse [8]	Cross-sectional experimental study with three age groups of male power line technicians, $N = 40$ (*)	Changes in physical capacity in heavy manual work	No significant differences in the strength measures made apart from hand grip strength that was significantly lower for >50 years age group
Kiss *et al.* [12]	Cross-sectional questionnaire survey, $N = 1100$ (**)	The need for recovery from psychosocial and physical work strain	Identified an association between age and scoring more highly on the need for recovery scale
Savinainen *et al.* [19]	Longitudinal study, $N = 95$ (**)	What are the changes in physical capacity in middle-aged workers >18 years	Significant reduction in spinal flexibility, decrease in trunk flexion strength and similar results for trunk extension strength as age increases
Savinainen *et al.* [20]	Longitudinal study, $N = 95$ (**)	What are the changes in physical capacity in middle-aged workers >18 years	Significant reduction in spinal flexibility, decrease in trunk flexion strength and similar results for trunk extension strength as age increases
Savinainen *et al.* [21]	Longitudinal study, $N = 95$ (**)	What are the changes in physical capacity in middle-aged workers >18 years	Significant reduction in spinal flexibility, decrease in trunk flexion strength and similar results for trunk extension strength as age increases
Schibye *et al.* [13]	Cross-sectional study of younger and older male waste collectors compared to two younger and older control groups, $N = 47$ (*)	Maximal strength measures in waste collectors	Waste collectors have a higher muscular capacity when compared with control groups. Older waste collectors have significantly higher strength for shoulder elevation and shoulder abduction but lower handgrip strength suggests a possible training effect
Woods and Buckle [14]	Review (**)	Impact of work, inequalities and musculoskeletal health	Great inter-individual differences, research confounded by data collection measures and exposure times have to identify the balance between physical workload and capacity

Table 3. Studies relating to the impact to heat exposure

Author	Study design, research type and quality	Research question	Information provided
Pandolf [15]	Review (**)	Heat intolerance in older individuals	Data provided on heat intolerance and factors affecting it identify that age is not a primary factor, rather age-related cardiovascular change and ill-health impact on the individual's heat tolerance
Pandolf [16]	Review (**)	Heat intolerance in older individuals	Data provided on heat intolerance and factors affecting it. Identifies that age is not a primary factor, rather age-related cardiovascular change and ill-health impact on the individual's heat tolerance
Shephard [9]	Review (**)	Age and physical work capacity	Data on reduction in age-related aerobic capacity with suggested reasons why
Wick *et al.* [17]	Case–control study of 20 participants measuring vasodilation in type 2 diabetes (*)	The impact of heat on vasodilation in participants with Type 2 diabetes	Suggests that individuals with Type 2 diabetes may have altered control of vasodilation in the skin

reduction in height and increase in weight have been found in both longitudinal and cross-sectional research [8,19–21]. Thus, there is evidence of age-related change in body dimensions but at the current time, there is no data available to identify whether these changes will require changes in current guidance on workplace design.

Physical strength and endurance

Physical strength and endurance abilities are very specific to the individual. Although it is apparent that physical activity and training can improve muscle strength, it has been found to remain constant until ~40 years old then reduces slightly between 40 and 65 years [9]. de Zwart *et al*. [22] suggest that there is an average decline of 10–25% in muscular capacity at age 65 compared with the highest lifetime value; again, this is impacted upon by leisure activities and inter-individual variation.

Longitudinal research has identified that a range of measures including spinal flexibility, isometric trunk strength and hand grip strength reduced significantly over the 16 year follow-up period [19–21]. Although longitudinal research identifies reductions in specific strength or flexibility, two cross-sectional studies identified that older participants involved in heavy physical work had maintained strength and there were suggestions of a training effect from work [8,13]. This research suggests that occupationally relevant strength testing rather than general measures may be beneficial.

The need for recovery has been addressed by two studies. The studies identified that there is a significant increase in the need for recovery associated with increasing age, high physical and high psychological demands, monotonous work and working for >42 h/week [10,12]. It is currently unclear whether gender is an issue but managing older workers and their recovery is important.

Musculoskeletal disorders have been found to increase in both prevalence and incidence with age [11,23]. However, a recent review of work, inequalities and musculoskeletal health identified that there are varied results when examining relationships between musculoskeletal disorders and age [14]. Although it can be generally stated that there is an increased risk of many musculoskeletal disorders with age, the research is often confounded due to the way data have been collected (survey versus physical examination) and the fact that older workers often have longer exposure.

Balance

Punakallio [24] measured both postural balance (normal and tandem standing on a force plate) and functional balance (walking along a plank with error measurement) in 238 workers with an age range of 23–61 years. The workers were from four occupational groups, including construction workers, firefighters, nurses and home care workers. Analysis of the results identified that age was significantly related to increased sway when standing normally and age and occupation were associated with a reduction in physical balance. However, both firefighters and construction workers scored better in relation to functional balance suggesting a possible training effect for individuals who have demand placed on their abilities. However, the reduction in balance with age must be borne in mind in terms of high-risk environments.

Thermal tolerance

Reviews of the scientific literature on heat tolerance have concluded that age itself does not have any effect on heat tolerance but paradoxically older people are more susceptible to heat-related problems [15,16]. It appears that heat tolerance decreases due to age-related change of the

cardiovascular system [9]. Other influences likely to be encountered with an ageing population include the reduced thermoregulatory ability of those with type 2 diabetes [17]. Where such factors are controlled, then an ageing workforce appears to be no more susceptible to adverse effects from working in heat than younger workers. However, any health surveillance or risk assessment relating to work in hot environments should account for these influences, recognizing that ageing individuals within an established workforce might develop conditions which predispose them to heat-related illness.

Psychological factors

There are numerous studies that have identified that with ageing comes a slowing of reaction times [25]. The application of laboratory-based studies into the workplace is fraught with difficulties in addition to the issues identified when using data from cross-sectional versus longitudinal studies. Morgan [26] reviewed psychological aspects of ageing and identified that although reaction time slows down, this is mainly due to a slowing of central processing time. This slowing is accompanied by an increase in caution; thus, there is a trade-off between speed and accuracy where individuals slow down to increase accuracy on a task. However, slowing can be compensated via accumulated knowledge and experience. Thus, performance measures using speed will show a decrement with age; however, accuracy of performance in relation to quality or safety may be a more relevant measure. In terms of maintaining and improving intellectual functioning, Morgan suggests that there is support for the 'use it or lose it' hypothesis where maintenance of intellectual abilities has been associated with high levels of educational attainment, high occupational mental workload, regular intellectual stimulation and cognitive exercises. This suggests that the long-term maintenance of health is dependent on physical activity, diet and intellectual stimulation.

Despite media assertions on the impact of ageing on psychological processing, there are large inter-individual differences [25]. However, 95% of 1600 people surveyed over the age of 65 showed no signs of impairment [25].

Mental well-being

Only two papers identified in the review tackled aspects of this topic. De Lange *et al.* [27] identified that emotional exhaustion could be predicted in older workers by low social support from co-workers and supervisors. The second study of US police officers identified that risk reduction strategies for stress and improving coping strategies in those aged >50 years were important [28].

Sensory abilities

Although there are changes in sensory abilities including vision and hearing through ageing, it is clear that such changes can often be accommodated within the workplace. Changes in vision including a reduction in visual acuity, loss of accommodation, reduction in depth perception and loss of colour discrimination are clearly evidenced [25,29,30]. Some of these changes can be compensated at both an individual (use of spectacles) and an organizational level (improved lighting or task lighting). An age-related decline in hearing is estimated to affect 7–15% of the population [31]. However, compensation can be made using hearing aids and ensuring hearing protection at work is maintained throughout working life.

Working time

Again limited research was identified with regard to time at work. Allen *et al.* [32], in a study of 2746 US heavy manufacturing employees, identified that for older workers, adverse health outcomes were associated with being an hourly paid employee (more likely to be a physically demanding job) and working >60 h/week. Thus, requirements for excessive overtime will impact on older workers in heavy physical work.

In a study of 1449 individuals working in health care, the chemical industry and construction, it was found that work ability scores reduced with age but the reduction was also associated with heavy physical workload but maintained in individuals with autonomy and higher mental involvement [33]. For those working in shifts, a reduction in work ability was found to occur earlier (age 35) in females when compared to males (age 45). It was hypothesized this was due to the dual roles of female employees.

Accidents and injuries in older workers

When collected accident data are reviewed, a number of patterns are identified and the evidence is summarized in Table 4. However, it should be borne in mind that data are often collected in a variety of ways, which will of course impact on quality. In the UK, data from the Health & Safety Executive self-reported injuries at work identified that for reportable non-fatal injuries, males aged >55 years had the lowest estimated incidence rate, whereas females had the highest estimated incidence rate, which was attributed to a concentration of workers in blue collar roles [35,36].

In general, older workers are seen as having a lower accident risk than younger workers [25,35,40]. The most frequent injury types were sprains and strains (approximately one-third), with fractures, bruises and cuts accounting for 10% of all injuries. Overexertion was the common event leading to injury in ~25% of cases but falls on the same level accounted for 20% of events. The source of injury in 25% of cases was the floor and ground surface. Further research on treatment in US hospital departments identified that service industries had the

Table 4. Studies relating to occupational injury

Author	Study design and research type	Research question	Information provided
Benjamin and Wilson[25]	Review (**)	Facts and misconceptions about age and employability	Younger workers are at greater risk of accidents
Grandjean *et al.* [34]	Data analysis (**)	A breakdown of severe occupational injuries in older workers	Greater risk of fatalities in older workers
HSE [35]	Survey data (**)	Results of the self-reported work-related illness and workplace injuries	Data provided on self-reported injuries
Laflamme and Pollack [36]	Retrospective analysis of data (**)	Age-related risk of injury in automotive assembly	Increase in risk of older females is related to type of occupation rather than age
Laflamme and Menckel [37]	Review (**)	A review of ageing and occupational accidents	Older workers take more time off to recover after serious accidents
Layne and Pollack [38]	Retrospective analysis of data (**)	Non-fatal occupational injuries from slips, trips and falls to older workers	Commonest injuries were fractures and older workers more likely to be hospitalized
Layne and Landen [39]	Retrospective analysis of data (**)	Non-fatal occupational injuries to older workers	Commonest injuries in service industry but agriculture has highest injury risk
Personick and Windau [40]	Data analysis (**)	A breakdown of severe occupational injuries in older workers	Risk of injury lower for older workers with sprains and strains most common injury after exposure to overexertion
Pransky *et al.* [41]	Postal survey, $N = 3056$ (**)	Age-related differences in return to work post injury	No age-related difference in return to work after injury for older workers
Rogers and Wiatrowski [42]	Data (**)	Summary of workplace illness and injuries	Older workers more at risk of fatalities in the workplace

greatest number of injuries (32%) but the highest injury rate was found in agriculture, forestry and fishing (1.5/100 workers) and the most common injuries for those aged >65 years were fractures or dislocations with older workers more likely to be hospitalized [38,39].

The rates of time off due to injury in the UK were found to be highest in males aged 16–24 years but for females this was highest in those aged >55 years [35]. It has been identified that injuries sustained by older workers are more severe and result in more time away from work (a median of 8 days for the whole population compared with 12 days for those aged 55–64 years and 18 days for those aged >65 years) [37,42]. Although there may be increased time away from work, Pransky *et al.* [41] have identified that there are no significant age-related differences in function on return to work. This highlights the importance of workplace influence in ensuring a positive return to work, including longer time with the employer, higher levels of job satisfaction and positive employer/employee interaction after injury [41].

When data on fatalities in the workplace are examined, the fatality rate for older workers aged >65 years in the USA is three times that of younger workers [34,42] with a fatality rate of 11.3/100 000 workers. Within the UK, the total number of fatalities at work has decreased but the rate is highest for those aged 55–59 years at 1.6 [35]. In analysing this data, larger numbers of incidents were found in agriculture, construction and transportation [40].

The research suggests that although younger workers are more at risk of an injury at work, older workers are more at risk of fatalities. Although time for recovery is longer in older workers, return to work should not be problematic with good employer support.

Ill-health and ageing

Although the individual changes both physically and mentally throughout life, age itself is not the only determinant of whether someone is healthy. For those aged >65 years, there have been decreases in deaths from coronary heart disease (CHD), stroke, cancer and suicide and increases in life expectancy [43]. For those <65 years of age, there are ~1.7 million people living with chronic conditions including diabetes and arthritis [44]. Predictions to 2030 suggest that mental illness, CHD, stroke, musculoskeletal disorders, diabetes and certain cancers are likely to increase from increased obesity and alcohol use [44]. These predictions are based on current available evidence and can take no account of the possible impact of health behaviour changes from community or workplace initiatives.

The Labour Force Survey identifies that estimated prevalence rates of illness are highest in males aged 55–64 years and females aged 45–59 years but incidence rates are lower compared to younger workers for those aged >55 years [35]. The self-reported sickness absence was higher for both genders over the age of 55 (1.6 days

Table 5. Interventions for health promotion

Author	Study design and research type/quality	Research question	Study population, setting and country sample size	Description of interventions	Outcome variables	Outcomes
Karazman *et al.* [47]	Before and after (**)	What is the impact of a health promotion intervention on urban transport drivers	122 urban transport drivers in Germany	Took part in 20 health days over the period of 1 year including physical exercise, physical skills training, diet counselling and group self-experience	Work Ability Index and Effect Typology	No significant changes in Work Ability Index. When results broken down into effect typology, the Work Ability Index Score was increased in those individuals in the groups of high evolution and evolution—those that were inducing health potentials
Karazman *et al.* [48]	Before and after (**)	What is the impact of a health promotion intervention on urban transport drivers	122 urban transport drivers in Germany	Took part in 20 health days over the period of 1 year including physical exercise, physical skills training, diet counselling and group self-experience	Work Ability Index and Effect Typology	No significant changes in Work Ability Index. When results broken down into effect typology the Work Ability Index Score was increased in those individuals in the groups of high evolution and evolution—those that were inducing health potentials

for men and 1.8 days for women). However, the largest source of absence in the UK is short-term uncertified absence generally associated with younger workers [25]. What is concerning is the new cases of self-reported ill-health of which musculoskeletal disorders and stress were the most commonly reported; those aged >45 years have the highest prevalence rate [35].

In examining predictors of early exit from working life, it was identified that reduction in work ability, increase in BMI, reduction in fitness and negative organizational change were good predictors for early retirement [45]. Although this was a small study, it does indicate the importance of supporting fitness and managing change to maintain work ability.

Safety, health and health promotion interventions for older workers

The following section reviews research regarding interventions in the workplace for older workers.

Workplace interventions for safety

Research has identified that older workers are at most risk of a fatal injury and take longer to recover from non-fatal serious injuries. However, at the current time, there were no intervention studies identified that evaluated strategies to reduce injuries in older workers.

Workplace interventions for occupational health

Although tackled within this review, to prevent repetition please see McDermott *et al.* [46] in this issue.

Workplace interventions for health promotion

The term health promotion is defined in this review as 'the process of enabling people to increase control over the determinants of their health thus to improve their health' [45]. There has been limited research in this area and Table 5 presents a summary. The review by Shephard [48] suggests that both physical health factors and mental well-being can be improved but there is little evidence of long-term maintenance of change. Health checks, counselling and health condition tests were seen as positive by older workers [49,50]. One intervention study involving workers taking part in 20 health days identified that the intervention had improved work relationships, health potentials and increased decision-making ability in workers

who had moved into the evolution state of effect typology. Those workers scored significantly higher on the work ability index [46,47].

There is limited research on health promotion but factors identified as important are ensuring participation by older workers in activities, the importance of occupational health in this process, having positive working environments, good relationships with supervisors and co-workers and maintaining health and individual skills.

Data gaps from the review

The data gaps identified within the review include a lack of longitudinal studies, few good quality intervention studies and, at the current time, no further advancement in understanding the reasons for higher reporting rates for fatalities, injuries or non-specific illness. The data gaps do highlight the need for further research including objective measurement of physical and mental capacity.

Conclusions

The research on ageing workers has highlighted both physical and psychological change occurring in those aged >50 years; however, those changes are subject to large inter-individual differences and can be reduced by maintaining activity. There is still limited interventional research available to aid in the health and safety management of this occupational group.

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Conflicts of interest

None declared.

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