[¶33-365] Preserving lumbar spine physiology in the cleaning industry

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Conflict of interest

The authors of this paper declare no conflict of interest.

Abstract

Background: Lumbar spine disc breakdown may begin as early as the second decade of life. Peak bone mass occurs between the ages of 16 and 25 years and continuously decreases thereafter where bone loss occurs at a faster rate in females increasing throughout menopause. The objectives of this study were to examine the relationship of age and gender against lumbar or non-lumbar musculoskeletal disorder (MSD) diagnosis and post-injury recovery time.

Methods: Records of 144 MSD-related incidents that were recorded between 2012 and 2016 (five years) were retrieved from the injury register of a large commercial cleaning organisation (n = 700 cleaners) for analysis. The mean age of the organisations workforce was 57 years of age and 62% of cleaners were female by payroll.

Results: The overall non-lumbar related MSD was higher within the older age (>45 years) group (n = 53) as opposed to the younger age (<45 years) group (n = 34). Consequently, more lumbar spine-related MSDs occurred in the younger age (<45 years) group (n = 33) than the older age (>45 years) group (n = 24). A strong relationship was identified between the age of a cleaner (greater than or less than 45 years) and the type of MSD (lumbar or non-lumbar) (p = 0.027).

It was identified that that 110 (76.38%) of cleaners recovered from their MSD within four weeks. Of those in the younger age (<45 years) group then 16.42% (n = 11) took longer than four weeks to recover. Of those in the older age (>45 years) group then 29.87% (n = 23) took longer than four weeks to recover. A relationship between age and recovery time was identified at the 90% confidence interval (p = 0.058).

Conclusions: It was identified that non-lumbar musculoskeletal injury is more likely to occur as one ages. Furthermore, it was identified that age may have an adverse effect upon injury recovery time. It was recommended that manual handling, return to work training programs and work schedules be periodically reviewed to strategically target the potential impacts of age and gender. It was also recommended that task-specific warm-up programs be developed to reduce the potential of cold lifting-related incidents.

Keywords: age, gender, recovery, musculoskeletal, back injury.

Introduction

The Code of Practice — Hazardous Manual Tasks (2016) defines a hazardous manual task as a task that requires a person to lift, lower, push, pull, carry or otherwise move, hold or restrain any person, animal or thing involving one or more of the following:

- repetitive or sustained force
- high or sudden force
- repetitive movement
- sustained or awkward posture
- exposure to vibration.

These factors (known as characteristics of hazardous manual tasks) directly stress the body and can lead to injury.[1]

The code also defines a musculoskeletal disorder (MSD) as "an injury to, or a disease of, the musculoskeletal system, whether occurring suddenly or over time. It does not include an injury caused by crushing, entrapment (such as fractures and dislocations) or cutting resulting from the mechanical operation of plant".

MSDs may include conditions such as:

- sprains and strains of muscles, ligaments and tendons
- back injuries, including damage to the muscles, tendons, ligaments, spinal discs, nerves, joints and bones
- joint and bone injuries or degeneration, including injuries to the shoulder, elbow, wrist, hip, knee, ankle, hands and feet
- nerve injuries or compression (eg carpel tunnel syndrome)
- muscular and vascular disorders as a result of hand — arm vibration
- soft tissue hernias
- chronic pain.

MSDs occur in two ways:

- gradual wear and tear to joints, ligaments, muscles and inter-vertebral discs caused by repeated or continuous use of the same body parts, including static body positions
- sudden damage caused by strenuous activity, or unexpected movements such as when loads being handled move or change position suddenly.[1]

Lumbar discs

Studies show that lumbar spine disc breakdown may begin as early as the second decade of life.[2] Peak bone mass occurs between the ages of 16 and 25 years and continuously decreases thereafter. In males, bone loss occurs at a rate of 0.3% per year and in females this is 0.5%. With menopause, this rate can be as high as 5–6% per year within the first five years.[3]

Lumbar spine disc degeneration is the initiating event resulting in secondary degeneration of the facets, muscles and ligaments. Spinal disc degeneration results from the failure of cellular activity for the production of a normal extracellular matrix. There is a decrease in collagen, loss of water and cartilage protein agrecan resulting in the reduction in disc height and all are signs of aging. There is enzymatic degradation demonstrating that in addition to genetic predisposition, aging of the disc means this process is very much multifactorial.[4]

A decrease in the level of nutrients supplied to the spinal discs is an important factor in relation to disc degeneration. The primary means by which discs gain their nutrients is via the permeability at the vertebral end plate and this permeability is known to decrease with age. Hence, blood flow is also decreased at the end plate and results in breakdown of tissue which begins within the disc nucleus.[5]

As aging progresses, the boundary between the disc nucleus and its annulus becomes less distinct with an increase in collagen in the nucleus. For most people in the third and fourth decades of life, concentric fissuring (cracking, tearing and/or splitting) may commence within the discs. Quite often, changes tend to

occur consistently throughout the spine potentially resulting in significant biomechanical consequences to the disc height and turgor (reduced rigidity).[6]

Loss of mechanical competence with age accompanied by disc flattening can result in diffuse bulging where such disc herniation is often associated with pre-existing age-related degenerative changes.[7] A normal healthy disc is avascular for the most part noting that the presence of blood vessels present in herniated disc tissue is a sign of discal degeneration. During degeneration, there is desiccation of the nucleus pulposus with disintegration of the annulus fibrosis resulting in an actual decrease in disc height.[8]

With advancing age, metalloproteinase (MMP) expression increases which enhances destruction pathways into the disc. Blood vessels also penetrate though disc rim lesions and inflammatory cells can also invade a degenerated disc.[9] Nerve fibres can accompany blood vessels and have been found within the nucleus of painful discs.[10] Hence, an innervated (nerve supplied) disc may be the source of lower back pain.

In summary, aging starts throughout the various structures of the spine as early as the second decade of life.[2] Subsequent failure of normal cell activity is related to nutrition, genetics and mechanical forces. Once the degenerative cycle commences, an integrated mix of biochemical and biomechanical factors develop into a vicious cycle which progressively drives the degenerative process.

Osteoporosis

Decreases in bone mass occur as one ages and osteoporosis is the term used to describe loss of bone mass to below a critical level to which fracture risk becomes substantially high. Hence the incidence of osteoporotic fractures increases with age.[11] Bone is living tissue in a state of continuous turnover and renewal which enables it to adapt to physiological loads and repair structural defects. Osteoclast cells resorb bone leaving shallow pits in bone and osteoblasts synthesise (calcify) new bone by filling in the pit defects caused by osteoclasts. As such, the bone remodelling unit is a result of coupled osteoclast/osteoblast activity where their metabolic activity determines overall bone turnover.[12]

Bone homeostasis is under the influence of endogenous hormonal changes and mechanical external loads resulting from physical activity. The literature suggests that physical activity increasing bone load-bearing can be of benefit in reducing fractures in older adults.[13] There are two types of skeletal bone that being cortical which is compact and dense (for example, a weight-bearing long bone femur) and trabecular bone (internal scaffolding of long bones) which is commonly found in the spine.[14]

Cancellous bone is richly vascularised by osseous vascular complexes that pass between the less densely packed trabeculae. This arrangement produces a high surface to volume ratio of bone to extracellular fluids making cancellous bone more sensitive to metabolic changes which make the bone more susceptible to bone resorption and hence osteoporosis. Furthermore, metabolic effects have been linked to other conditions such as inflammatory bowel disease where bone turnover during such disease is characterised by low bone formation in the presence of normal levels of calcium regulating hormones.[15]

In relation to the vertebral body strength, the bone density and geometry are very important and cleaning activities may test bone strength. Bone mineral density is a good test of vertebral health, where osteoporosis may be influenced by dietary calcium deficiency, inactivity, bone formation ratio and the cumulative effect of aging. These effects are particularly more marked in females where calcium and vitamin D supplementation, weight-bearing exercise and hormone replacement therapy may be effective strategies in reducing bone loss.[12] Estrogen deficiency is largely responsible for osteoporosis in post-menopausal women being associated with increased osteoclast activity leading to bone resorption resulting in bone loss over the years.[16]

There is an increasing rate of MSDs as age increases for both genders. The rate of age-related change is likely to be accelerated by the effects of exposure to risks such as physically demanding work. It is noted that females are at higher risk than males hence risk assessment needs to take into account the female physical and physiological capability.[17]

Randall and Jeter (2003, p 7) have stated that "our body changes considerably over time, especially after 40 years of age. Aging leads to reductions in physical work capacity, range of lumbar spinal motion, muscle strength, muscle contraction speed, shock absorbing characteristics of the lumbar discs, intra-abdominal pressure, load supporting capacity of the spine and aerobic capacity".[18]

Clearly, risk assessment needs to consider age and gender because an injury particularly later in life can result in considerable recovery time and result in considerable worker's compensation premium costs. Cognitive changes can also occur with aging and when compounded with various physical factors of the workplace then the risk of an MSD may be further increased. A study of 17,000 workers across 21 different occupational groups demonstrated that women had significantly higher cases of pain in the wrist, neck, shoulder and elbow than men when the data was controlled for occupation and age.[17]

The objectives of the present study were to examine the relationship of age and gender against MSD diagnosis and post-injury recovery times with a view to developing measures that where implemented may reduce the incidence of lumbar spine injury and improve recovery times post-injury.

Methods

Cleaning activities by their nature involve a significant amount of manual handling activity that is very difficult to risk control particularly as a cleaner ages. Activities such as mopping, vacuuming and toilet cleaning can involve repetitive motion of significant frequency and periods of duration. Decanting of chemicals and manoeuvring of polishers may involve lifting of weights that may result in injury when not properly carried out. Furthermore, wet floors and poor housekeeping in cleaning rooms can present slip and trip hazards that may result in fall-related MSDs.

The study organisation consists of 700 (n = 700) full-time equivalent cleaners. The mean age of the workforce is 57 years of age and 62% of cleaners are female by payroll. This study examined 144 MSD-related incidents over a five-year period between 2012 and 2016. The commercial cleaning organisation providing the data for this study has a 24-hour per day, 7-day per week safety hotline managed by safety professionals. All employees are aware of this means of consultation and sign a document at induction agreeing that they understand and agree to report and use it.

Every cleaner's room throughout the operation has a wall poster posted which provides information on the hotline. Once a call is made to the hotline, whether it be to report an incident, near miss or any other issue it is logged into a spreadsheet. After the information is entered into a spreadsheet a file is created for the occurrence which triggers an incident investigation.

The statistical test selected to determine the existence of relationships between categorical variables in this study was the non-parametric Chi-square test. While a 95% confidence interval is preferred, on occasion it was reduced to 90% as a p-value slightly above 0.05 may result in potential loss of trends and relationships. In accordance with Australian work health and safety legislation, there exists a primary duty of care to identify, assess and control hazards, hence accepting a 90% confidence interval is a diligent and effective risk management approach.

Results and discussion

Relationship of age and gender to MSD type

This study tested the hypothesis that there would be a relationship between the age of cleaners and whether their MSD was lumbar or non-lumbar. A non-lumbar MSD would be for example a shoulder strain as opposed to a lower back-related lumbar spine strain. In this study, the overall non-lumbar related MSD was higher within the older age (>45 years) group (n = 53) as opposed to the younger age (<45 years) group (n = 34). Consequently, more lumbar spine-related MSDs occurred in the younger age (<45 years) group (n = 33) than the older age (>45 years) group (n = 24) (Table 1). The data was then analysed to determine if the age of a cleaner (greater than or less than 45 years) and the type of MSD (lumbar or non-lumbar) were independent. The outcome indicated there is a strong relationship between the two (p = 0.027).

Table 1: Cleaner age in years (less or greater than 45) versus musculoskeletal disorder (MSD) type (lumbar or non-lumbar)

	Less than 45 (<45)	Greater than 45 (>45)	Total number
Lumbar MSD	33	24	57
Non-lumbar MSD	34	53	87
Total	67	77	144

With younger cleaners (<45 years) experiencing more lumbar spine MSDs and older cleaners (>45 years) experiencing more non-lumbar spine MSDs, then this finding has led to a recommendation that manual handling training programs engage a more age-focused approach in relation to MSDs. It is speculated that older cleaners may be more aware of and experienced with lower back risk and are better able to protect themselves against it. This knowledge should lead to a focus upon correct lifting techniques within the younger age group and reduced risk of repetitive motion activity in the older age group. Examination of regulatory MSD data indicates that the diagnosis of lumbar spine injury dominates injury statistics in Australia.[19]

The findings of the present study have led to revision of injury rehabilitation programs so return to work coordinators better understand that injury type may be influenced by age-related factors which may lead to more effective light duties selection through a return to work plan. This particular study has also led to further findings that 76 (52.77%) of MSDs occurred within the first two hours of a shift. This has led to the recommendation that task-specific pre-start warm-up programs be developed by occupational health professionals, to mitigate the injury occurrences. Other research studies have identified the benefits of warm-up in reducing the risk of injury.[20] , [21]

This study also tested the hypothesis that there would be a relationship between the gender of cleaners and whether their MSD was lumbar or non-lumbar. From analysis of the data (Table 2), no significant findings were identified. As such, an analysis to determine if gender held any relationship to the type of MSD indicated that there was no significant relationship (p = 0.666). Despite this outcome, there is evidence to suggest that females in the 55- to 74-year-old age group have significantly more knee injury (non-lumbar MSD) than their male co-workers (p = 0.046).[22]

Table 2: Cleaner gender versus musculoskeletal disorder (MSD) type (lumbar or non-lumbar)

	Male number	Female number	Total number
Lumbar MSD	25	32	57
Non-lumbar MSD	35	52	87
Total	60	84	144

In terms of gender, the literature has presented that MSD symptoms do differ between the genders. In one operationally-based study, female workers experienced a higher prevalence of symptoms than men in all body regions.[23] A further study indicated that the main risk factors for repeated episodes of lower back pain in women are genetic heritability and being overweight.[24] Further research in this area may lead to more effective risk management programs that may strategically target each gender respectively in relation to work duties.

Relationship of age and gender with injury recovery time

This study tested the hypothesis that there would be a relationship between the age of cleaners and their recovery times in relation to MSDs. The results of this study identified that 110 (76.38%) cleaners recovered from their MSD within four weeks indicating sound injury management performance. Of those in the younger age (<45 years) group then 16.42% (n = 11) took longer than four weeks to recover. Of those in the older age (>45 years) group then 29.87% (n = 23) took longer than four weeks to recover. This suggests that age may have an adverse effect upon recovery (Table 3). Statistical examination of the relationship of age to recovery time presented a relationship at the 90% confidence interval (p = 0.058).

Table 3: Cleaner age in years (less or greater than 45) versus recovery (less or greater than four weeks)

	Less than 45 (<45)	Greater than 45 (>45)	Total number

Less than four weeks	56	54	110
Greater than four weeks	11	23	34
Total	67	77	144

The literature supports that recovery time increases in relation to advancing age. The literature also supports the fact that the faster an injured cleaner returns to work on a graduated return to work program then the faster their overall recovery shall be.[25] In support of interventions promoting speedy return to work, most people with back pain recover quickly without any residual functional loss. Overall 60–70% recover within 6 weeks and 80–90% by 12 weeks. Recovery after 12 weeks is slow and uncertain with only half of those unfit for greater than 12 months returning to work where after two years the recovery chances are close to zero.[26]

Injury recovery time is critical in industry as time loss equates to increased workers compensation premium costs. In many large cleaning organisations, this can be as high as $5 in premium cost for every $1 actually incurred on the claim. Hence, the literature indicates that older workers when injured take more time to recover and return to their pre-injury duties.[27] Therefore, testing age (<45 and >45 years) against recovery time is an important part of this study where any identified relationship may direct further research into the areas of improved return to work programs and review of return to work coordinator views and approaches.

The findings of this research may lead to organisationally funded medical interventions focused on returning older cleaners to work on lighter duties better functionally suited for their recovery. Furthermore, it may lead to a review of manual handling programs where all cleaners can be educated on the benefits of return to work and strategies geared towards more speedy recovery.

This study also tested the hypothesis that there would be a relationship between the gender of cleaners and their recovery times in relation to MSDs. Of the male MSDs then, 31.66% (n = 19) took longer than four weeks to recover where 17.86% (n = 15) females took longer than four weeks to recover. This suggests that males may take longer to recover from MSD (Table 4). Statistical examination of the relationship of age to recovery time presented a relationship at the 90% confidence interval (p = 0.054).

Table 4: Cleaner gender versus recovery (less or greater than four weeks)

	Male number	Female number	Total number
Less than four weeks	41	69	110
Greater than four weeks	19	15	34
Total	60	84	144

Injury recovery time is critical in industry as time loss equates to increased workers compensation premium costs. In relation to the organisation in this study, payroll data indicates the mean age of cleaners is 57 years and 62% of cleaners are female. The outcome of this research suggests that more functionally based allocation of work duties that reduce the requirements of older females to manually lift may result in reduced MSDs.

One important concept is that of legitimacy; which is the degree to which an injured worker feels they are believed by others regarding the authenticity of their symptoms and injury.[28] Addressing this may lead to human behavioural adjustments in return to work programs to ensure all cleaners receive the support they need to return to work.

On a final note, management front-line training programs should be reviewed to ensure managers are aware of statistical trends that impact upon their injured cleaner's functional capacity and rate at which they return to work. Educating management in this area should lead to less confusion and remove the stress placed on a cleaner to return to work when they may not have fully recovered.

Conclusions

In Australia during 2015–2016, a total of 90% of serious claims were due to injury and musculoskeletal disorders with the remaining 10% due to diseases.[29] It was identified in this study that non-lumbar musculoskeletal injury is more likely to occur as one ages. Furthermore, it was identified that age may have an adverse effect upon injury recovery time. Hence, it is recommended that manual handling, return to work training programs and work schedules be periodically reviewed to strategically target the potential impacts of

age and gender. The finding that 76 (52.77%) of MSDs occur during the first two hours of a shift was most significant leading to the recommendation that task-specific pre-start warm-up programs be implemented in order to reduce the risk of MSDs.

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Footnotes

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