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Musculoskeletal Disorders, Workforce Health and Productivity in the United States

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Executive Summary

This white paper summarizes what is known about musculoskeletal disorders (MSDs) in the United States and their relationship to employment. We review the major existing clinical, epidemiological and labour market evidence on the prevalence and impact of MSDs in the U.S. working-age population.

Musculoskeletal disorders represent a group of conditions that affect the muscles, tendons, ligaments, joints, peripheral nerves and supporting blood vessels in the body. MSDs constitute a significant proportion of the disease burden in the United States and have substantial economic implications. Of particular interest to this paper is the impact that MSDs have on people of working age.

The white paper draws on a literature review of the existing academic and grey literature looking at the prevalence and impact of MSDs on the labour market in the United States. The main findings can be summarized as follows.

- At any one time, just under one-third of adult Americans are living with joint pain, swelling or limitation of movement.
- There is a steep increase in MSD prevalence with age. As the U.S. workforce is expected to work for longer, the appropriate treatment and management of MSDs will be increasingly relevant to the workforce. That said, some MSDs, such as ankylosing spondylitis, tend to develop when individuals are younger and are at the beginning or formative stages of their working lives.
- There is also stratification in MSD prevalence rates according to socioeconomic status. Lower-income individuals are more likely to extend their working lives because they need to support themselves; they are therefore more likely to be working while managing an MSD. Furthermore, the risk of developing an MSD is higher for those who live in poverty.
- There is a link between obesity and MSDs; conversely, there is also a link between weight loss and recovering from or alleviating symptoms related to an MSD.
- Various co-morbidities can be linked to MSDs, with additional MSDs, mental health, cardiovascular disease and other age- and obesity-related illnesses being more likely when an MSD is already present.
- Costs related to MSDs are generally those arising from disability, medical expenses and reduced quality of life. Although MSD costs tend to be related to high morbidity rates, in some cases, such as rheumatoid arthritis, there are also increased mortality

rates.

- Direct costs (medical costs) related to MSDs from 2004 to 2006 were $576 billion, or 4.5% of gross domestic product (GDP).
- Indirect costs (calculated as lost wages) related to MSDs from 2004 to 2006 were $373 billion, or 2.9% of GDP.
- There are no nationally representative data on the work-related costs for MSDs, but data from the Integrated Benefits Institute suggest that for every 100 employees, MSDs cost employers about $103,000 annually.
- MSDs are the biggest single cause of lost workdays in the United States. In 2012, 29% of illnesses and injuries leading to days off work could be attributed to MSDs. MSDs are also linked to heightened presenteeism, early retirement and economic inactivity.
- MSDs can also be directly caused by work, and there is near consensus that MSDs are causally related to occupational ergonomic stressors such as repetitive motions, forceful exertions, nonneutral postures, vibrations and so on.
- Other job characteristics have been found to cause or aggravate MSDs, including jobs that are either high demand and high control or high demand and low control when compared with jobs that are low demand and low control. Furthermore, the conditions that tend to be found in low-skilled work have been linked to an increased likelihood of developing an MSD. Specific sectors can also be linked to higher MSD prevalence rates, including homecare workers and construction workers (who are also less likely to return to work after developing an MSD).

The detrimental effect that MSDs have on the U.S. workforce should not be underestimated, in terms of both economic costs to the employer and economic and social costs to the individual. As more employees are expected to work until they are older and obesity levels continue to rise, MSDs are set to become an even larger issue. There are clinical and workplace interventions that can counter this trend and lessen the burden of MSDs on the U.S. labour market.

Contents

Introduction

This white paper summarizes what is known about musculoskeletal disorders (MSDs) in the United States and their relationship to employment. This paper reviews the major existing clinical, epidemiological and labour market evidence on the prevalence and impact of MSDs in the U.S. working-age population.

Musculoskeletal disorders represent a group of conditions that affect the muscles, tendons, ligaments, joints, peripheral nerves and supporting blood vessels in the body (Punnett and Wegman, 2004:13). MSDs are defined in this paper as the diseases that fall under codes M00 to M90 in the International Statistical Classification of Diseases and Related Health Problems (ICD-10, 2010). The term *musculoskeletal disorders* encompasses a variety of conditions, ranging from those that have an acute onset and a short duration to lifelong disorders (Woolf and Pfleger, 2003:646). MSDs can be caused by wear and tear or damage to the joints and bones (e.g., osteoarthritis) but also include autoimmune diseases (e.g., rheumatoid arthritis) and genetic diseases (e.g., ankylosing spondylitis). MSDs account for a significant proportion of the disease burden in the United States and have considerable economic implications.

Musculoskeletal disorders have a substantial and detrimental effect on people of working age in the United States. Currently, two widely prevailing yet erroneous assumptions mean that the link between MSDs and the labour market are underappreciated and understudied. First, it is often assumed that MSDs have an impact only on older, non-working-age cohorts and are not particularly common among working-age groups. As this paper will show, this is not the case; and although older age groups have higher incidence rates of MSDs, significant numbers of the working-age population are affected by MSDs, and the onset of some types of MSDs is most likely to occur when someone is of working age. Second, priorities for funding, policy and research agendas would appear to assume that because MSDs have low mortality rates but high morbidity rates, they do not have as large an impact as diseases for which the reverse is true. Of course, this assumption depends on one's definition of *impact,* but the high morbidity rates associated with MSDs have substantial implications, especially in the context of work, including reduced productivity at work, sickness absence and early retirement.

As employees in the United States are expected to work until they are older and the need to control healthcare costs becomes more acute in a time of economic recovery, the

importance of understanding the role that MSDs play in the U.S. labour market becomes even more pronounced. A healthy workforce is one of the key components of sustaining an economic recovery, and understanding, preventing, treating and accommodating MSDs are key to maintaining a healthy workforce.

Literature Search Rationale

This paper presents the findings from a literature review conducted to identify the existing evidence on the prevalence of MSDs and their direct and indirect impacts on work in the United States. It is important to emphasize that this paper represents the results from a literature review and not a systematic review, which would have followed a stricter process and been far more costly and time-consuming. The search rationale that was constructed and followed is outlined below.

The following research questions were identified.

1. What are the rates of MSD prevalence in the United States? What is their likely future prevalence?
2. What is the impact of MSDs in the workplace, including sickness absence from work, employers' healthcare costs, and direct and indirect levels of work ability and productivity?
3. Do MSDs vary among different occupational sectors?
4. Do MSDs vary on the basis of geography or demography?
5. Do some aspects of employment cause MSDs or exacerbate the symptoms of MSDs?
6. What co-morbidities occur alongside MSDs?

A keyword search of the databases PubMed, Google Scholar and the Cochrane Library used the following search terms: *MSD* and/or *musculoskeletal disorder* and *USA,* along with each of the following terms:

- *Employment*
- *Work*
- *Job retention*
- *Occupational exposure*
- *Job/work type/role*
- *Productivity*
- *Sickness absence*
- *Healthcare costs*
- *Gender/age/socioeconomic status*
- *Work ability*

Any literature published before 1980 was excluded, as was any literature in which the United States did not feature as the country, or one of the countries, included in the study. The titles of papers were scanned to ascertain whether they would be of relevance to the literature review, and inappropriate papers were rejected. Points relevant to the research questions in selected papers were recorded and synthesized. Reference lists of included papers were used to identify additional relevant literature. In addition to the search process, relevant grey literature and data were identified through collaboration with experts in the field and, in particular, with the Integrated Benefits Institute (IBI).

Biopsychosocial Model of MSDs

A biopsychosocial approach allows for an exploration of the multiple implications that MSDs have for the U.S. labour market. There is an increasing acceptance of the biopsychosocial model in the treatment and management of MSDs. Traditionally, a biomedical model of health has predominated, whereby disease and illness are understood as biological phenomena that can be objectively diagnosed and then treated with scientifically proven interventions (Schultz et al., 2007:332). The patient is often regarded—and treated—as passive within the biomedical model, with healthcare professionals deciding on and leading interventions. The biomedical model is still common in acute healthcare but is rapidly declining within the context of disability and chronic conditions as the biopsychosocial model of illness becomes increasingly influential (Schultz et al., 2007:332).

A biopsychosocial model means that musculoskeletal disorders should be thought of as an interaction among physiologic, psychological and social factors (Gatchel, 2004:161). This approach indicates that an MSD should be considered not only as existing biologically but also as something that is contingent on the psychological and social context in which the disorder is occurring. The ramifications of this model are that a comprehensive approach is required to successfully understand and also to treat the condition. This paper can be seen to fit within a biopsychosocial understanding, as it posits that employment is important for understanding how MSDs exist as part of people's working lives. Additionally, an employee's work context and employer policies can exacerbate or alleviate some of the symptoms associated with MSDs (Sherehiy, 2004).

The biopsychosocial model has received criticism for focusing too much on the psychological factors that influence illness and for underemphasizing the social factors (Schultz et al., 2007:339). This lack of focus on the social may mean that illness is conceived of in a static fashion, as opposed to something embedded in broader social processes. An emphasis on the psychological may also lead to too much attention being paid to the individual experiencing the illness, to the detriment of social considerations, which include broader external factors such as the role that the workplace plays. This paper employs a biopsychosocial model of illness and aims to bring to the fore the complex role that MSDs play in people's working lives.

Quantifying MSDs in the United States

Prevalence of MSDs in the United States

In 2005, 107.7 million U.S. adults reported that they experienced a musculoskeletal disorder for three months or longer (i.e., the condition was chronic) at some point in the preceding year; this is almost twice as many people as reported any other medical condition (BMUS, 2008:1).

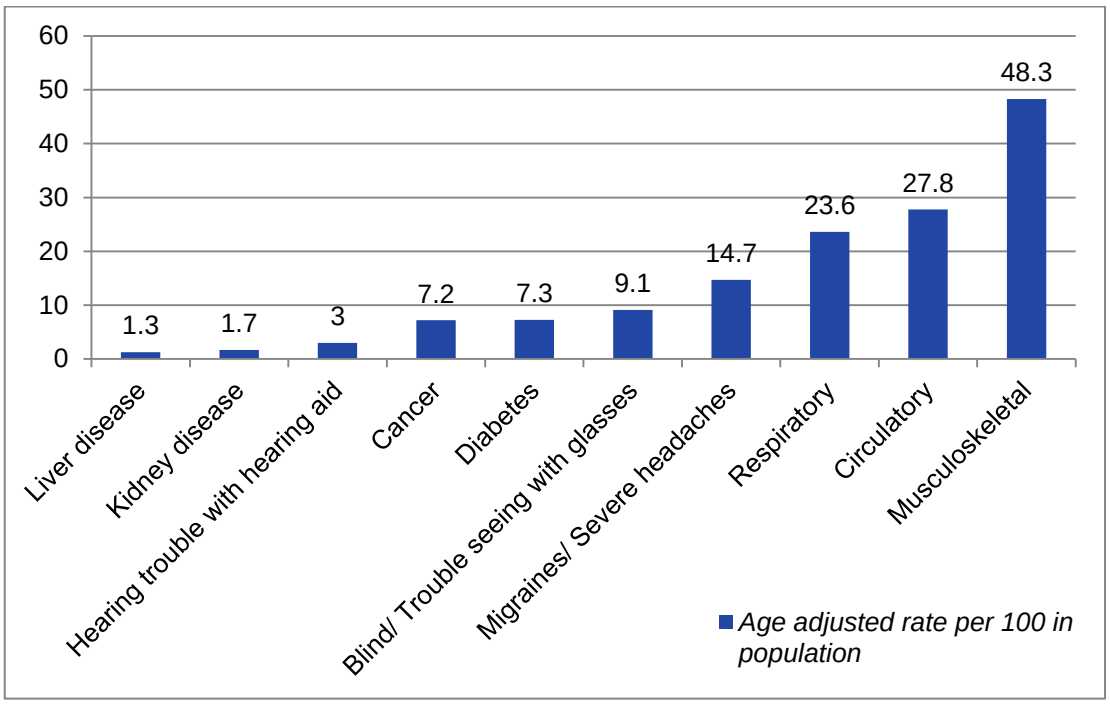

Figure 1. Prevalence of self-reported primary medical conditions for persons ages 18 or older, United States, 2005 (BMUS, 2008:1).

At any given time, just under one-third (30%) of U.S. adults are living with joint pain, swelling or limitation of movement (Woolf and Pfleger, 2003:646). Low back pain is the most prevalent type of musculoskeletal condition, with approximately 4% to 33% of the population suffering from back pain at any one time (Woolf and Pfleger, 2003:646). Arthritis and other rheumatic conditions are the second most prevalent MSD among adults (BMUS, 2008:3). The National Health Interview Survey found that in 2008, 61.6 million U.S. adults had chronic joint pain and that for 51.2 million of these people, the pain was attributable to arthritis (Dall et al., 2013:1). A further 62 million people had low back pain, and 31.4 million people experienced neck pain (Dall et al., 2013:1).

Demographics and MSDs

The prevalence of musculoskeletal disorders in the United States is higher among women than men and shows a steep increase with age (Woolf and Pfleger, 2003:647). Indeed, one of the major challenges of an aging population is the increasing burden of musculoskeletal disorders (BMUS, 2008:1). Along with obesity and the overuse of joints, age is one of the major risk factors for developing an MSD (Yelin, Trupin and Sebesta, 1999:778). This is borne out when one looks at the ages of those being diagnosed and treated for MSDs. In 2007, the average age of hospitalization for a person with low back pain was 60.5 years (BMUS, 2008:24). Some types of MSDs are particularly prevalent among older age groups, with osteoporosis occurring predominantly in those over 65, with those ages 75 and older accounting for 55% of diagnoses (BMUS, 2008:106). The ongoing increase in life expectancy in part informs projections that suggest that over the next 25 years there will be a 40% increase in arthritis diagnoses (BMUS, 2008:75).

The link between aging and MSDs does not mean that MSDs are not present in or relevant to the working-age population. One point to be made is that the United States, like many other developed countries, is in the process of increasing its retirement age. Those born in or after 1960 will have a “full retirement age” of 67, whereas those born in 1937 or earlier could retire and receive full-rate Social Security payments at age 65 (Office of Social Security, 2014). As it becomes increasingly normalized, and indeed legislated for, that people will work well into their sixties, it becomes increasingly important to consider the chronic conditions that may impede people’s ability to do so.

In addition, MSDs should not be considered as occurring exclusively in older age. Some MSDs are more likely to be diagnosed among younger age groups; for example, the onset of rheumatoid arthritis (RA) for women is most likely to occur between the ages of 30 and 60 (Arthritis Foundation, 2013). Ankylosing spondylitis is a form of arthritis whose onset usually occurs between the ages of 17 and 45 (Ankylosing Spondylitis, 2013). Other specific MSDs, despite being most prevalent among older cohorts, are showing an increase in prevalence among the working-age population. Indeed, the total share of osteoporosis diagnoses attributable to women between 18 and 44 rose from 13% in 2004 to 18% in 2006 (BMUS, 2008:107). Treatments for some types of MSDs are most prevalent among the working-age, as opposed to retirement-age, population. Approximately 70% of rotator cuff repairs, 81% of lumbar disc herniation operations and nearly 100% of anterior cruciate ligament reconstructions are conducted on patients younger than 65 (Dall et al., 2013:10). Workers under age 55 lose more work time in short-term disability (STD) claims due to sprains and fractures than older workers, and low back pain results in similar disability durations across age groups (Gifford, 2013).

Despite many MSDs being most prevalent among older cohorts, these conditions should not be considered as existing separately from the world of work. Furthermore, it has been found that, compared with their more affluent peers, lower-income Americans tend to extend their working lives to support themselves and are less likely to retire if they develop arthritis, meaning they continue to struggle in the workforce despite their condition (Caban-Martinez et al., 2011:1732).

Looking more closely at socioeconomic status, it has been found that how someone experiences an MSD and the impact it has on his or her life can be differentiated along socioeconomic lines. One study (Cleveland et al., 2013) found that living in a community with high household poverty rates and lower educational attainment is associated with poorer outcomes in relation to hip osteoarthritis. For individuals with systemic lupus erythematosus, early work disability has been found to be associated with having an income below the poverty line as well as with receiving Medicaid or having no health insurance (Partridge et al., 1997). The characteristics of some low-paying jobs that mean individuals are more likely to develop an MSD, or are more likely to suffer detrimental effects of an MSD once it has developed, are explored in greater detail later in this paper.

The current existing data present some barriers to further investigation of the prevalence of MSDs among the working-age population. As is presented in greater detail in the section MSDs and Work, occupational MSDs—that is, diseases attributable to working conditions—are often treated as separate from MSDs caused by other factors. The latter type of MSD is rarely considered in the context of work and the impact that it might have on someone's employment, whereas for the former type there is detailed data available on related prevalence rates, variation by industry sector, sickness absence and so on. Additionally, regardless of whether the underlying MSD conditions are caused by work, the symptoms of MSDs can be exacerbated or diminished by work-related factors, further illustrating that it is an oversimplification to treat as binary categories work-related MSDs and MSDs not directly attributable to work. Indeed, whether or not an MSD is caused by work, best practice should dictate the same treatment protocol for the underlying condition and the same supports to return the person to working status in a healthy manner.

MSDs and Personal Characteristics

MSDs have also been found to be associated with particular individual traits. There is a well-established link between obesity and some MSDs, which has been explored in the context of work to some extent. A review article found that the combination of being overweight or obese and jobs involving weight-bearing requirements is associated with an increased risk of both injury and musculoskeletal pain (Faghri and Momeni, 2014). Conversely, weight loss is

associated with a reduction in musculoskeletal pain, as was demonstrated in a study by Kotowski and Davis (2010).

MSDs have also been found to be associated with an individual's personal relationships. For example, a recent review (Brennan et al., 2009) found that individuals who were married or living with someone else had a reduced risk of experiencing an osteoporotic fracture. Another study further supports this finding, as it was seen that individuals with low social support tended to experience higher levels of musculoskeletal pain (Katz, 2002).

Co-morbidities

There are several other conditions that people are likely to experience alongside an MSD. People often do not experience one musculoskeletal disorder in isolation, and many will experience multiple MSDs simultaneously (Dall et al., 2013:1). MSDs can also be linked to mental health conditions, with the presence of an MSD signaling an increased likelihood of experiencing mental illness. Individuals with musculoskeletal disorders are likely to experience pain as part of the condition, and depressive symptoms and conditions are more likely to be found in people living with pain (Lubeck, 2003:535). A cross-sectional survey of 1,572 healthcare workers in two large hospitals in the Boston area found that those with MSD pain reported significantly higher levels of psychological distress than those who did not experience any pain (Reme et al., 2012:503). Another study found that among individuals with low back and/or neck pain, the following co-morbidities were significantly more likely: respiratory, cardiovascular, gastrointestinal, chronic pain, other musculoskeletal conditions and other chronic conditions (Strine and Hootman, 2007). MSDs, and rheumatoid arthritis in particular, represent an increased risk of developing a cardiovascular condition (Liao and Solomon, 2013:45). One article reviewing previous studies found that traditional cardiovascular co-morbidities such as dyslipidemia, obesity, insulin resistance and diabetes, hypertension, cigarette smoking and physical inactivity were also more often found among individuals with RA (Liao and Solomon, 2013:45).

It has already been shown that age and obesity are two of the major risk factors for developing an MSD (Yelin, Trupin and Sebesta, 1999:778), meaning some people with an MSD may also be living with other diseases associated with being overweight or with old age. The link between obesity and MSDs is complex; it has been found, for example, that obesity can cause osteoarthritis because it triggers the biomechanical and inflammatory changes that cause the condition (Koonce and Bravman, 2013). It is estimated that in the United States the prevalence of obesity is 54% higher among people with arthritis (Liao and Solomon, 2013:47).

The effect of co-morbidities has been quantified and shown to be substantial: It has been calculated in the U.K. context that co-morbid mental health problems that are present alongside long-term conditions raise total healthcare costs by a minimum of 45% (Naylor et al., 2012:1). A U.S. study on the impact of mental and physical co-morbidity on role disability found that musculoskeletal and socioemotional conditions had the largest estimated effects on disability of all the conditions assessed (Merikangas et al., 2007).

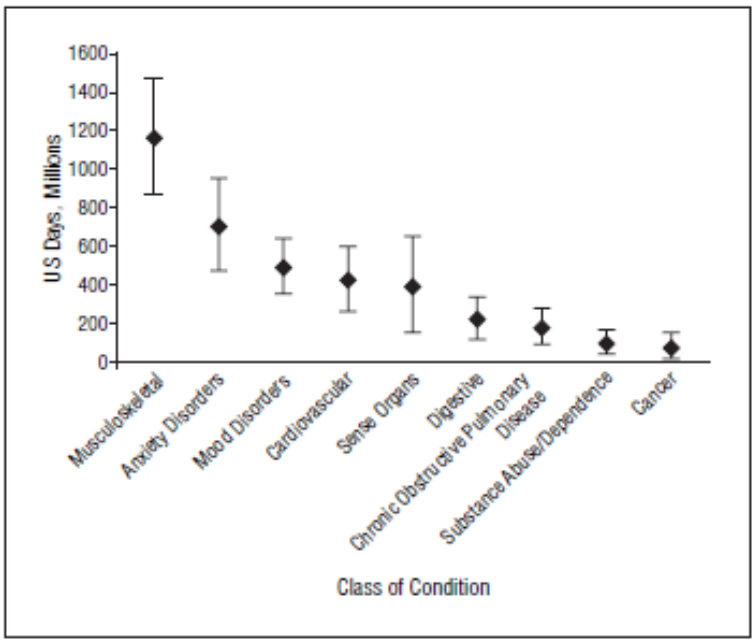

Figure 2. Mean (2 SEs) days of role disability at the population level attributable to each class of physical and mental condition (Merikangas et al., 2007).

Cost of MSDs

The direct and indirect costs attributable to MSDs are substantial. Generally speaking, the mortality rates linked to MSDs are low, although some types of MSDs, such as rheumatoid arthritis, represent an increased mortality risk compared with the general population (Ogdie et al., 2014). In fact, worryingly, the mortality rate for individuals living with RA has not improved in the past 20 years (Humphreys et al., 2014). The impact of most MSDs is felt in the form of rates of disability, medical costs and reduced quality of life (Lubeck, 2003:529).

The generally low mortality rates may be one reason why there is less attention, and indeed funding, for MSDs, as their impact is not viewed as being as substantial as those of diseases with higher mortality rates. This stance, however, overlooks the ways in which MSDs compromise people's well-being and ability to participate in and contribute to the workforce. Indeed, low back pain was the third-leading cause of disability-adjusted life years (i.e., the sum of years of life lost and years lived with disability) in North America in 2010; "other

musculoskeletal disorders" were the thirteenth most common cause, and osteoarthritis was the twentieth (Murray et al., 2012:2216).

Looking first at direct costs, it was estimated that from 2004 to 2006 the medical costs related to MSDs in the United States was $576 billion, which is equivalent to 4.5% of gross domestic product (GDP) (BMUS, 2008:219). Looking at more-specific groups of conditions, it can be seen that between 2002 and 2004 the cost of medical care for spinal conditions was $193.9 billion (BMUS, 2008:225), while the estimated cost of medical care for arthritis and joint pain was $281.5 billion (BMUS, 2008:224). Direct costs are likely to continue rising not only because of an increasing disease burden that can be linked to an aging population and rising rates of obesity but also because an increasing number of more expensive drug therapies are being developed, which also adds to rising costs (Lubeck, 2003:531).

Figure 3 shows that when one looks at aggregate healthcare costs for MSDs, the group accounting for the highest proportion of total costs are those ages 45 to 64, highlighting the importance of considering MSDs as conditions that are highly relevant to the working-age population. Indeed, the proportion of aggregate MSD healthcare costs attributable to the working-age (i.e., those ages 18 to 64) population (58%) is substantially higher than that for ages 65 and over (38%).

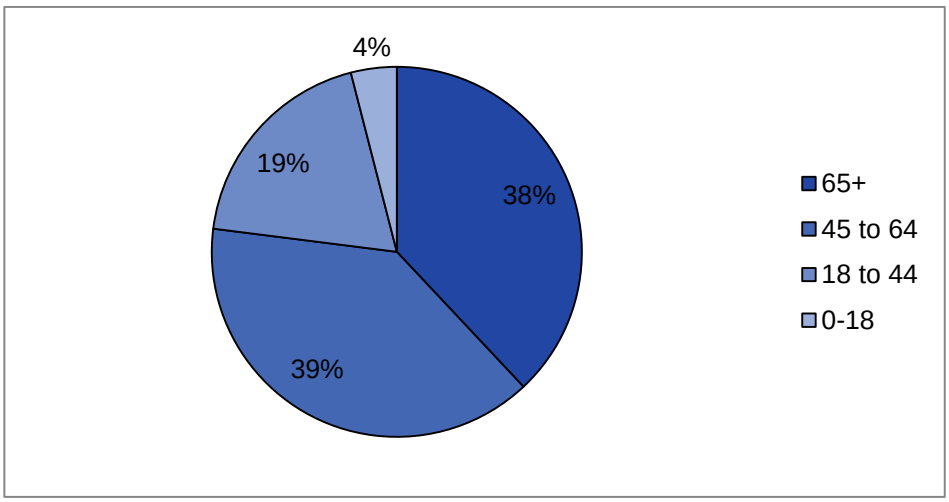

Figure 3. Aggregate healthcare costs for MSDs by age group, 2002–2004 (BMUS, 2008:245)

Indirect costs, which in this instance are defined as lost wages for people of working age with a musculoskeletal disorder, were $373.1 billion, or 2.9% of GDP, between 2004 and 2006 (BMUS, 2008:219). There are unanswered methodological issues involved in measuring indirect costs: Figure 4 estimates earnings losses only for those ages 64 or younger; all those ages 65 or older are excluded from the analysis because there is not a

large enough pool of people working to produce reliable wage-loss estimates. Furthermore, earnings-loss calculations were conducted only for people with an MSD who had a work history either before or after the onset of disease. This excludes from the analysis those who have never taken up paid work but would have done so if they did not have an MSD. Another methodological concern is that the figure presented here limits its analysis to wages lost by those with the condition, whereas it may be pertinent to also include relatives who have compromised their earnings because of care and support responsibilities. Additional costs beyond wages that are often unaccounted for in economic analyses include the influence of a worker's illness on other co-workers, the time sensitivity of production processes or service delivery and the ease of replacing staff—all of which exert real costs on the employer (Nicholson, 2006).

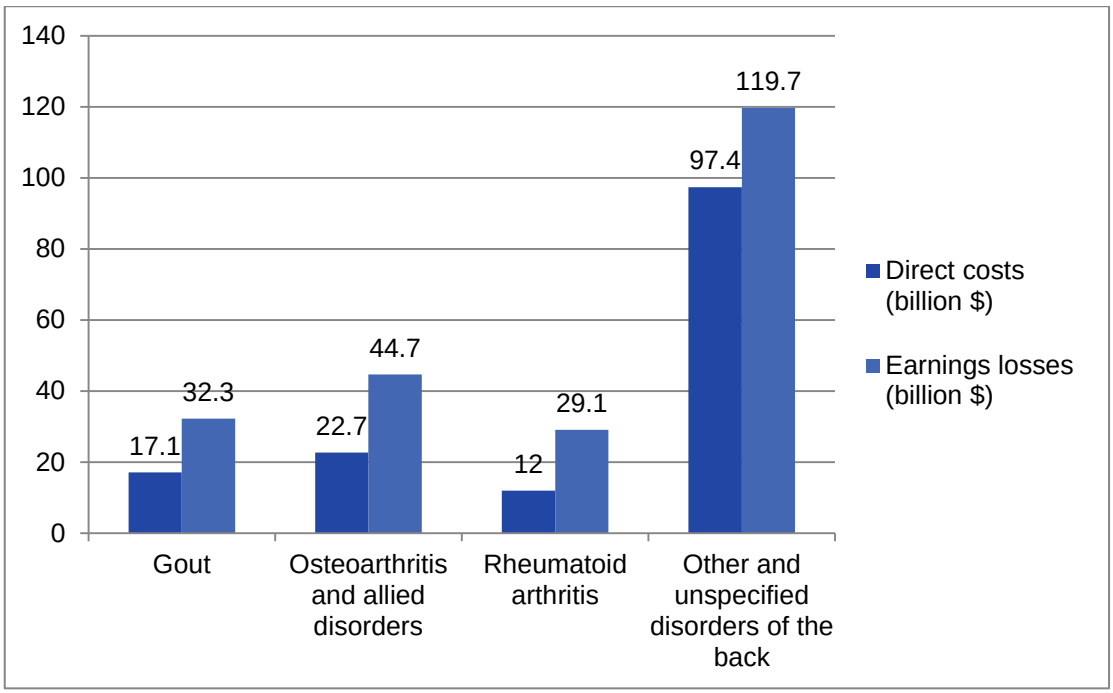

Figure 4. Total aggregate direct costs and earnings losses for selected MSDs in the United States, 2000–2004 (BMUS, 2008:249).

There are also differences between different demographic groups in terms of costs related to MSDs. Women with an MSD incur an expenditure that is about 20% higher than that of men, white people have costs that are 30% higher than other ethnicities, and those who are married, divorced, separated or widowed have costs that are 87% higher than those who have never been married (BMUS, 2008:226).

MSDs and Work

Musculoskeletal disorders must be considered in the context of workforce participation. In this paper, we define *work* as "paid employment." This is because the existing literature being synthesized in this paper focuses on paid employment and subsectors within this category and not because a claim is being made about the importance of paid work in comparison with work in the home, volunteering and so on. Indeed, there is a need to extend research on employment and health, and on employment and MSDs in particular, to include work that falls outside the category of formal employment.

MSDs can be linked to lost workdays and wages (which are quantified in the section MSDs and Work-Related Productivity Costs), reduced productivity, early retirement and unemployment. The consequences of MSDs are significant for the employee who is experiencing an MSD as well as for the employer. Furthermore, the fact that the U.S. evidence base on MSDs and work is often focused on occupational MSDs (that is, MSDs caused or associated with work) means that MSDs *not* caused by work but which may affect an employee's ability to work are not included in analyses, and the burden of MSDs is underestimated.

An employee who has an MSD diagnosis may experience a limited ability to work, which may in turn lead to lost wages, unwanted time away from the workforce, lowered self-esteem and social disconnection. An employer may experience lost productivity, loss of personnel or a rise in sickness payments and staff absenteeism. Conversely, employees who have better physical and mental health are likely to have lower stress levels and are more likely to be engaged and satisfied with their job (Aumann and Galinsky, 2011:15). A 2008 survey found that 35% of employees who rated their overall health as excellent described themselves as "highly engaged" in their work; between 22% and 27% of respondents who described themselves as "highly engaged" rated their health as good, fair or poor (Aumann and Galinsky, 2011:15).

MSDs are the greatest single cause of lost workdays and medical bed days in the United States (BMUS, 2008:5). The U.S. Bureau of Labor Statistics found that in 2012 MSDs accounted for 29% of all illnesses and injuries that required days off work (Gerr et al., 2013). Looking at one specific MSD for illustration, Puolakka et al. collected data on 152 gainfully employed patients who were having surgery for lumber disc herniation; 53% of the patients in the study reported taking sick leave because of their MSD, and 10% said that they had

been awarded a permanent work disability pension as a result of back pain (reported in Dall et al., 2013:2).

Another work-related issue posed by MSDs is presenteeism, that is, being at work while unwell, thus compromising productivity. Presenteeism is difficult to quantify, and national-level datasets do not include presenteeism estimates. A study by Ricci et al. looked at 412 workers in the United States who either did or did not suffer from clinically meaningful back pain (reported in Dall et al., 2013:13). Of those who did report back pain, 79.6% said that they experienced productivity loss due to presenteeism. The mean number of hours lost over a two-week period due to presenteeism equated to 4.4 hours per worker. A 2012 study by Lang et al. quantified the cost of presenteeism attributable to employees with arthritis and estimated that costs amounted to $252 per year per employee with the illness (Lang et al., 2012).

There is also a heightened risk of early retirement among those with an MSD. As has been seen already, the demographic spread of MSDs shows a greater prevalence among older cohorts; for example, back pain is most likely to occur among those ages 65 to 74 (BMUS, 2008:28). With MSDs being more common among populations toward the end of their working lives, the diagnosis of an MSD may prompt, or act as a catalyst for, someone to leave the workforce and retire. A study of 14,474 construction workers, for example, found that, controlling for other demographic factors, there was a 6% increase in likelihood of retirement with every point decrease in physical functioning (Welch et al., 2010:554).

There is also an increased likelihood of someone with a diagnosis of an MSD not participating in the labour force at all when compared with someone without any health problems. Working-age men with arthritis are 20% less likely than comparable individuals without arthritis to be economically active, while the same is true for 25% of women (Lubeck, 2003:530). Dall et al. found that physical limitations decrease the probability of being employed and suggest that MSDs are a major contributor to physical limitation (Dall et al., 2013:3). Compared with a person with no difficulty walking a quarter mile, the study found that someone reported as having “a little difficulty” was 16% less likely to be employed, whereas someone who found it “somewhat difficult” had their chances decreased by 24% and someone who found it “very difficult” would be 32% less likely to be employed.

MSDs and Work-Related Productivity Costs

A variety of direct and indirect costs associated with MSDs has been presented so far. Ideally, we would be able to report the full costs of the burden of MSDs in the workplace. Currently, there is no single source of nationally representative data in the United States to report this broader range of work-related impacts. Until such time, what is available are

estimates for the U.S. workforce of work-related productivity costs produced by the Integrated Benefits Institute (IBI, 2014).

To estimate the full costs of MSDs in the U.S. workforce, IBI uses a variety of data sources to produce comparable estimates. Incidence rates, cost assumptions and data sources are outlined below and in fuller detail in the referenced footnotes. What follows are the assumptions and inputs to the estimation model, followed by the full-cost result.

From IBI's multi-employer specialized research databases containing information on chronic conditions, absence and presenteeism as measured by HPQ-Select (IBI, 2014), a modification of the Health and Work Performance Questionnaire, 28% of respondents had at least one of the following four musculoskeletal conditions: low back/neck pain, arthritis, osteoporosis or other chronic pain across 99,558 employees. The HPQ-Select database is limited to these self-reported conditions, therefore absence and presenteeism estimates for MSDs reported here are likely low-end estimates of the burden of MSDs because a broader range of MSD diagnoses is not available. From the other data sources, the estimates are most often based on ICD-9 categories 710 to 739 and represent a more comprehensive set of MSD conditions. Refer to the footnotes for the assumptions made and data sources used.

In a population of 100 working people:

- 28% report at least one musculoskeletal condition.[1]
- 11% had treatment for osteoarthritis, 8% had treatment for back problems, 6% had treatment for lupus and other connective tissue disorders and 2% had treatment for other bone and musculoskeletal diseases.[2]
- There will be 59 short-term disability days for MSD conditions.[3]
- There will be 41 long-term disability (LTD) days for MSD conditions.[4]

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[1] Prevalence estimates for musculoskeletal conditions come from the Integrated Benefits Institute's multi-employer specialized research databases containing information on health risks, chronic conditions, sociodemographics and HPQ lost-time measures. Across 99,558 employees, 28% had at least one of the following four musculoskeletal conditions: low back/neck pain, arthritis, osteoporosis or other chronic pain.

[2] Agency for Healthcare Research and Quality (AHRQ), Medical Expenditure Panel Survey (MEPS), 2011 data. Results are for adults ages 18 to 64 with private insurance.

[3] Integrated Benefits Institute, IBI Health and Productivity Benchmarking, 2011. STD claims for about 12.9 new MSD (i.e., ICD-9 categories 710 to 739) claims per 1,000 covered lives, with an average of 45.8 lost workdays per closed claim. We assume that our hypothetical pool is 100% STD eligible.

[4] Integrated Benefits Institute, IBI Health and Productivity Benchmarking, 2011. LTD claims for about 2.1 active MSD claims per 1,000 covered lives, with an average of 198.8 lost workdays per calendar year. We assume that our hypothetical pool is 100% LTD eligible.

- There will be 11 workers' compensation (WC) days for back problems.[5]
- There will be ≈$3,200 for WC medical and nonwage indemnity costs for MSD conditions.

People[6] with arthritis:

- Are absent 3.4 more days per year than people without arthritis, and they have the equivalent of 0.8 more days of presenteeism than people without arthritis.
    - All of this lost time is attributable to co-morbidities.

People with back pain:

- Are absent 4 more days per year than people without back pain.
    - 1.5 of these days are attributable to back pain rather than co-morbidities.
- Have the equivalent of 4.4 more days of presenteeism than people without back problems.
    - 1 of these days is attributable to back pain rather than co-morbidities.

People with osteoporosis:

- Have the equivalent of 9.9 more days of presenteeism than people without osteoporosis.
    - All of these days are attributable to co-morbidities.

People with other chronic pain:

- Are absent 4.4 more days per year than people without chronic pain.
    - All of these days are attributable to co-morbidities.
- Have the equivalent of 4.9 more days of presenteeism than people without chronic pain.
    - 1.5 of these days are attributable to chronic pain rather than co-morbidities.

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[5] Integrated Benefits Institute, IBI Health and Productivity Benchmarking, 2011, and Bureau of Labor Statistics (BLS), Injuries, Illness and Fatalities, 2011. WC claims for about 1.6 new MSD claims with lost work time per 1,000 employees, with an average of 67.4 lost workdays per calendar year. There will be an additional 2.2 new MSD claims without lost work time per 1,000 employees.

[6] All sick-day and presenteeism results come from the Integrated Benefits Institute, HPQ-Select and Health & Productivity Snapshot. Marginal results are adjusted for age, sex, occupation and co-morbidities. The marginal values of lost productivity are used to make the results consistent with the single-cause costs for medical treatments and disability claims.

Economic assumptions:

- Average daily wages and benefits for sick days and presenteeism are $249.[7]
- Average daily wages and benefits for STD days are $185.[8]
- Average daily wages and benefits for LTD days are $102.[9]
- Average daily wages and benefits for WC days are $190.[10]
- The average WC claim has $3,215 in medical and nonwage indemnity costs. For the purposes of this display, nonwage indemnity costs are added to wage costs.
- The average person with a medical treatment for arthritis has total medical costs of $2,499.[11]
- The average person with a medical treatment for back problems has total medical costs of $1,938.[12]
- The average person with a medical treatment for lupus and other connective tissue disorders has total medical costs of $2,457.[13]
- The average person with a medical treatment for other bone and musculoskeletal diseases has total medical costs of $1,745.[14]
- For every missed workday, in addition to wage replacements we assume that an employer experiences opportunity costs in lost revenues, overtime and overstaffing equal to 38% of daily wages and benefits.[15]
- For every equivalent lost workday due to presenteeism, in addition to wage replacements we assume that an employer experiences opportunity costs in lost revenues, overtime and overstaffing equal to 31% of daily wages and benefits.[16]

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[7] BLS, Occupational Employment Statistics; National Compensation Survey. Average daily wages of $174, plus average daily benefits of $75. We assume that 100% of employees are eligible for paid sick days.

[8] BLS, Occupational Employment Statistics; National Compensation Survey; Employee Benefits Survey. Average daily benefits of $75 plus the lesser of 63% of daily wages or $112 per day.

[9] BLS, Occupational Employment Statistics; National Compensation Survey; Employee Benefits Survey. Average daily benefits of $0 plus the lesser of 59% of daily wages or $375 per day.

[10] BLS, Occupational Employment Statistics; National Compensation Survey; Employee Benefits Survey. National Academy of Social Insurance, Workers' Compensation: Benefits, Coverage, and Costs, 2010. Average daily benefits of $75 plus the lesser of 66% of daily wages or $171 per day.

[11] AHRQ, Medical Expenditure Panel Survey (MEPS), 2011 data. Results are for adults ages 18 to 64 with private insurance. Includes out-of-pocket expenses and payments by non-private insurance.

[12] AHRQ, Medical Expenditure Panel Survey (MEPS), 2011 data. Results are for adults ages 18 to 64 with private insurance. Includes out-of-pocket expenses and payments by non-private insurance.

[13] AHRQ, Medical Expenditure Panel Survey (MEPS), 2011 data. Results are for adults ages 18 to 64 with private insurance. Includes out-of-pocket expenses and payments by non-private insurance.

[14] AHRQ, Medical Expenditure Panel Survey (MEPS), 2011 data. Results are for adults ages 18 to 64 with private insurance. Includes out-of-pocket expenses and payments by non-private insurance.

[15] The method for valuing lost productivity is adapted from Nicholson S., Pauly MV, Polsky D, Sharda C, Szrek H and Berger ML. (2006). Measuring the effects of work loss on productivity with team production. *Health Economics, 15*(2), 111–123.

- There is no lost productivity for LTD.

Full Costs

Based on the foregoing assumptions and inputs, for every 100 employees MSDs cost employers about $103,000 annually. Of that $103,000, medical costs for treating MSDs account for about 60% of the total. Non-occupational disabilities—short-term disability and long-term disability—account for another 20%. The remaining 20% is split roughly equally among incidental sick days, occupational injuries (workers' compensation) and presenteeism (the value of lost productivity on the job attributable to MSDs). As noted previously, these are low-end estimates of the full costs of MSDs in the U.S. workforce, as only a limited range of types of MSDs is available in the multiple datasets used to produce these estimates.

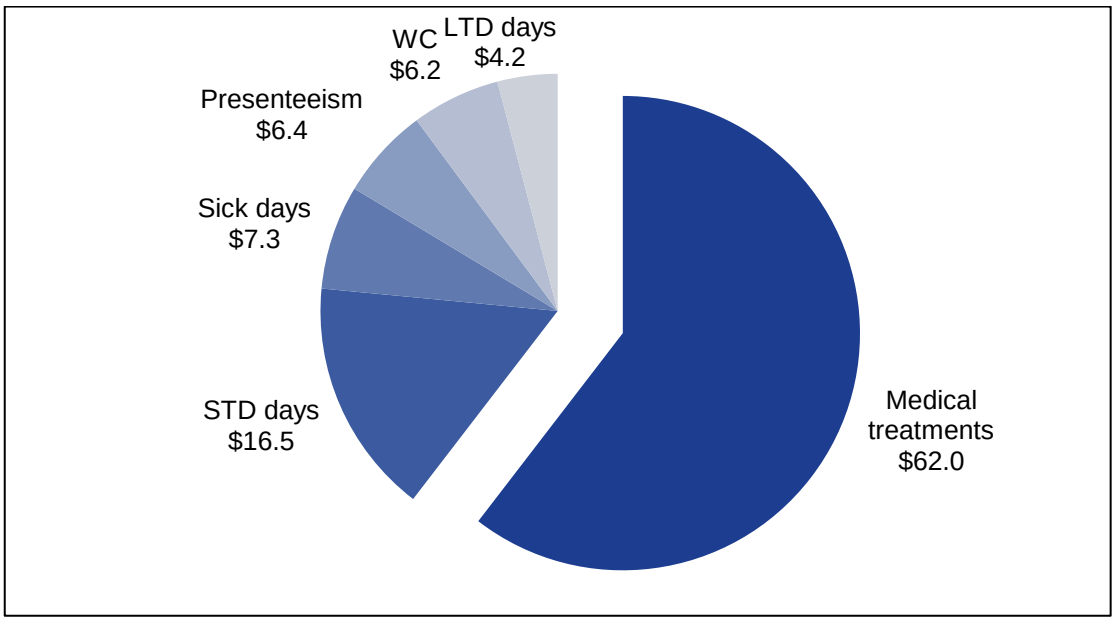

Figure 5. Annual MSD costs per 100 employees ($ thousands). Total costs per 100 = $103,000.

[16] The method for valuing lost productivity is adapted from Pauly MV, Nicholson S, Polsky D, Berger ML and Sharda C. (2008). Valuing reductions in on-the-job illness: 'Presenteeism' from managerial and economic perspectives. *Health Economics, 17*(4), 469–485.

Occupational MSDs

It is also important to investigate the role that work plays in causing or contributing to the development of MSDs. Occupational MSDs have been found to be the leading cause of work disability in the United States (Gatchel, 2004). Musculoskeletal disorders must be understood in terms of not only the impact they have on people retaining work but also the way in which workforce participation can lead to, or exacerbate, an MSD.

Looking more closely at the role that work plays in contributing to the development of MSDs, it has been found that types of physical activity in the workplace are associated with the development of a musculoskeletal condition. Punnett and Wegman (2004:19) explain that there is near international consensus that MSDs are causally related to occupational ergonomic stressors such as repetitive motions, forceful exertions, nonneutral postures, vibrations and so on. A systematic review found that the most commonly reported biomechanical risk factors with “reasonable” evidence for causing a work-related MSD were excessive repetition, awkward postures and heavy lifting (Da Costa and Vieira, 2010:318). Tanaka, Peterson and Cameron (2001:330) looked specifically at upper-body MSDs and found that 41% of these conditions in the U.S. employed population could be linked to occupational exposures, which equates to about 500,000 people every year.

Occupational factors have also been found to improve or impede recovery. Gatchel (2004:167) suggested that a combination of workplace factors contributed to slower recovery rates, namely, a high-demand and/or low-control working environment, the employee perceiving that the style of management in the workplace is unhelpful, an employee’s belief that he or she is working under time pressure and a belief in or actual poor social support from colleagues.

Despite these findings, gaps in our knowledge remain. One reason for this is that some frequently reported risk factors for work-related MSDs have not been studied in sufficient detail to confirm whether they do indeed represent a risk (Da Costa and Vieira, 2010:318). There are also ongoing methodological debates about how to measure occupational exposures, meaning there are often inconsistencies among current studies that make it difficult to reach consensus among pieces of research (Gerr et al., 2013).

Variation by Industry Sector

Considerable variation in work-related musculoskeletal disorders has been identified among different occupational groups. A systematic review looking at risk factors for work-related MSDs found that high biomechanical demands were associated with developing an MSD (Da Costa and Vieira, 2010:318). Not only physical factors need to be considered; Gerr et al.

(2013) found that psychosocial stress and job change are predictors of MSDs when personal characteristics and occupational exposure to physical factors are controlled for. Furthermore, it was found that when compared with jobs that offered low-demand and high-control working conditions, there was a large increase in the risk of developing hand or arm MSDs for both high-demand/high-control and high-demand/low-control job categories (Gerr et al., 2013). This variation can be predicted in part by the educational attainment of the employee and the sort of job in which he or she is then likely to be.

Cunningham and Kelsey (1984) used the U.S. Health and Nutrition Examination Survey to examine different demographic groups and their experiences of MSDs and work. They found that those with less than a high school level of education were more likely to have changed jobs because of a musculoskeletal condition or taken five or more days off work over the past year (Cunningham and Kelsey, 1984:579). It is proposed in the study that this finding corroborates the hypothesis that low-paid, low- or nonskilled jobs (where those with low levels of education are likely to work) often offer working conditions that make it harder to maintain work when one has an MSD.

Table 1. Occupational sectors with increased risk of developing an MSD (Punnett and Wegman, 2004:14).

High-risk sectors	• Nursing • Air transportation • Mining • Food processing • Leather tanning • Heavy and light manufacturing
Sectors associated with increased risk of developing upper-extremity MSDs	• Clerical work • Postal service • Cleaning • Industrial inspection and packaging
Sectors associated with back and lower-limb disorders	• Truck drivers • Warehouse workers • Airplane baggage handlers • Construction trades • Nurses • Nursing aides • Patient care workers • Crane operators • Other large vehicle operators

A complete picture is not presented, however, if one looks only at MSDs across conflated job categories: As well as findings showing that there are differences among broad categories of job types, it has been seen that MSDs and their relationship to work tend to vary among different specific occupations (Kim et al., 2010:446). Some studies have attempted to further disaggregate the relationship between MSDs and work, including a focus on specific jobs.

Some industries and occupations have a rate of MSD occurrence among employees that is three to four times higher than the rate across all occupational sectors (Punnett and Wegman, 2004:14). People who work in these higher-risk jobs are more likely to experience lower productivity, to exit the workforce or to transfer to less ergonomically stressful jobs (Punnett and Wegman, 2004:17). Punnett and Wegman (2004:14) categorised a range of occupational sectors according to their association with the development of musculoskeletal disorders.

Figure 6 shows the incidence rate, where incidence is calculated as the number of injuries and illnesses per 10,000 full-time workers, for musculoskeletal disorders across different industries in 2012.

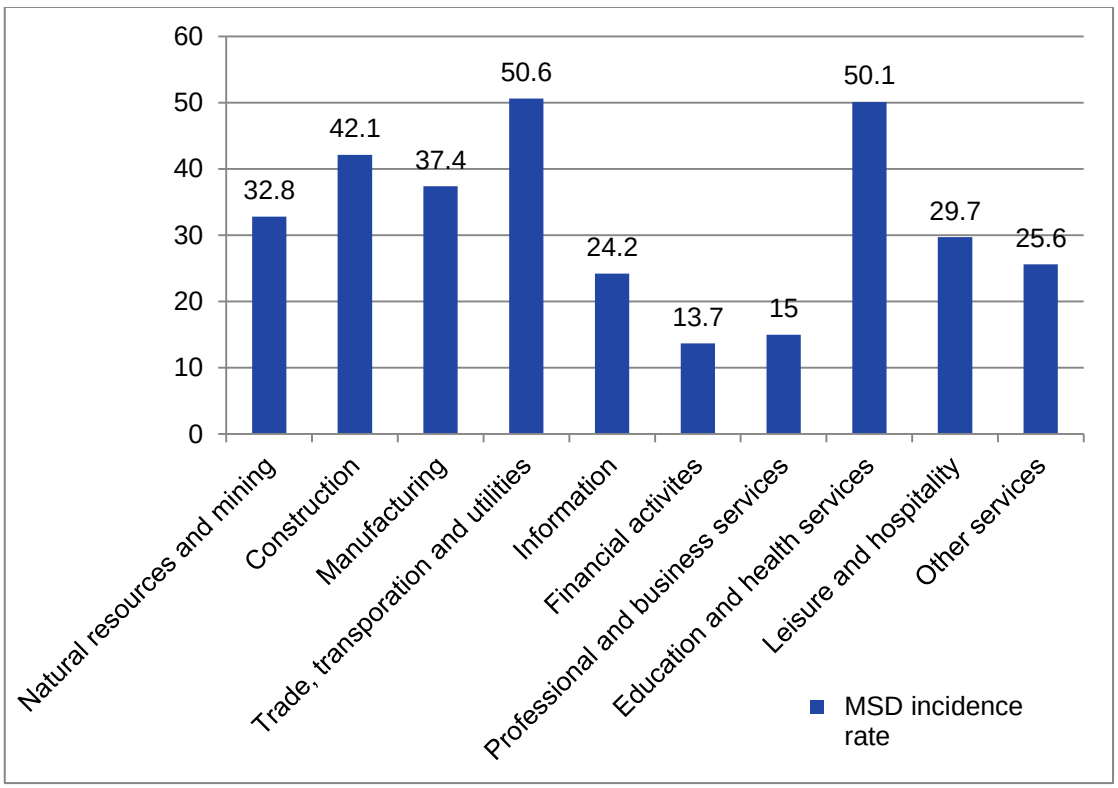

Figure 6. MSD incidence for selected occupational sectors (Bureau of Labor Statistics, 2012).

The Bureau of Labor Statistics also further disaggregates incidence rates among occupational groups and calculates median days away from work for each occupation; the results from the eight occupations with the highest absence rates and those with the lowest absence rates are presented in Figures 7 and 8.

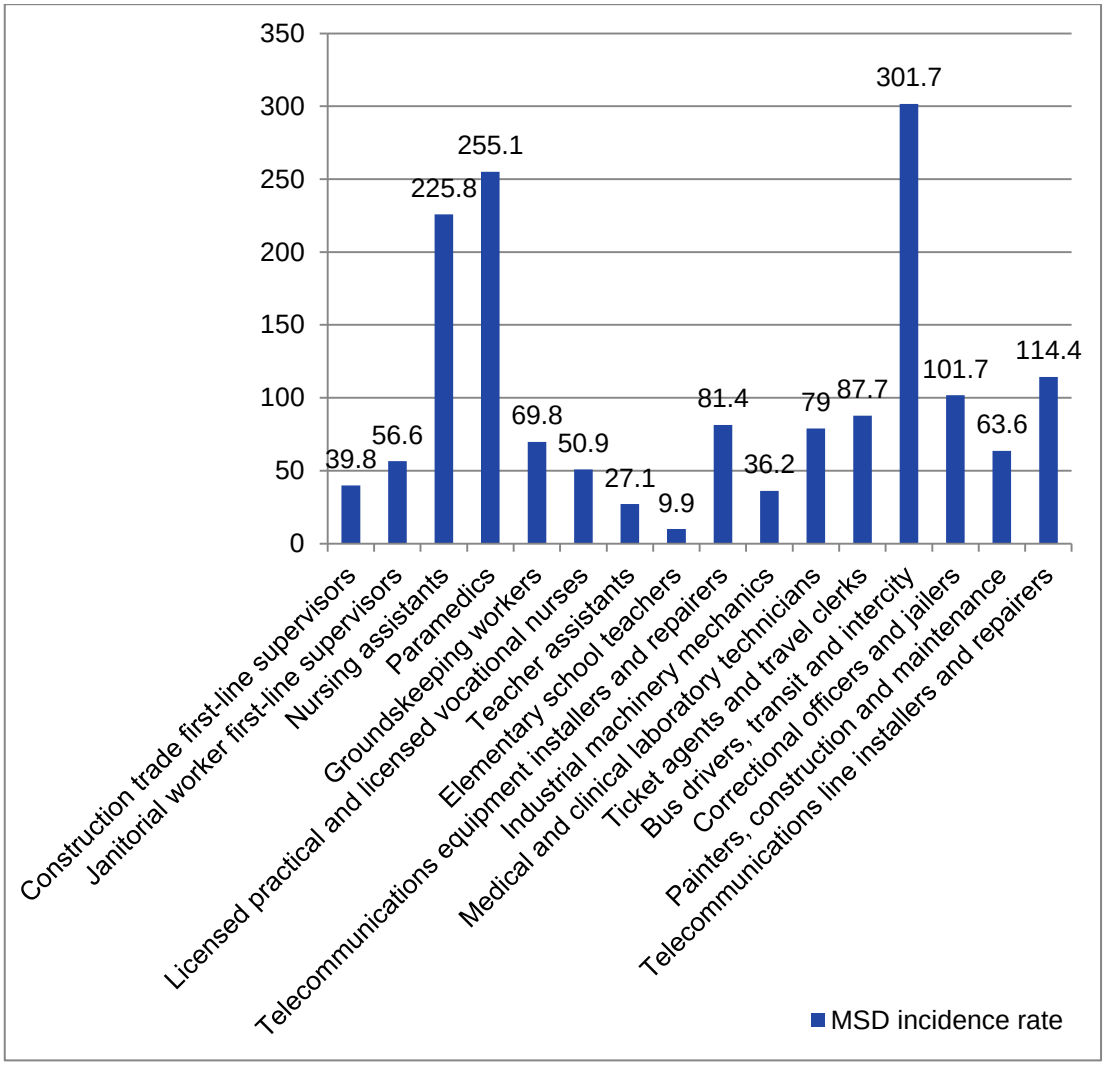

Figure 7. MSD incidence rate in selected occupations (Bureau of Labor Statistics 2012).

Looking at Figure 8, it is interesting to note the wide range of median days away from work. This supports the finding from other studies that different types of MSDs, which require different recovery times, are more common in different occupations; it also suggests that it is more feasible in some occupations than others to take time away from work to recuperate. The drastic variation observed in incidence rates further corroborates the understanding that employees are more likely to develop an MSD in some occupations than others. In this context, it is also pertinent to raise the fact that there is variation not only among sectors but also among different types of MSDs. Some MSDs, such as rheumatoid arthritis, are

characterized by fluctuating severity and “flares” of pain and stiffness, meaning an employee with RA may go from having the symptoms under control to suddenly having to take time away from work. The sort of understanding and accommodation needed from an employer in the case of an employee with RA is quite different from that for an employee with an acute, short-term MSD.

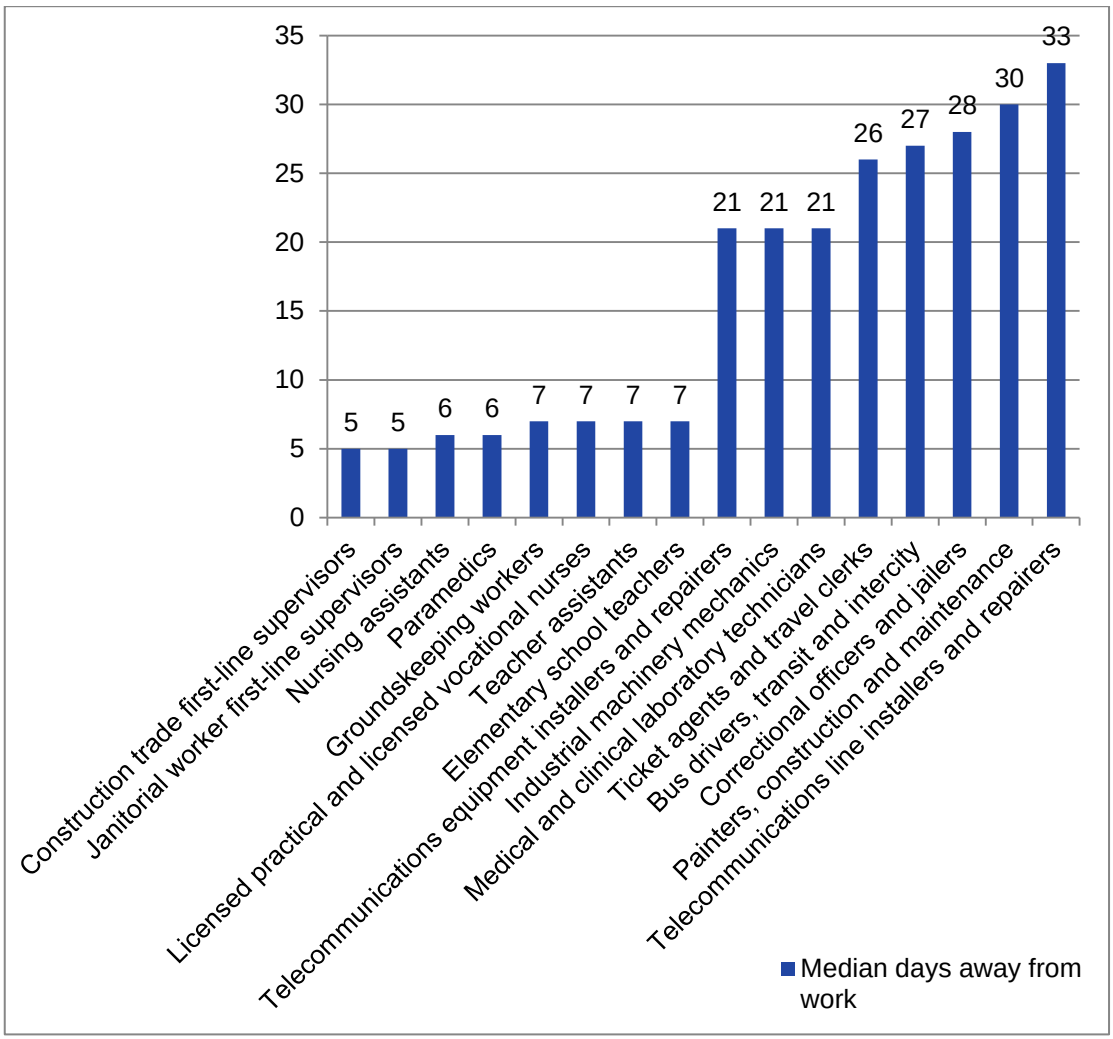

Figure 8. Median days away from work as a result of MSDs in selected occupations (Bureau of Labor Statistics, 2012).

Looking more closely at a few types of jobs, it has been found that those working in homecare are at greater risk of developing an MSD than those who work in construction, mining or manufacturing (Bureau of Labor Statistics, 2007, from Kim et al., 2010:446). Homecare is a physically demanding job that often involves physically lifting or supporting the person being cared for. The musculoskeletal impact of the physical demands of the job have been evidenced; a 2010 study found that lower back, neck and shoulder injuries accounted for 55% of all homecare worker injuries (Kim et al., 2010:446–447). The same

study found that 19% of homecare workers had a high risk of developing work-related back pain, and 12% left the nursing workplace because of back pain (Kim et al., 2010:446). The psychological aspects of homecare work were also found to be important; after controlling for age, it was seen that psychosocial demands and social support on the job, as well as physical demands, all were significantly associated with a higher probability of developing neck, shoulder and back MSDs among the study participants (Kim et al., 2010:445).

Another sector that has received specific attention in U.S. studies is construction workers. Research conducted in 2010 found that roofers with an MSD were eight times more likely to leave the profession than those who did not have an MSD (Welch et al., 2010:555). Furthermore, MSDs have been found to be responsible for 75% of disability-related retirements among sheet metal workers (Welch et al., 2010:558). An earlier study by Welch et al. (1999:538) found that approximately 10% of construction workers do not return to work after an acute MSD injury.

Although the preceding findings are enlightening, it must be remembered that methodological issues remain. For example, a study looking specifically at household appliance manufacturing workers in Iowa found that the way in which workplace factors were measured had an effect on whether they were found to be associated with the development of MSDs (Gerr et al., 2013). The study found that apart from the percentage of time of shoulder elevation above 90 degrees, which was significantly associated with neck and shoulder MSDs, no individual measure of biomechanical workplace factors had a significant association with the development of MSDs. When the Strain Index, a composite measure, was used, however, it was found to be significantly associated with hand and arm symptoms and disorders, highlighting the importance of the specific measures used and the difficulty often involved in comparing across studies that have employed different methodologies.

Conclusion

Limitations of the Current Data

As has been mentioned throughout this paper, there are significant gaps in our understanding and knowledge when it comes to musculoskeletal disorders and their relationship to employment.

There is a lack of longitudinal data that follow patient outcomes over time (Dall et al., 2013). Longitudinal data are extremely useful, as they show the temporal order of events (for example, the development of an MSD in relation to occupational exposure levels), meaning causality is more likely to be identified. Longitudinal data also mean that the same individuals are followed over time, so individual-level changes can be tracked, as opposed to the aggregate-level change that could be detected if using a repeated cross-sectional survey. A particular benefit of being able to track individuals is that a life course perspective can be adopted whereby a person with an MSD can be tracked through key life events such as transitioning from education into work.

In addition to the lack of longitudinal data, there is a lack of data capturing multiple outcomes that incorporate not simply fluctuations in healthcare costs associated with MSDs but also changes in a broader array of outcomes, including job performance, sickness absence, work disability incidence and durations as well as costs associated with these outcomes. Claims-based datasets in the United States tend to track either workers' compensation cases or short-term disability cases in separate administrative data files, and it is rare to find these types of cases linked in the same dataset for the same individual employee over time.

There has been some attempt in the United States over the past decade to create integrated databases for employers that include group health claims data (medical and pharmacy claims), occupational and non-occupational disability claims and other data sources, but such integrated databases are the exception rather than the rule. National datasets and other sources need to begin including a broader array of outcomes incorporating work-related impacts of MSDs. In addition to a biopsychosocial perspective for understanding and treating MSDs, the outcomes measured need to move beyond the biological realm and expand to include additional psychosocial measures. In this way, the full effects of MSDs, including financial costs, can be better understood and managed.

As has been mentioned multiple times throughout this paper, there is a lack of a standardized metric for types of occupational exposure, meaning it is often difficult to compare findings across different studies concerning the role that occupational factors play in the development of MSDs (Gerr et al., 2013). This lack of comparability is also true when it comes to MSD prevalence rates, and a considerable amount of variation can be found among different studies (Goetzel et al., 2004:404). The issue of consensus across studies is most acute when looking at indirect costs arising from productivity losses—as there remains no standard method or definition, and a wide range of possible approaches for measuring loss of productivity (Goetzel et al., 2004:408)—although there are ongoing efforts to reach a consensus on measurement (Tugwell et al., 2007). A further issue is that some studies use self-reported MSD incidence while others use physician-diagnosed incidence, meaning rates of illness cannot be compared (Cunningham and Kelsey, 1984:578).

An issue arising from some survey data is that sample sizes may not be big enough to disaggregate different types of MSDs (Cunningham and Kelsey, 1984:578). As was shown earlier, different MSDs are caused in various ways and have different effects on people's lives, meaning it is pertinent, but often impossible, to study them as separate conditions as opposed to a homogenous phenomenon.

Another criticism of existing research is that it has not managed to embed overarching conceptual models. Research investigating return to work and MSDs, for example, has thus far not coherently embedded the psychosocial model of illness (Schultz et al., 2007:327).

There also remains the challenge that MSDs that are caused by work are often considered completely separately from MSDs that are attributable to other factors. Studies looking at the former type of MSD often consider the impact that a condition has on an individual's working life, whereas studies looking at the latter often do not link these conditions to the working world, as they are not directly caused by them. Individuals with MSDs, regardless of their cause, however, often need similar support to successfully engage in the workforce. It would be beneficial if MSDs, while still acknowledging their differences, were more often considered as a group so that the significance of this group of conditions was realized and measures to ameliorate the working lives of people with MSDs could be more effectively pursued.

Despite there clearly being numerous areas in which research of MSDs could be conducted more rigorously, and the significant issues that MSDs pose for both the individual and society, there remains a paucity of funding and a lack of appreciation for the significance of these diseases. MSDs are not among the top 10 health conditions funded by research (BMUS, 2008:1). Indeed, since 2000 it has routinely been the case that less than 2% of the

annual National Institutes of Health budget has been awarded to research investigating MSDs (BMUS, 2008:2).

Summary

This paper reviewed musculoskeletal conditions in the context of employment. It has demonstrated that MSDs are highly relevant in the context of work and that the current economic and social implications of these conditions are sizeable and often underestimated. As the U.S. population ages and working lives become more extended, the incidence rates of MSDs among the working-age population will increase. Furthermore, there are some MSDs that exist or develop primarily among working-age cohorts and other MSDs that are caused or exacerbated by work itself. The cost borne by employers for MSDs has been found to be substantial: For every 100 employees, MSDs cost employers about $103,000 annually, and this is a lower-bound estimate.

It has been found that some types of jobs represent a heightened risk of developing or aggravating MSDs, with high-demand, low-control work and low-paid, low-skilled work being identified as job characteristics that pose such a risk. Specific sectors, including homecare, nursing, mining and manufacturing, have also been identified as posing a heightened risk of developing an MSD. The converse of work environments that aggravate MSDs is that work context can also contribute to improvements in MSD outcomes through ergonomic design, job duty adjustment and other employer policies. While this paper focuses on the prevalence, costs and demographics of MSDs, additional research should focus on the opportunities for employers and their clinical and other partners to improve workplace outcomes for workers with MSDs.

The economic and social implications of MSDs in the working-age population are huge. For the United States to achieve a sustainable, stable labour market, it must ensure that people with MSDs are able to participate in the workforce. Further work is needed around the extent to which job retention and return to work for people with MSDs is currently prioritized in the United States and identifying the factors that impede or enable people with MSDs to enter or remain in the labour market. The field could benefit from a review of clinical interventions, as well as workplace practices, that can best support people with MSDs to enter or remain in the workforce.

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