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**Bridging the gap:
Exploring the impact of musculoskeletal health on
performance and injury risk in the food and fibre sector**

Kellogg Rural Leadership Programme
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I wish to thank the Kellogg Programme Investing Partners for their continued support.

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Executive Summary

Working in the food and fibre sector is undoubtedly renowned as a ‘manual’ career. Good musculoskeletal health is essential in allowing workers to move, without pain or restriction, in life and work. To ensure the longevity of their career, workers must have sufficient levels of musculoskeletal health to allow the physical capability and capacity to perform at work every day, now and into the future.

This research seeks to understand the nature and extent of work-related musculoskeletal disorders in the food and fibre sector and how musculoskeletal health may correlate with injury risk and performance outcomes. The aims of the research are to:

- Review the nature and extent of work-related musculoskeletal disorders in the food and fibre sector.
- Explore any potential correlation between musculoskeletal health, injury risk and performance outcomes.
- Investigate sector understanding of injury risk factors.
- Investigate how musculoskeletal injury risk is currently managed in the food and fibre sector.
- Evaluate the potential benefits and barriers to adopting a more integrated and holistic approach to managing performance and mitigating injury risk in the food and fibre sector.

The methodology comprises a literature review to form the theoretical foundation from which to compare and contrast qualitative and quantitative data collected through multi-method data collection. A three-stage process was created to engage with industry employees: an online questionnaire, enrollment on a health and wellbeing app called Symmio, and a follow-up online questionnaire. A three-stage process was created to engage with food and fibre sector leaders responsible for injury risk management, comprising of an online questionnaire, a semi-structured interview, and a post-interview follow-up online questionnaire. Data was also collected and analysed through a Functional Movement Screen in the wool harvesting industry. Results were collected and explored from the industry employees' engagement with the Symmio app. Closed questions for the online questionnaires were analysed, and a thematic analysis approach was taken to look at the open questions from the questionnaires and the interviews.

Work-related safety is about creating a safe working environment, eliminating or minimising the risks at work that can impact a worker's health. Data analysis shows that the proportion of work-related injuries attributed to musculoskeletal disorders is twice as high in the food and fibre sector than is demonstrated across the general population, with 60% of the overall burden of harm from work-related injury. However, work-related health is also about the way worker health may impact working safely; therefore, worker health and wellbeing are injury risk factors. Results showed the importance of musculoskeletal (MSK) health and its contributing factors in influencing future injury risks and that the presence of risk factors may have a detrimental effect on the performance and productivity of the workforce. Opportunities to design holistic and educational approaches into the workplace as standard protocol and as just part of ‘what we do’ was seen as a requirement.

Recommendations from this research were:

- Co-investment is required from MPI, MBIE, WorkSafe NZ, ACC and industry good organisations to collaboratively resource the development of an over-arching strategy that bridges the gap between wellbeing and injury risk management. The strategy must align with the future Primary Industry Wellbeing Strategy.

To guide this strategy, further research is needed in the following areas:

- ACC and WorkSafe should conduct research on the nature and extent of MSK health risk factors, pain, and movement dysfunction sector-wide using an evidence-based screening tool. Subsequently, objective data could be provided about sector-specific requirements.
- Current government-funded injury risk management research projects should look to integrate evidence-based screening tools into their data collection and intervention development process to provide objective evidence about the effectiveness of interventions.

1. Introduction

Working in the food and fibre sector is undoubtedly renowned as a ‘manual’ career. Good musculoskeletal health is essential in allowing workers to move, without pain or restriction, in life and work. To ensure the longevity of their career, workers must have sufficient levels of musculoskeletal (MSK) health to allow the physical capability and capacity to perform at work every day, now and into the future.

The food and fibre sector holds significant importance in both the social fabric and economy of New Zealand. In the financial year to June 30, 2022, the sector accounted for a substantial 81.4% of the country's merchandise exports. The sector contributed 10.7% to New Zealand's GDP in the year to March 31, 2021, and employed approximately 359,000 individuals, representing 13% of the total workforce in the year to March 31, 2020 (Ministry for Primary Industries, 2022).

A thriving food and fibre sector is intrinsic to the sustainability and success of New Zealand's economy (Te Puna Whakaaronui, 2022). At the heart of the sector is its people, its workforce. Eliminating and mitigating work-related ill-health and injury risks is now a requirement of business, and investing in the wellbeing and resilience of the workforce is fast becoming common practice to ensure that everyone who comes to work gets home safe and healthy.

Unfortunately, the ‘Work-related musculoskeletal disorders - definitions review’ report indicated that musculoskeletal disorders account for over 30% of the overall burden of work-related ill-health and injuries in New Zealand (Kolose & Matulino, 2022). Furthermore, the agricultural sector exhibits a particularly high incidence of musculoskeletal disorders (MSD) claims (Kolose & Matulino, 2022).

This report investigates how MSK health is currently managed in the food and fibre sector and assess the adequacy and effectiveness of existing education and practical tools in supporting knowledge and capabilities within the workforce. This research seeks to understand the nature and extent of work-related musculoskeletal disorders in the food and fibre sector and the correlation this may have with injury risk and performance outcomes.

1.1 Aims

The aims of the research are to:

- Review the nature and extent of work-related musculoskeletal disorders in the food and fibre sector.
- Explore any potential correlation between musculoskeletal health, injury risk and performance outcomes.
- Investigate sector understanding of injury risk factors.
- Investigate how musculoskeletal injury risk is currently managed in the food and fibre sector.
- Evaluate the potential benefits and barriers to adopting a more integrated and holistic approach to managing performance and mitigating injury risk in the food and fibre sector.

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2. Literature Review

The author chose to take a more inductive approach by completing multi-tiered surveys and engagement and multi-tiered interviews before engaging in the literature review to counteract any potential for a narrowed analytic field of vision due to her professional experience (Braun & Clarke, 2006).

The literature review aims to understand the current outlook on health, safety and injury risk in the food and fibre sector. It will look to clarify definitions and risk factors associated with work-related musculoskeletal disorders (WRMSDs).

2.1 Work-related Health and Safety

According to the Health and Safety at Work Strategy 2018-2028, work-related health and safety (H&S) encompass more than just preventing injuries (Ministry of Business, 2018). H&S policies are designed to protect workers from workplace physical and mental health risks. It is seen as a critical part of doing business well (WorkSafe, 2018). Work-related safety is about creating a safe working environment, eliminating or minimising the risks at work that can impact a worker's health. However, businesses may tend to focus on existing or critical safety risks, with the more complex work-related health risks posing more of a challenge (Ministry of Business, 2018).

Work-related health is also not just about "the way work can impact on worker health." It is also about "the way worker health may impact on working safely" (WorkSafe New Zealand, 2019). "The effects of work on health, and health on work are interrelated" (Ministry of Business, 2018).

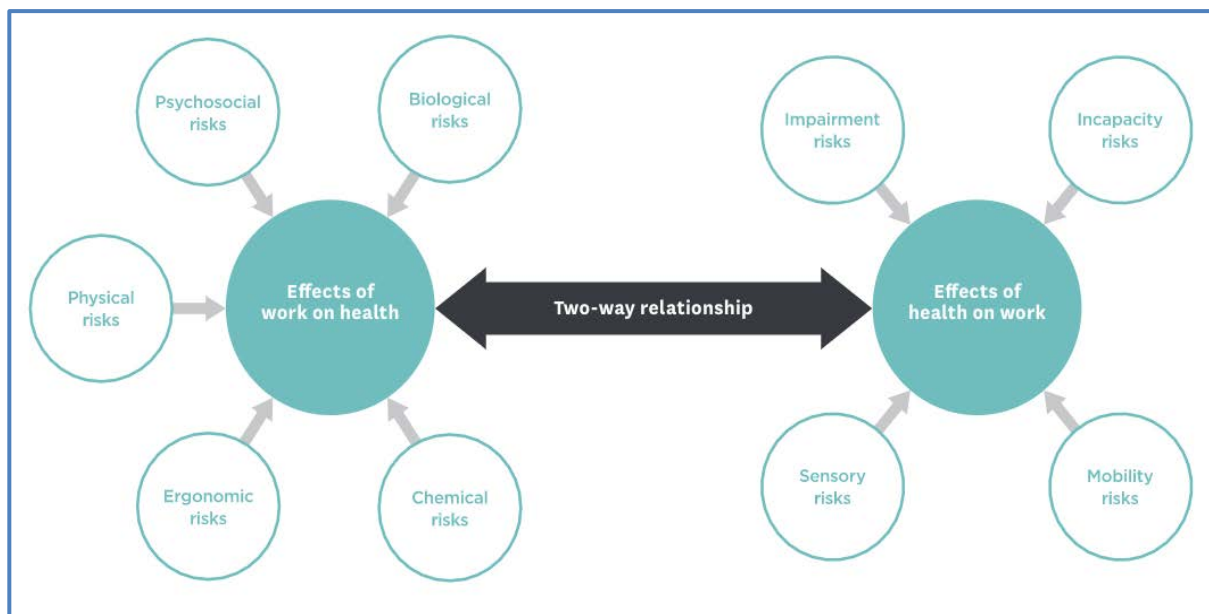


Figure 1- Two-way relationship between health and work. (Ministry of Business, 2018)

The Health and Safety at Work Strategy 2018-2028 (Ministry of Business, 2018) identifies:

Five key sources of work-related health risks:

- Physical
- Chemical
- Biological
- Ergonomic stressors

- Psychosocial

Four key ways that worker health may impact working safely:

- Impairment eg. fatigue may lead to reduced concentration
- Incapacity eg. an unknown or poorly controlled heart condition may lead to a worker suddenly losing consciousness while involved in a safety-critical task
- Sensory eg. damage to a worker's hearing may prevent them from correctly or quickly identifying and reacting to a workplace risk
- Mobility eg. physical frailty may prevent a worker from moving out of the way of an oncoming vehicle.

These four ways workers' health may affect working safely are interconnected with the individual's overall health and wellbeing. Worker health and wellbeing can be considered a workplace risk factor.

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2.2 Health and Wellbeing

In 1946, The World Health Organisation (WHO) defined health as “a state of complete physical, mental and social wellbeing and not merely the absence of disease or infirmity” (World Health Organisation, 1946, p. 1). However, the perception of health has evolved to be now seen as a continuum, not a static state. Individuals experience fluctuations between good health and poor health during their life course. Krahn et al. (2021, p. 1) proposed a redefinition of health as “the dynamic balance of physical, mental, social, and existential wellbeing in adapting to conditions of life and the environment.” They further described health as “dynamic, continuous, multidimensional, distinct from function, and determined by balance and adaptation.” Krahn et al.’s description of health can be seen in many ways to align with the Te Whare Tapa Whā model of health, developed by Māori health expert Professor, Sir Mason Durie in 1982.

The model portrays health and wellbeing as a wharenui (meeting house) with four walls representing;

- Taha wairua (spiritual wellbeing)
- Taha hinengaro (mental and emotional wellbeing)
- Taha tinana (physical wellbeing)
- Taha whanau (family and social wellbeing.)

The foundation of the wharenui is formed through its connection with the whenua (land.)

(Māori Health: Te Whare Tapa Whā Model – Public Health, n.d.)

This model depicts the knowledge that all four states of health and wellbeing directly impact each other; all need to be in balance for an individual to thrive (See figure 2.)

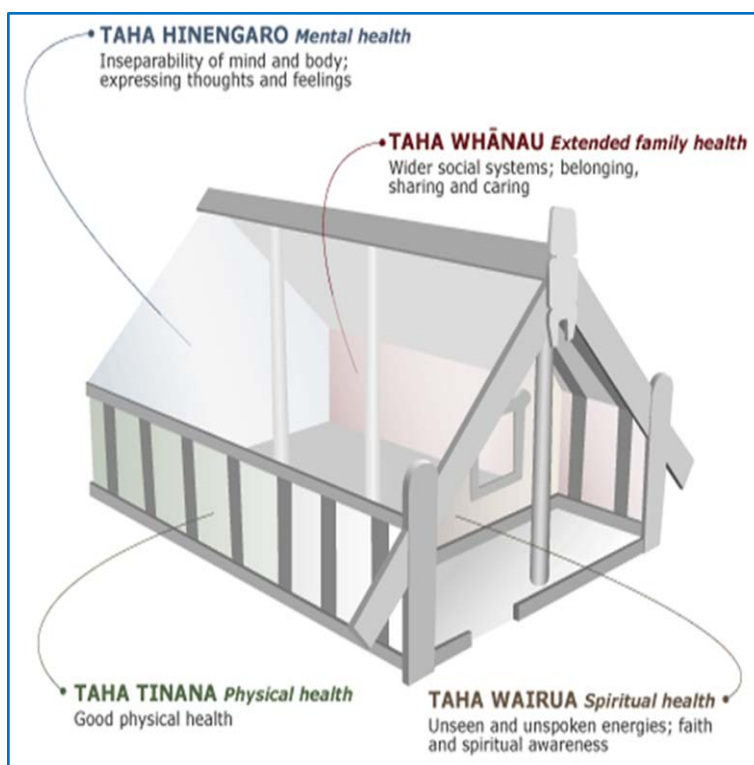


Figure 2: Te Whare Tapa Whā model (Māori Health: Te Whare Tapa Whā Model – Public Health, n.d.)

The American Psychological Association (APA) defines wellbeing as "a state of happiness and contentment, with low levels of distress, overall good physical and mental health and outlook, or good quality of life" (*APA Dictionary of Psychology*, n.d.). Wellbeing is dependent upon an individual's personal contexts and needs; it is subjective. It can be understood as the individual's perspective on life and their ability to cope with everyday stresses, both physical and mental. Wellbeing is described as a feeling, 'feeling well.' Wellbeing, like health, exists on a continuum.

A draft report prepared for the Ministry of Primary Industries, entitled 'Primary Industry Wellbeing Action Plan,' defines mental health as "emotional, psychological, and social states (how we think, feel, and act). One's state of mental health determines how they handle stress, relate to others, and make choices. Just like physical health, mental health is not bad or good; it is a continuum, and everyone will fluctuate between good mental health and poor mental health at different points in their life" (Scarlati, 2023, p. 8).

Physical health pertains to the condition of the body and its proper functioning. It encompasses characteristics such as body size and shape, functional capability, fitness, recovery ability, sensory acuity, absence, presence, or susceptibility to disorders or diseases.

The Primary Industry Action plan demonstrates that the health continuum is the same for mental health and physical health (see Figure 3). It highlights the interdependence of an individual's personal wellbeing/wellness and resilience.



Figure 3 – The health continuum (Scarlati, 2023, p. 9)

Craig Hudson, Xero managing director for New Zealand and Pacific Islands, stated, "We now know categorically that wellbeing delivers efficiency and productivity gains for businesses. Put simply: If small businesses are ignoring wellbeing, they are wasting money" (ACC, 2021, p. 1).

Going forward, this paper adopts the definition of health as "the dynamic balance of physical, mental, social, and existential wellbeing in adapting to conditions of life and the environment" (Krahn et al., 2021). This definition takes an integrated and holistic approach, looking towards the individual's resilience, and aligns well with the Te Whare Tapa Whā model.

2.3 Musculoskeletal Health

The terminology related to MSK health, pain and discomfort, injury risk, and their association with work can be challenging to navigate within health and safety, food and fibre sector businesses, or accident compensation and insurance.

One key component of physical health is MSK health (Kell et al., 2001, p. 1). From a professional perspective, the author would state that the MSK system (muscles, tendons, ligaments, joints, blood vessels, nerves and adjacent connective tissues) provides the body with the structure and means for movement. Functional movement for all physical activity and performance is built on the foundations of the ability to simply move without pain, restriction or limitation; to 'move well.' Therefore, the health of the MSK system is a crucial factor when discussing workplace injury risk and performance.

WorkSafe conducted a definitions review in 2022 and refined its definitions of MSDs and WRMSDs. Interestingly, this review did not include a specific definition of MSK health as a term.

Table 1 - Musculoskeletal definitions

Musculoskeletal Health	“Musculoskeletal health refers to the performance of the locomotor system, comprising intact muscles, bones, joints and adjacent connective tissues.” (World Health Organization, 2022)
Musculoskeletal Conditions	“Musculoskeletal impairments comprise more than 150 different diseases/conditions that affect the system and are characterized by impairments in the muscles, bones, joints and adjacent connective tissues leading to temporary or lifelong limitations in functioning and participation. Musculoskeletal conditions are typically characterized by pain (often persistent) and limitations in mobility and dexterity, reducing people’s ability to work and participate in society. Pain experienced in musculoskeletal structures is the most common form of non-cancer pain.” (World Health Organization, 2022)
Musculoskeletal Disorders (MSDs)	“MSDs are injuries and conditions affecting the muscles, ligaments, bones, tendons, blood vessels, and nerves. MSDs may also include inflammatory conditions (for example, rheumatoid arthritis, gout), degenerative conditions (for example, osteoarthritis), bone density conditions (for example, osteoporosis) and pain conditions (for example, fibromyalgia). The term MSDs is appropriate to use when referring to general conditions of the musculoskeletal system.” (WorkSafe New Zealand, 2023)
Work-related Musculoskeletal Disorders (WRMSDs)	“WRMSDs are injuries and conditions affecting the muscles, ligaments, bones, tendons, blood vessels, and nerves. WRMSDs occur when work demands lead or contribute to pain, discomfort, or injury. The term WRMSDs should be used when referring to conditions of the musculoskeletal system that occur when work demands lead or contribute to them. Most WRMSDs develop over time. They can also occur suddenly from a specific event or series of events. WRMSDs may be injuries from a work-related incident or accident.” (WorkSafe New Zealand, 2023)

MSK conditions are the leading contributor to the global demand for rehabilitation. Typically, MSK conditions cause pain, limit mobility, and can lead to a loss of function, detrimentally impacting an individual's ability to participate in work and daily activities (World Health Organization, 2022). In New Zealand, MSDs “make up over 30% of the overall burden of harm from work-related ill-health and injury” (Kolose & Matulino, 2022).

An ACC literature review identified WRMSDs as one of the seven factors driving costs to ACC, acknowledging that a long-term evidence-based MSK strategy is required (Conlon, 2014).

The severity of WRMSDs can vary from mild aches and pains to more serious conditions. Symptoms may include pain or discomfort, loss of strength, sensation, dexterity, or function (WorkSafe New Zealand, 2023). The multitude of names attributed to WRMSDs, such as sprains and strains, repetitive strain injury, occupational overuse syndrome, and discomfort, pain and injury, further contributes to the complexity of understanding of this topic (WorkSafe New Zealand, 2023).

WorkSafe’s definition may differ to that of ACC (Kolose & Matulino, 2022). ACC’s primary diagnosis of MSK injury is “equal to contusion/crushing, dislocation, fracture, soft tissue injury, sprain or strain” (Personal communication, May 19, 2023), and is a sub-category of work injury (See Figure 4.)

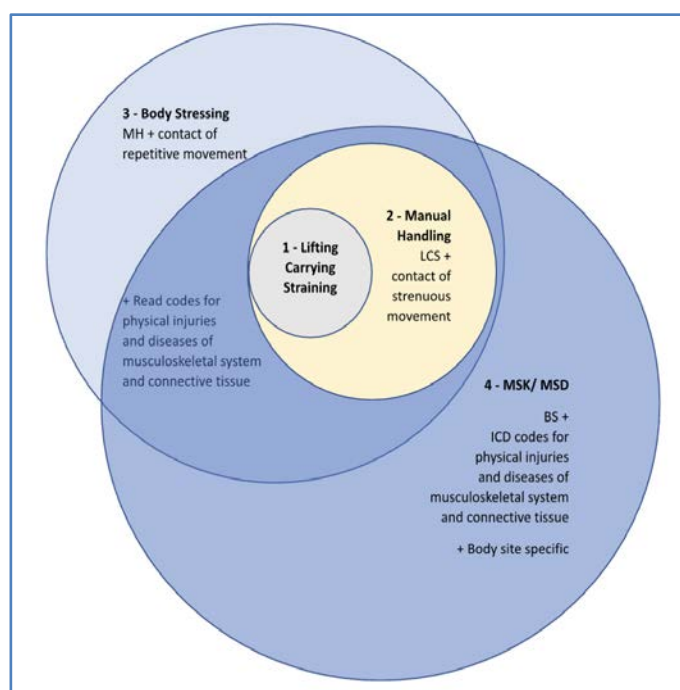


Figure 4 – ACC Musculoskeletal injuries diagram (Personal communication, May 22, 2023)

WRMSDs can be attributed to gradual onset, ‘over time’ risk factors, or they can occur due to an acute ‘event’ of relatively sudden onset (WorkSafe New Zealand, 2023). WRMSDs can result in time off work, and notably, they may reduce an individual’s performance and productivity at work. Sprains and strains, in particular, pose a substantial occupational health burden both in New Zealand and globally. In New Zealand, back injuries account for approximately one-third of all workers' ACC claims related to sprains and strains, with shoulder and arm injuries increasing faster than other sprain and strain injuries (Laird et al., 2022). WorkSafe acknowledges that WRMSDs may also harm mental health and contribute to other health issues developing (WorkSafe, 2023).

Thus, it is evident that the causes and outcomes of MSDs are complex and interrelated, and the implications are far-reaching.

2.4 Injury Risk Factors

Injury risk is multifactorial, meaning that the more risk factors you stack on top of each other, the higher the risk for injury (Lehr et al., 2013). As the exposure to injury risk factors increases the risk increases for MSDs to develop; fatigue, discomfort, pain, and injury. Injury risk factors are the root cause of MSDs (Colorado State University, n.d.). (See Figure 5.)

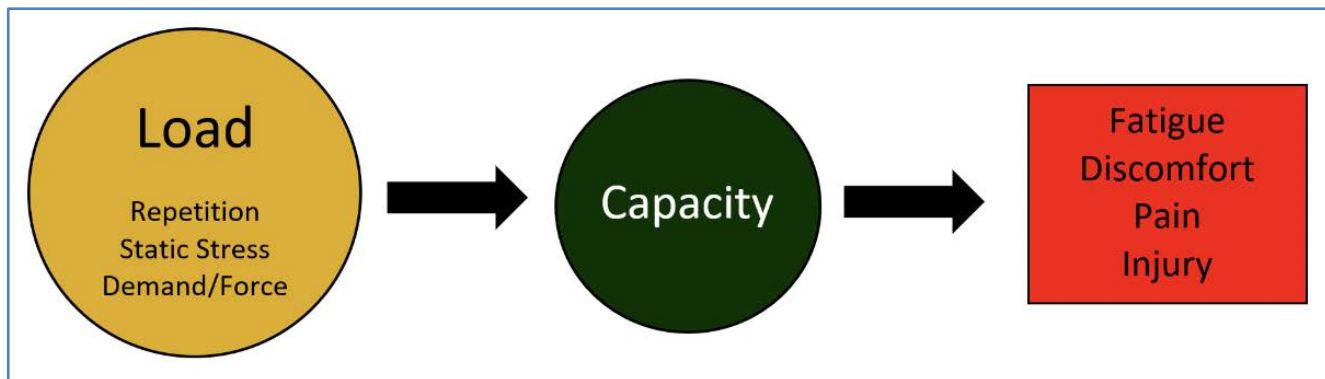


Figure 5 – What causes MSDs? (Colorado State University, n.d.)

Similar to the inconsistency in the language used to describe MSD's there has been inconsistency in how risk factors are defined. Subsequently, the recent 'WorkSafe musculoskeletal disorders: Literature overview' (2023) resulted in a list of the following risk factors:

- poor workstation design
- vibration
- low temperature
- poor equipment design
- working with computers/visual display units
- high repetition and task invariability
- posture-related risks
- physical loading/manual handling
- high BMI
- exposure duration
- experience of discrimination
- lack of training
- demographic factors
- working under time pressures
- harassment/bullying/violence
- gender-based division of work
- inadequate job design
- lack of recovery time
- inadequate resource provision
- lack of job control
- monotonous and repetitive task design/task invariability
- psychosocial risk factors
- inadequate leadership
- precarious employment
- poor safety climate (and underlying culture)

The WorkSafe website offers a diagrammatic version of risk factors (See Figure 6), categorising into:

- Work organisation factors
- Environmental factors
- Individual factors
- Psychosocial factors
- Biomechanical and physical factors

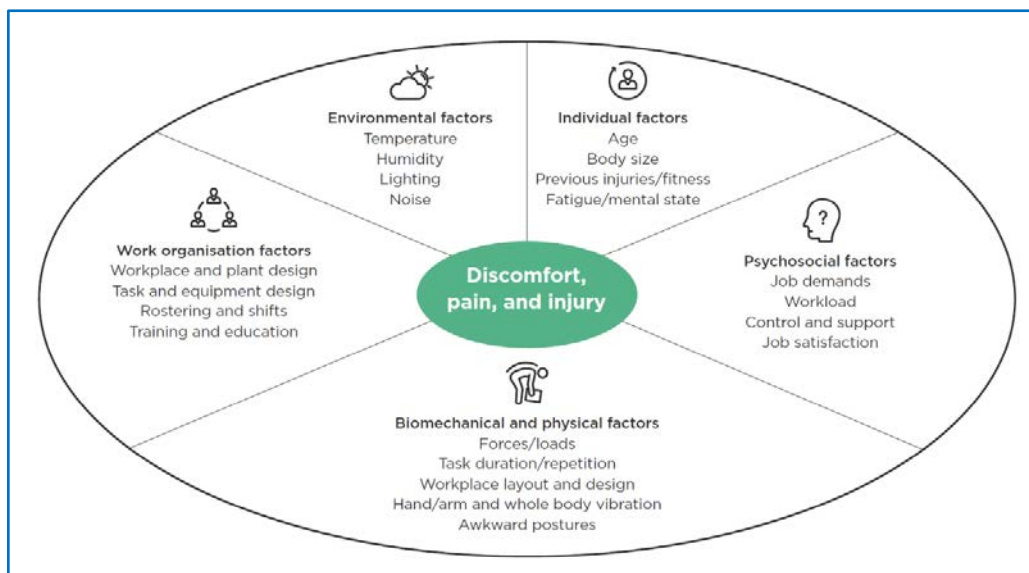


Figure 6 - Contributing factors for discomfort, pain, and injury/WRMSDs (WorkSafe, 2023)

The review highlighted that MSD risk factors are both complex and interrelated (Barton, 2023). Conventional approaches to mitigating WRMSD focus are such things as task design, manual handling loading, workstation and machinery design, and prevention through design (PtD.) The review suggested that taking a more holistic view on the risk factors would likely strengthen the current conventional approaches (Barton, 2023). Figure 6 supports this conclusion through the categories of individual and psychosocial factors, which are both related to the health and wellbeing of the individual.

This holistic perspective on injury risk is backed up by health, wellbeing, rehabilitation, sport, and performance focused research studies. As MSD risk is multifactorial, it has been suggested that strategies should subsequently address these multifactorial risks, including screening movement quality, behavioural health, sleep quality and nutrition awareness (Teyhen et al., 2020). Research has shown a strong relationship between depression, anxiety and the incidence of MSDs (Wride & Bannigan, 2018).

It tends to be common knowledge that increased physical activity can improve overall health and wellbeing and decrease the extent of MSDs, whereas inactivity has a negative impact (Booth et al., 2012, 2017). Conversely, starting an exercise programme to address the impacts of inactivity has also been shown to be a risk factor for the development of MSDs (Hart, 2017).

We can see that many MSK health factors have been shown to be related to future injury risk (See Table 2.)

Table 2 – Risk factors for MSK health

Movement health ie. the ability to move well enough to accomplish tasks without limitation or pain	(Cook et al., 2014b; Dorrel et al., 2018)
Previous injury	(Fulton et al., 2014; Teyhen et al., 2015, 2020; Toohey et al., 2017)
Lower perceived recovery from previous injury	(Teyhen et al., 2020)
Movement dysfunction ie. poor movement quality	(Chorba et al., 2010; Cook et al., 2014b, 2014a; K. B. Kiesel et al., 2014)
Movement Asymmetry	(K. B. Kiesel et al., 2014)
Decreased or asymmetrical ankle mobility	(Teyhen et al., 2020)
Decreased or asymmetrical dynamic balance	(Plisky et al., 2006; Teyhen et al., 2020)
Pain with movement	(Teyhen et al., 2015, 2020)
Behavioural health ie. emotions, behaviours and biology which relate to mental wellbeing, and the ability to function in everyday life	(Office for Health Improvement and Disparities, 2022; Teyhen et al., 2020; Wride & Bannigan, 2018)
Nutritional awareness	(Office for Health Improvement and Disparities, 2022; Teyhen et al., 2020)
Breathing quality	(Chapman et al., 2016)
Sleep quality	(Chun et al., 2018; Harrison et al., n.d.; Skarpsno et al., 2021)
Reduced physical activity	(Booth et al., 2012, 2017; Office for Health Improvement and Disparities, 2022)
Exercise	(Hart, 2017)
High BMI	(Bastick et al., 2016)
Aerobic fitness	(Lisman et al., 2013; Teyhen et al., 2015, 2020)

Functional Movement Systems (FMS) launched Move2Perform (M2P) in 2009, to assess an individual's risk level, through an algorithm that assesses multiple research-backed risk factors. The M2P approach was validated in a study (Lehr et al., 2013) which showed that individuals in the high-risk M2P categories faced a 3.4 times higher risk compared to those in the low-risk categories. A similar model was used in two studies involving general soldiers and army rangers, which identified MSD risk factors of pain experienced during movement, decreased dynamic balance, previous injury, and lower perceived recovery from a previous injury (Teyhen et al., 2015, 2020). Additional factors considered to contribute to risk were ankle dorsiflexion mobility and asymmetry and reduced aerobic fitness. These studies considered these risk factors to be a benchmark for the general population.

The importance of MSK health to future injury risk is clear. Many of these MSK health risk factors can be described as elements of wellbeing. Addressing, managing and optimising these factors can positively impact an individual's outlook and quality of life and reduce the risk of MSDs.

2.5 Injury risk management strategies in the Food and Fibre Sector

It is not within this project's scope to analyse all the current management strategies within the food and fibre sector; significant resources would be required to undertake such research. An overview approach was taken.

Figure 7 outlines the conventional methods for managing injury risk and, subsequently, for risk management of WRMSDs. This hierarchy of controls has been designed to be applied to physical, chemical, biological, ergonomic stressors, and psychosocial risk factors. Interventions tend to focus on reducing task-specific risks and hazards and the environment and organisation of the workplace (Laird et al., 2022). WorkSafe states that all control measures should remain effective, be fit-for-purpose, sustainable for the nature and duration of the work, and be correctly implemented by workers (WorkSafe, 2023).

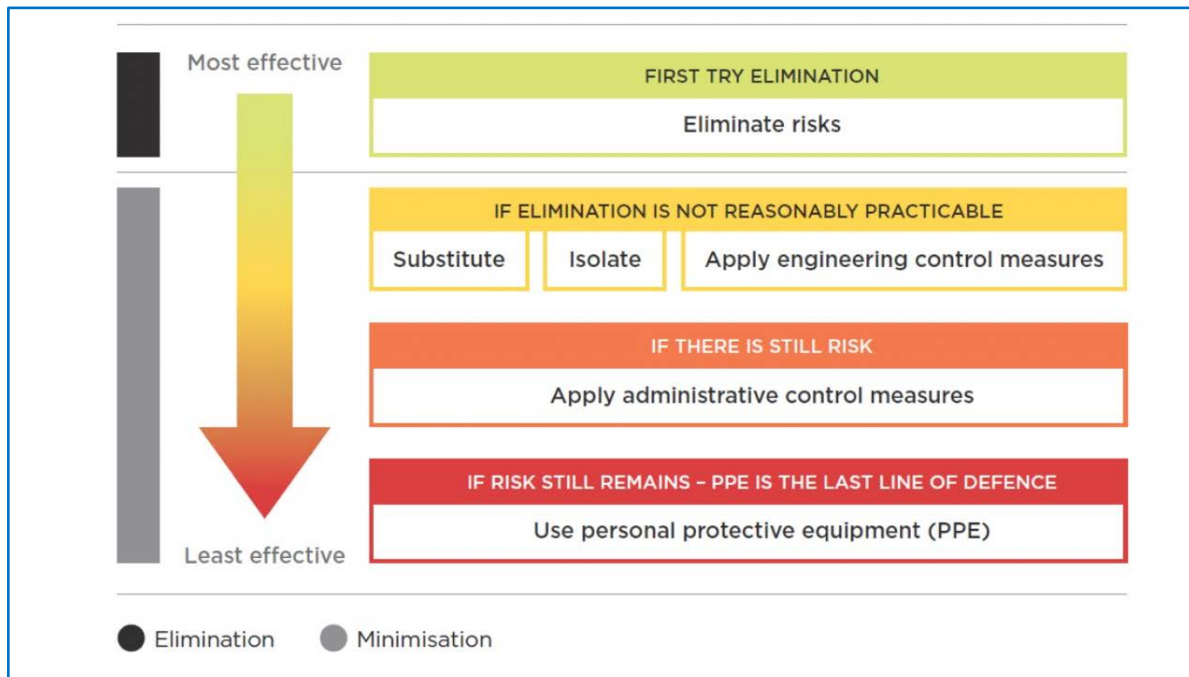


Figure 7 - Hierarchy of controls (WorkSafe, 2023)



In most management and prevention strategies, there is normally a significant focus on behaviour change (Laird et al., 2022). One of the key behavioural outcomes to understand is why health and safety processes are not followed and what the barriers are to reducing health and injury risk (Barton, 2023). What drives human behaviour is too complex a topic to address in this report (See Figure 8.) However, it is observed that most strategies consider models of behaviour in order to achieve significant and long-lasting changes (Barton, 2023).

Figure 8 - A simple model of human behaviour (Barton, 2023, p. 14)

Significant success has been shown in many WRMSD prevention and management strategies. However, there is often an inability to define which aspects of the intervention's success can be attributed to (Laird et al., 2022). The New Zealand regional work-related sprains and strains surveillance, management and prevention programme concludes that “significant changes in injury prevention practice are required to address the problem, including a shift in emphasis from strategies aimed at changing behaviour to more comprehensive approaches which take into account all aspects of an individual’s work, and which also draw upon the subject matter expertise of those doing the work and incorporate the wider context in which the work is taking place” (Laird et al., 2022). A better understanding of the complex and multifactorial nature of injury risk factors in the workplace can provide a foundation for prevention strategies that reduce losses in productivity and time off work (Teyhen et al., 2020).

ACC’s ‘Literature review to inform MSK prevention strategies’ stated, “Injury is a result of a mismatch between the physical abilities of the worker and the physical demands of the job (Conlon, 2014, p. 10). It was noted that only a few high-quality studies have been conducted in agriculture, meaning there is limited evidence. It determined that education and training components should be included within multifaceted interventions rather than stand-alone entities and that ergonomically based functional screening should be used to identify workers who can safely perform physically demanding tasks. The review also concluded that developing multidimensional interventions that incorporate strength and flexibility training tailored specifically to the sector should be highly important. Interestingly, the review noted that job descriptions should address ergonomic risk factors (Conlon, 2014).

Both WorkSafe NZ and ACC are doing significant work to develop and implement new health and safety strategies. The ACC Injury Prevention Team have partnered with external agents to promote change and solve workplace health and safety challenges by developing, sharing, investing in, and implementing solutions for common and relevant problems. Some notable examples are:

- The Reducing Sprains and Strains project is a collaboration with Dairy NZ, QCONZ, Healthy Lifestyle NZ, and Pāmu farms. It is looking to identify solutions that enable workplace structural change or engineering options on dairy farms, instead of relying on behaviour change amongst the farm team (Scarlati, 2022).
- The Hawke's Bay Sprains and Strains Surveillance, Management, and Prevention Project is a collaboration between Massey University and The Hastings Health Centre. The project aims to assess the extent of sprains and strains injuries amongst workers, whilst working closely with employers to identify opportunities for designing out the causes of these injuries. The project utilises Prevention through Design (PtD), which involves actively engaging with workers and end-users in the design process to eliminate hazards and risks at their source. (Personal communication, May 28, 2023).
- Tahi Ngatahi is an online learning platform that uses video clips to pass on essential skills and safety tips to farmers, shearers and wool handlers. It was developed in collaboration with New Zealand Shearing Contractors Association (NZSCA,) WorkSafe and Federated Farmers with the aim to make health and safety training accessible, part of ‘business as usual,’ build a stronger and more skilled workforce, whilst also supporting the wellbeing of rural families and communities (New Zealand Shearing Contractors Association, n.d.). A representative from NZSCA attributed Tahi Ngatahi as a major contributor to the decline in ACC claims over a two and a half year period, showing that this type of online educational resource is effective (Personal communication, March 6, 2023).

Investment is also being made by the Ministry of Primary Industries (MPI) into primary industry wellbeing. “MPI is concerned about the wellbeing of primary industry people and is seeking to drive collaboration across industry and government” (Scarlati, 2023). Though this work is not directly focused on injury, WRMSD management or MSK health improvement, wellbeing itself is an injury risk factor; therefore, the development of strategies such as this can be seen to have a direct correlation to the future landscape of food and fibre sector H&S. The draft report prepared for MPI, entitled ‘Primary Industry Wellbeing Action Plan’ has collated all existing wellbeing resources which support the primary sector in New Zealand (See Figure 9.)



Figure 9 - Existing wellbeing resources (Scarlati, 2023)

The action plan gap analysis showed that there was not comprehensive knowledge of whether the diverse resources were effective, fit-for-purpose and meeting the need. Pathways of connection to the resources, knowledge of which resources were available in what locations or communities, and coordination between the plethora of resources is sparse (Scarlati, 2023). Some alignment can be drawn between this gap analysis for existing wellbeing resources and the difficulty in identifying which aspect of multiple component injury risk interventions successful outcomes can be contributed to (Laird et al., 2022).

The final thoughts of the action plan stated: "There are an array of resources and support for farmers, growers and fishers, but they are being delivered in a fragmented and uncoordinated way." It was highlighted that there is no current strategy around the prioritisation and coordination of initiatives into a cohesive package (Scarlati, 2023).

This literature review shows that strategies are in place which focus on reducing and eliminating workplace risk. Work is underway for a Primary Industry Wellbeing Strategy, with the aim of bringing cohesion and a durable plan for maintaining and improving sector wellbeing (Scarlati, 2023). The author sees Tahī Ngatahi to be a successful integrated and educational approach, combining conventional injury risk mitigation and a holistic approach, by including health and wellbeing education.

2.6 Functional Movement Screening

An ACC review stated that ergonomically based functional screening should be used to identify workers who can safely perform physically demanding tasks (Conlon, 2014).

Human movement testing is commonly used in fitness and rehabilitation. Particularly in the United States, movement testing is becoming more common in the occupational setting, where physical or manual jobs may negatively affect workers' movement patterns or cause injury (Bock & Orr, 2015).

The Functional Movement Screen (FMS) is an internationally recognised comprehensive assessment tool, designed to evaluate movement limitations and asymmetries (Cook et al., 2006). It screens seven fundamental movement patterns and three clearing tests (See Figure 10.)



Figure 10 - Functional Movement Screen (See Appendix 5 for more detail about each movement screen.)

It has been shown that high-performing individuals often exhibit compensatory movement patterns during activities, sacrificing efficiency for performance. Over time this increases their risk of injury (Cook et al., 2006). The FMS has been shown to predict injury risk in various populations, both sporting and occupational, including professional football players, female collegiate athletes, firefighters, and military personnel (Butler et al., 2013; Chorba et al., 2010; K. Kiesel et al., 2007; Lisman et al., 2013; O'Connor et al., 2011)

Research shows that individuals are at higher risk of injury if they:

- score zero; meaning they are experiencing pain
- score below 14
- exhibit asymmetries
- exhibit movement dysfunctions

(Bonazza et al., 2017; Mokha et al., 2016)

Due to the nature of injury risk, the FMS cannot guarantee injury prevention. It identifies movement problems that can contribute to injury risk (Bonazza et al., 2017; K. Kiesel et al., 2007; Teyhen et al., 2015). Movement problems identified in the FMS should be addressed through prescribed exercises, resulting in an appreciable improvement in movement quality, perception, and performance. Regular re-screening, and subsequent adjustment of exercises, are necessary until the individual re-establishes an acceptable movement baseline (Bodden et al., 2015; Campa et al., 2019; K. Kiesel et al., 2011; Suzuki et al., 2021). Individuals who pass the screen are understood to have an acceptable movement baseline (K. B. Kiesel et al., 2014).

2.7 Symmio

Symmio is a culmination of 25+ years of research. The Symmio app is an outcome of the product development of Move2Perform. The screens, exercise strategies, and algorithm are backed by extensive research and testing.

Symmio is a self-screening tool that simultaneously evaluates and considers multiple research-validated factors to categorise individuals into high, moderate, slight and low-risk categories. Symmio can be seen to be a triage system. “Determining the level of risk is the first step in recognising who needs help and at which level of care” (Symmio, n.d.)

The Symmio app allows individuals to assess their own risk factors;

- Movement health
- Behavioural health
- Injury history
- Breathing quality
- Physical activity
- Body composition
- Sleep wellness
- Nutrition awareness

The individual scores are evaluated by the algorithm and then calculated into a final cumulative evidence-based MSK health score. Results are shown as current and average scores based on age and gender.

The individuals categorised as high-risk need referral to either a healthcare provider or a behavioural health professional. The high-risk category is associated with pain during the movement screen, reported pain in the injury history assessment, if the user has not seen a healthcare provider or physiotherapist for their pain, or for low behavioural health screen results. It is possible to have a pain score but not be categorised as high risk, dependent upon the level of risk shown in other screening factors.

Symmio prioritises awareness and education; daily short reading articles explain why each component of MSK health is important, as well as tips and recommendations for developing and maintaining long-term overall health and wellbeing. The goal is to support individuals to make small changes over time and develop positive daily habits.

Corrective exercises programmes are assigned with the focus on restoring natural pain-free movement. Exercise videos are 8-13 minutes long, so they are easy to fit into daily life. Prescribed exercises should result in a quick and appreciable positive change in the movement pattern, allowing the individual to achieve improved movement quality, perception, and performance.

If using the app daily, corrective exercise programmes will last 7-14 days before the Symmio app requests the individual to re-test movement health. The app will only request a re-test if the assigned number of exercise sessions have been completed. The lifestyle assessment relies heavily on the education and behavioural change developed through the reading articles; therefore Symmio retests these factors approximately every 30 days.

Matsel et al. showed that the Symmio app was fairly consistent in identifying risk factors. App results were compared to healthcare professionals' observations using statistical analysis, showing an agreement of 89%. The study found that the Symmio self-screen app is a reliable, accurate and practical tool for identifying musculoskeletal risk factors (Matsel et al., 2023). The Symmio app allows individuals to assess their own risk factors and identify pain and movement problems. Identifying these early allows for the application of preventative strategies, which should improve movement quality, perception and performance, improve MSK health, reduce injury risk, and potentially reduce occupational health burden.

3. Methodology

3.1. Data Collection

3.1.1. Industry employees - Multi-tiered survey and engagement

A three-stage process was created to engage with industry employees. As the author was researching a relatively underexplored area, the online questionnaire was chosen with the objective of collecting qualitative data to capture the diversity of voices, experiences, perspectives, and positionings from participants. (Braun et al., 2021)

a) Online questionnaire

A questionnaire was designed using the SurveyMonkey platform (See appendix 1) and sent out by email to all participants prior to their enrollment on the Symmio app. The questionnaire included open and closed questions discussing injury risk across the food and fibre sector, MSK health risk, and consent for participation in the research project. Forty-one individuals completed the survey, from sheep and beef farming, dairy farming, wool harvesting industry, apiculture and agri-business.

b) Symmio app

After completing the online questionnaire, participants were invited to enrol on the Symmio app for twelve weeks. Thirty-one participants enrolled.

The Symmio app was used to look at MSK health and to see if online education and video-based practical tools could positively impact participants' MSK health.

Individuals who had a high-risk score received a notification from the app to book an appointment with a healthcare professional. They also received an email from the author acknowledging their high-risk score and encouraging them to seek care.

c) Online questionnaire – Symmio feedback

A questionnaire was designed using the SurveyMonkey platform (See Appendix 2) and sent out by email to all participants after their Symmio subscription was terminated. The questionnaire included open and closed questions about their experience using the app. Eighteen individuals completed the questionnaire.

3.1.2. Sector leaders - Multi-tiered Interviews

Similar to the industry employees, a three-stage process was created to engage with food and fibre sector leaders, who have responsibility within their role for injury risk management. Participants from different sectors of the industry and from different company types were chosen to gain a diverse set of views and perspectives (See Appendix 3.)

a) Online questionnaire

A replica of the industry employees' online questionnaire (See Appendix 1) was sent out by email to all participants prior to their interview. Eighteen individuals completed the questionnaire.

b) Semi-structured Interview

A semi-structured interview was developed (See Appendix 3). Fourteen interviews were conducted using Zoom, over a seven-week period. The interviews were conducted under Chatham House rules, with all participants understanding that identities would remain anonymous, information would be treated confidentially, and extracts quoted in this report would be disguised.

c) Online questionnaire – Post-interview follow up

Thematic analysis was applied to the semi-structured interview transcripts to seek a level of patterned response and meaning from the qualitative data (Braun & Clarke, 2006). The author designed a second questionnaire using the SurveyMonkey platform (See Appendix 5), which was sent out by email to all participants. This questionnaire gave an opportunity for the author to provide collated feedback to the interviewees and seek more of a consensus. All fourteen leaders completed the follow-up questionnaire.

3.1.3. Functional Movement Screening in the Wool Harvesting Industry

A Functional Movement Screen (FMS) was performed on one hundred and fifty-eight individuals in the wool harvesting industry during the 2021-22 WOMOlife wool harvesting industry training courses. A functional movement screen was used to determine the quality of individuals' movement patterns and identify deficits in symmetry, mobility, and stability, as identifying these early and quickly can be an important factor in the prevention of injuries and improving performance. (Cook et al., 2014b)

3.1.4 Accident Compensation Corporation (ACC) data

A request for information from ACC was made, under the Official Information Act Request 1982 (OIA), for injury claims data for the food and fibre sector. An OIA was also made to the Ministry for Primary Industries (MPI) for workforce statistics. MPI did initially not hold this data, so they sought this information from Statistics New Zealand about estimated employee counts to fulfil the OIA.

3.2. Analysis

3.2.1. Data analysis

ACC data was summarised to understand distributions and trends and compare and contrast new claims across sectors. Sectors chosen for analysis were: grain growing, sheep and beef cattle farming, sheep farming, beef cattle farming, dairy cattle farming, deer farming and shearing services. Employee numbers data was also analysed and used in conjunction with the ACC new claims data.

FMS data was analysed by looking at pain during movement, movement dysfunction and asymmetries, comparing and contrasting results for the upskill group versus the beginners' group, and shearers versus wool handlers.

Symmio data was analysed using the administration portal reporting function.

The online questionnaires included both open and closed questions. The closed questions provided quantitative data for workers and sector leaders to compare and contrast for data analysis.

3.2.2. Thematic analysis

Reports were produced for each of the online questionnaires using the SurveyMonkey platform. The open answers were used as qualitative data. All interviews were video recorded, and then transcribed. This combination of qualitative data was analysed using thematic analysis. Thematic analysis is a method “for identifying, analysing and reporting repeating patterns (themes) within data.” (Braun & Clarke, 2006, p. 79). Key thoughts and ideas were captured into a Word document, with associated quotes cited, and identified as ‘codes.’ These codes were then grouped into themes. These themes were reviewed, combined, and refined as the analysis progressed in alignment with the process suggested by Braun and Clarke (2006). Further reports were produced following the second sector leader questionnaire. Thematic analysis was then applied to this further refined data set. This iterative process allowed the author to suppress personal observational bias and capture diverse perspectives and insights into opportunities and barriers. Thematic maps were created using the Miro website to show the themes observed.

Photograph – Author



4. Analysis and Results

4.1 Online questionnaire analysis

Forty-one individuals completed the worker survey: thirteen from sheep and beef farming, seven from dairy farming, nine from the wool harvesting industry, one from apiculture and eleven from agri-business. Eighteen sector leaders completed the survey, fourteen of whom went on to participate in the interviews (See Appendix 4 for information about the sector leaders.)

Participants were asked if they thought eight different factors had an impact on injury risk. These factors were those that the Symmio app screens to establish an overall health MSK health score. The data shows a good understanding. Sector leaders attributed a lower level of impact with injury risk to nutritional awareness, breathing quality and BMI. Workers attributed a lower level of impact with injury risk to breathing quality, injury history, physical activity and BMI. Both sector leaders and workers rated breathing quality and BMI as having a low impact on injury risk. (See Figures 11 and 12.)

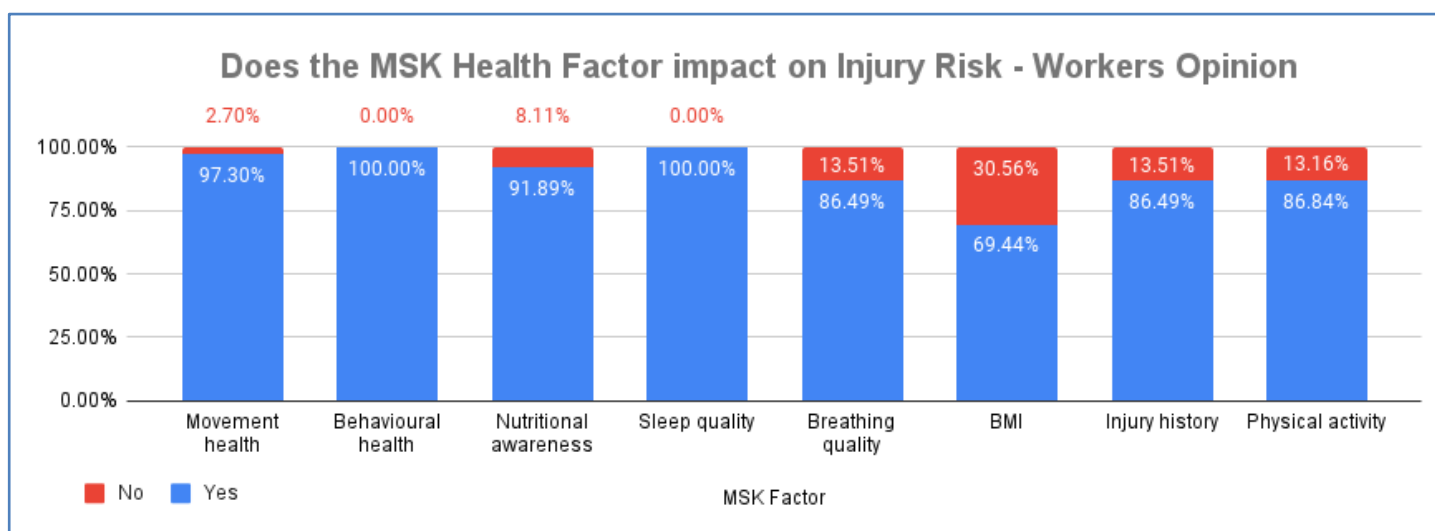


Figure 11 – Musculoskeletal health factors impact on injury risk – Workers' opinion

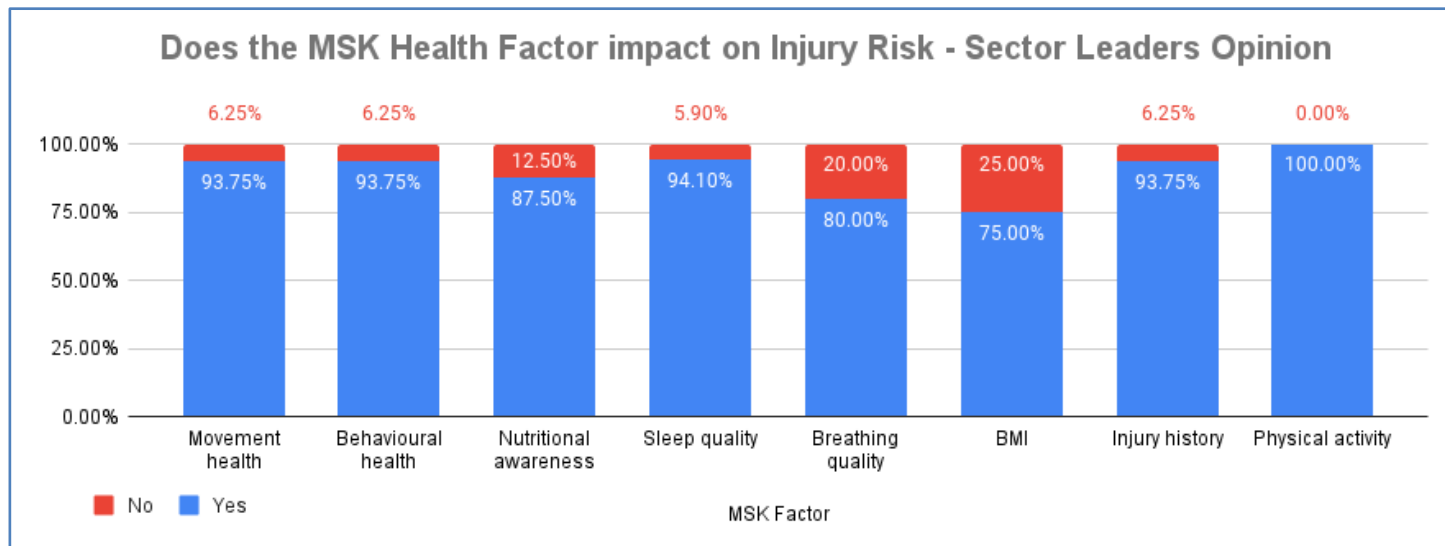
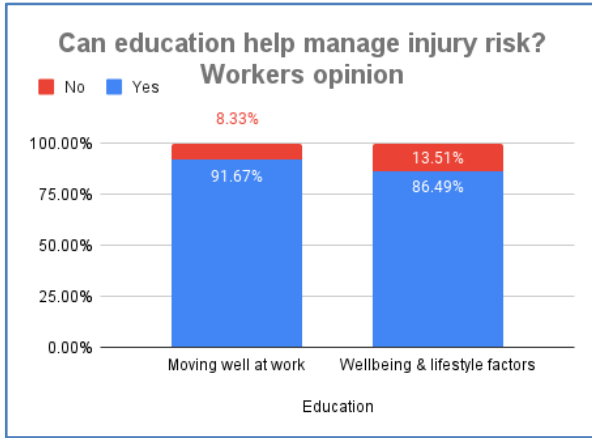
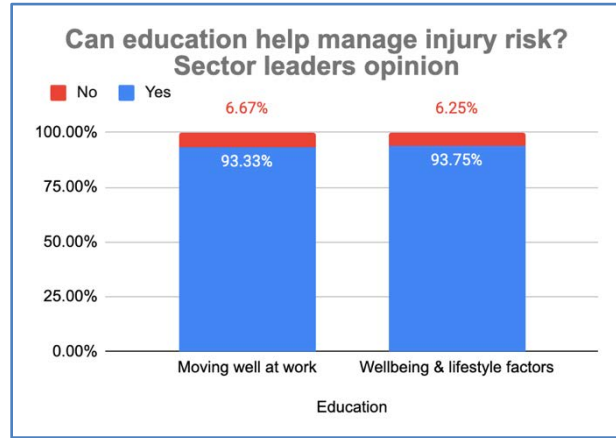


Figure 12 – Musculoskeletal health factors impact on injury risk – Sector leaders' opinion

The vast majority of both sector leaders and workers felt that education about moving well at work, and wellbeing and lifestyle factors could help to manage injury risk. 93% of sector leaders felt education on both topics was important. Workers rated education about moving well at work at 91%, higher than wellbeing and lifestyle factors which they rated at 86%. (See Figures 13 and 14.)



Can education help manage injury risk
Figure 13 – Sector leaders' opinion



Can education help manage injury risk
Figure 14 – Workers' opinion

Photograph – ER Imaging



4.2 Thematic Maps

The online questionnaires and interviews showed a high level of understanding of the factors that contribute to MSK health and the holistic perspective of how MSK health can affect injury risk in the workplace. Diverse perspectives, ideas and insights were put forward during interviews, showing the complexity of the topic. Subsequently, the development of themes was an extremely iterative process. Once these themes had been established, the author felt the viewpoints were still expansive; therefore, a further feedback questionnaire was sent out to all the interviewees to gain more clarity and achieve more of a consensus (See Appendix 5.) During the semi-structured interviews, the 'Chatham House Rule' applied; therefore, all quotes and extracts are anonymous and, in some instances, may be partially disguised.

Workplace injuries

Thematic analysis was applied to both the sector leader and worker questionnaires and the sector leader interviews, bringing together five themes for workplace injuries:

- MSK injury occurrence
- Lack of reporting
- Event injuries
- Over time injuries
- Pain and discomfort

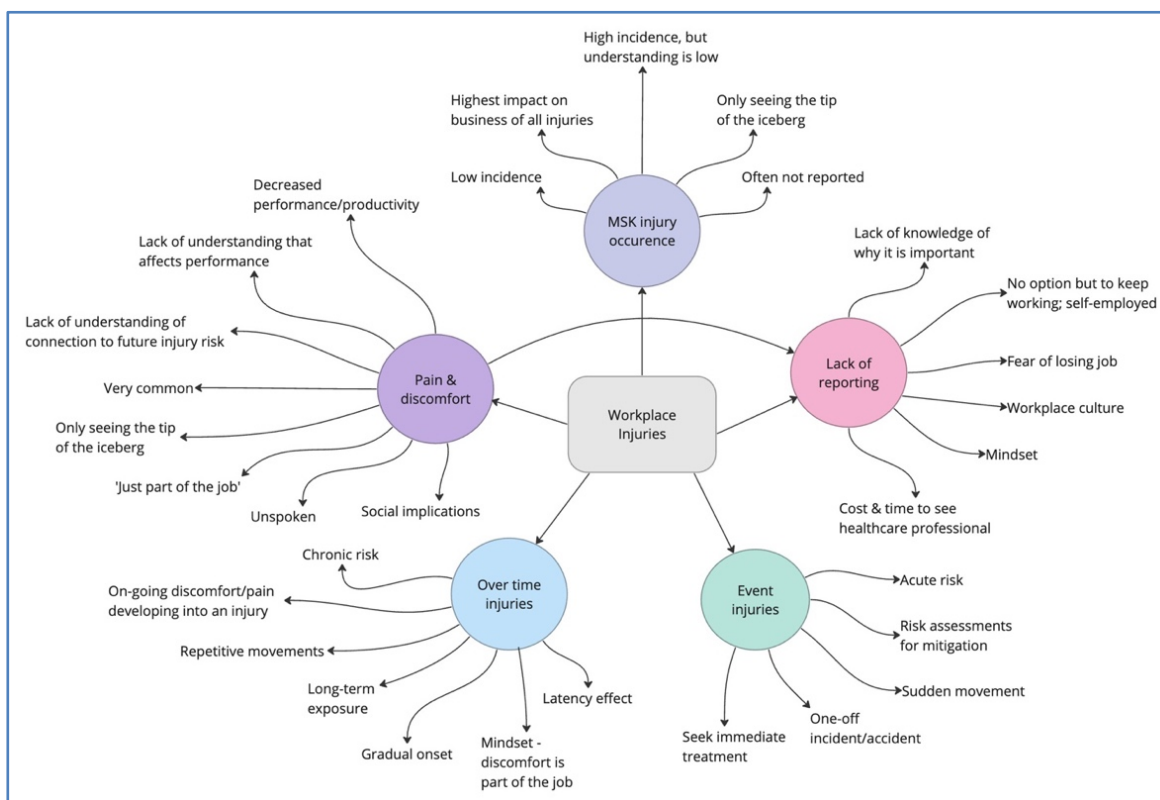


Figure 15 – Workplace injuries – Online questionnaire and interview data – A thematic analysis

Barriers to early pain and injury reporting

The theme of lack of reporting had a sub-theme looking at the barriers to early pain and injury reporting. The three themes which emerged were:

- Mindset
- Financial
- Healthcare

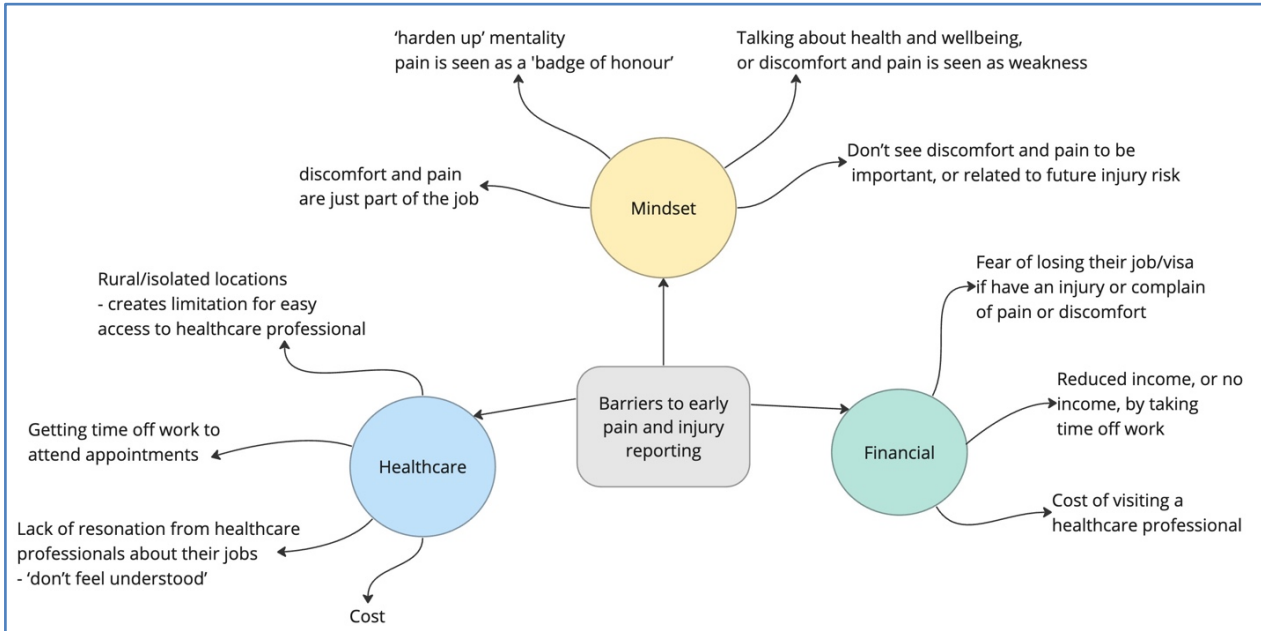


Figure 16 – Barriers to early pain and injury reporting – Interview data – A thematic analysis

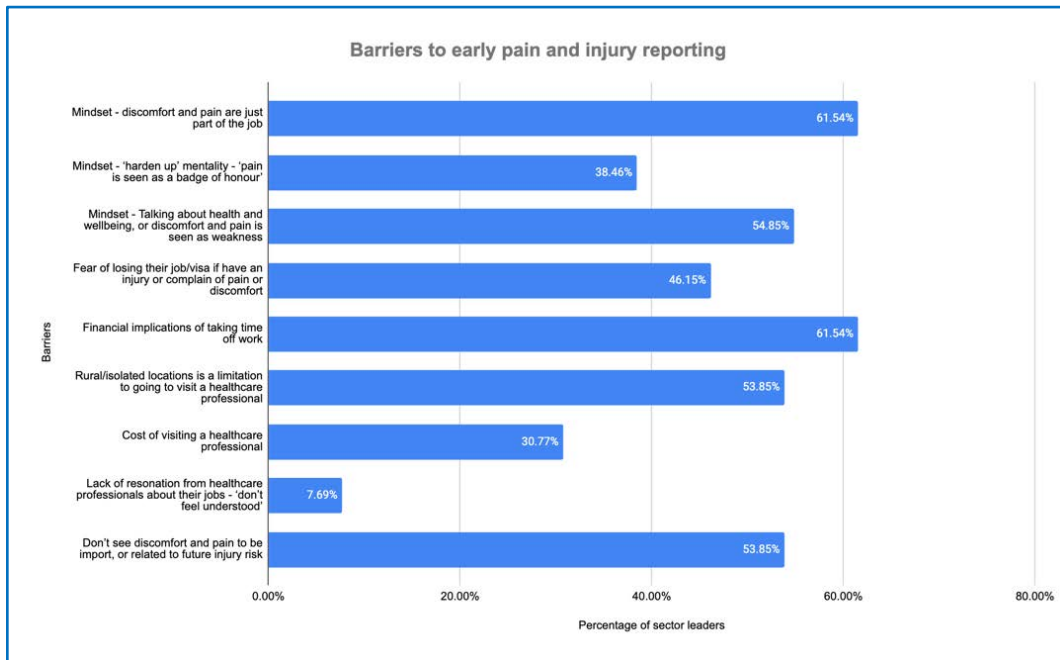


Figure 17 – Barriers for early pain and injury reporting – Follow-up questionnaire data

Implications of Time of Work from Injuries

During the interview, sector leaders were asked about the social and economic implications of injuries that cause time off work.

Under social implications, three themes emerged:

- Individual/personal
- Family
- Work team

Under economic implications, two themes emerged:

- Business
- Employee

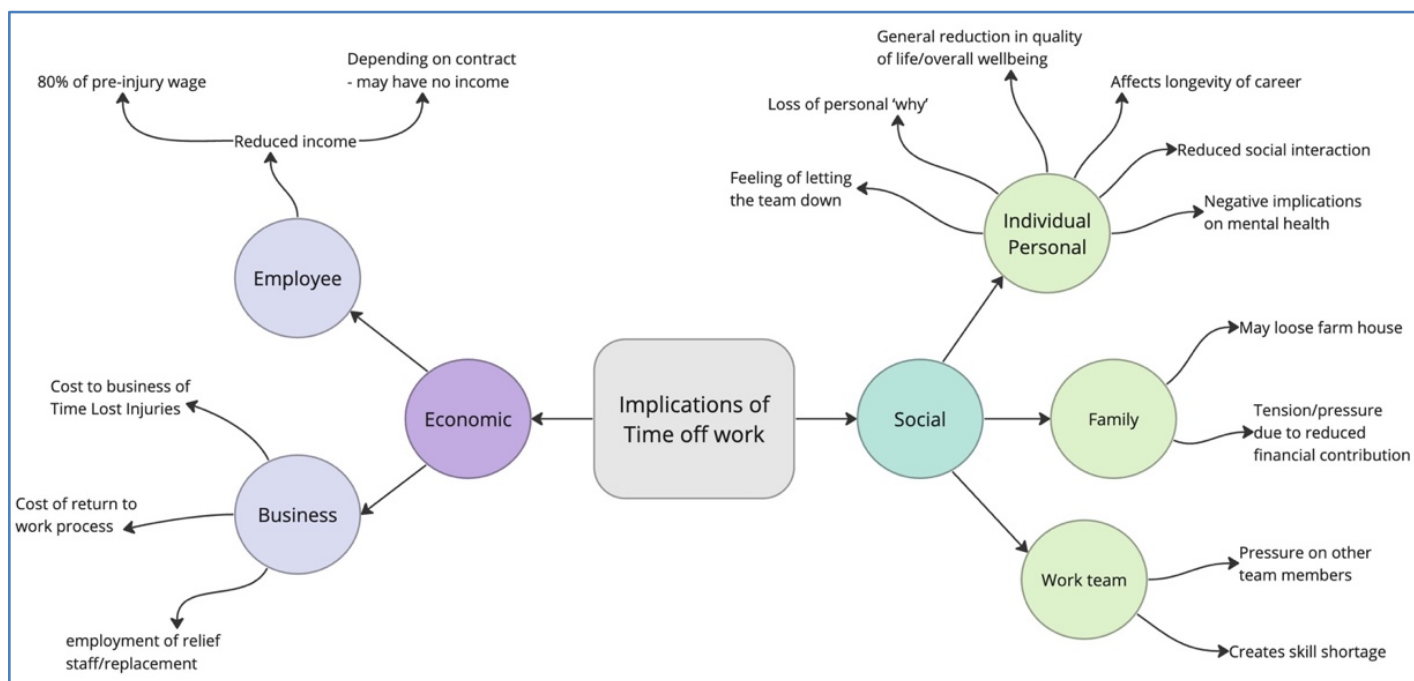


Figure 18 – Implications of time off work – Interview data – A thematic analysis

Both themes showed the far-reaching impact of time off work, highlighting the importance of preventative management strategies that can reduce injury risk factors.

Injury Risk Management Strategies

Sector leaders described the strategies employed currently in the businesses they work for and their perspective of strategies within the sector, fitting into four main themes:

- Workplace culture and policy
- Multi-level approach
- Risk assessments
- Training

Strategies ranged from extremely comprehensive in the corporate environment to more simplistic in the smaller businesses, relying on the individual to take personal responsibility.

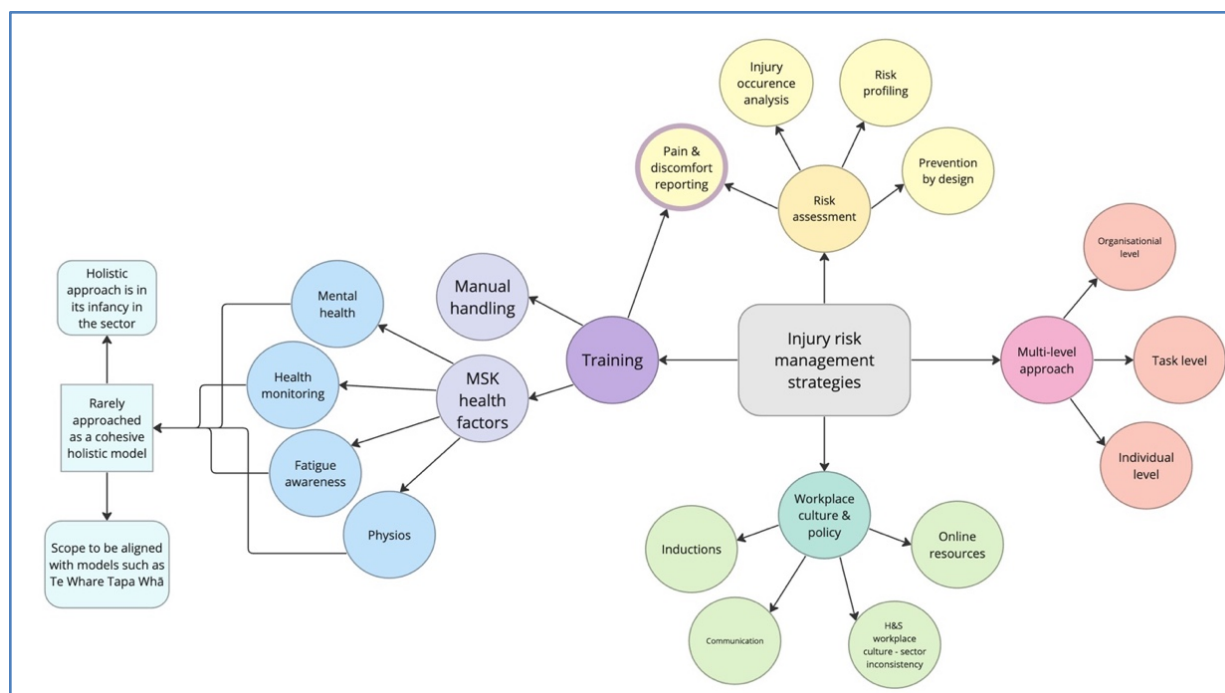


Figure 19 – Injury risk management strategies in the food and fibre sector – Interview data – A thematic analysis

The theme of training showed a sub-theme of training about MSK health factors; such as mental health, health monitoring, fatigue awareness and physiotherapists workshops. The overarching view was that MSK health training is rarely approached in a cohesive manner, and a holistic approach is in its infancy in the sector. Some sector leaders thought there was scope to align such a holistic approach with the well-known model of Te Whare Tapa Whā.

“We have health and safety in place, but it just comes down to common sense.”

“We have seen a reduction in those MSK injuries with changes to processes and moving into more automated/tool assisted tasks.”

“We are working hard to work both in an organisational level, at a task level, and an individual level. We are trying to manage the risk at all those three levels. I don't think that's everywhere though. I think you'll have the more mature companies in their safety who should at least be thinking physical and mental anyway, but you're smaller SME's won't be, I wouldn't think, it'll be more organic.”

“Reshaped our safety and wellbeing journey to be more aligned in that in that kind of thinking (holistic approach) away from the traditional approach, that safety is compliance. So, it's refreshing to hear that I'm not completely on my own my thinking. But it is really at its infancy.”

Pain and discomfort

When discussing injury risk management strategies, a common discussion was that workers were not good at early reporting of pain and discomfort. This was further explored in the feedback questionnaire. Sector leaders were asked if, in addition to reported injuries, there is a level of pain and discomfort in the sector. The answers resoundingly agreed that there is a level of unspoken pain and discomfort, that it is often just expected as ‘part of the job,’ and that may have a negative impact on individual’s performance.

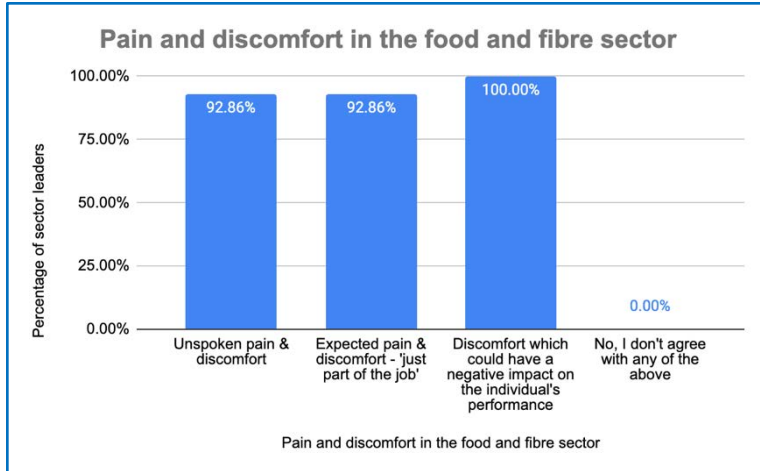


Figure 20 – Pain and discomfort in the food and fibre sector - Follow-up questionnaire data

Injury risk factors

A plethora of injury risk factors were put forward in both questionnaire answers and interviews. These risk factors were brought together into themes.

In the first online questionnaire, 93.3% of the sector leaders thought that education about how to move well at work could help manage injury risk, and 93.75% thought that education about lifestyle and wellbeing factors could help manage injury risk, it was asked in the post-interview questionnaire which injury risk factors the leaders felt could be reduced if movement, health and wellbeing were improved, or if workers had more education/awareness of these topics.

The thematic map shows twenty-seven risk factors, twenty-four of which the sector leaders felt could be reduced if workers' movement, health and wellbeing were improved or if workers had more education/awareness of these topics (Figure 21.)

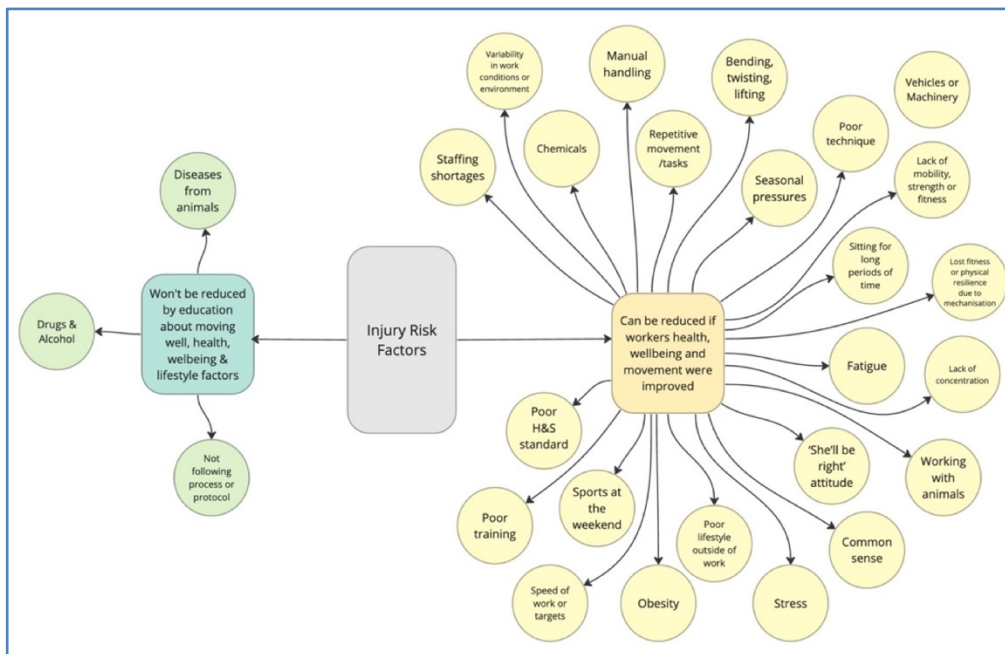


Figure 21 – Injury risk factors – Online questionnaire and follow-up questionnaire data – A thematic analysis

Some particular topics were very highly rated: 100% of sector leaders thought manual handling risks could be reduced, 93% thought repetitive movements/tasks, bending, twisting and lifting, poor technique, and fatigue, and 86% thought lack of strength, mobility and fitness and poor lifestyle outside of work. Overall, with twenty-four of the risk factors acknowledged to have the potential for reduction, this shows considerable potential benefit to taking a holistic and educational approach to managing risk factors.

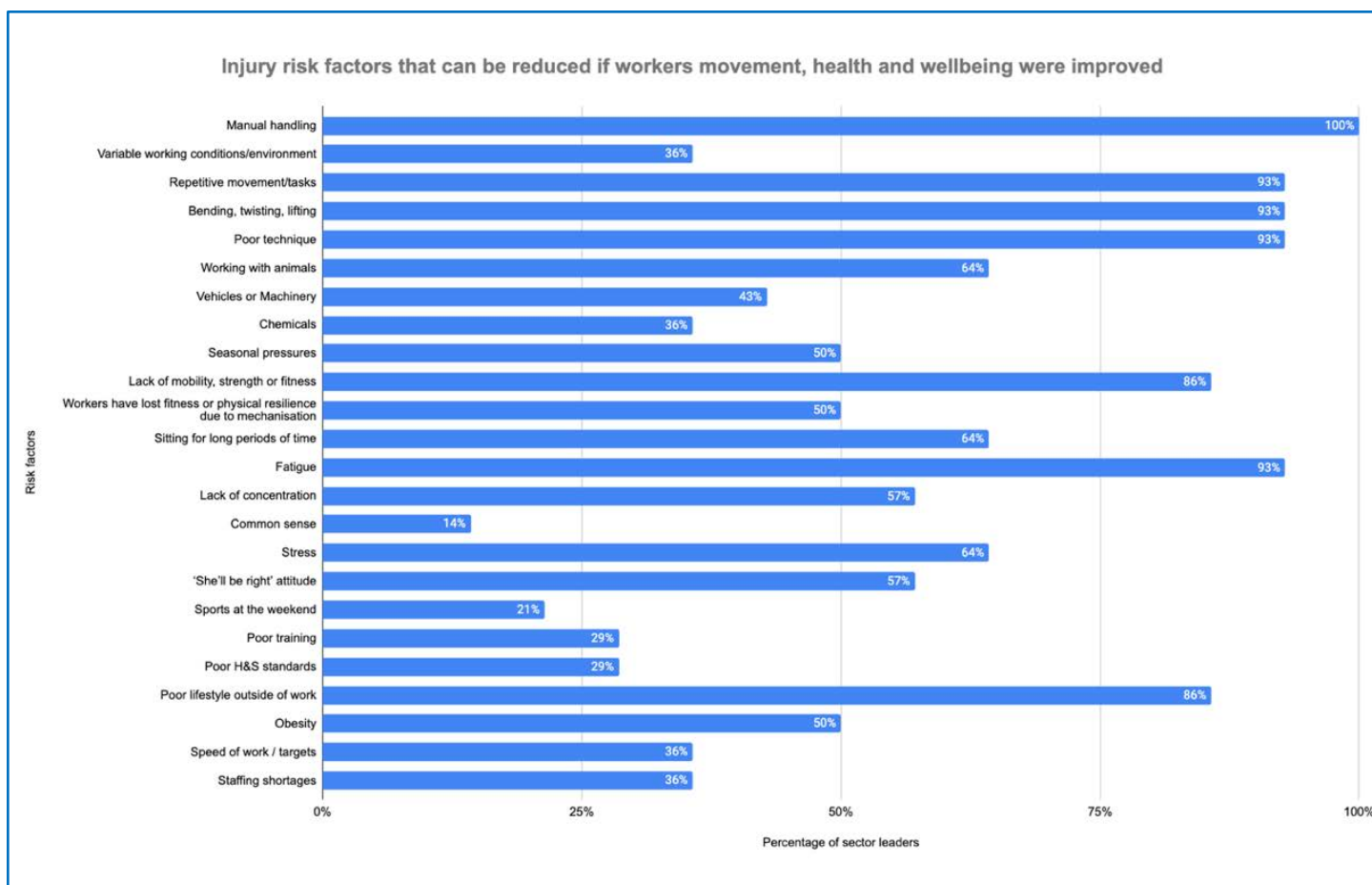


Figure 22 – Injury risk factors that can be reduced if workers' movement, health and wellbeing were improved or if workers had more education/awareness of these topics – Follow-up questionnaire data

Worker understanding of MSK health and injury risk

Sector leaders were split in their opinions of workers understanding of MSK health and its relation to injury risk. Leaders in smaller businesses tended to think workers didn't understand. Leaders in corporately run businesses felt the workers had a basic or intuitive understanding of MSK health but were not connecting the dots or were unable to apply this understanding.

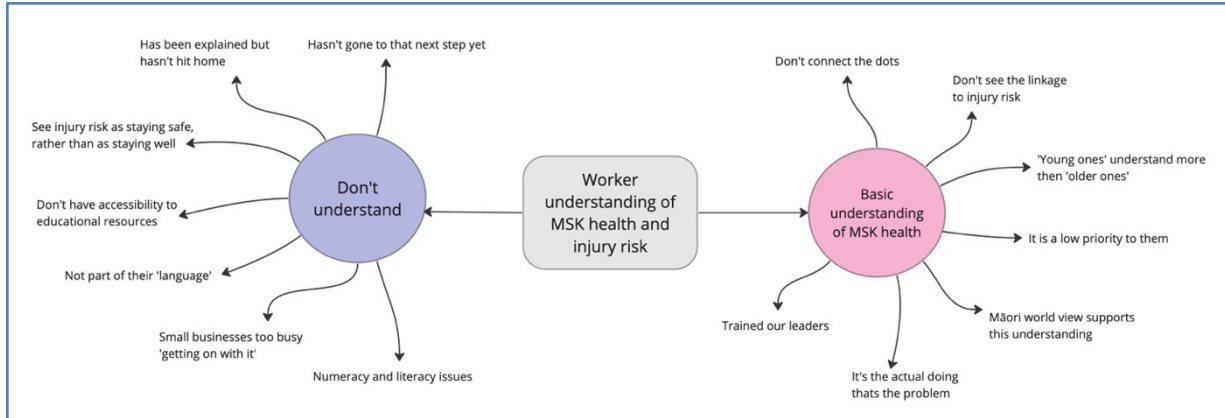


Figure 23 – Worker understanding of MSK health and injury risk – Interview data – A thematic analysis

“I don't think they've connected the dots right, and sometimes the understanding is there when they've had an injury and learnt from it and then can look back on it, but I don't think that they necessarily think about good health, good sleep, good nutrition, good physical well-being, mental wellbeing, and all that contributes. They're all connected, so connected, and I genuinely believe that I don't think people have necessarily connected it yet in our industry.”

“It is probably another kind of industry-related thing; understanding risk doesn't seem to be particularly mature in making business and personal decisions. Risk is seen to be something negative, as opposed to contemplating the factors that makeup risk. Not correlating the factors of whether it is a critical risk, an injury risk, or just accepting something is the way it is without challenging that is probably a bit of an issue for the industry at a global level.”

MSK Health – Education and Awareness

Nine themes emerged of MSK health related topics that lack areas of education and awareness.



Figure 24 – MSK health topics which lack in education and awareness in the food and fibre sector – Interview data – A thematic analysis

In the follow-up questionnaire, eight topics were put forward for the sector leaders to choose which topics require awareness and education to be introduced. All were rated to be important, with the highest priority being teaching workers 'self-care levers.'

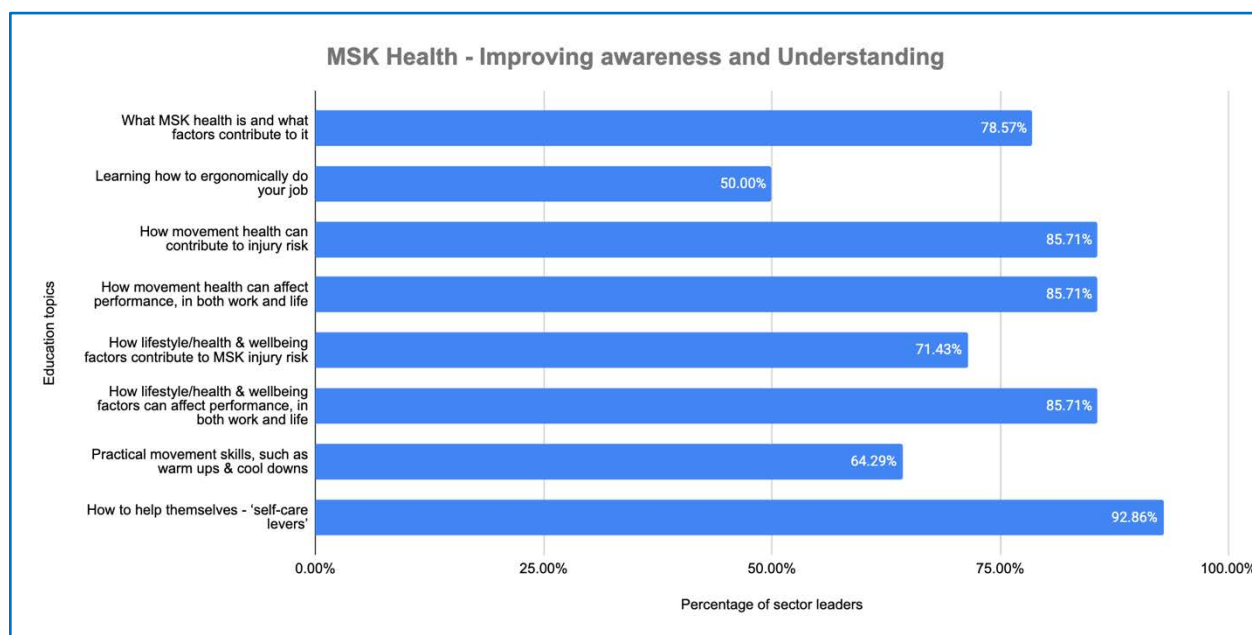


Figure 25 – MSK health topics which lack in education and awareness in the food and fibre sector – Follow-up questionnaire data

“Probably to start the conversation - would be awareness around what MSK health is in general (the what) - then building out the "why, how" - how holistically movement health supports performance, lifestyle, reduces risk etc.”

“Would be ideal to have a connection back to personal lifestyle as well as improved work performance i.e. safety as a currency rather than a cost, the personal 'why' you want to improve MSK health and lower any associated risk.”

Te Whare Tapa Wha

The Te Whare Tapa Whā model was the ninth theme that emerged. This was not included in the above question. It was discussed separately in the follow-up questionnaire. 91.67% of sector leaders all agreed that a more holistic approach of education to improve MSK health and reduce injury risk factors aligns with the Te Whare Tapa Whā model. The 1% who did not agree as they were unsure what the model was.

“I believe that to achieve positive health outcomes, there are multiple dimensions that are influencers and are interrelated.”

“Linking models reduces the confusion in language. MSK isn't a stand-alone health component.”

Opportunities for integration of MSK health management strategies

An extensive and diverse range of suggestions were made as to the best context/setting to integrate education and teach practical skills to help improve the management of MSK injury risk. Six themes emerged:

- Education
- Business
- Third party
- Community
- Hybrid
- Sector

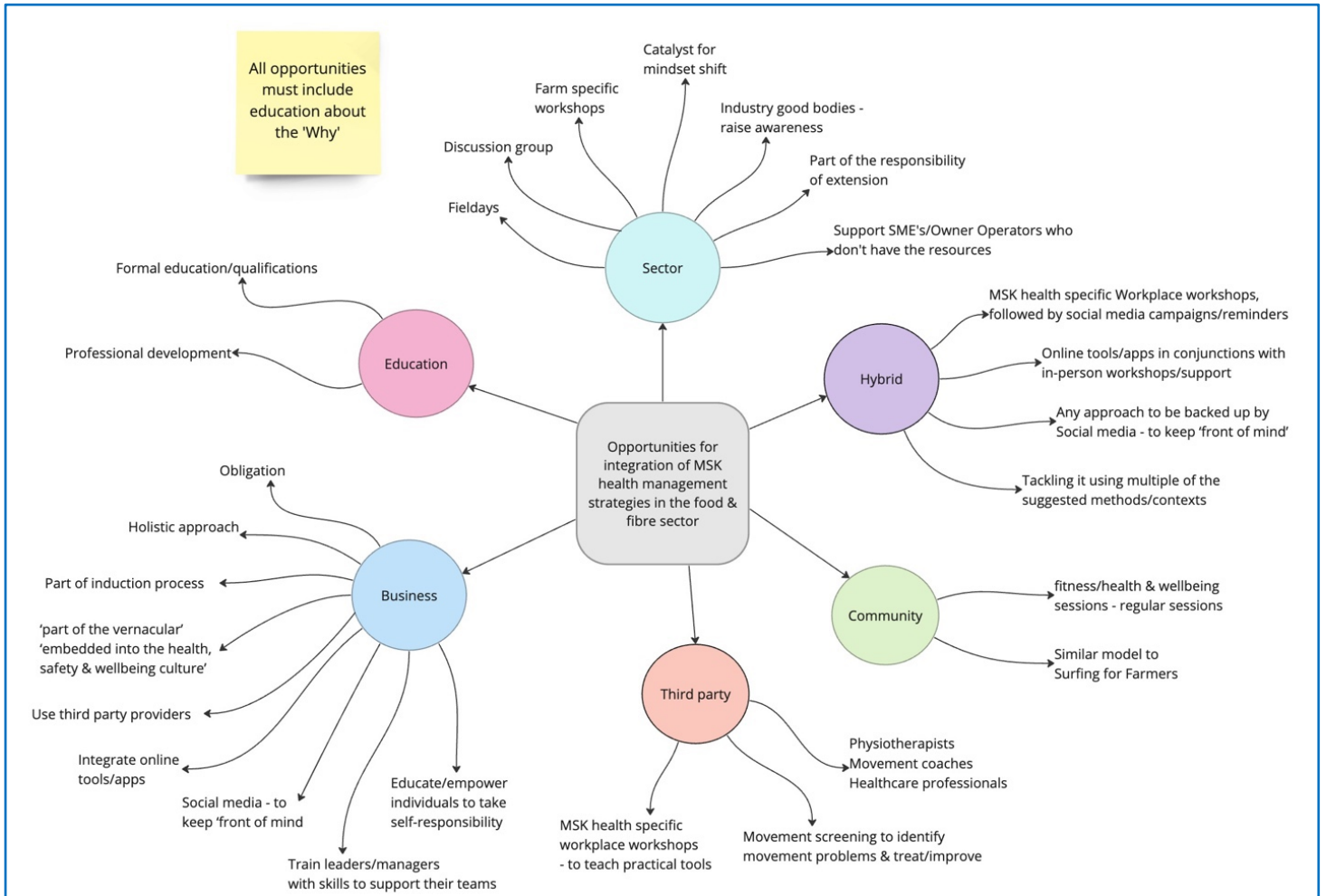


Figure 26 – Opportunities for MSK health management strategies in the food and fibre sector – Interview data – A thematic analysis

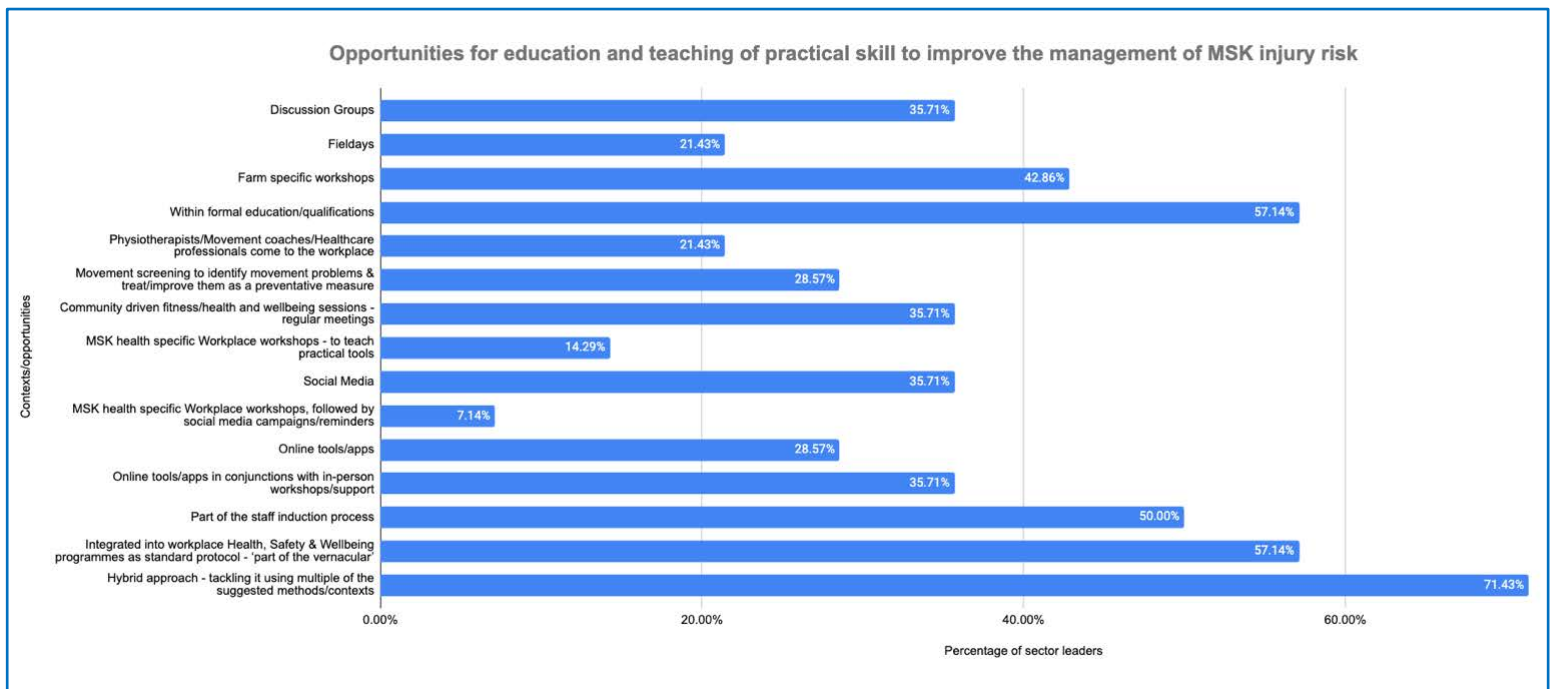


Figure 27 - Opportunities for MSK health management strategies in the food and fibre sector – Follow-up questionnaire data

Taking a hybrid approach to tackle the problem using multiple suggested methods/contexts was rated the highest at 71.43%. Including MSK health education into formal education, qualifications and professional development was rated at 57.14%, alongside integrating it into workplace health, safety and wellbeing programmes as standard protocol.

“Designing this into the workplace and way of working is important. Also building this into the industry, so it becomes industry and workplace lead.”

“No 'one size fits all' and need to be conscious of multiple requests for time off-farm or away from the workplace if targeted - in a larger business such as ours, it is best weaved into the wider programmes of work we are doing.”
 “It needs to be part of what we do.”

The Why

During the interviews, an independent theme emerged; it is extremely important that in all work to improve education and awareness and introduce practical tools to communicate the ‘Why’ of managing MSK health.

It was unanimous that an important factor to communicate to workers is that MSK health and injury risk management are important so they can come home happy and comfortable and enjoy life outside of work and with their family, scoring 100%. To live well and longer, for quality of life, and understanding that pain and discomfort is not necessarily part of the job, both scored 71.43%. Showing that the three highest factors in the ‘Why’ that leaders felt workers needed to understand were not reasons about their job; they were reasons about their personal life, life outside of work and personal wellbeing.

When asked how best to integrate the mindset shift associated with the ‘why’ the leaders were almost equally split in their opinion of how best to do this. 42.86% said the focus on creating mindset/culture change first - the ‘Why’ - before introducing any of the education/awareness/practical skills opportunities. 57.14% said the focus on mindset/culture change - the ‘Why’ - is an integral part of any of the opportunities.



Figure 28 – The Why – Interview data – A thematic analysis

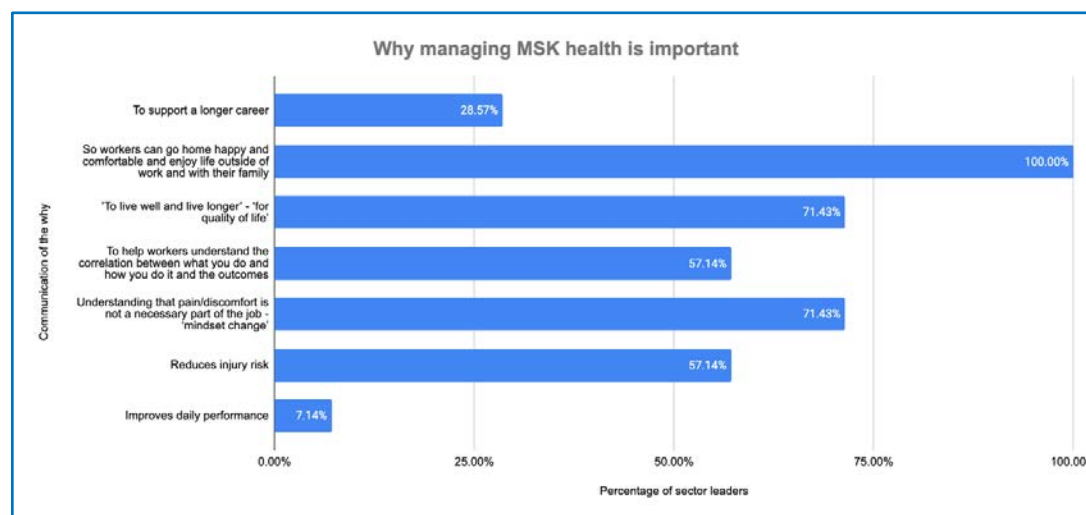


Figure 29 – Why managing MSK health is important – Follow up questionnaire data

Barriers to integration of MSK health management strategies

An extensive range of factors/barriers were put forward that could limit the integration of education and awareness about MSK health and its impact on injury risk. The themes which emerged were:

- Mindset
- Workforce characteristics
- Employees
- Business
- Accessibility

The four highest-rated barriers were:

Mindset - the job has to get done, so I just have to crack on, I don't have any other option – 61.54%

Mindset – 'discomfort and pain are just part of the job,' 'harden up' mentality, 'she'll be right' attitude – 53.85%

'Just another thing to do,' 'too much noise,' another thing adding pressure – 53.85%

How to keep it front of mind – 38.46%

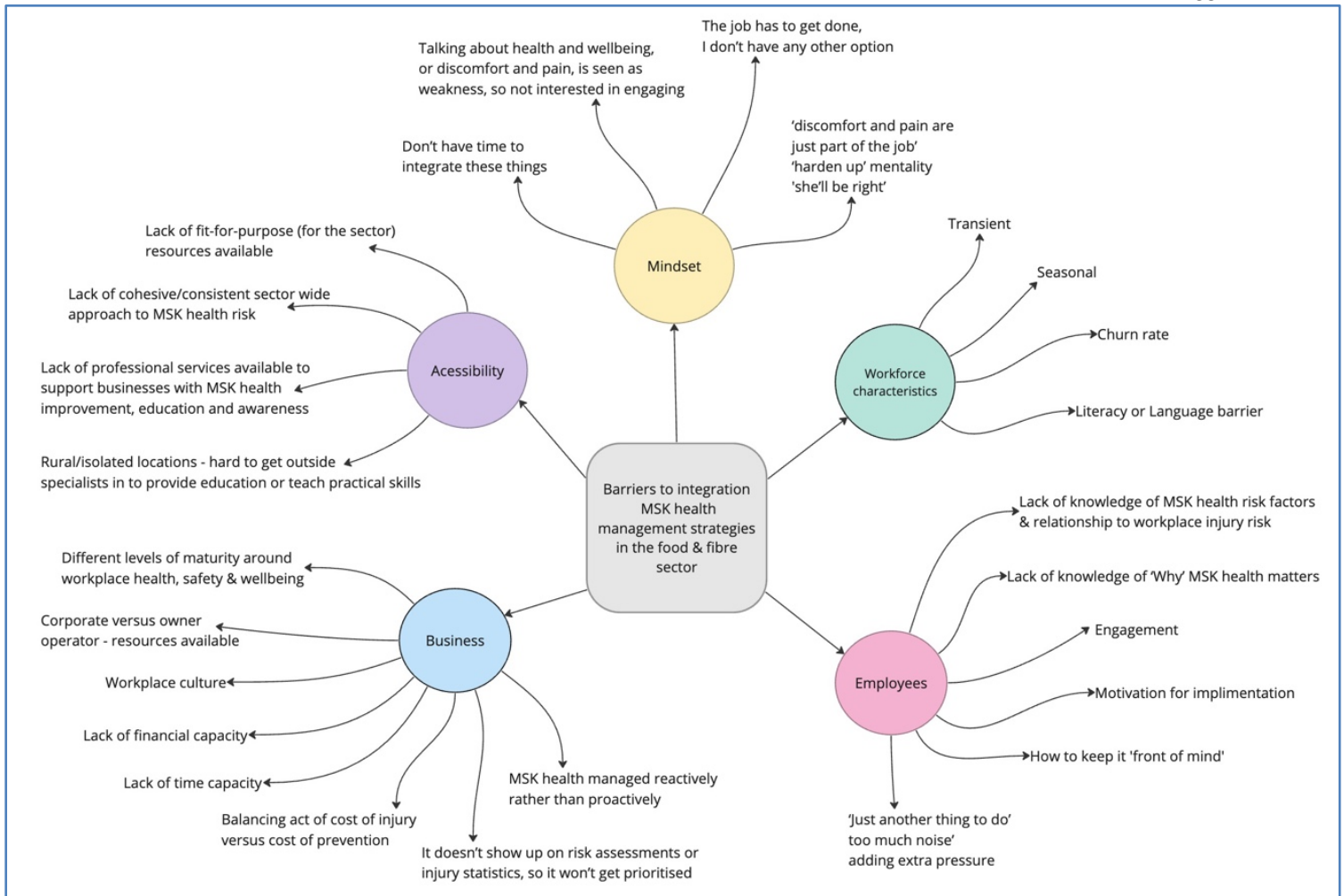


Figure 30 – Barriers to integration of MSK health management strategies – Interview data – A thematic analysis

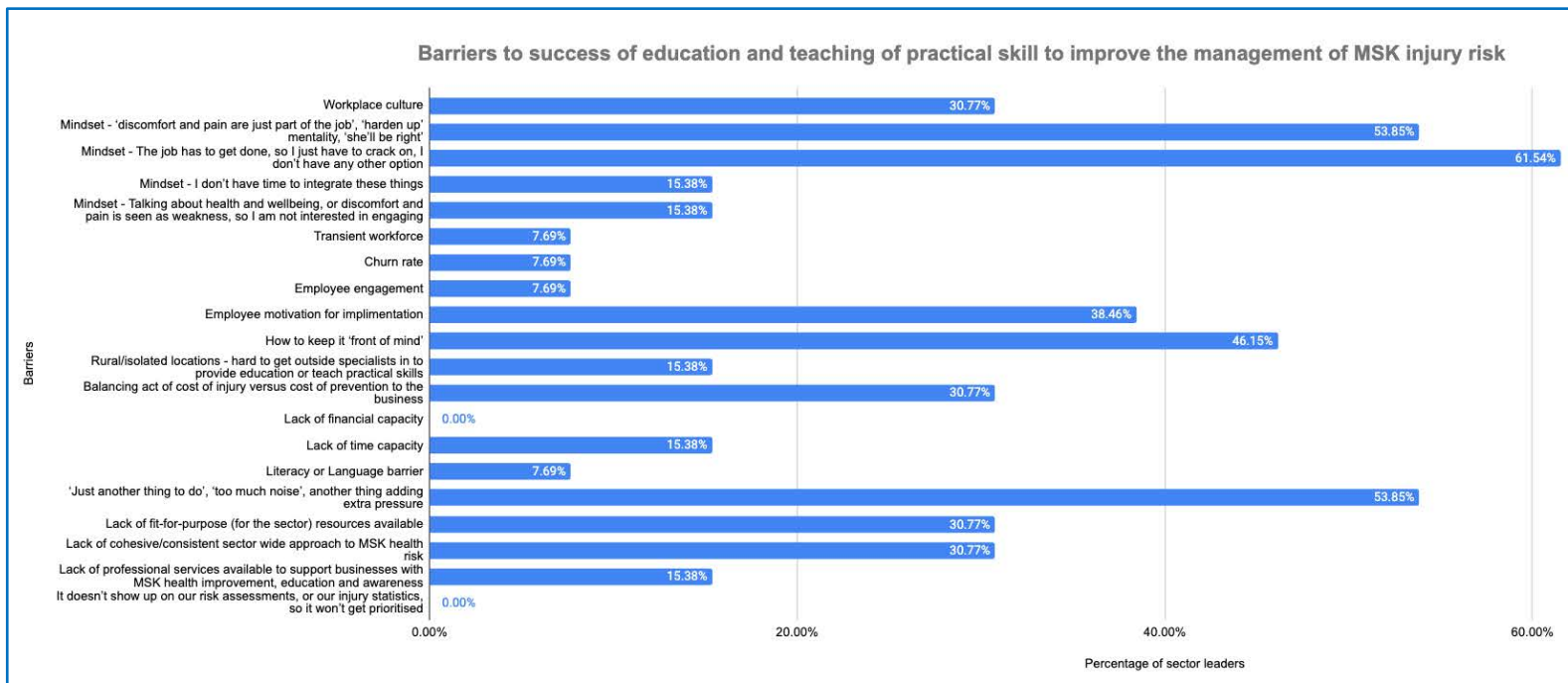


Figure 31 – Barriers to integration of MSK health management strategies – Follow-up questionnaire data

Efforts from the sector and businesses to support a change in mindset and the empowerment of workers to understand 'why' MSK health is important are seen as influential for the success of any future interventions and strategies. Opportunities to design holistic approaches into the workplace, embedding them into the vernacular, and making them just part of 'what we do', and creating a hybrid approach could be seen as both opportunities and ways to mitigate some of the barriers to success.

Photograph – ER Imaging



4.3. Symmio app

Thirty-one participants enrolled on the Symmio app and completed an initial screen.

Reports were run from the Symmio administration portal to be able to analyse all participants' results. (See Appendix 8.)

Of the thirty-one participants, eleven had high-risk MSK health scores, exhibiting multiple or significant MSK health risk factors, and needing to seek care from a healthcare professional or behavioural specialist (See Figure 22.) This equates to 35.48% of users being in the high-risk category.

Fourteen of the participants, equating to 45.16%, had moderate-risk scores, exhibiting manageable MSK health risk factors and may need to be under the supervision of fitness, healthcare or nutritional specialists while improving their movement quality (See Figure 22.)

Twelve participants had pain scores, equating to 38.7%. Ten of whom were categorised as high-risk. (See Appendix 8.)

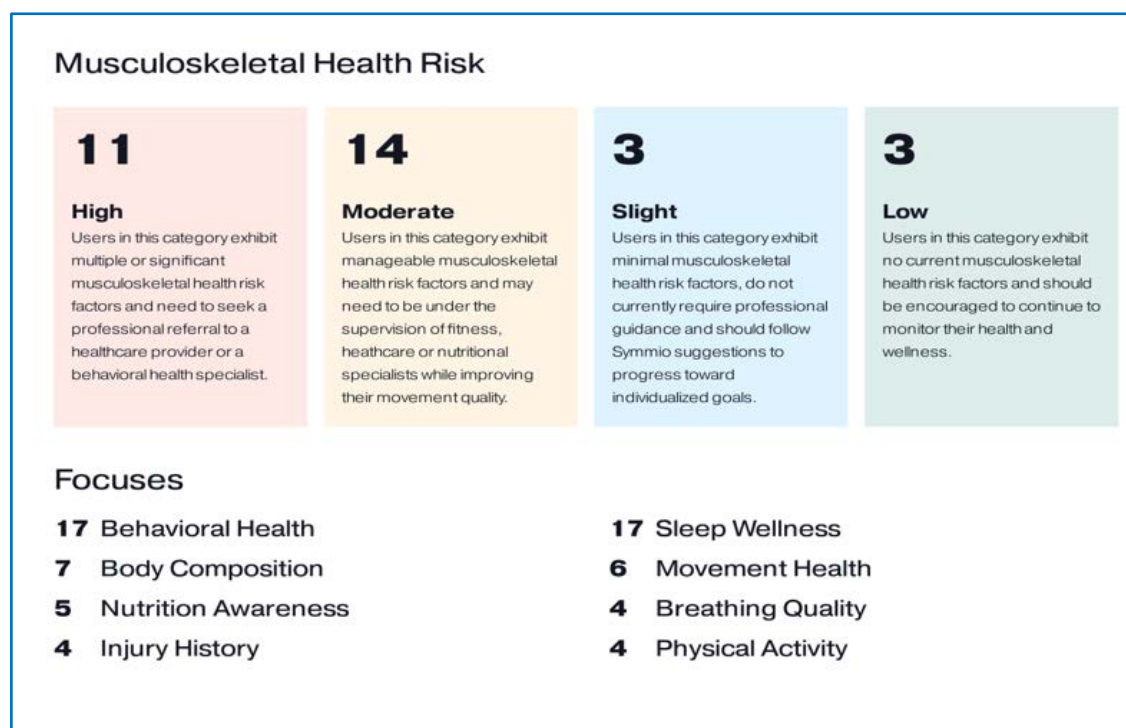


Figure 32 - Summary scores for thirty-one participants after initial screen

The summary report (Figure 32) shows that behavioural health and sleep wellness were the two MSK health factors that showed as focus areas, with both showing to be risk factors for 54.8% of the participants.

It must be noted that the author purposefully chose not to encourage the users of the app to test whether an online app was a successful method of providing education and practical tools to workers in the sector. The administration portal of the app does not currently run a report to define an individual's over-time use or percentage weekly commitment. However, the administration portal does show which users were re-screened, indicating the level of commitment and motivation to using the app. If the user was not re-screened, this means they had not connected with the app enough times for the algorithm to acknowledge their commitment to the

corrective exercise programme and the education and awareness articles to warrant a re-screen. Therefore, it can be seen through the number of re-screens the results of motivation and engagement with the app on MSK health scores.

The results demonstrate that if engagement with the app was consistent enough for the algorithm to ask to rescreen, the individual MSK health scores improved. Those who were more consistently engaged over the 2-3 month timeframe (demonstrated by two to four rescreens) had significantly higher improvement in their MSK health score. (See Table 3.)

Table 3 – Average MSK health score increase by number of re-screens completed

	Number of re-screens completed				
	0	1	2	3	4
Number of users	17	10	1	1	2
Average MSK score increase	0	2.2	2	6	10
Average MSK Score increase - minus 1x injury user		2.4			

These results show Symmio to be a useful triage tool to identify individuals with MSK risk factors and to initiate an intervention before these factors develop, reduce the individual's wellbeing or lead to injury. If individuals engaged with the app consistently, MSK health improved, showing that small changes through education and practical tools are effective and can positively impact individuals' MSK health. The Symmio app is both a successful triage tool and MSK health intervention. However, motivation and consistency of use were barriers, indicating that further understanding of the benefits, incentives or encouragement may be needed to achieve appreciable success through this online tool.

Photograph – ER Imaging



4.4 FMS - Wool Harvesting Industry

A Functional Movement Screen (FMS) was performed on one hundred and fifty-eight individuals in the wool harvesting industry during the 2021-22 WOMOLife wool harvesting industry training courses. Fifty-six of those individuals were new entrants to the industry, attending beginner courses, one hundred and two were currently working in the industry, attending upskill courses.

The data shows a significant difference in the number of movement patterns where pain was exhibited in the upskill group compared to the beginner group. The percentage of the upskill group exhibiting pain in one or more movement patterns was 1.75 times that of the beginner group, with 47% in the upskill group versus 27% in the beginner group (See Figure 33.) This suggests a connection between the physical demands of working in the wool harvesting industry and the likelihood of workers experiencing pain during movement.



Figure 33 - Percentage of people with no pain and pain in one or more movement patterns, split by beginner and upskill groups

The data shows a significant difference in the number of movement patterns where movement dysfunction was exhibited in the upskill group compared to the beginner group (See Figure 34.) This suggests a connection between the physical demands of working in the wool harvesting industry and the likelihood of experiencing movement dysfunction.



Figure 34 - Percentage of people with movement dysfunction, split by beginner and upskill groups

The data shows a significant increase in the percentage of movement dysfunction in the upskill group compared to the beginner group in specific movement patterns (See Table 4.) An average of 1.3 times more movement dysfunction was shown in the deep squat, active straight leg raise, and trunk stability push up movement screens in the upskill group compared to the beginner group. An average of 2.25 times more movement dysfunction was shown in the upskill group's hurdle step and shoulder mobility movement screens compared to the beginner group. This suggests that the physical demands and biomechanics required when working in the wool harvesting industry have more impact on certain movement patterns than others, and show an increased likelihood of movement dysfunction developing in those movement patterns.

Table 4 - Percentages of movement dysfunction in specific movement patterns, split by beginner and upskill groups.

	Deep Squat	Inline Lunge	Hurdle Step	Shoulder Mobility	Active Straight Leg Raise	Trunk stability push up	Rotary Stability
Beginner	35.7%	25.0%	17.9%	17.9%	57.1%	41.1%	71.4%
Upskill	50.0%	30.4%	40.2%	41.2%	72.5%	53.9%	79.4%

(See Appendix 5 for more detail about each movement pattern screen.)

The data shows a significant difference in the number of movement patterns where asymmetry was exhibited in the upskill group compared to the beginner group. The percentage of the upskill group exhibiting asymmetry in two or more movement patterns was 1.75 times that of the beginner group, with 40% in the upskill group versus 23% in the beginner group (See Figure 35.) This suggests a connection between the physical demands of working in the wool harvesting industry and the likelihood of developing asymmetry.

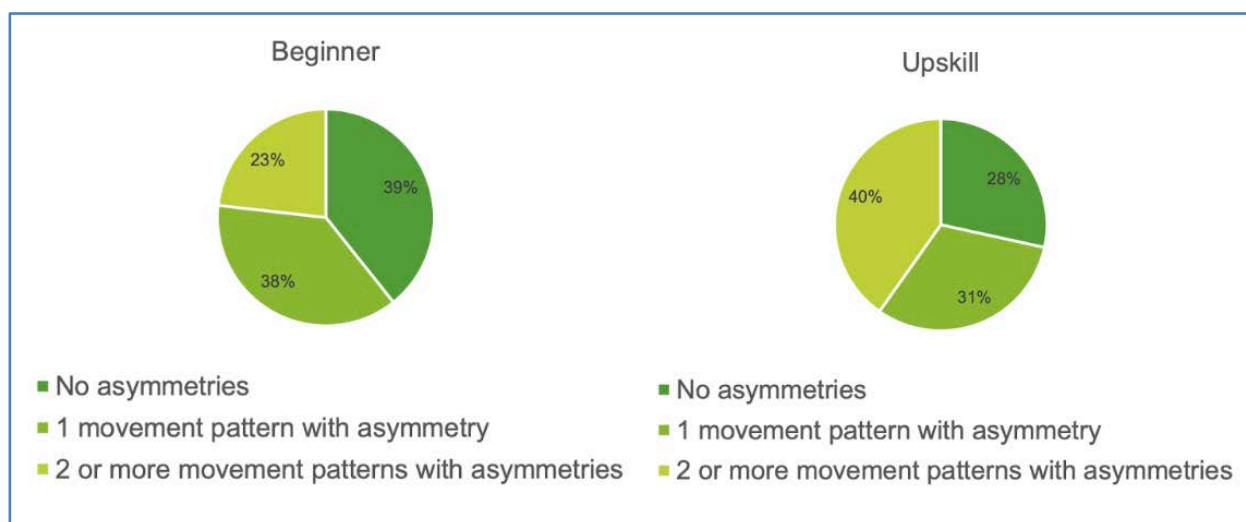


Figure 35 - Percentage of people with asymmetries, split by beginner and upskill groups

The data shows a significant increase in the percentage of asymmetry in the upskill group compared to the beginner group in specific movement patterns. An average of 1.5 times more asymmetries were shown in the upskill group compared to the beginner group in the Inline lunge, ankle clearing, shoulder mobility and active straight leg raise movement screens (See Table 5.) This suggests that the physical demands and biomechanics required when working in the wool harvesting industry have more impact on certain movement patterns than

others, and show an increased likelihood of asymmetries developing in those movement patterns.

Table 5 - Percentage of asymmetry in specific movement patterns, split by Beginner and Upskill groups.

	Inline Lunge	Ankle Clearing	Hurdle Step	Shoulder Mobility	Active Straight Leg Raise	Rotary Stability
Beginner	8.9%	16.1%	12.5%	23.2%	8.9%	23.2%
Upskill	13.7%	25.5%	17.6%	35.3%	12.7%	22.5%

(See Appendix 5 for more detail about each movement pattern screen.)

These findings indicate that many workers in the wool harvesting industry are experiencing pain, movement dysfunction and asymmetry, which can increase their risk of injury. The upskill group has a higher occurrence of these factors compared to the beginners. This suggests a connection between the physical demands of working in the wool harvesting industry and the likelihood of experiencing movement dysfunction, asymmetry, and pain. (See Appendix 6 – Complete Functional Movement Screen summary results.)

However, this data also presents an opportunity for improvement. By identifying movement limitations, weaknesses, asymmetries, and imbalances, individuals can proactively address these issues and enhance their movement quality, perception, and overall performance. Prescribed exercises can lead to positive changes in movement patterns, helping achieve better movement competency and reduce injury risk.

Photograph – Photos for Jean



4.5 ACC data

The initial Official Information Act Request (OIA) spreadsheet received focused on new MSK injury claims lodged and active claims per financial year. Financial years defined by ACC are 1st July to 30th June. ACC counts new claims by the date they were lodged with ACC, which may be immediately after the injury or later. Active claims can continue over time; therefore, it was decided to focus only on the new claims data.

The data showed dairy farming to have significantly higher new claims for MSK injury lodged each year than any other sector included in this analysis. Sheep and beef cattle farming had just under half the number of new claims compared to dairy farming, with all the other industries showing significantly less new claims lodged per year (See Table 6 and Figure 36.)

Table 6 - Number of new claims for musculoskeletal injuries by industry, lodged between 1 July 2017 and 31 March 2023 (ACC, OIA, May 4, 2023)

Work Indicator	New claims in Lodgement Financial Year				
	2017/18	2018/19	2019/20	2020/21	2021/22
Grain Growing	61	77	57	54	53
Sheep and Beef Cattle Farming	2,249	2,143	1,943	2,013	1,599
Sheep Farming	334	283	291	333	289
Beef Cattle Farming	538	537	462	486	401
Dairy Cattle Farming	4,746	4,344	4,291	4,360	3,724
Deer Farming	91	89	65	83	63
Shearing Services	467	426	435	484	405
Total across sector	8486	7899	7544	7813	6534

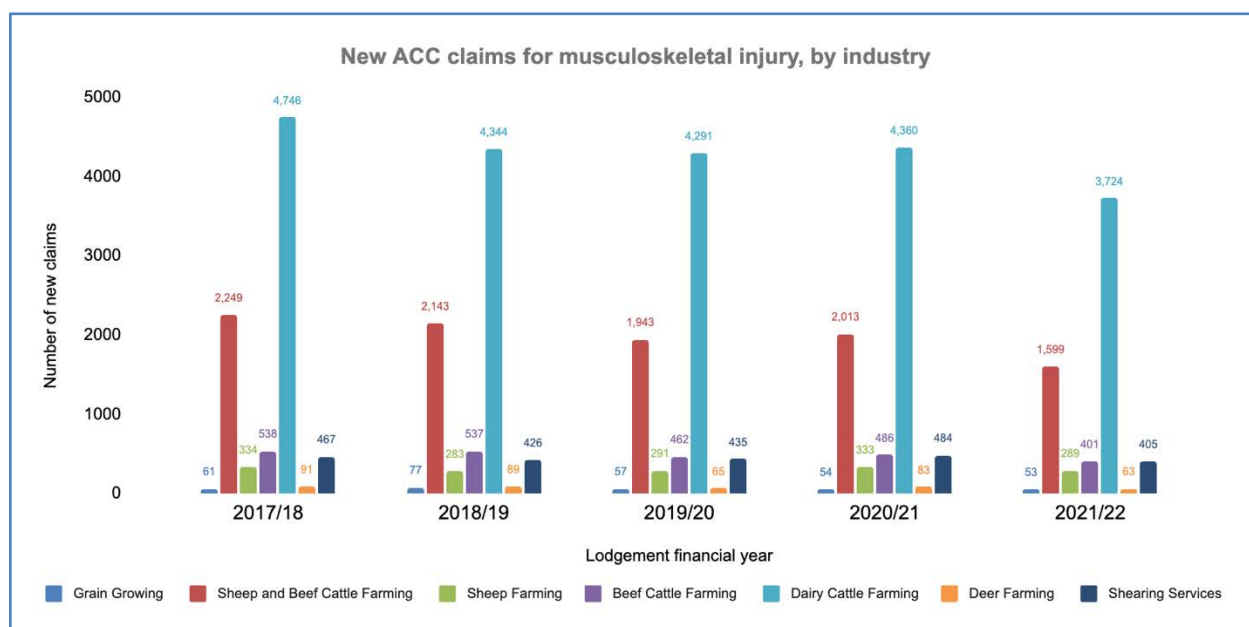


Figure 36 - Number of new claims for musculoskeletal injuries by industry, lodged between 1 July 2017 and 31 March 2023 (ACC, OIA, May 4, 2023)

This data was analysed further to assess the percentage of the MSK injury new claims accounted for by industry in

each lodgement financial year (See Figure 37.)

On average, over the past five lodgement years, dairy farming accounted for 56.12% of all new MSK injury claims, sheep and beef cattle farming 25.92%, beef cattle farming 6.32%, shearing services 5.81%, sheep farming 4.01%, deer farming 1.02% and grain growing 0.79%.

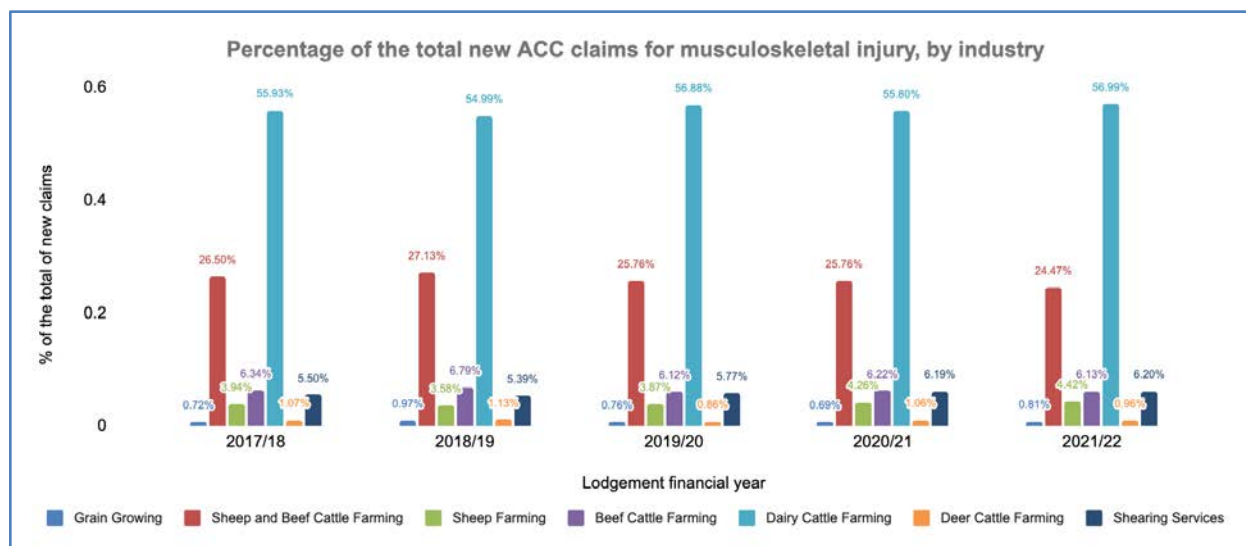


Figure 37 - Percentage of new claims for musculoskeletal injuries by industry, lodged between 1 July 2019 and 31 March 2023 (ACC, OIA, May 4, 2023)

This data shows the new claims for MSK injuries each year by sector, but does not represent the percentage of new claims within each industry. The total number of employees per sector was collected through an OIA to MPI. This information was provided to MPI by Statistics New Zealand, through their annual February year end business survey (See Table 7.) Financial years defined by ACC are 1st July to 30th June. The author notes that there may therefore be minor discrepancy in the calculations, however, they will provide indicative data of the MSK injury occurrence/risk by industry.

Table 7 – Total number of employees by industry, by year (MPI, OIA, May 29, 2023)

Work Indicator	Total number of employees				
	2017/18	2018/19	2019/20	2020/21	2021/22
Grain Growing	970	880	910	920	730
Sheep and Beef Cattle Farming	10,400	10,600	10,300	9,600	9,400
Sheep Farming	4600	4700	4650	4700	4800
Beef Cattle Farming	4350	4250	4100	3750	3850
Dairy Cattle Farming	25,300	25,200	25,400	25,400	24,900
Deer Farming	530	530	620	570	510
Shearing Services	4950	5000	4750	4500	4350
Total across sector	51100	51160	50730	49440	48540

Employee numbers were then used with the data for new claims by industry, by lodgement year, to calculate the percentage number of employees with new ACC claims for MSK injury, by industry, by year. Once the sector-wide employee numbers were used in combination with the number of new claims, this gave a more indicative representation of the level of MSK injury risk by industry (See Figure 38.)

Over the past five lodgement years sheep and beef cattle farming had an average percentage of employees with new claims for MSK injury of 19.74%, dairy cattle farming 17%, deer farming 14.27%, beef cattle farming 11.93%, shearing services 9.44%, grain growing 6.89% and sheep farming 6.53%.

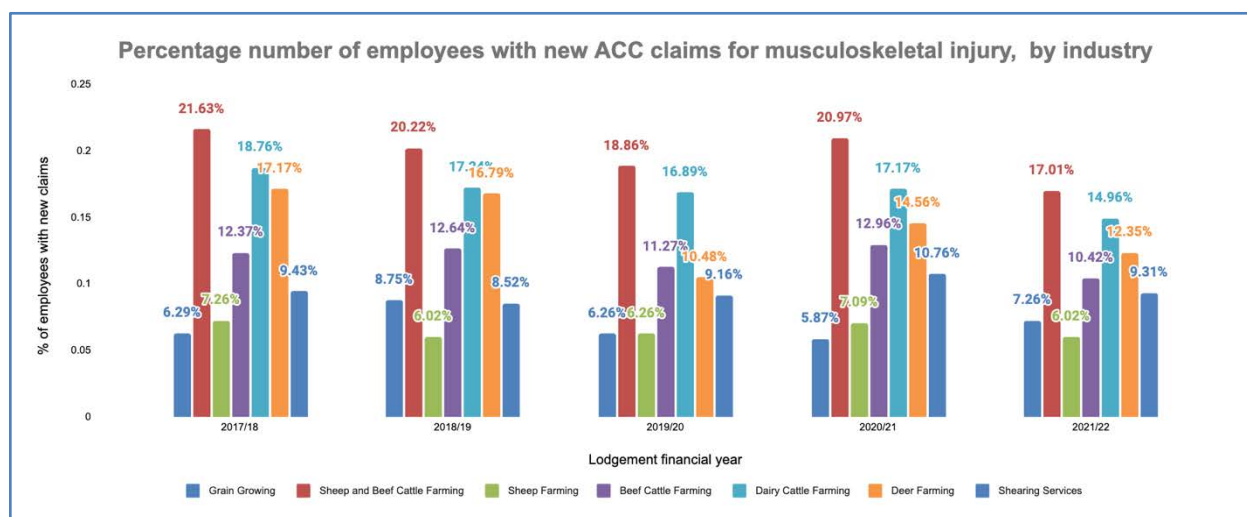


Figure 38 - Percentage of employees with musculoskeletal injuries by industry, lodged for the payment financial year of 2019/20 (ACC, OIA, May 4, 2023; MPI, OIA, May 29, 2023)

The second OIA spreadsheet received focused on work injury claims lodged during the financial year, active claims per financial year, primary diagnosis, accident cause and primary injury site. Due to resource limitation, it was decided to only look at the total number of work claims by industry.

MSK injuries are a sub-set of work injuries. This data, therefore, allowed collation of the total number of work injuries and the total number of MSK injuries by sector, by year (See table 8.)

Table 8 - Number of new claims for all work injuries and musculoskeletal injuries by industry, lodged between 1 July 2017 and 31 March 2023 (ACC, OIA, May 4, 2023; May 19, 2023)

Work Indicator	Lodgement Financial Year									
	2017/18		2018/19		2019/20		2020/21		2021/22	
	Total work injuries	MSK injuries	Total work injuries	MSK injuries	Total work injuries	MSK injuries	Total work injuries	MSK injuries	Total work injuries	MSK injuries
Grain growing	104	61	125	77	102	57	109	54	96	53
Sheep and beef cattle farming	3,788	2,249	3,436	2,143	3,161	1,943	3,153	2,013	2,511	1,599
Sheep farming	521	334	455	283	460	291	498	333	448	289
Beef cattle farming	827	538	767	537	680	462	727	486	617	401
Dairy cattle farming	6,967	4,746	6,205	4,344	6,085	4,291	6,062	4,360	5,119	3,724
Deer farming	146	91	149	89	112	65	136	83	119	63

Shearing services	785	467	723	426	750	435	772	484	669	405
Total across sector	13,138	8486	11,860	7899	11,350	7544	11,457	7813	9,579	6534

This data was then analysed to find the percentage of work injuries by sector, by lodgement financial year, that were categorised as MSK injuries. The remaining percentage of work injuries were then categorised by the author as 'other work injuries' (See table 9.)

Table 9 - Percentage of new work injury claims by musculoskeletal injury and other work injury by industry, lodged between 1 July 2017 and 31 March 2023 (ACC, OIA, May 4, 2023; May 19, 2023)

Work Indicator	Lodgement Financial Year									
	2017/18		2018/19		2019/20		2020/21		2021/22	
	MSK injuries	Other work injuries	MSK injuries	Other work injuries	MSK injuries	Other work injuries	MSK injuries	Other work injuries	MSK injuries	Other work injuries
Grain growing	62%	41%	62%	38%	56%	44%	50%	50%	55%	45%
Sheep and beef cattle farming	59%	41%	62%	38%	61%	39%	64%	36%	64%	36%
Sheep farming	64%	36%	62%	38%	63%	37%	67%	33%	64%	36%
Beef cattle farming	65%	35%	70%	30%	68%	32%	67%	33%	65%	35%
Dairy cattle farming	68%	32%	70%	30%	71%	29%	72%	28%	73%	27%
Deer farming	62%	38%	60%	40%	58%	42%	61%	39%	53%	47%
Shearing services	59%	41%	59%	41%	58%	42%	63%	37%	61%	39%
Average across all sectors	62%		64%		62%		63%		62%	

Analysis of the ACC data shows that, in the food and fibre sector industries included in this research, MSDs make up just over 60% of the overall burden of harm from work-related injury. The literature review showed that in New Zealand MSD's "make up over 30% of the overall burden of harm from work-related ill-health and injury" (Kolose & Matulino, 2022). It was noted that the agricultural sector has a particularly high incidence of MSD claims (Kolose & Matulino, 2022). Thus, this ACC data analysis shows that the proportion of work-related injuries attributed to MSDs is twice as high in the food and fibre sector than is shown across the general population.

5. Findings and Discussion

Findings are discussed under five headings, aligning with the objectives of this report.

5.1 Nature and extent of work-related musculoskeletal disorders in the food and fibre sector

ACC data analysis shows that the proportion of work-related injuries attributed to MSDs is twice as high in the food and fibre sector than is shown across the general population, with 60% of the overall burden of harm from work-related injury. Dairy farming accounted for half of new MSK injury claims to ACC each year. However, sheep and beef farming had the highest percentage of employees with new ACC claims for MSK injury each year, showing the highest risk for the occurrence of MSK injuries. Time off work due to WRMSDs has far-reaching social and economic implications.

The sector leaders had varying opinions of the extent of MSK injuries in the food and fibre sector. They felt there was a lack of reporting of injuries, particularly of discomfort and pain. WorkSafe NZ and sector leaders defined WRMSDs into two categories: over-time and event injuries. Adopting such categorisations sector-wide could make positive steps to taking a more holistic approach to identifying causative factors and opportunities for prevention.

It was highlighted that sector-wide, there is a lack of reporting of injury, pain and discomfort. FMS screen findings indicate that 47% of workers in the wool harvesting industry were experiencing pain, and significant movement dysfunction and asymmetry were present. These factors can increase individuals' risk of injury and reduce daily performance. This suggests a connection between the physical demands of working in the wool harvesting industry and the likelihood of experiencing movement problems and pain. Symmio results showed that across the sector there was a high occurrence of individuals presenting with multiple MSK health risk factors, and 45% had high-risk MSK health scores requiring preventative referral to a healthcare professional. However, this data also presents an opportunity to improve and proactively manage WRMSDs.

5.2 Correlation between musculoskeletal health, injury risk and performance outcomes

The connection between MSK health, contributing factors, and the gradual development of MSDs over time is clear. It has also been acknowledged that the presence of risk factors may have a detrimental effect on performance and productivity.

Ahead of seasonal peaks, with increased demands on workers and increased risk exposure, it would be recommended to address workforce MSK risk factors. FMS and Symmio are evidence-based screening protocols that could act as triage tools to obtain objective data about workers' movement health and MSK health risk factors, thus providing guidance for the development of targeted interventions and strategies. Re-screens with these tools would provide information about these seasonal peaks' impacts on workers' movement quality and MSK health factors.

Many of these MSK health risk factors can be described as elements of overall wellbeing. Addressing and optimising these factors can positively contribute to workers' quality of life whilst also reducing the risk of WRMSDs. Alignment is apparent between this holistic perspective and the four key ways, stated in The Health and Safety at Work Strategy 2018-20128, that worker health may impact working safely.

5.3 Sector understanding of injury risk factors

Workers and sector leaders understood the diversity and multitude of injury risks in the workplace and the association between MSK health factors and injury risk.

Sector leaders believe that education about how to move well at work and about lifestyle and wellbeing factors

could help manage injury risk. Out of the twenty-seven identified risk factors, it was felt that twenty-four could be reduced if workers' movement, health and wellbeing were improved or had more education/awareness of these topics. Manual handling risks, repetitive movements/tasks, bending, twisting and lifting, poor technique, fatigue, lack of strength, mobility and fitness and poor lifestyle outside of work were particularly highly rated. Considerable potential benefit was identified to taking a holistic and educational approach to managing risk factors.

Analysis showed that workers intuitively understood the factors contributing to MSK health and their correlation with injury risk. However, sector leaders were split in their opinions, some believing workers did not actually understand and others feeling they had a basic or intuitive understanding of MSK health but were not connecting the dots or did not have the skill or knowledge to be able to apply this understanding.

5.4 Musculoskeletal injury risk management in the food and fibre sector

Work-related safety is about creating a safe working environment, eliminating or minimising the risks at work that can impact a worker's health. Subsequently, conventional approaches to mitigating WRMSD focus are such things as task design, manual handling loading, workstation and machinery design, and prevention through design (PtD.) There is noted to be difficulty in identifying which aspect of multiple component injury risk interventions successful outcomes can be contributed to.

However, work-related health is also about the way worker health may impact working safely; therefore, worker health and wellbeing are injury risk factors. This concept is acknowledged within the sector, though a holistic approach is in its infancy. Holistic strategies are currently primarily focused on mental health, fatigue awareness, health monitoring and physiotherapy. Approaches and resources are currently being delivered in a fragmented, uncoordinated and unmonitored way. The development of the Primary Industry Wellbeing Strategy is underway.

It has been acknowledged that ergonomically based functional screening should be used to identify workers who can safely perform physically demanding tasks; however, movement screening is currently not integrated into sector strategies. Screening the multifactorial risks associated with MSK health has also yet to be adopted. Findings show that there could be significant benefits to integrating this approach alongside the more conventional methods, supporting workers to remain adaptable and durable against the demands of their work.

Injury risk management is required on a multi-level approach in businesses; operational level, task level and individual level. However, applying risk management depends on workplace culture and policy. It is also significantly impacted by the different availability of resources between corporate businesses and smaller, owner-operator or family-run businesses.

5.5 Benefits and barriers to adopting a more integrated and holistic approach

It was shown that there is a lack of availability of awareness and education resources about MSK health factors and their association with injury risk. Highlighted as the highest priority was to teach workers self-care levers. Communicating the 'Why' of managing MSK health and injury risk was seen as an integral requirement to any intervention or strategy.

A significant opportunity was identified to introduce MSK education into formal education, qualifications and professional development settings.

An extensive range of factors/barriers were put forward that could limit the integration of education and awareness about MSK health and its impact on injury risk; related to mindset, workforce characteristics, the employees, the business and the accessibility of resources. The biggest barriers were workers' mindset toward injury risk management, their mindset to accept pain and discomfort as part of the job, the 'she'll be right' attitude, and how to keep health and wellbeing front of mind.

Efforts from the sector and businesses to support a change in mindset and the empowerment of workers to understand 'why' MSK health is important were identified to be influential for the success of any future interventions and strategies. Designing holistic and educational approaches to injury risk management in the workplace as standard protocol and making it just part of 'what we do' were seen as requirements. These options could be seen as opportunities and a way to mitigate some barriers to success. Taking a hybrid approach to reduce WRMSDs using multiple suggested methods/contexts was rated highly by sector leaders. There would be an opportunity to align future holistic approaches with the already understood Te Whare Tapa Whā model, further highlighting that MSK health is not a standalone component and reducing confusion in language.

6. Limitations

There are considerable limitations to this study, the most prominent of these were the lack of time and resources to analyse the extensive data collected. Word number constraints also meant that only the highest priority data was presented, and many areas of data and thematic analysis were not expanded upon to the level of detail the author would have preferred.

ACC data was comprehensive and complex, presenting an opportunity for further in-depth analysis. Only the foundational data was analysed and presented in this report.

FMS wool harvesting industry data was collected during vocational training courses. The nature of this environment did not allow for individuals to be rescreened to see if the prescribed exercises were making an appreciable positive change. Such data would have provided distinct evidence to validate this project's conclusion.

There is difficulty in studying injury prevention programmes and strategies, as they are multi-dimensional, overlapping and applied differently depending on the type, structure, and location of the workplace. Therefore, only an overview was possible within the scope of this project.

Behavioural models associated with the application and success of injury risk strategies was too complex to look at during this project, despite human behaviour being intrinsic to this subject matter.

Photograph – ER Imaging



7. Conclusions

Work contributes to health, and health contributes to work; subsequently, worker wellbeing is a risk factor for injury. Injury risk is multifactorial, and risk factors are the root cause of MSDs. WRMSDs encompass injury, pain and discomfort and gradual onset is associated with a reduction in performance and productivity at work. Lack of reporting of injury, pain and discomfort is a problem sector-wide. WRMSDs may also have detrimental effects on mental health and may even contribute to other health issues developing. MSDs can be categorised as over-time injuries and event injuries.

Government, sector and business-driven strategies are in place which focus on reducing and eliminating risk. However, taking a more educational and holistic view on the risk factors would likely strengthen the current conventional approaches and could reduce injury risk and improve workers' performance and quality of life. Strategies should address the multifactorial nature of injury risk from an individual, task, and organisational level. There is scope to look to align future holistic approaches with the already understood model of Te Whare Tapa Whā.

The current diversity of wellbeing resources is fragmented and uncoordinated, and there is no evidence to show if they are fit for purpose and effective. Subsequently, a Primary Industry Wellbeing Strategy is under development, looking to facilitate a cohesive approach to sector wellbeing.

FMS and Symmio screens showed an underlying issue with workers presenting with pain, movement dysfunction and multiple MSK health risk factors. Introducing such evidence-based screening protocols to workplace injury risk management strategies could provide the opportunity to obtain objective data about workers' movement health and MSK health risk factors, presenting a powerful opportunity for improving and proactively managing WRMSDs, worker performance and overall wellbeing. Such screening protocols would also provide evidence-based information about specific sector requirements, ensuring that interventions are targeted and effective.

Both sector and businesses should look to facilitate a mindset shift, with the 'why' at the heart of future strategies. Significant focus should be put on education and awareness about MSK health and its impact on injury risk, performance, wellbeing and quality of life.

This research has only scraped the surface of this subject. However, there is a clear need to bridge the gap between wellbeing and injury risk management in the food and fibre sector through the development of an integrated holistic strategy.

8. Recommendations

The following recommendations are made:

- Co-investment is required from MPI, MBIE, WorkSafe NZ and ACC and industry good organisations to collaboratively resource the development of an over-arching strategy that bridges the gap between wellbeing and injury risk management. The strategy must align with the future Primary Industry Wellbeing Strategy.

To guide this strategy, further research is needed in the following areas:

- ACC and WorkSafe should conduct research on the nature and extent of MSK health risk factors, pain, and movement dysfunction sector-wide; using an evidence-based screening tool, providing objective data about sector-specific requirements.
- Current government-funded injury risk management research projects should look to integrate evidence-based MSK health screening tools to provide objective evidence about the effectiveness of interventions.

Photograph – ER Imaging



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10. Appendices

Appendix 1 – Online questionnaire – Workers and sector leaders

Sector leader survey asked additional questions of: a) full name, b) job title

Consent to take part in research

1. I voluntarily agree to participating in this research study.
 I consent

2. I understand that even if I agree to participate now, I can withdraw at any time or refuse to answer any question without any consequences of any kind.

I understand that I can withdraw permission to use the data from my questionnaire, within 2 weeks of completion, in which case the data will be deleted.

I understand that this questionnaire, and all data subsequently collected through my enrollment in the Symmio app, may be used within Laura Hancock's Kellogg Rural Leadership Programme research project report and presentation.

I understand that Laura Hancock's Kellogg Rural Leadership Programme research report will be made publicly available and published on the Rural Leaders website.

I understand that all information I provide for this research project will be treated confidentially.

I understand that in any report on the results of this research my identity will remain anonymous.

I understand that disguised extracts from my questionnaire may be quoted in a published research paper and research project presentation.

I understand that all data collected through this questionnaire and through the Symmio app will be retained by the researcher in a password-protected laptop and device until after day and full date, when all the course and research projects are completed.

I understand that under freedom of information legislation I am entitled to access the information I have provided at any time while it is in storage as specified above.

I understand that I am free to contact any of the people involved in the research to seek further clarification and information.
 I understand

Background information

3. What sector do you work in?
 Agri-business
 Sheep and beef farming
 Dairy farming
 Wool harvesting industry (working the wool shed - shearing, rousying, pressing, sheepo.)
 Other (please specify)

4. Age
 18-24 years old
 25-34 years old
 35-44 years old
 45-54 years old
 55-64 years old
 65-74 years old

5. Gender
 Male
 Female
 Other (please specify)

6. What region do you live in?

Injury risk at work

7. Please describe what factors you think contribute to injury risk at work.

8. What do you think are the most common injuries in your sector?

9. Following on from the previous question, how do you think the most common injuries in your sector are caused?

10. Move the slider to rate how you perceive injury risk when working in agri-business.
 Low Average High

11. Move the slider to rate how you perceive injury risk when working in sheep and beef farming.
 Low Average High

12. Move the slider to rate how you perceive injury risk when working in dairy farming.
 Low Average High

13. Move the slider to rate how you perceive injury risk when working in the wool harvesting industry.
 Low Average High

Factors affecting injury risk

14. Move the slider to rate how you perceive the physical demands of working in agri-business.
 Low physical demands Average physical demands High physical demands

15. Move the slider to rate how you perceive the physical demands of working in sheep and beef farming.
 Low physical demands Average physical demands High physical demands

16. Move the slider to rate how you perceive the physical demands of working in dairy farming.
 Low physical demands Average physical demands High physical demands

17. Move the slider to rate how you perceive the physical demands of working in the wool harvesting industry.
 Low physical demands Average physical demands High physical demands

18. Do you think movement health can affect injury risk?
(Movement health is the ability to move well enough to accomplish tasks without limitation or pain.)

Yes
 No

If yes, please describe how you think movement health can affect injury risk

19. Do you think behavioural health can affect injury risk?
(Behavioural health is emotions, behaviours and biology which relate to mental wellbeing, and the ability to function in every day life.)

Yes
 No

If yes, please describe how you think behavioural health can affect injury risk

20. Do you think nutritional health can affect injury risk?

Yes
 No

If yes, please describe how you think nutritional health can affect injury risk

21. Do you think that breathing quality can affect injury risk?

Yes
 No

If yes, please describe how you think breathing quality can affect injury risk

22. Do you think that sleep quality can affect injury risk?

Yes
 No

If yes, please describe how you think sleep quality can affect injury risk

23. Do you think Body Mass Index (BMI) can affect injury risk?
(BMI is a measure of body fat based on height and weight.)

Yes
 No

If yes, please describe how you think BMI can affect injury risk

24. Do you think physical activity can affect injury risk?
(Physical activity is all movement including during leisure time, as part of work activities, and all general movement during the day.)

Yes
 No

If yes, please describe how you think physical activity can affect injury risk

25. Do you think that injury history can affect injury risk?

Yes
 No

If yes, please describe how you think injury history can affect injury risk

26. Please rate how much each factor contributes to injury risk.

	Not at all	Not much at all	Average	A lot	Significantly
Movement health	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Behavioural health	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Nutritional health	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Breathing quality	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Sleep quality	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
BMI	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Physical activity	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Injury history	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Managing injury risk

27. In order to manage injury risk which factor do you think is more important?

- Moving well
(moving well enough to get into all positions comfortably, without limitation or pain - moving effectively and efficiently)
- Being fit

Neither (please specify why)

28. In order to manage injury risk which factor do you think is more important?

- Good mobility
- Being strong
- Neither (please specify why)

29. Do you think that education about how to move well at work could help manage injury risk?

- Yes
- No

If yes, please describe how and why

30. Do you think that education about wellbeing and lifestyle factors could help manage injury risk?

- Yes
- No

If yes, please describe how and why

Additional comments

31. Do you have any additional comments about injury risk in the food and fibre sector that you would like to share?

32. Do you have any additional comments in response to any of the questions you have just answered in this questionnaire that you would like to share?

Appendix 2 – Online questionnaire – Symmio feedback

Consent

1. I voluntarily agree to participate in this research study.

I consent

2. I understand that even if I agree to participate now, I can withdraw at any time or refuse to answer any question without any consequences of any kind.

I understand that I can withdraw permission to use the data from my questionnaire, within 2 weeks of completion, in which case the data will be deleted.

I understand that this questionnaire may be used within Laura Hancock's Kellogg Rural Leadership Programme research project report and presentation.

I understand that Laura Hancock's Kellogg Rural Leadership Programme research report will be made publicly available and published on the Rural Leaders website.

I understand that all information I provide for this research project will be treated confidentially.

I understand that in any report on the results of this research, my identity will remain anonymous.

I understand that disguised extracts from my questionnaire may be quoted in a published research paper and research project presentation.

I understand that all data collected through this questionnaire will be retained by the researcher in a password-protected laptop and device until after day and full date, when all the course and research projects are completed.

I understand that under freedom of information legislation, I am entitled to access the information I have provided at any time while it is in storage as specified above.

I understand that I am free to contact any of the people involved in the research to seek further clarification and information.

I understand

Background Information

3. Full name

4. What sector do you work in?

Agri-business

Sheep and Beef farming

Dairy farming

Wool harvesting industry

Apiculture

Other (please specify)

5. Age

18-24 years old

25-34 years old

35-44 years old

45-54 years old

55-64 years old

65-74 years old

6. Gender

Male

Female

Other (please specify)

Symmio

7. How did you find the process of the initial screen on the Symmio app?

8. Did the results of your initial Symmio screen.....

Interest you

Surprise you

Tell you things you already knew

Confuse you

Other feeling

Please tell me more about how you felt about your Symmio screen results

9. When you completed your initial screen on Symmio did you receive a 'high risk' score where the app suggested you see a healthcare provider?

Yes

No

If yes, you did receive a 'high risk' score.....
Did you book an appointment as was recommended? If you did not, why did you not book an appointment?

10. Did Symmio ask you to do any re-screens?

Yes

No

If yes, had your overall musculoskeletal health score improved?

11. Having used Symmio, what do you think the factors are which contribute to your musculoskeletal health?

12. Do you think our musculoskeletal health score has an impact on our musculoskeletal injury risk?

Yes

No

Any comments

13. Did you find the daily reading articles informative?

Yes

No

Any comments

14. Did you enjoy the daily exercise videos?

Yes

No

Any comments

15. The daily exercises on Symmio are designed to help improve your mobility or help your nervous system become more efficient in specific movement patterns. This is why the exercises are often repetitive. Would you have liked more information about this to help you understand the exercise progression process?

Yes

No

Not sure

Any comments

16. What were the biggest barriers for you to using the app daily?

17. Over time, most people's use of the Symmio app declined.
If this was the case for you, can you identify the reason?

18. Do you think app based health and wellbeing apps like Symmio are.....

- Great to use in your own home, by yourself
- Would work better combined with one on one support and communication
- Would work better combined with in-person exercise sessions
- I don't think app based health and wellbeing programmes are very good
- I have a different opinion/thought

Can you tell me more about your answer.....

Additional comments

19. Is there anything else you would like to share about your experience using Symmio?

Appendix 3 - Interview questions – Sector leaders

Interview: Musculoskeletal health and injury risk in the food and fibre sector

Definitions:

The musculoskeletal system comprises of muscles, bones, joints, connective tissues and other organs and systems it interacts with.

A musculoskeletal injury is an injury that affects the musculoskeletal system and can result in widespread or localised pain.

A musculoskeletal disorder is a condition that affects the musculoskeletal system. These disorders can result in pain and loss of function.

Musculoskeletal health is an essential component of human health. Musculoskeletal health refers to the performance of our musculoskeletal system so that we can move well, without restriction and without pain.

Questions:

- 1) a) What sector do you work in within the food and fibre sector?
b) What is your job title?
c) Could you briefly describe what your job role entails?
- 2) a) How would you describe the nature and extent of musculoskeletal (MSK) injuries in you workforce/sector?
b) What do you think are the social implications of MSK injuries to the business you work for?
c) What do you think are the economic implications of MSK injuries to the business you work for?
d) How do injuries contribute to workers' time off work in the business you work for?
- 3) a) What factors do you think contribute to MSK health risk in the workplace/your business?
b) What is your perception of workers' understanding/knowledge of the factors which contribute to MSK health risk?
c) What is the worker's understanding/knowledge about how MSK health factors contribute to injury risk?
- 4) How do you think managing MSK health can reduce injury risk in the sector you work in?
- 5) a) How is MSK health risk currently managed in the workplace in the business you work for?
b) Do you believe this is effective?
c) How do you think it could be improved?
- 6) a) Do you think practical tools and education can help improve the management of MSK injury risk in the food and fibre sector?
b) If so, how?
c) In what particular area of MSK health do you think we need to focus?
d) What are the limiting factors for education and practical tools to be integrated into your workplace?
e) What are the limiting factors for education and practical tools to be integrated into your sector?
- 7) Is there anything else you would like to share with me?

Appendix 4 - Interview Participants

Information about sector leaders who participated in the multi-tiered interview process.

Company Type	Sector	Company Size	Job Role
State owned	Sheep & Beef / Dairy / Deer milking / Sheep milking / Horticulture	Approx 800	Health, Wellbeing and Rehabilitation Advisor
State owned	Sheep & Beef / Dairy / Deer milking / Sheep milking / Horticulture	Approx 800	Health & Safety Business Partner
Co-operative	Dairy	850 plus approx. 1200 seasonal workers	Chief People Officer
Corporate	Agri-business	1700 – 1800	General Manager People & Safety
Corporate	Agri-business	950	Head of Safety and Wellbeing
Corporate	Dairy	Approx 350	People & Culture Officer
Iwi organisation	Sheep & Beef / Dairy / Horticulture	Approx 500	Senior Health, Safety & Wellbeing Advisor
Iwi organisation	Sheep & Beef / Dairy / Horticulture	Approx 500	General Manager Safety & Wellbeing
Privately owned	Aquaculture	85 - 150 Seasonal workers	Operations Coordinator
Owner Operator	Wool industry	7	Wool Broker
Family run business	Wool Industry	6	Wool Buyer
Owner-operator (+ Industry Good body)	Dairy	3	Owner
Family business (+ Industry Good body)	Sheep & Beef	6	Managing Director
Self-employed	Dairy	2	Contract Milker
Industry Good body	Wool Harvesting Industry	2x 0.25	Executive Officer

Appendix 5 – Online questionnaire - Post-interview follow-up

Introduction

1. The sector leader questionnaires and interviews showed a high level of understanding of the lifestyle, health and wellbeing factors which contribute to musculoskeletal (MSK) health, and the holistic perspective of how MSK health can affect injury risk in the workplace.

Interviewees suggested a diverse and extensive range of options/ideas/opportunities for future integration of musculoskeletal health management strategies into the food and fibre sector. Many barriers or limitations to the future integration of such strategies were also put forward. I have collated all the thoughts collected during these interviews into a selection of opportunities/options and limiting factors/barriers.

I would very much value your feedback about these topics, in order to gain more clarity from these diverse perspectives, and to achieve more of a consensus about the most appropriate recommendations for MSK health management for the food and fibre sector.

I understand

2. Full name

Workplace Injuries

3. In the questionnaire, 93.3% of the sector leaders thought that education about how to move well at work could help manage injury risk, and 93.75% thought that education about lifestyle and wellbeing factors could help manage injury risk.

In both the questionnaires and the interviews multiple workplace injury risk factors were stated.

Listed below are the risks which were repeatedly mentioned.

Please select the risks factors which you think could be reduced if workers movement, health and wellbeing were improved, or if workers had more education/awareness of these topics.

(multiple choice - can select as many as you like, or none at all)

- Manual handling
- Variable working conditions/environment
- Repetitive movement/tasks
- Bending, twisting, lifting
- Poor technique
- Working with animals
- Vehicles or Machinery
- Chemicals
- Seasonal pressures
- Lack of mobility, strength or fitness
- Workers have lost fitness or physical resilience due to mechanisation
- Sitting for long periods of time
- Fatigue
- Lack of concentration
- Common sense
- Stress
- 'She'll be right' attitude
- Sports at the weekend
- Poor training
- Poor H&S standards
- Poor lifestyle outside of work
- Obesity
- Speed of work / targets
- Staffing shortages

4. Would you agree that we could categorise MSK injuries into two categories of:

- a) injuries which happened due to an 'Event',
b) injuries that happened 'over time' or due to 'life course'?

Yes

No

Please comment on the reason for your selection

5. Would you agree that within the food and fibre sector, in addition to the reported injuries, there is a level of:

(multiple choice - can select as many as you like, or none at all)

- Unspoken discomfort & pain
- Expected pain & discomfort - 'just part of the job'
- Discomfort which could have a negative impact on the individual's performance
- No, I don't agree with a, b or c
- Comments, if any

Musculoskeletal (MSK) health factors

6. A high proportion of interviewees thought that there was a lack awareness/understanding amongst workers about MSK health and associated injury risk.

Please select the topics which you believe require improved awareness or education.

- Awareness of what MSK health is and what factors contribute to it
- Learning how to ergonomically do your job
- Education/improved awareness about how movement health (moving well, moving without pain or limitation) can contribute to injury risk
- Education/improved awareness about how movement health can affect performance, in both work and life (ie. movement health can affect performance as well as injury risk)
- Education/improved awareness about how lifestyle/health & wellbeing factors contribute to MSK injury risk
- Education/improved awareness about how lifestyle/health & wellbeing factors can affect performance, in both work and life
- Practical movement skills, such as warm ups & cool downs
- How to help themselves - 'self-care levers'
- None of these
- Of the topics you selected, which would you put at the highest priority?

Opportunities for integration of MSK health management strategies into the workplace

7. An extensive and diverse range of suggestions were made as to the best context/setting in which to integrate education and to teach practical skills to help improve the management of MSK injury risk. Listed below.

Please select 0-5 contexts which you believe could be the most successful.

- Discussion Groups
- Fielddays
- Farm specific workshops (eg. Calving Smart or Milk Smart workshops)
- Within formal education/qualifications (eg. Wool harvesting certificate, School, University, Cadetship, Upskill course, Professional Development courses)
- Physiotherapists/Movement coaches/Healthcare professionals come to the workplace
- Movement screening to identify movement problems & treat/improve them as a preventative measure (offered on farm by a professional)
- Community-driven fitness/health and wellbeing sessions - regular meetings (eg. similar to the Surfing for Farmers model)
- MSK health specific Workplace workshops - to teach practical tools
- Social Media
- MSK health specific Workplace workshops, followed by social media campaigns/reminders
- Online tools/apps (eg. Tahi Ngatahi or Symmie)
- Online tools/apps in conjunctions with in-person workshops/support
- Part of the staff induction process
- Integrated into workplace Health, Safety & Wellbeing programmes as standard protocol - 'part of the vernacular'
- Hybrid approach - tackling it using multiple of the suggested methods/contexts
- Of the contexts that you selected, which would you rank highest as potentially the most successful?

8. A repeated view was that communicating the 'Why' is extremely important as part of the education/awareness. Please select the option you agree with the most.

- Focus on creating mindset/culture change first (the 'Why') before introducing any of the education/practical skills opportunities suggested in the previous question
- Focus on mindset/culture change (the 'Why') as an integral part of any of the opportunities suggested in the previous question
- I don't think workers need to know much about the 'Why'

Any comments

9. Multiple aspects of 'Why' looking after MSK health is important were mentioned during the interviews.

Please select 0-5 options which you feel are important to communicate to workers as part of the 'why.'

- Support a longer career
- So they can go home happy and comfortable and enjoy life outside of work and with their family
- 'To live well and live longer' - 'for quality of life'
- Understanding the correlation between what you do and how you do it and the outcomes
- Understanding that pain/discomfort is not a necessary part of the job - 'mindset change'
- Reduces injury risk
- Improves daily performance
- Any comments

10. We can view the factors which contribute to MSK health (movement health, behavioural health, nutritional awareness, breathing quality, sleep quality, body composition, injury history, physical activity) as a holistic approach to reducing some of the risk factors for workplace injury risk.

Would you agree that there is alignment with this holistic approach and the Te Whare Tapa Whā model?

If you do agree, please comment on if/how you think this could help integration of MSK health education/awareness into the workplace.

- I agree
- I don't agree

Comments

Barriers to integration of musculoskeletal health management strategies into the workplace

11. An extensive range of factors/barriers were put forward that could limit the integration of education and awareness about Musculoskeletal health and its impact on injury risk. Listed below.

Please select 0-5 factors that you believe to be the largest barriers to success.

- Workplace culture
- Mindset - 'discomfort and pain are just part of the job', 'harden up' mentality, 'she'll be right'
- Mindset - The job has to get done, so I just have to crack on, I don't have any other option
- Mindset - I don't have time to integrate these things
- Mindset - Talking about health and wellbeing, or discomfort and pain is seen as weakness, so I am not interested in engaging
- Transient workforce
- Churn rate
- Employee engagement
- Employee motivation for implementation
- How to keep it 'front of mind'
- Rural/isolated locations - hard to get outside specialists in to provide education or teach practical skills
- Balancing act of cost of injury versus cost of prevention to the business
- Lack of financial capacity
- Lack of time capacity
- Literacy or Language barrier
- 'Just another thing to do', 'too much noise', another thing adding extra pressure
- Lack of fit-for-purpose (for the sector) resources available
- Lack of cohesive/consistent sector-wide approach to MSK health risk
- Lack of professional services available to support businesses with MSK health improvement, education and awareness
- It doesn't show up on our risk assessments, or our injury statistics, so it won't get prioritised
- Any comments

12. Multiple factors/barriers were put forward about why pain and discomfort, and even injuries, are not reported. Listed below.

Please select 0-5 factors that you believe to be the strongest reasons/barriers to injury reporting.

- Mindset - discomfort and pain are just part of the job
- Mindset - 'harden up' mentality - 'pain is seen as a badge of honour'
- Mindset - Talking about health and wellbeing, or discomfort and pain is seen as weakness
- Fear of losing their job/visa if have an injury or complain of pain or discomfort
- Financial implications of time off work
- Rural/isolated locations is a limitation to going to visit a healthcare professional
- Cost of visiting a healthcare professional
- Lack of resonance from healthcare professionals about their jobs - 'don't feel understood'
- Don't see discomfort and pain to be import, or related to future injury risk
- Any comments

13. Do you believe that the resources available are different between corporately run farming business, SME's and owner operator farming businesses to such an extent that it has an impact upon how MSK health and injury prevention is managed within a business?





If yes, please comment on how you think this could be changed.

- Yes
- No

How do you think this could be changed? And any comments

Appendix 6 - Functional Movement Screen Explained

Scoring Explained

Symbol	Associated Scores	Recommendation
 Green Light Ready to Train	Indicated by optimal (3/3) and acceptable (2/2) scores only.	Pursue fitness and performance goals while training movements in this pattern.
 Yellow Light Cautious Training	Indicated by scores (2/3). Minor difference between left to right.	Use caution when engaging in higher level activities that use this pattern. Consistently screen this pattern to ensure the difference does not get worse.
 Red Light Not Ready to Train	Movement pattern limitation Indicated by any score of 1.	Focus on exercises to improve movement in this pattern and avoid higher intensity exercises that use this pattern until improvement is seen.
 Pain Indicated with Movement	Any score of 0.	See a health care provider for assessment and do not progress exercises that use this painful pattern.



The functional movement screens are scored with a raw score, a final score and a total score.

For movement which can be performed bilaterally, raw scores are scored on both the left and right sides of the body in order to identify asymmetries.

When referring to some of the current research the final and total scores are used to determine a 'cut-off mark' for injury risk.

If the individual is able to perform a movement and receives a raw score of 1, 2 or 3, but exhibits pain during the movement then the final score will be marked as a 0, for pain.

Three of the screens have additional clearing tests which are performed with the purpose of identifying pain. They are therefore not scored but given a positive or negative result for pain. If a movement screen receives a raw score of 1, 2 or 3, but the associated clearing screen exhibits pain then the final score for the movement screen will be marked as a 0, for pain.

Adjusting the final score due to pain whilst still recording the raw score provides us with movement quality information (raw score - 1, 2 or 3) as well as the information about pain in the final score (0), giving more detail and directed focus in the report to the health care professional when the individual is referred for evaluation due to the pain score.

Low raw, final and total scores do not mean that an individual must not work or move. Instead, it gives guidance on the movement patterns which may subject the individual to a risk of injury and will need attention, avoid loading, and require corrective exercises in order to improve performance and reduce injury risk. Good raw, final and total scores show those individuals who are safe and consistent in their movement patterns and are likely to perform with more effectiveness, efficiency, adaptability, reliability and durability.

Screens Explained

Showing relevance to the wool harvesting industry

Deep Squat



The deep squat is screened during the functional movement screen. It allows the tester to see whether the individual can move symmetrically through a full range of motion of the hips, knees and ankles whilst maintaining an overhead position with the arms. This deep squat screen shows if the individual can access full lower body mobility without needing to 'steal' movement from the upper body and extremities.

Squatting is a fundamental movement ability that appears early in the human developmental stages. To perform a fundamental squat the individual needs to be able to lower and control their centre of mass whilst using a symmetrical stance.

Working in the woolshed environment workers perform tasks that require them to raise and lower their centre of mass under control using the squat pattern. They are also required to squat whilst using their upper body and extremities in tasks. Therefore, movement competency of the squat pattern is important for wool industry workers.

Hurdle Step



The hurdle step is screened during the functional movement screen. It allows the tester to see whether the individual can maintain a single leg stance whilst also performing a dynamic stepping motion with the other leg. The high step requires mobility and range of motion with the stepping leg and stability of the stance leg. The screen also shows whether the upper body position alters during the stepping motion indicating a compensatory movement being used. This hurdle step screen shows if the individual can access full lower body motion and control without needing to 'steal' movement from the upper body position.

The double leg to single leg movement pattern is fundamental to our locomotive mechanics, requiring control of the individual's centre of mass whilst the base of support changes.

In the wool shed workers are required to load one side of the body when performing off-centre tasks and when reaching from a narrow base over a single leg. Transferring from double leg stance to single leg stance is often required when performing tasks. Therefore, movement competency of the hurdle step pattern is important for wool industry workers.

Inline Lunge



The inline lunge is screened during the functional movement screen. It allows the tester to see whether the individual can lower their centre of mass in a stride or asymmetrical foot position. It requires the ability to maintain dynamic control of the pelvis and core with an asymmetrical hip position. The hurdle step observes the descent part of the true step and lunge. It shows both left and right function in a narrow base, split stance position whilst the upper body is in a reciprocal pattern. This uncovers mobility and stability compensations within the lunging pattern. It challenges hip, knee, ankle and foot mobility and stability and demands spine stabilisation through core control.

The lunge is a natural extension of developmental patterns and posture called the half kneel position which was used when transitioning from the ground to standing.

Inline lunge focuses on the stresses as simulated during rotation, deceleration, directional change and lateral movements. In the wool shed workers are often required to assume a split stance position and reciprocal upper body position during their work. They perform rotation, lateral movements and require deceleration in multiple areas of their work. Therefore, movement competency of the inline lunge pattern is important for wool industry workers.

Ankle Clearing



The ankle clearing screen is screened after the hurdle step in the functional movement screen. It allows the tester to see whether the individual's ankle mobility is a barrier to their movement competency. Adequate ankle mobility is a prerequisite for motor control of lower body movements. If ankle mobility is not optimal this may be a strong contributing factor to the score of the deep squat and the inline lunge.

If there is pain exhibited during the ankle screen this will alter the final score of the inline lunge as a pain free ankle is imperative for good movement competency when moving from a double leg to single leg stance.

In the wool shed workers are required to use the full range of motion of their ankles in a lot of their movement. They also need to exhibit good motor control of their lower body movements at all times when working with load and with live animals. Therefore, ankle mobility is very important for wool industry workers.

Shoulder Mobility



Shoulder mobility is screened during the functional movement screen. It allows the tester to look at reciprocal upper body movement patterns with both arms moving at once. This will show if movement on one side of the upper body compromises movement on the other side. The shoulder mobility screen requires coordination of the thoracic spine and scapula alongside control of the shoulder and upper limbs.

Upper limb movement is fundamental to movement ability and appears early in the human developmental stages during rolling and crawling. Upper limb mobility and control are integral to many movements in everyday life. The upper extremities are also reciprocally involved in locomotion amongst other activities such as pushing, pulling, carrying, reaching, throwing and swinging. These are all movements which are required throughout the day when working in the woolshed. Therefore, movement competency in shoulder mobility is important for wool industry workers.

Shoulder Clearing



The shoulder clearing screen is screened after shoulder mobility in the functional movement screen. This clearing screen is done because shoulder impingement will sometimes go undetected by shoulder mobility testing alone.

If there is pain exhibited during the shoulder clearing screen this will alter the final score of the shoulder mobility screen as a pain free shoulder is imperative for good movement competency when using upper body movement patterns.

In the woolshed workers use upper body movement a lot in their required movement. Therefore, ensuring they do not have shoulder impingement is very important.

Active Straight Leg Raise



The active straight leg raise is screened during the functional movement screen. It allows the tester to look at reciprocal lower body movement. This is not just a hamstring flexibility test. To perform the active leg raise well the individual requires lumbo-pelvic control, extension of the bottom leg and flexion of the raising leg and a degree of core control all in combination. It shows the ability of the individual to lift and bend whilst maintaining core control to protect their spine.

Using the lower limbs in contralateral movements and counterbalancing upper body movement is fundamental in our human developmental stages; in crawling, walking and running. Stepping, split kneeling and lunging also requires the ability for reciprocal lower body movement.

In the wool shed workers are repeatedly required to control their centre of mass whilst using a hip hinge, bend and lift, and change direction and position using lower body reciprocal movements. Most movements required in working in the woolshed require acceleration, deceleration, and directional changes in some form or another. Dysfunction in this movement pattern can have an effect on many other movements, postures and positions. Therefore, movement competency of the active straight leg raise pattern is important for wool industry workers.

Trunk Stability Push Up



The trunk stability push up is screened during the functional movement screen. It allows the tester to observe reactive sagittal plane stability, looking at the individual's ability to resist extension whilst transferring forces from the lower to upper body. This screen asks the individual to press up while maintaining the trunk position to resist extension forces. Due to the set up position it does not solely test upper body strength but also challenges the trunk stability pattern.

There is an integral connection between the upper and the lower body in order to resist forces and maintain our trunk alignment whilst pushing, swinging, lifting and overhead movements. Competency in this movement pattern

is important in order to ensure that the individual does not sacrifice core stability in order to perform a task or movement.

In the wool shed workers repeatedly perform movement and tasks which require them to resist extension forces to their trunk and to transfer forces from their lower to upper body. Therefore, movement competency of the trunk stability pattern is important for wool industry workers.

Extension Clearing



The extension clearing screen is screened after the trunk stability push up in the functional movement screen. This clearing screen is done to observe for a pain response during spinal extension.

If there is pain exhibited during the extension clearing screen this will alter the final score of the trunk stability push up screen as a pain free spinal extension is imperative for good movement competency of the trunk stability pattern.

In the woolshed workers require spinal mobility for many of their movements. Therefore, ensuring they do not have pain during spinal extension is very important.

Rotary Stability



Rotary stability is screened during the functional movement screen. It allows the tester to observe reactive tri-planar movement. It shows how capable the individual is of maintaining stability when there is a change in their base of support. When the arm and leg are lifted the individual's stability is disturbed and they require quick

reactive core stability and effective motor control to resist a loss of balance and rotational forces.

Learning to resist rotation is fundamental during our human developmental stages, when crawling, climbing, and running. The reactive tri-planar pattern is used when an individual has to resist rotation, in response to a push or pull on one side of their body, in order to maintain a position. Climbing, running, throwing and swinging all require rotary stability.

In the wool shed workers are often required to resist rotation when they lift, pull, carry, throw or push with a direction towards one side of their body. They must then have the ability to brace with the opposite side of their body. Therefore, movement competency of the rotary stability pattern is important for wool industry workers.

Flexion Clearing



The flexion clearing screen is screened after rotary stability in the functional movement screen. This clearing screen is done to observe for a pain response during spinal flexion.

If there is pain exhibited during the flexion clearing screen this will alter the final score of the rotary stability screen as a pain free spinal flexion is imperative for good movement competency of the rotary stability pattern.

In the woolshed workers require spinal mobility for many of their movements. Therefore ensuring they do not have pain during spinal flexion is very important.

Appendix 7 – FMS - Complete Results Summary

Functional Movement Screens in the wool harvesting industry

Total number of people screened

Beginner	Upskill	Total
56	102	158

Upskill group, split by shearer and wool handlers

Wool Handlers	Shearer	Total
31	71	102

Upskill versus Beginner

The data shows a significant difference in the number of movement patterns where pain was exhibited in the Upskill group compared to the beginner group.

- The percentage of the upskill group who exhibited pain in one or more movement patterns was 1.75 times that of the beginner group, with 47% in the upskill group versus 27% in the beginner group.
- The average number of movement patterns where pain was exhibited in the upskill group was more than double that of the beginner group, with an average of 0.79 in the upskill group compared to 0.34 in the beginner group.

The data shows a significant difference in the number movement patterns where movement dysfunction was exhibited in the Upskill group compared to the beginner group.

- Only 1% of the upskill group had an acceptable baseline of movement competency.
- The beginner group exhibited movement dysfunction in an average of 2.66 movement patterns, compared to an average of 3.68 in the upskill group.

The data shows a significant increase in the percentage of movement dysfunction in the upskill group compared to the beginner group in specific movement patterns.

- An average of 1.3 times more movement dysfunction was shown in the Deep squat, Active straight leg raise and Trunk stability push up movement screens in the upskill group compared to the beginner group.
- An average of 2.25 times more movement dysfunction was shown in the Hurdle step and Shoulder mobility movement screens in the upskill group compared to the beginner group.

The data shows a significant difference in the number movement patterns where asymmetry was exhibited in the Upskill group compared to the beginner group.

- 61% of the beginner group exhibited asymmetry in one or more movement patterns, compared to 72% of the upskill group.
- The percentage of the upskill group who exhibited asymmetry in two or more movement patterns was 1.75 times that of the beginner group, with 40% in the upskill group versus 23% in the beginner group.
- The beginner group exhibited asymmetry in an average of 0.93 movement patterns, compared to an average of 1.27 in the upskill group.

The data shows a significant increase in the percentage of asymmetry in the upskill group compared to the beginner group in specific movement patterns.

- An average 1.5 times more asymmetries were shown in the upskill group compared to the beginner group in the Inline lunge, ankle clearing, shoulder mobility and active straight leg raise movement screens.

Wool Handler versus Shearer in Upskill group

The data shows a significant difference in the percentage of movement dysfunction exhibited for the wool handlers in the upskill group compared to the shearers in specific movement patterns.

- An average of 1.25 times more movement dysfunctions were shown in the wool handlers compared to the shearers of the upskill group in the Inline lunge movement screen.
- An average of 2.75 times more movement dysfunctions were shown in the wool handlers compared to the shearers in the Trunk stability push up movement screen.
- An average of 1.5 times more movement dysfunctions were shown in the shearers compared to the wool handlers of the in the Hurdle step movement screens.

The data indicates notable differences in the number of movement patterns where asymmetry was exhibited for the shearers in the upskill group compared to the wool handlers.

- The percentage of wool handlers with no asymmetries (45%) was more than double the percentage of shearers (21%) with no asymmetries.
- The percentage of shearers (45%) with 2 or more areas of asymmetry was more than 1.5 times the percentage of wool handlers (25%) with 2 or more areas of asymmetry.

The data shows a significant difference in the percentage of asymmetry in the shearers of the upskill group compared to the wool handlers of the upskill group in specific movement patterns.

- An average 1.5 times more asymmetries were shown in the shearers of the upskill group compared to the wool handlers in the Inline lunge, ankle clearing, hurdle step shoulder mobility and active straight leg raise movement screens.

Appendix 8 – Symmio reports

Detail report – names removed for participant confidentiality
31 participants – March 2023

Age	Group	Score	MSK Risk	Pain	Focus(s)
39	Kellogg research project	61	Slight	N	Behavioral Health, Sleep Wellness
54	Kellogg research project	58	Moderate	N	Sleep Wellness, Physical Activity
44	Kellogg research project	76	Moderate	N	Sleep Wellness, Nutrition Awareness
34	Kellogg research project	84	Moderate	N	Injury History, Physical Activity
51	Kellogg research project	48	High	Y	Behavioral Health, Sleep Wellness
44	Kellogg research project	66	High	N	Behavioral Health, Sleep Wellness
50	Kellogg research project	54	High	Y	Behavioral Health, Movement Health
46	Kellogg research project	69	Moderate	N	Nutrition Awareness, Body Composition
37	Kellogg research project	83	Low	N	Body Composition, Physical Activity
31	Kellogg research project	93	Low	N	Nutrition Awareness
0	Kellogg research project	52	Moderate	N	Behavioral Health, Movement Health, Breathing Quality
31	Kellogg research project	61	High	Y	Behavioral Health, Sleep Wellness
37	Kellogg research project	78	Slight	N	Sleep Wellness, Body Composition
36	Kellogg research project	77	Moderate	Y	Movement Health, Sleep Wellness
35	Kellogg research project	68	High	Y	Behavioral Health, Sleep Wellness
45	Kellogg research project	64	High	N	Injury History, Behavioral Health
45	Kellogg research project	71	High	Y	Behavioral Health, Movement Health
52	Kellogg research project	68	Slight	N	Behavioral Health, Sleep Wellness

Age	Group	Score	MSK Risk	Pain	Focus(s)
42	Kellogg research project	65	Moderate	Y	Behavioral Health, Sleep Wellness
49	Kellogg research project	79	Moderate	N	Sleep Wellness, Body Composition
27	Kellogg research project	76	High	Y	Behavioral Health, Sleep Wellness
43	Kellogg research project	74	High	Y	Behavioral Health, Injury History
30	Kellogg research project	64	High	Y	Injury History, Movement Health, Breathing Quality
33	Kellogg research project	63	Moderate	N	Physical Activity, Body Composition
34	Kellogg research project	83	Moderate	N	Sleep Wellness, Nutrition Awareness
33	Kellogg research project	81	Low	N	Behavioral Health, Nutrition Awareness
40	Kellogg research project	68	Moderate	N	Sleep Wellness, Body Composition
50	Kellogg research project	69	Moderate	Y	Behavioral Health, Sleep Wellness
48	Kellogg research project	27	High	Y	Behavioral Health, Movement Health, Breathing Quality
37	Kellogg research project	87	Moderate	N	Sleep Wellness, Breathing Quality
26	Kellogg research project	72	Moderate	N	Behavioral Health, Body Composition

Score report – names removed for participant confidentiality
31 participants – March 2023

Movement	Breathing	Injury Hist.	Behavioral	Activity	Body Comp.	Sleep	Nutrition	MSK
84	71	94	41	0	43	63	60	61
58	68	53	100	32	70	50	30	58
70	83	65	100	80	93	50	60	76
100	83	59	100	80	98	88	75	84
50	74	12	59	80	48	50	70	48
88	89	24	62	100	66	63	75	66
45	71	47	53	80	38	63	75	54
90	83	12	100	90	82	88	75	69
90	92	82	100	80	60	88	90	83
80	88	100	100	100	96	88	75	93
24	61	35	53	80	74	63	70	52
70	63	29	47	80	84	63	75	61
74	77	82	100	100	43	63	80	78
45	92	100	100	80	67	63	60	77
62	83	41	41	100	94	63	100	68
82	83	47	65	80	45	63	75	64
63	83	47	74	90	87	88	75	71
80	57	88	56	32	68	63	75	68
50	79	65	68	80	82	50	30	65
100	88	65	100	100	37	63	100	79
60	79	100	65	100	38	50	100	76
72	72	65	65	80	82	75	100	74
40	63	47	100	80	80	75	75	64
80	72	35	100	64	48	88	75	63
100	88	65	100	100	78	63	50	83
94	88	94	68	80	64	75	40	81

Movement	Breathing	Injury Hist.	Behavioral	Activity	Body Comp.	Sleep	Nutrition	MSK
73	88	12	100	100	83	63	100	68
52	88	76	62	80	65	63	90	69
12	59	6	71	0	51	75	40	27
88	73	82	100	80	98	63	100	87
74	92	76	59	80	58	75	75	72

Detail report – names removed for participant confidentiality
31 participants – May 2023

Age	Group	Score	MSK Risk	Pain	Focus(s)
39	Kellogg research project	61	Slight	N	Behavioral Health, Sleep Wellness
54	Kellogg research project	58	Moderate	N	Sleep Wellness, Physical Activity
44	Kellogg research project	80	Moderate	N	Sleep Wellness, Nutrition Awareness
34	Kellogg research project	84	Moderate	N	Injury History, Physical Activity
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44	Kellogg research project	66	High	N	Behavioral Health, Sleep Wellness
50	Kellogg research project	54	High	Y	Behavioral Health, Movement Health
46	Kellogg research project	69	Moderate	N	Nutrition Awareness, Body Composition
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43	Kellogg research project	74	High	Y	Behavioral Health, Injury History
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34	Kellogg research project	83	Moderate	N	Sleep Wellness, Nutrition Awareness
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40	Kellogg research project	68	Moderate	N	Sleep Wellness, Body Composition
50	Kellogg research project	69	Moderate	Y	Behavioral Health, Sleep Wellness
48	Kellogg research project	27	High	Y	Behavioral Health, Movement Health, Breathing Quality
37	Kellogg research project	87	Moderate	N	Sleep Wellness, Breathing Quality
26	Kellogg research project	72	Moderate	N	Behavioral Health, Body Composition

Score report – names removed for participant confidentiality
31 participants – May 2023

Movement	Breathing	Injury Hist.	Behavioral	Activity	Body Comp.	Sleep	Nutrition	MSK
84	71	94	41	0	43	63	60	61
58	68	53	100	32	70	50	30	58
90	83	65	100	80	93	50	60	80
100	83	59	100	80	98	88	75	84
50	74	12	59	80	48	50	70	48
88	89	24	62	100	66	63	75	66
45	71	47	53	80	38	63	75	54
90	83	12	100	90	82	88	75	69
90	92	82	100	80	60	88	90	83
80	88	100	100	100	96	88	75	93
24	61	35	53	80	74	63	70	52
70	63	29	47	80	84	63	75	61
74	77	82	100	100	43	63	80	78
45	92	100	100	80	67	63	60	77
62	83	41	41	100	94	63	100	68
82	83	47	65	80	45	63	75	64
74	83	47	74	90	87	88	75	73
80	57	88	56	32	68	63	75	68
83	79	65	68	80	82	50	30	72
100	88	65	100	100	77	63	100	85
60	79	100	65	100	38	50	100	76
72	72	65	65	80	82	75	100	74
40	63	47	100	80	80	75	75	64
80	72	35	100	64	48	88	75	63
100	88	65	100	100	78	63	50	83
94	88	94	68	80	64	75	40	81

Movement	Breathing	Injury Hist.	Behavioral	Activity	Body Comp.	Sleep	Nutrition	MSK
73	88	12	100	100	83	63	100	68
52	88	76	62	80	65	63	90	69
12	59	6	71	0	51	75	40	27
88	73	82	100	80	98	63	100	87
74	92	76	59	80	58	75	75	72