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# Effects of Stretching Exercises on Pain and Functional Disability in Quarry Workers with Work-related Low Back Pain

Samuel O Bolarinde<sup>1</sup>, Babatunde O.A Adegoke<sup>2</sup>, Olusola Ayanniyi<sup>2</sup>, Michael O Olagbegi<sup>1</sup>

## Abstract:

This study compared the effectiveness of stretching exercises, repeated over eight weeks combined with back care education, lumbar stabilisation combined with back care education, and back care education only, on pain and functional disability in quarry workers with work-related low back pain. The study involved 96 Nigerian quarry workers with work-related low back pain that were randomly assigned into; stretching exercise with back care education group, lumbar stabilisation exercise with back care education group, and back care education group. Participants' pain was evaluated using Quadruple Visual Analogue Scale while functional disability was assessed using Oswestry Low Back Pain Disability Questionnaire. Eighty-six participants completed the study (stretching exercise = 29, lumbar stabilisation = 27 and back care education = 30). There were no significant differences in demographic and clinical characteristics between the three groups at baseline. At week four of the study, stretching exercise demonstrated more significant reductions ( $p < 0.05$ ) in pain and functional disability than back care education. Also, participants in the stretching exercise demonstrated more significant reductions ( $p < 0.05$ ) in pain and functional disability than those in both lumbar stabilisation exercise and back care education at the end of week eight of the study. Stretching exercises are therefore better than lumbar stabilisation exercises and back care education in reducing pain and functional disability in individuals with work-related low back pain and are hence recommended for reducing pain and functional disability in individuals with work-related low back pain.

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## KEYWORDS

Work-related Low Back Pain; Stretching Exercises; Pain; Functional Disability

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## Introduction

Low back pain is the most common musculoskeletal problem in the work place (Omokhodion and Sanya, 2003) and is a major cause of work-related disability (Cunningham et al, 2008). It is associated with major costs in terms of health resource usage, worker disability and absenteeism (Maniadaki and Gray, 2003) and is one of the most common reasons for sick leave in the western world Reiso et al, 2003).

Lotters and Burdorf (2006) indicated that working class employees in the construction industry are prone to high incidence of short and long-term sick leave absence, due to the high-risk of developing lower back pain. Work-related low back pain is prevalent in Nigeria with Aliu and Saidu (2006) reporting a 64% prevalence rate among stone quarry workers in northern Nigeria while Egwuonwu et al, (2013) reported 78.9% prevalence among drivers, mechanics, blasters, crushers and drillers working in a quarry industry in a South Eastern Nigeria.

Various non-surgical approaches, such as back school, physical therapy modalities and exercise have been used in the treatment of low back pain (Sahin et al, 2011). Systematic reviews have been conducted to determine which intervention is most appropriate in decreasing complications of absenteeism and financial expenses of work-related low back pain (Tveito et al, 2004; Van Tulder et al, 2000).

Studies have shown that spinal stabilisation exercises for acute, subacute, and chronic lower back pain patients

produce positive effects in terms of relieving pain, improving spinal function, and reducing limitations in daily life (Lewis et al, 2005; Niemisto et al, 2003). Similarly, Martins and Silva (2005) reported improvement in clinical symptoms of back pain following a course of stretching exercise. Back care education has also been shown to be effective in reducing pain and functional disability in individuals with low back pain (Ribeiro et al, 2008; Ayanniyi et al, 2015).

However, the comparative efficacy of stretching and stabilisation exercises in individuals with work-related low back pain seems not to have been investigated. This study was hence designed to compare the effects of 8-weeks of lumbar stabilisation exercises with back care education, stretching exercises with back care education and back care education on pain and functional disability in quarry workers with work-related low back pain. It was hypothesized that the three interventions will be equally effective.

## **Materials and Methods**

The single-blind randomised controlled trial was approved by the Health Research Ethics Committee of the University of Ibadan and University College Hospital, Ibadan, Nigeria, and all participants gave their informed consent. The participants were quarry workers with primary complaints of low back pain of not less than three months' duration and who had been screened for work-related low back pain using a standard Nordic musculoskeletal questionnaire, history of pain, and physical examination. Individuals with work-related low back pain but with history of recent spinal surgery or elevated blood pressure (>140/90mmHg) were excluded from the study.

Computer generated random numbers were used to assign participants to any of the three intervention groups namely: lumbar stabilisation exercise with back care education; stretching exercise with back care education; and back care education. A minimum sample size of 78 (26 per group) was estimated from Cohen's table using  $\alpha = 0.05$ , power = 80% and effect size = 0.8 (Cohen's, 1988). However, 96 participants were recruited to account for attrition and randomly assigned into the three intervention groups. Ten participants did not complete the eight weeks of intervention and their data were not included in final analysis, while 86 participants (lumbar stabilisation group n=27, stretching exercise group n=29 and back care education group n=30) completed the study, thus giving an overall attrition rate of 10%.

Participants were asked to rate their pain using the Quadruple Visual Analogue Scale, their functional disability was assessed by asking them to complete the English version of the Oswestry Low Back Pain Disability Questionnaire at baseline, week four and week eight of the study.

## **Interventions**

Participants were required not to alter their normal daily activities or take part in any additional form of physical activity or physiotherapy while the study lasted.

### ***(1) Lumbar Stabilisation Exercise with Back Care Education Group***

Participants in this group were treated individually and performed the following exercise as outlined into the following three phases:

**Phase 1:** Development of the perception of isolated isometric specific contraction of stabilising muscles.

Participants were asked to perform ten repetitions of ten-second isometric contraction of the transversus abdominis and multifidus muscle. The exercises were carried out twice a week during weeks one and two of the study.

**Phase 2:** Closed chain, low velocity, low load exercises that included bridging in prone position, bridging in supine position and single-leg bridging. Each of the final positions was held for ten seconds and repeated 20 times and included from week three to week five of the study.

**Phase 3:** Open chain, low velocity, high load exercises that involved the quadruped with alternate legs and the quadruped alternate arms/opposite leg exercises. Each of the final positions was held for a count of 20 seconds and repeated 20 times from week six to week eight of the study.

Participants in this group were also taken through back care education.

### ***(2) Stretching Exercise with Back Care Education Group***

Participants in this group were treated individually and performed stretching exercises of the erector spinae, iliopsoas, hamstring and hip adductor muscles as described by Akulhota and Nedler, (2004). All stretches were held for ten seconds for five repetitions during weeks one and two, for ten seconds and ten repetitions from week three to week five and for 20 seconds and 20 repetitions from week six to week eight of the study. Participants also received back care education.

### (3) Back Care Education Group

The participants were taught back care education for standing, sitting, lifting and other activities of daily living. The education class which comprised lectures on the structure of the back/spinal column, factors predisposing to back pain, bad and good postures assumed during activities of daily living, stages involved when executing a lift, tips on good (correct) back posture, exercise for prevention/alleviation of back pain and practical demonstrations of working postures was held weekly for 8 weeks of the study. Small handbills describing the back care education instructions were also given as a reminder to the participants.

### Data Analysis

The data were analysed using SPSS 20.0 version software (SPSS Inc., Chicago, Illinois, USA). Descriptive statistics of mean, standard deviation were used to summarise the data. Friedman's ANOVA was used for within-group comparison of participants' pain and functional disability with Wilcoxon Signed Rank Test used for the post-hoc analysis. Kruskal Wallis test was used for between-group comparison of pain and functional disability with the Man Whitney U test used for post hoc analysis. Alpha levels were set at = 0.05 and 0.017 for between-group and within-group post-hoc tests respectively.

### Results

The groups were not significantly different in their physical characteristics and baseline clinical parameters (Table 1). The total average pain and functional disability scores across the three time frames of the study for lumbar stabilisation group ( $p < 0.001$ ), stretching exercise group ( $p < 0.001$ ) and back care education group ( $p < 0.001$ ) (Table 2) were significantly different. Post hoc analysis using Wilcoxon signed rank indicated significant reduction in total average pain and functional disability among participants in the three groups at all the time frames of the study (Table 2).

Post-hoc analysis indicated significant differences in the groups' total average pain and functional disability at the end of weeks four and eight of the study (Table 3). At week four of the study, the stretching exercise group had significantly lower mean total average pain and functional disability than those in back care education group, but, there was no significant difference in mean total average pain and functional disability between stretching exercise group and lumbar exercise group. At the end of week eight, participants in the stretching exercise group had significantly lower mean total average pain and functional disability than those in either lumbar exercise group or back care education group. The trends of total average pain and functional disability across the three time points of the study are presented in figures 1-2.

**TABLE 1**

One-way ANOVA comparison of participants' demographic and clinical variables by treatment groups

Variables	LSEBCEG (n=27) Mean ± SD	SEBCEG (n=29) Mean ± SD	BCEG (n=30) Mean ± SD	P- value
Age (Years)	35.926 ± 7.205	34.414 ± 6.827	33.600 ± 6.678	0.442
Height (m)	1.716 ± 0.076	1.732 ± 0.072	1.697 ± 0.059	0.153
Weight (Kg)	68.037 ± 11.271	71.414 ± 9.799	65.267 ± 9.392	0.072
BMI (Kg/m <sup>2</sup> )	23.060 ± 2.955	23.831 ± 3.324	22.610 ± 2.534	0.282
Total average pain	55.922 ± 7.411	54.367 ± 6.732	54.222 ± 5.933	0.916
Disability	26.593 ± 4.862	23.862 ± 5.829	25.200 ± 3.305	0.133

BMI = Body mass index;  $\alpha = 0.05$

Key:

LSEBCEG = Lumbar Stabilisation Exercise with Back Care Education Group  
SEBCEG = Stretching Exercise with Back Care Education Group  
BCEG = Back Care Education Group

**TABLE 2**

Friedman's ANOVA and Wilcoxon signed ranked test comparison of Total average pain and Disability scores among participants across the 3 times point of the study.

Variables	Time Frame	LSEBCEG (n=27) Mean ± SD	SEBCEG (n=29) Mean ±SD	BCEG (n=30) Mean ± SD
<b>Total average pain</b>	Baseline	55.922 ± 7.411 <sup>a</sup>	54.367± 6.732 <sup>a</sup>	54.222± 5.933 <sup>a</sup>
	Week 4	33.567 ± 6.067 <sup>b</sup>	27.901± 9.829 <sup>b</sup>	37.889± 4.989 <sup>b</sup>
	Week 8	23.945 ± 4.033 <sup>c</sup>	16.551± 3.618 <sup>c</sup>	28.222± 4.610 <sup>c</sup>
	p	0.001 *	0.001 *	<0.001 *
<b>Disability</b>	Baseline	26.593 ± 4.862 <sup>a</sup>	23.862 ± 5.829 <sup>a</sup>	25.200 ± 3.305 <sup>a</sup>
	Week 4	13.852 ± 3.799 <sup>b</sup>	12.207 ± 4.761 <sup>b</sup>	17.600 ± 3.379 <sup>b</sup>
	Week 8	10.370 ± 3.283 <sup>c</sup>	4.689 ± 2.285 <sup>c</sup>	11.067 ± 2.864 <sup>c</sup>
	p	<0.001 *	<0.001 *	<0.001 *

\*indicate significant difference at  $\alpha = 0.05$  a, b, c. For a particular variable, mean values with different superscripts are significantly different. Mean value with the same superscripts are not significantly different.

Key: LSEBCEG = Lumbar Stabilisation Exercise with Back Care Education Group  
 SEBCEG = Stretching Exercise with Back Care Education Group  
 BCEG = Back Care Education Group

**TABLE 3:**

Kruskal-Wallis test comparison of Total average pain and Functional Disability of participants' treatment outcome across the groups at baseline, week 4 and week 8.

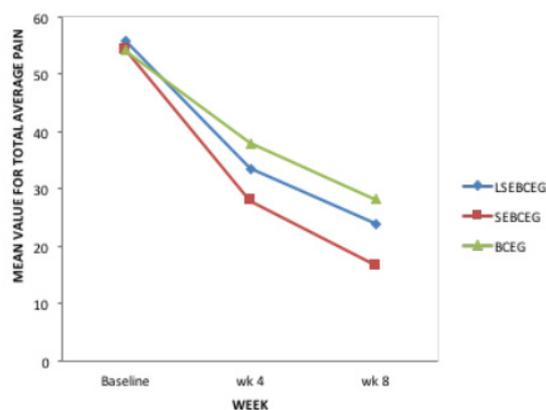
Variables	Time Frame	LSEBCEG (n=27) Mean ± SD	SEBCEG (n=29) Mean ±SD	BCEG (n=30) Mean ± SD	P – value
<b>Total Average Pain</b>	Baseline	55.922 ± 7.411 <sup>a</sup>	54.367± 6.732 <sup>a</sup>	54.222± 5.933 <sup>a</sup>	0.916
	Week 4	33.567 ± 6.067 <sup>a</sup>	27.901± 9.829 <sup>a</sup>	37.889± 4.989 <sup>b</sup>	<0.001 *
	Week 8	23.945 ± 4.033 <sup>a</sup>	16.551± 3.618 <sup>b</sup>	28.222± 4.610 <sup>c</sup>	<0.001 *w
<b>Disability</b>	Baseline	26.593±4.862 <sup>a</sup>	23.862 ±5.829 <sup>a</sup>	25.200±3.305 <sup>a</sup>	0.133
	Week 4	13.852±3.799 <sup>a</sup>	12.207± 4.761 <sup>a</sup>	17.600±3.379 <sup>b</sup>	<0.001 *
	Week 8	10.370±3.283 <sup>a</sup>	4.689 ± 2.285 <sup>b</sup>	11.067±2.864 <sup>a</sup>	<0.001 *

\*indicate significant difference at  $\alpha = 0.05$  a, b, c. For a particular variable, mean values with different superscripts are significantly different. Mean value with the same superscripts are not significantly different.

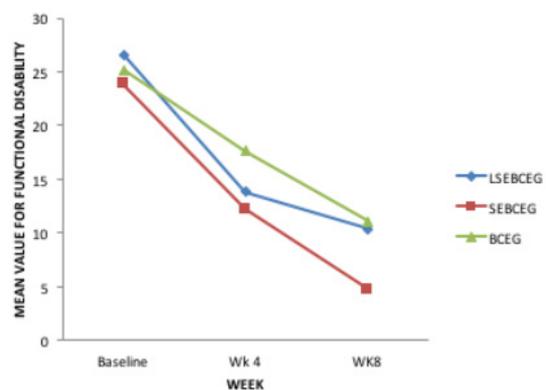
Key: LSEBCEG = Lumbar Stabilisation Exercise with Back Care Education Group  
 SEBCEG = Stretching Exercise with Back Care Education Group  
 BCEG = Back Care Education Group

**FIGURE 1**

Trends of total average pain for the LSEBCEG, SEBCEG and BCEG at the three time points of the study.

**FIGURE 2**

Trends of disability for the LSEBCEG, SEBCEG and BCEG at the three time points of the study.



## **Discussion**

### ***Effects of stretching exercises with back care education on pain and functional disability***

Within-group comparison across the three time-points (weeks 0-4, 4-8 and 0-8) of the study revealed that the stretching exercise had significant effects on pain and functional disability. These findings are consistent with previous reports that demonstrated evidence for the use of stretching exercises in the management of low back pain (Hayden et al, 2005; Buchner et al, 2006; Richard et al, 2012; Chen et al, 2014).

Reduction in pain and consequent improvement in function following stretching exercise have been attributed to elongation of the muscle tendon unit, reduction in peak force, decrease in rate of force production and tensile stress on the muscle tendon unit, and alteration of the visco-elastic property of the muscle-tendon unit, thus resulting in less tight tissue (Magnusson et al, 1996). Bruno et al, (2008) submitted that maintenance of static exertion for a prolonged time as occurs in occupational setting compresses the veins and capillaries inside muscles thereby causing micro-lesions from the absence of oxygenation and nutrition. In turn, there is muscle imbalance, fatigue, discomfort and pain as a result of disruption of tissues. Stretching has hence been recommended for lengthening muscles that are shortened due to postural and structural compensation of postural muscles, and those that have been affected by somatic referral patterns from the lumbar spine injury (Richard and Jull, 1995). Findings from this study therefore compare favourably with those of Sung (2013) and Chen et al, (2014); that stretching exercises effected a significant reduction in pain in individuals with low back pain.

Individuals with non-specific low back pain often report impaired ability to perform daily activities and the impact of pain on a patient's daily functioning can be expressed as a patient's level of disability or a reduction in physical functioning. McGregor et al, (1995) found that individuals with low back pain usually present with reduced lumbar flexibility and mobility in all planes of motion, thereby suffering functional disability. This implies that reduced pain brought about improved functional ability. It was hence expected that reduction in pain would translate into improved functional ability of the participants, as implied by the result of the present study which showed that stretching exercise resulted in significant improvement in participants' functional ability from week four of the study. This finding agrees with previous reports on stretching exercises having significant effects on functional disability (Franca et al, 2012; Sung, 2013). Franca et al, (2012) found significant improvement in functional ability among individuals with low back pain after six-weeks of stretching exercise while Sung (2013) reported a significant reduction in participants' functional disability after four weeks of stretching exercise.

### ***Effects of lumbar stabilisation exercise with back care education on pain and functional disability***

Within-group comparison across the three time-points (weeks 0-4, 4-8 and 0-8) of the study revealed that the lumbar stabilisation exercise with back care education significantly reduced participants' pain and functional disability. The effect of lumbar stabilisation exercises on pain and functional disability in this study are comparable with the outcome of previous studies that compared lumbar stabilisation exercises with other therapeutic exercises in the management of individuals with low back pain (O'Sullivan et al, 1997; Franca et al, 2012; Rhee et al, 2012; Moon et al, 2013; Shavilika 2013). Reduction in pain and consequent improvement in function following lumbar stabilisation exercises have been attributed to improvement in the activation patterns of trunk muscles, in order to relieve lumbar pain and incapacity through trunk muscle contraction (Golby et al, 1996; Kavcic et al, 2004).

It has been established that weakness and lack of motor control of deep trunk muscles are common in low back pain (Hides et al, 1996; Richardson et al, 2004). Ferreira et al, (2010) and Hodges et al, (1996) also demonstrated that individuals with chronic low back pain are more likely to have delayed recruitment and insufficient control of the transversus abdominus while McDonald et al, (2006) suggested the existence of neurophysiologic, and histochemical dysfunctions in the lumbar multifidus of individuals with low back pain. Beneck and Kulig (2012) indicated that decreases in the size of the multifidus would reduce lumbar stability and cause painful structures or new injuries, thereby inducing pain and functional disabilities. Hides et al, (1996) opined that damage to the multifidus causing low back pain would not be naturally cured and the resultant lack of stability in local regions was a factor that would increase the recurrence rate of low back pain. This lack of spinal stability induces pain, reduces endurance and flexibility, and restricts the range of motion of the lumbar joints and resultants disability (Gill et al, 1998). Therefore, stabilisation exercises have been recommended for the prevention of the recurrence of pain due to damage of the musculoskeletal system and improvement of functions (Jette, 1995). The result of this study therefore compared favourably with that of Franca et al, (2012) that reported a significant reduction in pain and functional disability in individuals with LBP after six weeks of lumbar stabilisation exercises.

### ***Effects of back care education on pain and functional disability.***

Within-group comparison across the three time-points (weeks 0-4, 4-8 and 0-8) of the study revealed that back care

education had significant effect on pain and functional disability of participants with work-related low back pain. The effect of back care education on pain and functional disability in this study was comparable with the outcome of previous studies that reported a significant reduction in pain and disability in individuals with low back pain (Klaber et al, 1986; Keijser et al, 1989; Heyman et al, 2006; Tavafian et al, 2007; Ribeiro et al, 2008; Ayanniyi et al, 2015).

Education of patients with low back pain on appropriate musculoskeletal structures, functions and the basic pathology of the patient's problem, and life style adaptation that may be necessary to prevent recurrence of low back pain are essential components of physical therapy management of low back pain (Twomey, 1992). Effects of back schools on low back pain have been reported in the literature. Heyman et al, (2006) concluded that low intensity back school was effective in reducing work absence and functional disability. Akinpelu and Odebiyi (2004) investigated the effects of a Nigerian back school model on some industrial workers with low back pain, and found that the back school model was effective in improving the workers' knowledge of low back pain and back care. Ayanniyi et al, (2015) also opined that back care education should be used to reduce back pain and disability in individuals with low back pain. Also, Cochrane back reviewers (Heyman et al, 2004,2006) and a meta-analysis on the efficacy of back school versus sham diathermy and placebo reported that back school was superior to sham diathermy and placebo for short term recovery and return to work but not for pain on long term recurrences (Maier and Harter, 2001). It has therefore been generally submitted by authors that back school should be integrated into the other effective means of management of individuals with low back pain. The findings of this study showed a significant reduction in pain and functional disability at week four and eight. This is in tandem with findings of Tavafian et al, (2007) that reported a significant reduction in pain and disability at the end of week five of back care education for individuals with low back pain.

### ***Comparative efficacy of stretching, lumbar stabilisation exercises and back care education on pain and functional disability***

The three groups were comparable at baseline in their anthropometric and clinical variables; hence any subsequent difference between the groups post-intervention may not be attributable to such baseline between-group differences. Stretching exercises with back care education resulted in significantly greater reduction in pain and functional disability than back care education at the end of week four and either lumbar stabilisation exercises with back care education or back care education alone at the end of week eight of the study.

From this result, it seems that stretching exercises combined with back care education is more effective than either lumbar stabilisation exercises combined with back care education, or back care education alone for pain relief in individuals with work-related low back pain. Studies on the effects of stretching on musculoskeletal pain have reported significant reduction in work-related musculoskeletal pain (Yu, 2008). Thus, Kim (2009) reported a significant decrease in upper extremity pain following a programme of stretching exercise while Lee (2007) observed a significant reduction in shoulder pain among frequent computer users after stretching exercise. Jung and Hwang (2014) also reported significant reductions in pain and subjective musculoskeletal symptom of the neck and shoulder following 4 weeks of stretching exercise. The present study differed from the aforementioned study in that it focused on work-related low back pain. However, it could be concluded from these studies that performing stretching for work-related musculoskeletal symptoms had a positive influence on the symptoms and reduced pain.

The result of the present study on pain is in line with the findings of Chen et al, (2014) on the effectiveness of a stretching exercise program on low back pain and exercise self-efficacy among nurses in Taiwan. They found that participants in the stretching exercise group showed higher significant reduction in pain than those in the control group when assessed at week eight of the study.

There seems to be a paucity of literature on comparative effects of stretching exercises and lumbar stabilisation on pain and disability in individuals with work-related low back pain. In most systematic reviews with meta-analysis on stabilisation exercises and other forms of exercises, the majority of studies combined stabilisation exercises with different forms of body exercises such as strengthening, stretching, and light aerobic exercises (Hayden et al, 2005; Searle et al, 2014; Smith et al, 2014). In the systematic review carried out by Smith et al, (2014) only two studies out of the 29 studies reviewed compared stabilisation exercises with stretching exercise on chronic low back pain of different aetiology (Franca et al, 2012; Sung 2013).

Franca et al, (2012) compared the effects of muscular stretching and segmental stabilisation on functional disability and pain in patients with chronic low back pain and found that though both stretching and stabilisation exercises improved pain and reduced disability at week six, participants in the stabilisation group showed a significantly higher change in both variables than those in the stretching exercise group at the end of week six of the study.

Sung (2013) compared the effects of four weeks' core stabilisation exercise and stretching on disability and back muscle fatigability changes in participants with recurrent low back pain. He found out that participants in the stabilisation group had significantly higher reduction in functional disability than those in the stretching

exercise group. The present study did not show any significant difference in functional disability between the effects of lumbar stabilisation exercises combined with back care education and stretching exercise combined with back care education at week four, though stretching exercises combined with back care education resulted in significantly greater reduction in functional disability than lumbar stabilisation exercise combined with back care education at the end of week eight. The reasons for this difference may also be attributed to the addition of back care education and duration of intervention.

The findings of this study with respect to comparative effects of stretching exercise and back care education on pain and functional disability showed that stretching exercises are significantly better than back care education in the management of individuals with work-related low back pain. Unfortunately, there is a dearth of studies that compares the effects of stretching exercise and back care education on low back pain, however, the work of Sahin et al, (2011) that investigated the effectiveness of back school for treatment of pain and functional disability in patients with chronic low back pain submitted that the addition of back care education was more effective than exercise and physical treatment modalities alone in the treatment of patients with chronic low back pain. The finding of the present study on the superiority of stretching exercises over back care education therefore corroborated the findings of Sahin et al, (2011).

## Conclusion

The findings of this study have shown that stretching exercises, lumbar stabilisation exercises and back care education are all effective in reducing pain and functional disability in individuals with work-related low back pain but stretching exercises are more effective than lumbar stabilisation exercises and back care education for pain relief and improvement of functions.

Physiotherapists are encouraged by the findings from this study to combine stretching exercises with back care education in the management of individuals with work-related low back pain for improvement of pain and functional disability. Future studies should investigate and compare the effects of the three interventions on non-work-related low back pain.

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# The Risk of Trigger Finger from Lifting Tasks

John Culvenor

## Abstract:

The review examines the connection between workplace tasks, with a particular interest in lifting actions where the finger is in the trigger shape, and the condition of trigger finger. It is a state of knowledge review about agents of this harm, and if any the indications of critical exposure durations, loads or other risk measures. Trigger finger is so named because it often involves a finger locked in a position as if pulling a trigger. A posture of this kind is commonly needed to use handles for lifting. The eccentric loading at the intermediate phalanx will create a bending moment. Mechanically this will be resisted by tension in the flexor tendons. But to what extent are workplace tasks that involve the trigger posture connected with risk of development of the condition of trigger finger?

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## Introduction

The analysis and prevention of harms in the workplace can be understood in terms of the agent, exposure, and recipient. Arguably it was most prominently proposed by the US occupational physician Alice Hamilton (1929). The analysis of workplace risks depends on the state of knowledge. From this, judgements can be made about what agents are of interest, the means of exposure, and exposure levels.

This paper is about the condition known as trigger finger. It is so named because it often involves a finger being locked in a position as if pulling a trigger. It is a review of the state of knowledge about agents of this harm, and, if any, the indications of critical exposure durations, loads or other measures of risk. The review was prompted by an inquiry about the connection between lifting actions where the finger is in the trigger shape and the actual condition of trigger finger where it becomes locked. It is a posture commonly needed to use handles for lifting.

The action of lifting is a commonplace human activity in and outside work. Sometimes this will create a biomechanical load in the finger flexor tendons. A hook grip can be used where the grip only need create a hanging type of connection. It involves the finger in the trigger posture. This hook style grip will occur in a vast range of lifting actions. In many cases it will occur where handles have been provided ostensibly to improve manual handling. Cut-out 'handles' in cartons are an example. The fingers protrude through the carton wall and adopt a hook shape. The load rests most likely on the intermediate phalanx or its joints with its neighbours. Carrying shopping bags would be similar. Other examples would be buckets for household use or workplace supplies. Paint and other building materials are provided in pails of up to 20kg. Drums of edible oil for restaurants and caterers are often about 20kg and are carried by a handle. Holding ropes or leads would be other examples; holding onto the lead of an animal for instance. Tying a load onto a vehicle or other task involving using a rope and any sporting activity involving climbing or restraint against falling with the hands could be similar. Climbing a rope ladder or sailing would be examples. The eccentric loading at the intermediate phalanx or nearby will create a bending moment. Mechanically this will need to be resisted by a tension load in the flexor tendons. But to what extent do workplace tasks that involve the posture connected with the condition of trigger finger point toward a risk of development of that condition? That is the purpose of the review.

## State of knowledge review

Trigger finger is commonly described as a type of tenosynovitis (Trezies et al. 1998). Clinically it is reported as a “*common cause of pain and disability in the hand*” (Akhtar et al. 2005). Corley (2000) provides a summary of the condition. Corley writes that it can affect a finger or thumb and is characterised by a finger locked in flexion with pain at the site of the first annular pulley (A1) and at the proximal interphalangeal joint (PIP), often worse in mornings. The following are other typical descriptions of the condition:

*“Trigger finger presents with discomfort in the palm during movement of the involved digits. Gradually, or in some cases acutely, the flexor tendon causes a painful click as the patient flexes and extends the digit. The patient may present with a digit locked in a particular position”* (Akhtar et al. p. 30).

Lohn and Fleming (2015) write that “*Idiopathic trigger finger is an acquired condition in which the sheath of the flexor tendon of a finger (or thumb) thickens and narrows at the A1 pulley level such that the flexor tendon cannot glide freely through it*” (p. 28).

Callegari (2012) writes that “*Trigger finger is a stenosing tenosynovitis that originates from a thickening of the first annular (A1) pulley of the flexor tendons. In order of frequency, the thumb, annular, middle, little, and index fingers are affected*”.

On epidemiology, Corley notes that trigger finger usually occurs in middle-aged adults (but can affect infants), that women experience the condition more often than men, that it commonly occurs among people with diabetes and rheumatoid arthritis, that multiple digits can be affected and it is associated with carpal tunnel and de Quervain’s syndrome. Other evidence is supportive of this summary. In their review paper, Makkouk et al. (2008) write that trigger finger occurs in about 2-3% of the population rising to about 10% among diabetics. They write that it most commonly occurs when people are aged in their 40’s and 50’s and the prevalence is greater among women than men. Akhtar et al. (2005) observe that in clinical practice trigger finger is the fourth most common reason for referral to their hand outpatient clinic. The age of patients suffering trigger finger is typically in the mid-later life is also noted by Blyth and Ross (1996) who found the mean age of 100 trigger finger surgery patients was 56 years among males and 57 years among females. Trigger finger occurs more commonly among women than men. For example: of these 100 trigger finger surgery patients there was a 2:1 ratio female to male (Blyth and Ross 1996). A bias toward female incidence was also reported by Al-Qattan (2007); among 50 trigger finger surgery patients there was a 3:2 ratio female to male.

While it occurs in all digits, the ring finger is the most common digit (Bonnici & Spencer 1988). Others have found that the thumb and ring finger and are the most common sites, making up 41% of the incidence across all ten digits (21% and 20% incidence Kumar & Chakrabarti 2009).

Trigger finger is associated with diseases such as diabetes (Blyth and Ross 1996). Koh et al. 2010 found that the incidence rate of trigger digits was about 10% among diabetic patients and the rate of diabetes among trigger digit surgery patients was about 20%. Their survey of 544 diabetes patients revealed 54 had a history of trigger digits (proportions 8% among men and 17% among women). In reverse, they surveyed 138 patients who had trigger digit surgery and among this group 20% (27) reported diabetes.

The Industrial Injuries Advisory Council (2007) uses a guide that an occupation should be linked to 50% of the incidence. This is called the attributable fraction. Reviews of evidence have not found established links between trigger finger and occupational exposure (see Andreu et al. 2011 for example). Among hand pain conditions, Andreu et al. found notable associations between some diseases and work (such as vibration white finger), but that for other diseases, trigger finger included, the evidence was not established.

The 2008 Health and Safety Executive (HSE) review paper (Burton et al.) found commonly an absence of direct occupational cause and effect relationships regarding upper limb disorders (ULDs). The authors propose a term ‘work-relevant’, meaning that work may be relevant to a condition although not a cause. They wrote (p. 21): “*...musculoskeletal symptoms affecting the upper limb and neck are a common experience among the general population, tending to be a recurrent complaint. This high prevalence suggests that the symptoms arise from normal physiological processes and everyday events, such as fatigue or soft tissue strain, rather than some sinister pathology. ...For many people, their symptoms will be work-relevant: their work may be painful or difficult irrespective of the origin of the symptoms. However, even when work is related to the expression of symptoms, that does not mean work was necessarily the underlying cause: it is apparent that work is not the predominant cause of most ULDs.*”

Callegari writes that “*Most cases of trigger finger are idiopathic*” (p. 113). Kumar & Chakrabarti 2009 found that most cases of trigger finger and carpal tunnel syndrome have “*no predisposing cause*”. Kumar & Chakrabarti studied 681 patients with carpal tunnel syndrome or trigger finger or both. Of these 130 had other diseases thought to be related to trigger finger leaving the majority without identified cause.

Treziez et al. (1998) tested the prospect of a link between occupation and trigger finger. Treziez et al. (1998) obtained occupation data on 178 patients treated for trigger finger at a Nottingham hospital between 1994 and 1997 (out a potential cohort of 208 patients). Occupations were allocated to categories being no paid work, office work, light manual and heavy manual. The proportions of patients in each group were not found to be outside the proportions expected based on the general population in each group. Thus they concluded (p. 540) that “*Our group of patients with trigger digits had a similar spectrum to the local general population which suggests that the majority of trigger digits develop for reasons unrelated to work.*”

## **Conclusion:**

### ***Implications for workplaces***

In workplace analysis there is no factor to identify or measure in relation to trigger finger. Workplace tasks can be distinct in two ways. They can be distinct because of their nature and or quantity. That is the agent might be one that only or usually occurs at work or it might be a common one not distinguished by its nature but distinguished by exposure. There are some things that people rarely do outside an occupational setting. Then there are other exposures which are commonplace at work and otherwise. Hand actions to grip, lift, carry, push, pull, etc. are activities of normal human existence. Hence generally what distinguishes a workplace in terms of manual actions is the extent of exposure. It is of interest to know what posture or action is connected to a condition and then what exposure duration is harmful. The consensus view however is that workplace exposures are not linked to trigger finger. The causes of this condition are mostly described as idiopathic. There are many tasks using the finger that adopt the posture associated with trigger finger. But there is no known relationship between these or any other tasks and the condition. Some injuries and diseases are transparently connected to a workplace, but other conditions occur in and out of work and the relationship is not present. This is one of those conditions. Hence by the state of knowledge on this topic, as far as the provision of handles on objects or other tasks involving trigger like force application are concerned, there is no reason to change these strategies.

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# Moral Intensity and Individual State Constructs: Maturing Safety Culture through an Ethical Lens

Daniel Carpenter and Colin James<sup>1</sup>

## Abstract:

After decades of workplace safety evolution, organisations are looking for new insights in order to prevent harm. However, there has been little focus on the role of ethical decision-making. This study analysed 376 survey responses from workers in the Australian telecommunications and broadcast industry to examine the influence of moral intensity, individual moral potency and philosophy and safety culture on forming ethical intentions in response to safety and health dilemmas. Respondents answered questions related to three vignettes designed to reflect health and safety dilemmas that participants might experience at work. A quantitative research model was developed to test twelve hypotheses and bivariate analysis was used to analyse the results. The findings suggest that perceptions of moral intensity are stronger for safety dilemmas than workplace health dilemmas. Moral intensity and forming moral intentions vary significantly between safety and health dilemmas. Individuals with strong moral potency perceive higher levels of moral intensity and are more likely to form moral intent in response to health and safety dilemmas. The findings also suggest it is also more likely for an idealistic person to form moral intent for safety dilemmas but not health concerns. Individuals with strong levels of relativism were less likely to form moral intent. Safety culture had almost insignificant positive associations with perceptions of moral intensity and forming moral intent.

This study may assist businesses to understand what influences worker perceptions of moral intensity and how they form moral intentions that lead to safe behaviour, enhancing behaviour-based safety programs and compliance.

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## Introduction

Scholars and practitioners are divided on how Australian businesses should improve approaches to safety culture to prevent workplace injuries, illness and fatalities. Some advocate further investigation of the relationships between health & safety performance and ethical decision-making (Borys 2014). One area of uncertainty is the extent to which the 'moral intensity' of a health or safety related dilemma influences the forming of ethical intent and ultimately behaviour. Also uncertain is the influence that an organisation's safety culture and individual factors have on perceptions of moral intensity and whether people form ethical intentions to act. Traditional research on organisation based ethical decision-making has focused generally on misconduct and fraud related issues (Tenbrunsel & Smith-Crowe 2008). Health and safety links to ethical decision-making have been limited mainly to consumer safety and employee conditions and rights issues (Tsalikis, Seaton & Shepherd 2008).

Many researchers agree that the decision-making process comprises ethical awareness, judgment, forming an ethical intent and then acting (Rest 1986; Trevino 1986; Jones 1991, Valentine & Hollingworth 2012), although arguments continue regarding various potential influences on the ethical decision-making process (Craft 2013). This study explores both well-established and new theoretical constructs that may influence ethical decision-making. These include the moral intensity model which has six components: *magnitude of consequence*, *social consensus*, *probability of effect*, *temporal immediacy*, *proximity* and *concentration of effect* (Jones 1991). Moral intensity is the extent to which people see an issue as being an ethical one. Magnitude of consequence is the sum of the harms (or benefits) done to victims (or beneficiaries) of the moral act in question (Jones 1991; Weber 1996; Chia & Mee 2000). Social consensus is the degree of social agreement that a proposed act is either evil or good (Jones 1991; Jones & Huber 1992; Shaw 2003). Probability of effect is a joint function of the probability that the act

will actually take place and will actually cause the harm or benefit predicted (Jones 1991). Temporal immediacy is the length of time between the incident and the onset of the consequences of the moral act in question (Jones 1991; Morris & McDonald; Kelley & Elm 2003). Proximity is the feeling of nearness (social, cultural, psychological or physical) that the moral agent has for victims or beneficiaries (Jones 1991). Concentration of effect is an inverse function of the number of people affected by the act of given magnitude (Jones 1991), for example, whether a large number of people were affected intensely or vice versa.

Here moral intensity is tested to measure its influence on the forming of moral intentions by people in a workplace setting, in response to operational health and safety scenarios. Moral intensity has been described as ‘the extent to which an issue, event, or act has the characteristics that make it subject to moral consideration, moral judgment, or moral action’ (Reynolds 2006, 234). Additionally, this research explores the relevance of the ‘moral potency’ psychological construct which consists of *moral courage*, *moral efficacy* and *moral ownership* (Hannah & Avolio 2010).

Individual moral philosophies have existed since the time of Aristotle, however more recent research developed by Forsyth (1980) produced an individual moral philosophy typology used in this study to measure an individual’s levels of relativism and idealism. High levels of relativism suggest that there may be many ways to look at morality. Contrastingly, high levels of idealism suggest deontological ethical views that reject consequence as a basis for moral evaluation (Forsyth 1980).

Finally, this study tested ‘safety culture maturity’ as a variable to measure the influence of perceptions of moral intensity and forming moral intent. It is measured using a Safety Culture Maturity escalating typology, which progresses from pathological through to reactive, calculative, proactive and generative (Parker, Lawrie & Hudson 2006).

### **Theoretical contribution**

This study responds to calls by Singhapakdi, Vitell, & Franke (1999), Hannah & Avolio (2010) and Tenbrunsel & Smith-Crowe (2008) for future ethics research to investigate personal characteristics, by introducing the moral potency construct (Hannah & Avolio 2010) and the ethical positioning questionnaire (EPQ) (Forsyth 1980) to measure its influence on moral intensity and the forming of ethical intent. We also accepted the challenge by Jeffries (2011), and added to the work of Singhapakdi *et al* (1999) to evaluate the relationship between perceived safety culture maturity of respondent organisations and ethical decision-making. In addition, this study explores the influence of distinct health and safety operational dilemmas on ethical decision-making recommended by Valentine & Hollingworth (2012) and Treviño, Weaver & Reynolds (2006) by sampling real organisational settings. Thus, this research brings together traditional and new research and practice by unravelling the relationships between the moral intensity of a health or safety problem, an individual’s pre-existing moral philosophies and their likelihood of acting on their moral intent. This study improves our understanding of how people perceive common health & safety problems and how they are likely to respond.

Similar to moral potency, Forsyth’s (1980) Ethical Position Questionnaire (EPQ) has reliably measured the influence of individual moral philosophy on perceptions of moral intensity and forming ethical intentions (Singhapakdi *et al* 1999) and provides the opportunity to examine the relationship between moral philosophy and other predictive variables in a health and safety context. The safety culture variable is used as an organisational factor to measure relationships between safety culture maturity and perceptions of moral intensity and forming moral intentions, and may help our understanding of individual ethical decision-making. Analysing perceptions of safety culture maturity and pre-existing moral philosophy may provide new insights into predictive relationships between the two constructs.

The overriding hypothesis is that: the direct relationships between moral intensity, moral potency and individual moral philosophy variables help explain the forming of moral intentions, a key aspect of the ethical decision-making process, and sets the stage for future development of a comprehensive theoretical model. This research elevates safety culture research to the same level of academic understanding as ethical culture and broader organisational culture in an ethical frame. By studying ethical responses to health and safety related dilemmas, based on studies into the influence of ethical leadership on safety behaviour (Chughtai 2015) including incident reporting (Brown & Mitchell 2010), we may learn more about the intrinsic factors that contribute to safety compliance and participation (Jeffries 2011). Moreover, earlier research suggests that traditional workplace injuries are seen to be more important than health related issues such as mental health (Weber 1996). Therefore, this study enables further insights into differences between ‘traditional’ safety dilemmas and health related dilemmas.

Similarly, the unique characteristics of Australian organisations have not been explored sufficiently in relation to moral philosophy and moral potency beyond Singer (1996, 1997). Although moral intensity has been

studied, many researchers used student populations to test scenarios, which has been criticised (Weber 1992; Reynolds 2006; Tsalikis *et al* 2008) and none concentrated on a health & safety specific context (O'Fallon & Butterfield 2005; Craft 2013). Moreover, there has been no known research that incorporates moral intensity, moral philosophy, moral potency and the safety culture maturity model. Given that health and safety are such key components of modern management, as is ethical conduct, further detailed investigation of these topics is relevant and necessary.

### **Practical Contribution**

Health and safety related research has focused more on organisational or extrinsic level influences including values based safety on behaviours (Hopkins 2006; Jeffries 2011) rather than intrinsic individual factors (Tidwell 2000; McKendall *et al* 2002; Martin & Cullen 2006). The practical impact for organisations not understanding individual ethical decision-making frames within safety systems and behaviours include risking the continued division of resources between ethics and safety management and leadership, contrasting and separate training, and misunderstanding of how ethical decision-making can be managed to improve health & safety outcomes. By understanding individual factors such as moral philosophy and moral potency of the workforce, organisations can target programs at increasing the ethical salience of dilemmas and also develop the ethical decision-making systems and behaviours that ultimately improve safety culture.

This study posits that with the lack of alignment in training and practice of ethical decision-making in a safety behaviour context, the likely status quo in many organisations is that decision-making may be systematically subject to whatever health or safety or other business regimes are applied, potentially inconsistently, from manager to manager and from section to section. More concerning is the potential for amoral decision-making based on business metrics such as cost reduction that could cloud the ethical decision-making process and lead to harmful decisions and behaviour. Some scholars identify the trade-off between profit and safety as a key indicator of poor safety culture (Parker *et al* 2006). Ethics research tells us that improving our understanding of how moral intentions are formed improves organisational capacity to predict future behaviour and may lead to safer outcomes.

### **Method**

The methods were approved by the University of Newcastle Australia Human Research Ethics Review Committee (H-2010-1101) and involved a correlational research design to test the influence of individual and organisational variables on perceptions of moral intensity and forming moral intentions to act in response to health and safety dilemmas. We distributed an online questionnaire to employees at twelve telecommunications and broadcast companies based in Australia.

The instrument presented three vignettes designed to reflect common health and safety related problems to test twelve hypotheses on the variance in perceptions of moral intensity, and the forming of ethical intentions based on distinct operational Australian workplace settings. Vignettes are commonly used in ethics research (Jones 1991; Singhapakdi *et al* 1996, 1999; Reidenbach & Robin 1988, 1990; Dursum, Morrow, & Beauchamp, 2003; McMahon & Harvey 2007; Lincoln & Holmes 2011; Valentine & Hollingworth 2012).

To allow for context and accepting that various situations influence perceptions of moral intensity (Jones 1991) the vignettes included one health and two safety dilemmas based on real operational scenarios, similar to the approach taken by others (Shaw 2003; Peslak 2006; Lincoln & Holmes 2011; Feng Feng 2013). Two dimensions of Parker *et al's* (2006) safety culture maturity model, incident reporting and following safe work methods, provide the context for two vignettes because self-reporting of safety incidents tends to be underreported (Pransky, Snyder, Dembe, & Himmelstein 1999) and it is central to a reporting culture (Reason 1997; Parker *et al* 2006; Hudson 2007). Complying with safe work methods was chosen because they are central to modern safety management systems (Burke, Sarpy, Tesluk, & Smith-Crowe 2002, 432). The third scenario relates to psychosocial issues in the workplace, which represents modern movements towards active caring and shifts away from organisations concentrating their efforts on occupational safety compared to health. This approach is consistent with Mencl & May (2009) and explores the distinction made between perceptions towards injuries compared to psychological illness (Weber 1996). The health related vignette provides the capacity to analyse variances between the safety and health related dilemmas and how workers respond to each.

The survey was distributed by participating organisations to operational business areas and made available for four weeks, the data was later analysed with SPSS. A manual review and preliminary classification of the variables assigned dependent and independent status according to the information in the hypotheses. Subscales for moral intensity, relativism, idealism and moral potency were created using transformations in SPSS. We

evaluated the data for parametric testing and then tested for Skewness, Kurtosis, violations of normality, linearity, singularity, multicollinearity and homoscedasticity for the relevant variables. In order to evaluate the internal consistency of the scales, that is, to measure how closely related the items within the scales are, Cronbach's Alpha was used. Bartlett's test of sphericity (BTS) and the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy were used to confirm that the basic assumptions for factor analysis had been met for each variable (Coakes & Ong 2010; Nunnally 1978). Correlation analysis was undertaken.

Owing to the contrasting views of whether to apply parametric or non-parametric tests to single question Likert scales (Norman 2010; Wigley 2013), both were applied including Pearson's Product-Moment Correlation coefficient and Spearman Rank Order Correlation. Both linear and ordinal regression analyses were used to interpret the direct effects of moral intensity and safety culture and forming ethical intentions as well as direct relationships between moral potency and individual moral philosophy on moral intensity and forming moral intentions. Additionally, Friedman's Analysis of Variance (ANOVA) was used to evaluate differences between results for safety related dilemmas and the health related dilemma relevant to hypothesis 12.

## Results

The survey was completed satisfactorily by 376 respondents from six companies. A pairwise analysis revealed a strong minimum response rate of 92% per variable indicating that the data was suitable for analysis. The average age of respondents was 45 years consistent between male and female. Approximately 80% of respondents were male, 18% were female and three respondents did not identify themselves as either. The high percentage of male respondents is reflective of the male dominated industry. 66% of workers had more than twenty years' experience, which indicates a mature work force (<http://lmip.gov.au> accessed 10/10/2015). 57% of respondents worked in organisations having between 1,000 and 5,000 employees. 56% were classified as worker/team member with another 25% being in supervisory roles, the remaining 19% were middle to senior management. Over 70% of respondents held diploma level education or higher.

Correlation analysis was undertaken whereby the coefficient provides a numerical summary of the direction and strength of the linear relationship between two variables. A perfect correlation of 1 or -1 indicates that the value of one variable can be determined exactly by knowing the value of the other variable (Pallant 2005, 114; De Veaux, Velleman & Bock 2012). Cohen (1998) suggests the following guidelines to interpret the strength of correlation.

$r = .10$  to  $.29$  Small

$r = .30$  to  $.49$  Medium

$r = .50$  to  $1.0$  Large

### ***Hypothesis 1: Perceived moral intensity of a situation and forming moral intent are positively related.***

The full moral intensity construct presented significant results suggesting there is a medium to strong direct and positive association between moral intensity and forming moral intent. Based on ordinal regression analysis, the moral intensity scale predicted between 21% and 34% of variance and the stronger the magnitude of consequence, temporal immediacy, social consensus and probability of effect of a health or safety based dilemma, the more likely a person will form an ethical intention.

In addition to the full moral intensity scale, each individual component underwent correlation analysis. Proximity did not report significant relationships with forming moral intent. Concentration of effect and temporal immediacy had a relatively insignificant impact. All other individual items had medium to strong correlations with forming moral intent. Social consensus produced the strongest results across all scenarios consistent with the original moral intensity study conducted by Jones & Huber (1992) and supported more recently by Lincoln & Holmes (2011).

These findings suggest that workers in the Australian telecommunications and broadcasting industry are more likely to form moral intentions when there is a strong perceived potential harm, especially when there are high levels of social consensus. The results are consistent with 12 out of 14 moral intensity studies conducted between 2000 and 2005 (O'Fallon & Butterfield 2005) and support arguments from McMahon & Harvey (2007) and May & Pauli (2002) that moral intensity is underpinned by magnitude of consequence, probability of effect and temporal immediacy. The correlation findings also suggest that proximity to those involved in the dilemma did not influence decision-making, similar to Valentine & Hollingworth (2012). We also found that concentration of effect only has a small influence, contrary to earlier studies which found it has a significant influence (Singhapakdi *et al* 1996). Furthermore, we found that the aforementioned components had a strong influence, but other studies found components such as temporal immediacy did not have a significant influence (Barnett

& Valentine 2004), reinforcing the idea that moral intensity is issue contingent (Jones 1991). These findings are important because they suggest that combinations of moral intensity dimensions that influence whether workers form moral intentions to act are different for health and safety compared to other types of dilemmas.

***Hypothesis 2: Moral potency and forming moral intent are positively related.***

The results show moral potency was a significant predictor of forming moral intent in response to health and safety dilemmas, explaining between 12% and 20% of variance depending on the scenario. The regression model was statistically significant and therefore an association exists between individual moral potency and forming moral intentions. This suggests that workers with strong moral potency are more likely to form a moral intent in response to a safety dilemma than workers with lower levels of moral potency. Moreover, there is a positive association between moral potency and forming moral intent in response to health related scenarios. These findings are important because there have been very few studies on the relationship between moral potency and forming moral intentions, and they reinforce the proposal by Hannah & Avolio (2010) that moral potency influences forming of moral intent.

***Hypothesis 3: Idealism and forming moral intent are positively related.***

Consistent with Singhapakdi (2004) and contrary to subsequent research (Valentine & Bateman 2011), there was a positive linear relationship between idealism and forming moral intent. Based on ordinal regression, idealism explained between 12% and 17% of variance in respondent's scores on the moral intent scale in response to safety dilemmas. Results in response to the health related scenario were not significant. This suggests that idealism has a small but significant positive influence on whether a worker in the Australian telecommunications and broadcasting industry will form the intention to act ethically in response to safety dilemmas. However, idealism had no statistically significant influence on how workers respond to health related dilemmas.

***Hypothesis 4: Relativism and forming moral intent are negatively related.***

Taking into consideration parametric and non-parametric testing, we found a small negative relationship between relativism and forming moral intentions to follow safe work methods, consistent with Valentine & Bateman (2011). The strongest result was observed for the health related dilemma in the third scenario. Relativism did not influence the forming of intentions to report a near-miss safety incident in the first scenario. Generally, relativism explained between 2% - 4% of variance in their forming moral intent scale. In other words, although negatively associated, consistent with other studies (Singhapakdi *et al* 1999), relativism only had a negligible influence on whether a worker in the Australian telecommunications and broadcasting industry would form the intention to act ethically.

***Hypothesis 5: Safety culture and forming moral intent are positively related.***

Analysis using Spearman's correlation coefficient identified a small positive linear relationship between safety culture and forming moral intent with the lowest strength in relation to the health dilemma. That is, we found a small positive association between workers having a strong safety culture and forming moral intentions. This result provides an interesting line of enquiry for future research, because, given the pre-existing theoretical linkages between social consensus and organisational culture, one may have expected more consistent results in relation to how social consensus and safety culture influences the forming of moral intent (Nelson & Quick 2013).

***Hypothesis 6: Idealism and perceived moral intensity are positively related.***

Analysis using the Pearson correlation coefficient identified a small positive linear relationship between idealism and perceptions of moral intensity, similar to Singhapakdi *et al* (1999) and Valentine & Bateman (2011). Generally, based on regression analysis, idealism helped explain approximately 6% of variance in respondents scores on the forming moral intent scale.

***Hypothesis 7: Relativism and perceived moral intensity are negatively related.***

We predicted a negative relationship between relativism and perceptions of moral intensity, following Singhapakdi *et al* (1999) and Valentine & Bateman (2011). However, similar to Chan & Leung (2006), and using the Pearson correlation coefficient, we found no significant relationship, suggesting the importance of issue-contingence and the ability of context to produce varying results.

***Hypothesis 8: Moral potency and perceived moral intensity are positively related.***

Using parametric and non-parametric tests we found a medium positive correlation between moral potency and perceptions of moral intensity. Generally, based on regression analysis, moral potency explained approximately 10% of variance on the perceptions of moral intensity scale. Moral potency appears to have a slightly stronger influence on health related dilemmas than safety related dilemmas.

This is an important finding as Hannah & Avolio (2010) recommended that further research should be undertaken to evaluate the relationship between moral potency and perceptions of moral intensity. We found that enhancing individual moral potency may increase the likelihood of a worker applying an ethical decision frame in response to a health or safety dilemma and in turn increase their intrinsic motivation to act on their moral intentions.

***Hypothesis 9: Safety culture and perceived moral intensity are positively related.***

Our parametric and non-parametric tests found a small positive correlation between safety culture and perceptions of moral intensity, with safety culture explaining approximately 2% of variance on the moral intensity scale. Technically the hypothesis is supported however due to the low level of association and inconsistency across scenarios the results need to be considered with caution. More research is required to better evaluate the influence of safety culture maturity on perceptions of moral intensity.

***Hypothesis 10: There is a positive association between safety culture and idealism***

***Hypothesis 11: There is a negative association between safety culture and relativism***

The relationship between safety culture and idealism in this study was positive, and the relationship between safety culture and relativism was negative consistent with Forsyth (1988). However no significant associations were identified with idealism, and only a small positive correlation was detected between safety culture and relativism using Pearson's Product Moment correlation with a coefficient of  $r = -.107, p = .047$ . Although there is no significant relationship between safety culture and idealism there is a possible small correlation between safety culture and relativism, albeit the parametric and non-parametric tests presented conflicting results. Due to the borderline levels of significance it is likely that any influence safety culture has on individual moral philosophy is negligible.

***Hypothesis 12:***

***a) Moral intentions are stronger for safety related issues than health related issues***

***b) Perceptions of moral intensity are stronger for safety issues than health issues***

Consistent with Jones (1991) and Singhapakdi *et al* (1996) the forming of moral intent varies between scenarios. The stronger results for safety dilemmas compared to health dilemmas in both forming moral intent and perceptions of moral intensity support Weber's (1996) assertion that people are less likely to perceive psychological injuries as being as serious as physical safety related issues. This is supported by our ANOVA results, which show a statistically significant difference between the two safety-related scenarios and the health related scenario, while there is no statistical difference between the two safety-related scenarios. This result has important implications for management practice as organisations strive to combat increasing instances of psychosocial issues in the workplace (Safe Work Australia 2013). If a workforce does not perceive that dealing with health related issues is as ethically charged as dealing with physical issues, then dedicated education programs, leadership and policy need to be targeted at raising awareness.

**Discussion & Conclusion**

Historically, health & safety concerns have become relevant to business ethics research when the behaviour of senior executives damages organisations' reputations and puts the public at risk; an example is James Hardy in Australia (Austin *et al*, 2012). However, there is a much more common and operational need for ethical decision-making in the health and safety area. Getting to the hearts and minds of workers to behave safely is a critical element of strong safety cultures (Parker *et al* 2006). Many organisations have traditionally focused a great deal of attention on developing processes and enforcing compliance with regulations. However, intrusive supervision of all workers, especially in disaggregated workforces, is neither economical nor desirable, so in order to empower the workforce to identify risks and to make the 'right' decisions, organisations must establish a culture whereby safety and health related dilemmas as seen to have high levels of moral intensity and more importantly people in all workplace domains genuinely possess the moral intensity. Ethical decision-making provides workers with a decision-frame that supports the principles of preventing harm, and actively caring.

This study reinforces the relationship between health & safety and ethical decision-making by presenting the correlated nature of individual factors, including individual moral potency and individual moral philosophy as well as safety culture and moral intensity, with forming moral intentions. Although the majority of the sample population demonstrated strong perceptions of moral intensity and moral intent in response to the scenarios, more than 20% of respondents did not. In a workplace this presents concerns because people who are not applying ethical decision-making frames are likely to be applying less desirable decision-frames such as cost-benefit. Parker *et al* (2006) refer to a culture where individuals weigh up getting caught with doing the right thing as pathological and this type of culture sits at the lowest order. When a large percentage of the workforce does not feel strongly about reporting incidents, following safe work methods or checking whether a colleague is okay there is an obvious need for effective policies to improve both the ethical and safety cultures. This study suggests that coalescing approaches to both sub cultures is key to getting to the hearts and minds of the workforce and thus improving the entire organisational culture.

This study identifies the influence that individual moral potency has on perceptions of moral intensity as well as the forming of moral intentions. It suggests that developing moral potency in workers will positively influence safety behaviours and ultimately the culture of the organisation. Moreover, this study highlights the influence that moral intensity factors such as social consensus and magnitude of consequence have on individual decision-making. Armed with this knowledge, organisations can target education and training, leadership programs and organisational culture strategies towards enhanced workforce safety behaviours and outcomes.

Specifically, this research supports a model which is shown at least to partially predict the forming of moral intent, and strengthens the literature in several important ways. Firstly, we found different components of moral intensity had stronger results for health and safety dilemmas compared to other studies (Singhapakdi *et al* 1996, 1999; Sweeney & Costello 2009; Valentine & Hollingworth 2012). Secondly, our participants viewed the safety and health dilemmas with different levels of moral intensity and moral intent. These findings suggest that unsafe behaviour, with potential for physical injury, is perceived to be more morally intense than situations with potential for psychological harm. This perception creates challenges for organisations trying to prevent psychosocial harm in the workplace by for example, minimising stress and anxiety. Although this study found only small associations between safety culture and individual moral philosophy, there are sufficient grounds for future research to explore these relationships more closely.

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