The relationship between knowledge of pain neurophysiology and fear avoidance in people with chronic pain: A point in time, observational study.

Claire Fletcher Ba (physio)[1,3], Lynley Bradnam PhD[2], Christopher Barr PhD[3]

1. Physiotherapy Department
North Eastern Rehabilitation Centre, Australia
2. Applied Brain Research Laboratory, Center for Neuroscience
School of Health Sciences
Faculty of Medicine, Nursing and Health Sciences
Flinders University
3. Department of Rehabilitation, Aged and Extended Care
School of Health Sciences
Faculty of Medicine, Nursing and Health Sciences
Flinders University

Abstract

Chronic pain is prevalent in the western world; however fear of pain often has a greater impact than the degree of initial injury. The aim of this study was to explore the relationship between knowledge of the neurophysiology of pain and fear avoidance in individuals diagnosed with chronic pain. Twenty-nine people with chronic musculoskeletal pain were recruited and completed questionnaires to determine their understanding of pain neurophysiology and the degree of their fear avoidance beliefs. There was an inverse relationship between knowledge of pain neurophysiology and the level of fear avoidance. Patients with higher pain knowledge reported less fear avoidance and lower perceived disability due to pain. There was no relationship with educational level or compensable status for either variable. The findings suggest fear avoidance is positively influenced by neurophysiology of pain education, so that a higher level of pain knowledge is associated with less activity-related fear. The clinical implication is that reducing fear avoidance/kinesiophobia using neurophysiology of pain education in people with chronic pain may provide an effective strategy to help manage fear avoidance and related disability in the chronic pain population in order to improve treatment outcomes.

Key Words

Chronic pain

Kinesiophobia

Pain Neurophysiology

Pain Education

Fear avoidance

Introduction

Chronic pain is prevalent in epidemic proportions in the western world (Blyth et al., 2001; Breivik, Collett, Ventafridda, Cohen, & Gallacher, 2006; Johannes, Le, Zhou, Johnston, & Dworkin, 2010). Defined as lasting for more than 12 weeks, chronic pain is associated with aberrant processing in the central nervous system, often unrelated to the state of tissue damage or healing (Gifford & Butler, 1997). Chronic pain impacts on sensory information processing within the cerebral cortex and the experience of pain is modulated by emotion and beliefs, supporting an emphasis on psychological interventions (Flor, 2014; Moseley & Flor, 2012; Simons, Elman, & Borsook, 2014). Pain can also be conceptualised as a multisystem output, arising when the brain concludes the body tissues are in danger and an action is required (Moseley, 2007). In the chronic pain state, the efficacy of the brain and nervous system to generate pain is increased due to altered sensitivity within spinal and cortical nociceptive networks. This phenomenon, often termed central sensitisation, creates a nonlinear relationship between nociceptive input, tissue damage and pain (Woolf, 2011).

Kinesiophobia or fear of movement is described as an irrational and debilitating fear of physical movement and activity which results from a feeling of vulnerability to painful injury or re-injury (Kori, Miller, & Todd, 1990). Maladaptive beliefs about pain greatly influence disability and function, even more so than the current state of tissue damage (Woby, Roach, Urmston, & Watson, 2007). The fear avoidance model of chronic pain links maladaptive beliefs about pain with increased disability due to the development of avoidance behaviours such as kinesiophobia (Vlaeyen, Kole-Snijders, Boeren, & van Eek, 1995; Vlaeyen & Linton, 2000). Avoidance of the pain experience or painful activity increases the fear of triggering pain, ultimately leading to activity avoidance (Lethem, Slade, Troup, & Bentley, 1983), characterised by a reduction in physical activity. In turn, targeting maladaptive beliefs about pain and reducing fear avoidance behaviours could provide an effective therapeutic strategy for the management of kinesiophobia and persistent pain states (Moseley, 2007). Pain Neurophysiology Education (PNE) is an educational therapy that builds on the principles of "explaining pain" as first described by (Moseley, 2002). Using education as a treatment for pain was tested in randomised controlled trials over a decade ago (Moseley, Nicholas, & Hodges, 2004; Moseley, 2003; Moseley, 2007). (Nijs, Paul van Wilgen, Van Oosterwijck, van Ittersum, & Meeus, 2011). PNE aims to change maladaptive pain beliefs which may lead to increased fear of movement (Meeus, Nijs, Van Oosterwijck, Van Alsenoy, & Truijen, 2010; Moseley, 2003). PNE is effective in changing a persons' understanding and beliefs about pain, a concept often termed "reconceptualization'. More recent work by Nijs et al (2011) further developed the content, delivery style and patient interaction required for optimal delivery of PNE.

The evidence of the success of PNE in persistent pain states is encouraging, both as a stand-alone treatment and as part of a wider rehabilitation program (Moseley & Butler, 2015; Zimney, Louw, & Puentedura, 2014). A systematic review indicated that education of the neurophysiology and neurobiology of pain may have positive benefits on pain, disability and function in chronic musculoskeletal pain disorders (Louw, Diener, Butler, & Puentedura, 2011). However, a second review into the use of PNE specifically for low back pain was inconclusive, and the authors were unable to recommend PNE for routine clinical practice (Clarke, Ryan, & Martin, 2011). More recently, while written pain education does not impact clinically on the effects of pain (van Ittersum et al., 2014), face to face education has been shown to lead patients to view their surgical experience more favourably and use health care facilities less (Louw, Diener, Landers, & Puentedura, 2014). In order to better understand the effectiveness of PNE in the treatment of chronic pain, a link must first be established between the degree of pain knowledge and fear avoidance in these individuals. Furthermore, there are other factors that may impact on activity-related fear and pain knowledge; for example educational levels or previous treatment such as surgery, that need to be explored. Therefore, the primary aim of this observational point in time study was to determine if a relationship exists between knowledge of pain neurophysiology and fear avoidance in a cohort of people experiencing chronic pain. The hypothesis was that increased pain knowledge would be associated with reduced fear avoidance. A secondary aim was to determine whether factors such as perceived disability using the Pain Disability Index (PDI) (Soer, Reneman, Vroomen, Stegeman, & Coppes, 2012), pain level (visual analogue scale, VAS) (Hjermstad et al., 2011) and duration, compensable status, educational attainment and past surgical interventions are associated with fear avoidance or pain neurophysiology knowledge. The secondary hypotheses were that greater pain knowledge would be associated with less pain disability and Kinesiophobia, while Kinesiophobia and pain disability would be associated with higher pain scores. However, neither of pain knowledge, disability or Kinesiophobia would be associated with educational, compensable or surgical status.

METHODS

Setting and Participants

A convenience sample of 29 people (20 female) with a mean age of 48.6 (SD 11.3) were recruited from a private rehabilitation hospital specialising in the provision of multidisciplinary pain rehabilitation programs. These programs aim to address the physical, psychological and functional consequences of persistent pain states with an individualised, goal focused approach and involve the delivery of PNE. It was not determined for the purpose of this study whether participants had commenced, partially completed or fully completed a pain management program at the time of data collection. Participant demographics are provided in Table 1. Of note, all participants had experienced persistent pain for greater than 6 months and had been diagnosed with chronic pain by a Pain Rehabilitation Specialist. Pain region or type (e.g. neuropathic) was not recorded. Potential participants who had undergone surgical intervention within the last three months, had pain due to cancer or malignancy or were unable to understand and/or read English were excluded. Ethics approval was obtained from the local ethics committee and all participants provided written informed consent.

Methods

Each participant was required to complete two questionnaires and provide demographic information at a single session. The revised Neurophysiology of Pain Questionnaire (rNPQ) was used to assess the neurophysiology of pain knowledge. The rNPQ is a 13 part questionnaire consisting of true/false statements that assess how an individual conceptualizes biological mechanisms underpinning their pain. The rNPQ is a reliable and valid measure to determine pain knowledge in the chronic pain population (Catley, O'Connell, & Moseley, 2013). Mean scores for patients that have been trained or exposed to PNE are reported to be as high as 61% compared to untrained patients at 21% (Moseley, 2003). A larger score indicates a greater understanding of the biological mechanisms that underpin chronic pain (Catley et al., 2013). Fear avoidance was assessed using the Tampa Scale of Kinesiophobia (TSK), a 17 item, self-report Likert scale checklist that measures movement related fear and activity avoidance (Kori et al., 1990). Participants rate how strongly they agree with statements about beliefs regarding the effect of movement and physical activity. The TSK is a reliable measure of fear avoidance in people with chronic pain (French, France, Vigneau, French, & Evans, 2007; Vlaeyen et al., 1995).

In addition, several secondary outcomes were assessed. The Pain Disability Index (PDI) measured the degree to which pain interferes social, vocational and physical function (Soer et al., 2012). The PDI is valid for use in chronic back pain. Participants are asked to rate their perceived disability from 0 (no disability) to 10 (worst disability) across10 categories including family responsibilities, social activities and self-care. Pain severity was assessed using a Visual Analogue Scale (VAS) for pain (Hjermstad et al., 2011). Participants marked on a 100 mm line the severity of their pain, with the left side labelled as “no pain” and the right side as “worst imaginable pain”. Finally, demographic information with regards to age, gender, duration of pain symptoms, compensable status, educational attainment and previous surgical intervention was also recorded.

Data analysis

The distribution of the data was checked using the Shapiro-Wilk test and met the assumptions of normality. The primary data was analysed using Pearson's correlation (*r*) to determine if there was any relationship between scores for TSK and rNPQ. The Pearson’s test was also used to explore the relationship between each primary outcome measure and the secondary outcome measures of PDI and pain VAS. The difference in the mean scores for the primary outcome measures with different demographic factors such as compensable status and educational attainment were separately analysed using independent t-tests and analysis of variance (ANOVA). Alpha was set to 0.05 for all statistical analyses.

RESULTS

Correlations

There was a negative relationship between the primary outcome measures rNPQ and TSK (r=-0.406, p=0.029). For the secondary outcome measures, there was a negative relationship between rNPQ and PDI (r=-0.453, p=0.014) and between PDI and level of education (r=-0.420, p=0.023) (see table 2). There was a positive correlation between TSK and PDI (r=0.505, p=0.005), between pain scores and TSK (r=0.387, p=0.038) and PDI and pain scores (r=0.616, p<0.001). Duration of pain was positively correlated with increasing age (r=0.456 p=0.013). There was no correlation between the NPQ and pain scores or duration of pain or between TSK and duration of pain. There was no correlation between length of time of symptoms and pain.

Primary and Secondary outcome measures

Descriptive statistics for rNPQ, TSK, PDI, Pain VAS, duration of pain and age grouped by compensable status, educational attainment, gender and presence of surgical intervention are provided in Table 1. There was no difference in TSK or rNPQ scores when grouped by compensable status, surgical intervention or educational attainment. Participants who had undergone surgical intervention reported longer duration of pain (167.5 months, SD 167.2) than those without surgery (45.6 months, SD 49.1) (p=0.005). There were no other significant findings.

Discussion

The results of this observational point in time study revealed a negative association between knowledge of pain neurophysiology and kinesiophobia in a population of people experiencing chronic pain. Participants with a higher degree of pain knowledge reported lower fear avoidance-related beliefs, which suggest a relationship exists between understanding neurophysiology of pain and reduced fear avoidance behaviour. Previous reviews of the literature have produced inconclusive evidence as to the effect of PNE on the experience of chronic pain (Clarke et al., 2011; Louw et al., 2011). Our results suggest a positive relationship between PNE and the experience of kinesiophobia in chronic pain conditions. Although our cross sectional study design and correlational analysis limit our conclusions we consider our results provide preliminary support that kinesiophobia is positively influenced by greater knowledge of pain neurophysiology. However, as we have no evidence of causality, our conclusion that our primary hypothesis was supported must be interpreted conservatively until proven by an interventional clinical trial.

In agreement with our secondary hypotheses, there was a negative correlation between level of pain knowledge and pain disability and a positive relationship between kinesiophobia and pain disability. Therefore, there is a clear possibility that higher pain knowledge and lower fear avoidance beliefs were associated with lower perceived disability, in agreement with previous authors (Louw et al., 2011; Meeus et al., 2010; Van Oosterwijck et al., 2013; Van Oosterwijck et al., 2011). Participants with less kinesiophobia also reported lower pain scores. Greater pain-related disability was associated with higher pain scores and lower educational status. There was no impact of compensable status or surgical intervention on neurophysiology of pain knowledge or kinesiophobia, although there were few participants in the latter category. Our results were not corrected for multiple comparisons as in a study of this nature, corrections would increase the likelihood of Type II errors (Nakagawa, 2004), and we have likely overestimated the number of potential relationships. However, these associations between variables are useful to highlight areas worthy of further investigation in interventional trials.

There was no relationship between an individual's education level and the rNPQ, the TSK or the degree of pain knowledge in the current study. The lack of an association between educational level and pain knowledge agrees with previous findings that people who experience pain have the capacity to understand complex pain biology concepts regardless of their educational level (Moseley et al., 2004). We did not record the extent of PNE that each participant had completed. However, Moseley and colleagues reported that specific PNE training in people with chronic pain yielded a mean rNPQ score of around 60% (Moseley et al., 2004) and our mean the rNPQ score was 55% (range 23-84%). The upper end of the score range suggests some of the population included in the current study had high knowledge of pain neurophysiology, meaning those participants may have been exposed to some form of education. However, we did find the level of an individual's education was inversely associated with self-reported disability, in agreement with previous findings (Roth & Geisser, 2002). However, high levels of self-reported disability in lesser educated people were related to increased thoughts relating to pain and harm (Roth & Geisser, 2002), and perhaps an individual with a compensable injury may report higher pain disability (Rainville, Sobel, Hartigan, & Wright, 1997). These associations are worthy of further investigation.

The current study has highlighted that an association between higher PNE and less kinesiophobia exists, supporting the concept of reconceptualising pain by education (Moseley, 2007). The next stage of this research is to investigate whether increasing pain knowledge via PNE is the causal factor in the reduction of movement-related fear. Because previous interventional studies have demonstrated a direct impact of PNE in several chronic pain conditions (Meeus et al., 2010; Moseley et al., 2004; Nijs, De Meirleir, & Duquet, 2004; Van Oosterwijck et al., 2013; Van Oosterwijck et al., 2011), we believe PNE may be the main driver of the association found in this study. The study design however limits any clear conclusions but provides evidence that further research is warranted.

Limitations

The small sample size and study design limits the ability to draw causal conclusions regarding the relationships explored in the current study as the impact of PNE interventions on fear avoidance behaviours was not directly tested. Furthermore, the population sampled had a high percentage of person's receiving compensation relating to their pain condition. Previous authors have suggested the percentage of compensable patients within a cohort of people with chronic pain is around 40% (Nicholas, Asghari, & Blyth, 2008). The high compensable population in the current study likely reflects the single recruitment site and therefore, may have limited external validity. Location or type of pain wasn't considered as part of this investigation; therefore conclusions about specific sub groups which may present differently to the whole cohort cannot be made from the current results.

CONCLUSION

The fear avoidance model is the leading explanatory paradigm for understanding how pain and disability are related, in that negative cognitions about pain sustain and reinforce the process of chronic pain (Vlaeyen & Linton, 2000). Education regarding pain neurophysiology may reduce the experience of pain (Moseley, 2007). The current study found an association between increased pain knowledge and decreased fear of movement worthy of further exploration in an interventional study. If, as we suggest, pain education is effective at reducing disability and pain for people with high levels of kinesiophobia, PNE may provide a cost effective and easy to apply intervention in the clinical setting. Further research is warranted to continue to explore and address factors that impact upon increasing pain neurophysiology knowledge to reduce fear avoidance and disability in chronic pain conditions.

Acknowledgements

The authors would like to acknowledge the generous support received from the staff and management of the Physiotherapy Department at North Eastern Rehabilitation Centre throughout this project.

Competing interests

This project was completed as part of the completed of a Masters of Clinical Rehabilitation at Flinders University, SA. There are no conflicts of interest reported.

Funding Support

None

References

Blyth, F. M., March, L. M., Brnabic, A. J., Jorm, L. R., Williamson, M., & Cousins, M. J. (2001). Chronic pain in Australia: a prevalence study. *Pain, 89*(2-3), 127-134

Breivik, H., Collett, B., Ventafridda, V., Cohen, R., & Gallacher, D. (2006). Survey of chronic pain in Europe: prevalence, impact on daily life, and treatment. *Eur J Pain, 10*(4), 287-333

Catley, M. J., O'Connell, N. E., & Moseley, G. L. (2013). How good is the neurophysiology of pain questionnaire? A Rasch analysis of psychometric properties. *J Pain, 14*(8), 818-827

Clarke, C. L., Ryan, C. G., & Martin, D. J. (2011). Pain neurophysiology education for the management of individuals with chronic low back pain: systematic review and meta-analysis. *Man Ther, 16*(6), 544-549

Flor, H. (2014). Psychological pain interventions and neurophysiology: implications for a mechanism-based approach. *Am Psychol, 69*(2), 188-196

French, D. J., France, C. R., Vigneau, F., French, J. A., & Evans, R. T. (2007). Fear of movement/(re)injury in chronic pain: a psychometric assessment of the original English version of the Tampa scale for kinesiophobia (TSK). *Pain, 127*(1-2), 42-51

Gifford, L. S., & Butler, D. S. (1997). The integration of pain sciences into clinical practice. *J Hand Ther, 10*(2), 86-95

Hjermstad, M. J., Fayers, P. M., Haugen, D. F., Caraceni, A., Hanks, G. W., Loge, J. H., . . . European Palliative Care Research, C. (2011). Studies comparing Numerical Rating Scales, Verbal Rating Scales, and Visual Analogue Scales for assessment of pain intensity in adults: a systematic literature review. *J Pain Symptom Manage, 41*(6), 1073-1093

Johannes, C. B., Le, T. K., Zhou, X., Johnston, J. A., & Dworkin, R. H. (2010). The prevalence of chronic pain in United States adults: results of an Internet-based survey. *J Pain, 11*(11), 1230-1239

Kori, S. H., Miller, R. P., & Todd, D. D. (1990). Kinesophobia: A new view of chronic pain behaviour. *Pain Management, 3*, 35-43

Lethem, J., Slade, P. D., Troup, J. D., & Bentley, G. (1983). Outline of a Fear-Avoidance Model of exaggerated pain perception--I. *Behav Res Ther, 21*(4), 401-408

Louw, A., Diener, I., Butler, D. S., & Puentedura, E. J. (2011). The effect of neuroscience education on pain, disability, anxiety, and stress in chronic musculoskeletal pain. *Arch Phys Med Rehabil, 92*(12), 2041-2056

Louw, A., Diener, I., Landers, M. R., & Puentedura, E. J. (2014). Preoperative pain neuroscience education for lumbar radiculopathy: a multicenter randomized controlled trial with 1-year follow-up. *Spine (Phila Pa 1976), 39*(18), 1449-1457

Meeus, M., Nijs, J., Van Oosterwijck, J., Van Alsenoy, V., & Truijen, S. (2010). Pain physiology education improves pain beliefs in patients with chronic fatigue syndrome compared with pacing and self-management education: a double-blind randomized controlled trial. *Arch Phys Med Rehabil, 91*(8), 1153-1159

Moseley, G. L., & Butler, D. S. (2015). 15 Years of Explaining Pain - The Past, Present and Future. *J Pain*

Moseley, G. L., & Flor, H. (2012). Targeting cortical representations in the treatment of chronic pain: a review. *Neurorehabil Neural Repair, 26*(6), 646-652

Moseley, G. L., Nicholas, M. K., & Hodges, P. W. (2004). A randomized controlled trial of intensive neurophysiology education in chronic low back pain. *Clin J Pain, 20*(5), 324-330

Moseley, L. (2002). Combined physiotherapy and education is efficacious for chronic low back pain. *Aust J Physiother, 48*(4), 297-302

Moseley, L. (2003). Unraveling the barriers to reconceptualization of the problem in chronic pain: the actual and perceived ability of patients and health professionals to understand the neurophysiology. *J Pain, 4*(4), 184-189

Moseley, L. (2007). Reconceptualizing pain according to modern pain science. *Physical Therapy Reviews, 12*(30), 169-178

Nakagawa, S. (2004). A farewell to Bonferroni: the problems of low statistical power and publication bias. *Behavioral Ecology, 15*(6), 1044-1045

Nicholas, M. K., Asghari, A., & Blyth, F. M. (2008). What do the numbers mean? Normative data in chronic pain measures. *Pain, 134*(1-2), 158-173

Nijs, J., De Meirleir, K., & Duquet, W. (2004). Kinesiophobia in chronic fatigue syndrome: assessment and associations with disability. *Arch Phys Med Rehabil, 85*(10), 1586-1592

Nijs, J., Paul van Wilgen, C., Van Oosterwijck, J., van Ittersum, M., & Meeus, M. (2011). How to explain central sensitization to patients with 'unexplained' chronic musculoskeletal pain: practice guidelines. *Man Ther, 16*(5), 413-418

Rainville, J., Sobel, J. B., Hartigan, C., & Wright, A. (1997). The effect of compensation involvement on the reporting of pain and disability by patients referred for rehabilitation of chronic low back pain. *Spine (Phila Pa 1976), 22*(17), 2016-2024

Roth, R. S., & Geisser, M. E. (2002). Educational achievement and chronic pain disability: mediating role of pain-related cognitions. *Clin J Pain, 18*(5), 286-296

Simons, L. E., Elman, I., & Borsook, D. (2014). Psychological processing in chronic pain: a neural systems approach. *Neurosci Biobehav Rev, 39*, 61-78

Soer, R., Reneman, M. F., Vroomen, P. C., Stegeman, P., & Coppes, M. H. (2012). Responsiveness and minimal clinically important change of the Pain Disability Index in patients with chronic back pain. *Spine (Phila Pa 1976), 37*(8), 711-715

van Ittersum, M. W., van Wilgen, C. P., van der Schans, C. P., Lambrecht, L., Groothoff, J. W., & Nijs, J. (2014). Written pain neuroscience education in fibromyalgia: a multicenter randomized controlled trial. *Pain Pract, 14*(8), 689-700

Van Oosterwijck, J., Meeus, M., Paul, L., De Schryver, M., Pascal, A., Lambrecht, L., & Nijs, J. (2013). Pain physiology education improves health status and endogenous pain inhibition in fibromyalgia: a double-blind randomized controlled trial. *Clin J Pain, 29*(10), 873-882

Van Oosterwijck, J., Nijs, J., Meeus, M., Truijen, S., Craps, J., Van den Keybus, N., & Paul, L. (2011). Pain neurophysiology education improves cognitions, pain thresholds, and movement performance in people with chronic whiplash: a pilot study. *J Rehabil Res Dev, 48*(1), 43-58

Vlaeyen, J. W., Kole-Snijders, A. M., Boeren, R. G., & van Eek, H. (1995). Fear of movement/(re)injury in chronic low back pain and its relation to behavioral performance. *Pain, 62*(3), 363-372

Vlaeyen, J. W., & Linton, S. J. (2000). Fear-avoidance and its consequences in chronic musculoskeletal pain: a state of the art. *Pain, 85*(3), 317-332

Woby, S. R., Roach, N. K., Urmston, M., & Watson, P. J. (2007). The relation between cognitive factors and levels of pain and disability in chronic low back pain patients presenting for physiotherapy. *Eur J Pain, 11*(8), 869-877

Woolf, C. J. (2011). Central sensitization: implications for the diagnosis and treatment of pain. *Pain, 152*(3 Suppl), S2-15

Zimney, K., Louw, A., & Puentedura, E. J. (2014). Use of Therapeutic Neuroscience Education to address psychosocial factors associated with acute low back pain: a case report. *Physiother Theory Pract, 30*(3), 202-209

		TSK	NPQ	VAS - Pain	PDI	Pain Duration	Age
All participants (n=29)		37.9 (8.9)	54.9 (15.5)	52.8 (23.4)	56.0 (18.9)	79.2 (108.6)	48.6 (11.3)
Compensable	**Yes (n=22)**	39.3 (9.5)	53.9 (15.6)	49.3 (25.3)	55.8 (19.1)	74.3 (101.7)	47.4 (10.0)
	No (n=7)	33.4 (4.6)	58.2 (10.8)	63.9 (11.1)	56.7 (19.9)	94.9 (135.8)	52.6 (14.8)
	Mean difference (95% CI)	5.8 (-1.9 - 13.6)	-4.4 (-17.4 - 8.6)	-14.6 (-35.0 - 5.8)	-1.0 (-18.1 - 16.2)	47.8 (-118.7 - 77.5)	4.9 (-15.2 - 4.8)
Surgical intervention +	**Yes (n=8)**	34.8 (9.1)	60.6 (14.5)	44.3 (27.0)	54.6 (18.3)	167.5 (167.3)*	51.9 (12.6)
	No (n=21)	39.0 (8.8)	52.8 (14.2)	56.1 (21.7)	56.6 (19.5)	45.6 (49.1)*	47.4 (10.9)
	Mean difference (95% CI)	-4.2 (-11.8 - 3.2)	7.8 (-4.4 - 20.0)	-11.8 (-31.5 - 7.9)	-2.0 (-18.4 - 14.4)	121.9 (40.8 - 202.9)	4.5 (-5.2 - 14.1)
Gender	**Female (n=20)**	37.5 (9.1)	55.8 (14.1)	53.2 (25.7)	55.4 (21.4)	96.1 (126.3)	50.8 (11.0)
	Male (n=9)	38.8 (8.9)	53.0 (16.1)	52.1 (18.4)	57.4 (12.8)	41.9 (33.7)	43.9 (11.0)
	Mean difference (95% CI)	-1.3 (-8.8 - 6.1)	2.8 (-9.3 - 14.9)	1.1 (-18.5 - 20.7)	-2.0 (-17.9 - 13.8)	54.1 (-34.5 - 142.7)	6.9 (-2.2 - 15.9)
Education level	**Secondary (n=13)**	38.6 (8.6)	52.7 (14.3)	59.7 (22.6)	64.8 (16.4)	64.7 (92.9)	46.1 (10.4)
	TAFE (n=10)	38.0 (9.6)	58.5 (16.3)	47.2 (22.2)	51.1 (15.7)	98.6 (128.2)	47.8 (9.8)
	University (n=6)	36.0 (9.8)	53.9 (12.9)	47.5(27.0)	45.2 (22.9)	78.5 (118.6)	55.5 (14.5)

Table 1: Comparison of outcome measures by compensable, surgical, and education status, and gender. All values are mean (SD).

*significant to .05

+ surgical intervention > 3 months ago.

	Pain duration	Education+	VAS-Pain	rNPQ	TSK
Education+	0.077				
VAS-Pain	-0.164	-0.234			
NPQ	0.070	0.071	-0.333		
TSK	-0.243	-0.107	0.387*	**-0.406****	
PDI	-0.115	**-0.420***	0.616**	**-0.453***	0.505**

*Significant to .05

**Significant to .01

+ Spearmans correlation used for categorised level of education correlations.

Table 2. Correlation analysis of aspects of pain, education, and kinesiophobia. Negative values indicate an inverse relationship, highlighted bold.