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Influence of psychosocial factors on the experience of musculoskeletal pain: a literature review

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ABSTRACT

Musculoskeletal pain is a health problem that affects approximately 33 % of the adult population, of which 56 % corresponds to elderly people and 35% to people of working age. Some epidemiological investigations have shown that there are certain groups of people within the population most likely to develop chronic musculoskeletal pain, these studies have allowed to identify different weaknesses and needs in the interventions of health professionals in this problem. The data have shown that the prevalence of pain is higher in women, smokers, with incomplete education, with psychological or social risk, in this way the evidence has removed attention to the nociception of body structures as the only causal factor of pain musculoskeletal This has forced researchers to explore the influence of psychosocial factors in the experience of musculoskeletal pain, consider the integration of various factors and mechanisms to explain the development of the painful experience. The objective of this review is to describe the psychosocial factors that influence the experience of musculoskeletal pain in order to relate them to contemporary neuroscientific models

Key words: Muscle skeletal pain, psychosocial factors, pain, literature review.

RESUMEN

El dolor musculoesquelético es un problema sanitario que afecta aproximadamente a un 33 % de la población adulta, del cual un 56 % corresponde a personas adultos mayores y un 35 % a personas en edad laboral. Algunas investigaciones epidemiológicas han demostrado que existen ciertos grupos de personas dentro de la población más propensos a desarrollar dolor crónico musculoesquelético; estos estudios han permitido identificar diferentes debilidades y necesidades en las intervenciones de los profesionales de la salud en esta problemática. Los datos han demostrado que la prevalencia del dolor es mayor en mujeres, personas fumadoras, con educación incompleta, con riesgo psicológico o social, de esta manera la evidencia le ha quitado la atención a la nocicepción de las estructuras corporales como único factor causal de dolor musculoesquelético. Esto ha obligado a los investigadores a explorar la influencia de los factores psicosociales en la experiencia de dolor musculoesquelético, considerar la integración de diversos factores y mecanismos para provocar explicar el desarrollo de la experiencia dolorosa. La presente revisión tiene como objetivo describir los factores psicosociales que influyen en la experiencia de dolor musculoesquelético para relacionarlos con los modelos neurocientíficos contemporáneos.

Palabras clave: Dolor musculoesquelético, factores psicosociales, dolor, revisión bibliográfica.

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INTRODUCTION

Musculoskeletal pain is a health problem affecting approximately 33 % of the adult population. A total of 56 % of the affected subjects are elderly people and 35% are people at working age (1). Some epidemiological studies have shown that certain groups of people within the population are most likely to develop chronic musculoskeletal pain (2,3). These studies have contributed to the identification of different weaknesses and needs of the interventions of healthcare professionals regarding this problem. Data have shown that the prevalence of pain is higher in women (3), smokers (4), people with incomplete education (5) or, at psychological or social risk (6). In this way, the evidence has removed the focus on the nociception of body structures as the only causal factor of musculoskeletal pain (7).

It has been mentioned that some healthcare professionals consider nociception and pain as synonyms (8). Because of this, society in general has developed beliefs based on an erroneous model of knowledge (7). In these models, the cause of musculoskeletal pain is related to a damaged tissue that sends painful signals to the central nervous system for its perception (8). However, there is no such relationship between pain and nociception, nor between pain and tissue damage (9). Several Systematic Reviews (RS) have demystified these knowledge models. Van Tulder *et al*. (10) included 35 observational studies seeking to identify the relationship between imaging findings and low back pain in their SR. The authors concluded that no solid evidence confirming a relationship between pain and imaging findings in subjects with low back pain is available. Brinjikji *et al*. (11) included 13 studies that evaluated the imaging findings and disc degeneration in asymptomatic subjects. These authors concluded that no relationship between the degree of disc degeneration and the intensity of pain in 3110 asymptomatic patients was present. Christensen *et al*. (12) did not find any causal relationship between postural alterations and painful symptoms when evaluated 54 studies. Therefore, current research has a neuroscience-oriented approach to reconceptualize pain and answer several questions to improve the understanding of this problem (13).

Currently, pain is defined as a complex interaction of homeostatic systems in response to an identified threat (14); in this way, pain should be considered a process integrating sensory, cognitive and/or emotional information coming from real or potential threats (15). This process of evaluation of the threat is carried out by a set of cortical and subcortical structures denominated pain neuromatrix (16). In functional terms, the neuromatrix of people with acute or chronic pain is composed of the bilateral secondary and primary contralateral somatosensory cortex, insular cortex, cerebellum, basal ganglia, thalamus and the anterior cingulate cortex (17). Therefore, beliefs and emotions are capable of activating the neuromatrix, provoking and even perpetuating pain without the need for nociception (18). This has forced researchers to explore the influence of psychosocial factors on the experience of musculoskeletal pain, to consider the integration of various factors and mechanisms to explain the development of the painful experience (19).

The objective of this review is to describe the psychosocial factors influencing the experience of musculoskeletal pain in order to relate them to contemporary neuroscience models.

MATERIAL AND METHODS

An electronic search was performed in the following databases: Medline, PEDro, Central, SPORTDiscus, the search terms were: Musculoskeletal Pain [Mesh], Chronic Pain [Mesh], Social Determinants of Health [Mesh], Psychology [Mesh], Pain. Articles published until January 31, 2018 in English and Spanish were selected. For the selection of articles, articles were first filtered by title and abstract, and then articles were filtered by full text. A total of 64 studies were analyzed to conduct this review.

PSYCHOSOCIAL FACTORS OF THE EXPERIENCE OF MUSCULOSKELETAL PAIN

Cognitive-affective factors

Research regarding cognitive-affective factors in people with musculoskeletal pain has grown exponentially in recent years (20). In general, people with emotional or behavioral problems, excessive alcohol consumption or sleep disorders have shown to be more likely to develop musculoskeletal pain in the medium or long term (21,22). Generally, people with cognitive-affective disorders describe pain in more than one part of their bodies, of greater intensity and functional restriction in their daily activities (23-25). From this point of view, negative emotions in people with pain, such as shame, guilt or fear of negative evaluation of their peers have been shown to be predictors of high pain indices (26).

Catastrophizing

Catastrophizing is the tendency to generate irrationally negative predictions related to a perceived threat (20). Several research studies have confirmed the positive correlation between catastrophizing, pain intensity and degree of perceived disability (25,27,28). Slepian *et al*. (29) showed that the presence of catastrophizing significantly reduces the effectiveness of physical therapy when this aspect is not considered during rehabilitation, because catastrophizing has a significant impact on cortical motor activity and sensory integration areas, which would limit the outcomes of approaches that include physical exercise (30). Furthermore, Vargas Prada *et al*. (31) conducted a study including 971 patients with chronic musculoskeletal pain, these authors showed that the onset and transition of disabling musculoskeletal pain was mediated by high levels of catastrophizing (31). Lee *et al*. (32) studying experimental

pain could identify the role of catastrophizing in the initial stages of an injury. For this, they applied an acid solution in the tibialis anterior in 189 asymptomatic subjects, this study evidenced that people with high negative emotionality showed higher local pain, mechanical hyperalgesia and the likelihood of experiencing referred pain compared to a group with less negative emotionality. Niederstrasser *et al*. (33) showed that high levels of catastrophizing and fear of pain predict an increase in the response to a non-harmful stimulus. This study was conducted in 82 asymptomatic university subjects using a protocol for the induction of unilateral muscle pain (33). Other studies have shown that catastrophizing accompanied by fear of pain or depressive symptoms increase the risk of pain in areas distant from the origin of the injury, persistency and impair function after a musculoskeletal injury (34-36).

Depression and anxiety

The relationship between pain and depression has been thoroughly studied. From this perspective, a certain linear relationship has been found between depressive symptoms, disability and pain, which is translated into a lower quality of life (37, 38). Depression has been identified as a predictor of chronic pain in the wrists, hands, shoulders and cervical spine (39-41). Kim *et al*. (42) showed in a study conducted in 218 subjects with neck pain, that 53.7% developed mild-severe insomnia and depression was the strongest predictor of this insomnia. Another study in older adults with dementia showed that depression was related to the intensity of chronic musculoskeletal pain (43). Anxiety in a very common condition in people with musculoskeletal disorders. Current studies have showed some correlation between pain intensity, degree of disability and anxiety (23, 43). An observational study showed that 50% of workers with musculoskeletal pain associated with some degree of disability have generalized anxiety, which decreases significantly when interventions are conducted to improve the degree of disability (44). Losa *et al*. (45) showed in a study conducted in 421 workers that young and single women tend to have higher levels of pain and anxiety than men.

Neuroticism and perception of stress

Studies related to neuroticism are scarce. Wong et al. (46) showed in 401 people with chronic musculoskeletal pain that patients with higher levels of neuroticism and negative affectivity have higher levels of catastrophizing regarding pain. Moreover, Molina *et al*. (47) showed that adolescents with musculoskeletal pain show higher perceived stress than healthy controls. Another study conducted in 422 adolescents identified that 22% of the population reported moderate to severe stress, 79% of them attributed it to the presence of pain; therefore, perceived stress was associated with more reports on pain, intensity and number of affected sites (48). However, the presence of adverse events in life is a predictor of chronic pain, regardless of the function of biological stress systems, socio-demographic factors, lifestyles, chronic diseases, depression and/or anxiety (49).

In a cross-sectional study conducted in 1646 people with or without musculoskeletal pain, Generaal *et al*. (50) showed that high levels of stress correlate positively with the presence and severity of chronic pain. Sommer *et al*. (51) confirmed the positive correlation between pain and work stress in men. Nevertheless, Bonzini *et al*. (52) after researching 305 nurses, the authors pointed out that stress does not seem to be a causal factor of musculoskeletal pain, but rather a consequence of the pain. From a neuroendocrine point of view, dysfunction of the hypothalamic-pituitary axis and immune system were not associated with the onset of musculoskeletal pain in a sample of 2039 subjects at a 6-year follow-up (49). Furthermore, Paanamem *et al*. (53) showed an association between hypoactivity of the hypothalamic-pituitary-adrenal axis in stressful situations and the presence-severity of pain problems 4 years later.

Hypervigilance and kinesiophobia

Research on hypervigilance and pain relationship is scarce. Wong *et al*. (54) researched 401 people with chronic musculoskeletal pain, and showed that the fear of pain is conditioned by hypervigilance, which increases levels of anxiety and catastrophizing. With regard to fear of movement and kinesiophobia, Sell *et al*. (55) mention that there is a positive association between kinesiophobia and disability. Gil-Martínez *et al*. (56) found a moderate correlation between craniofacial and cervical pain and the degree of disability.

From another perspective, it has been shown an inverse relationship between the degree of understanding of neurophysiology of pain and the levels of kinesiophobia in people with chronic musculoskeletal pain. Intervention through therapeutic education has shown a positive influence on kinesiophobia and fear-avoidance beliefs (57).

Social factors

Unlike cognitive-affective factors, the study of social factors of pain is more recent. There is a predominance of research linked to work and its environment.

Interpersonal relationships and social support

In relation to this issue, poor social support of supervisors at work has shown to be associated with higher rates of musculoskeletal pain (58-60), especially in women (61). However, social support at work and economic independence are protective factors in women with depression (62). Tang *et al*. (63) showed in 6676 older adults that physical limitation and the reduction of social participation have been correlated

with significant increases in pain and insomnia during 3 years of follow-up. Similarly, Wilkie *et al*. (64) showed that the pain-depression relationship is also negatively influenced by the reduction of social participation in older adults.

Family conflicts and gender inequality have been strongly associated with the presence of musculoskeletal pain in workers of different healthcare services (65, 66). According to Boonstra *et al*. (67), people with higher levels of pain, usually dissatisfied with their self-care ability and work situation, show a tendency to evaluate in a positive manner the relationship with partners, family life and contact with friends. Consequently, family conflicts caused by work seem not to influence the experience of pain. However, emotional exhaustion at work seems to be a more important mediator in pain levels (68).

Cultural factors

Research on cultural factors is scarce. Dionne *et al*. (69) conducted a cross-sectional study with 14,249 subjects; this study has shown that the prevalence of severe pain in shoulder-arm and knee-leg is significantly lower in the groups of higher socioeconomic status. Moreover, Mehlum *et al*. showed that the prevalence of pain is higher in women of working age with low socioeconomic status (70).

Work history

From this perspective, the perception of heavy work is a predictor of pain in back, upper extremity (71) and lower extremities (72). Heavy work at home, excessive control at work and imbalance between work-family lives associated with work with high physical demands have proven to be predictors of various musculoskeletal disorders (73, 74). Some characteristics of work such as precariousness (41), high pressure (61), inequality in the degree of effort-reward (75), perception of lack of staff (76), security problems (77), labor organization (78) and long work days, as well as poor social support have been correlated positively with different types of musculoskeletal pain disorders (79). Furthermore, heavier physical workloads, especially in groups of workers with low levels of schooling, show higher rates of musculoskeletal pain (80). Similarly, workers with shifts have higher somatization rates than those who have free weekends (59); it should be noted that, in this sense, there are certain groups of workers that are more vulnerable to somatization (81). In addition, personal factors, such as low job satisfaction, poor teamwork capacity (82) and beliefs that work can be a significant risk factor, have been positively correlated with the number of pain problems (77). In contrast, people presenting musculoskeletal pain and continue working show significantly lower levels of fear, avoidance, catastrophizing, perception of overload, greater acceptance and self-efficacy compared to sick workers who are out of work while they recover (83).

DISCUSSION

The present literature review aimed to describe the evidence of psychosocial factors influencing the experience of musculoskeletal pain. Some of the results indicate that depression is an important predictor of musculoskeletal pain (39-41). This is consistent with the results obtained by Sertel *et al*. (84), Hirchins *et al*. (85) and Christensen *et al*. (86). A recent systematic review (87) showed that depression is a predictor of the development of chronic non-cancer pain in people over 18 years of age. The studies included in the present review show that catastrophizing and depression were the most studied cognitive-affective factors and these factors had the highest correlation with musculoskeletal pain (25, 27, 28, 31, 37, 38). Similar findings have been described in other review studies such as Ramond *et al*. (88), Somers *et al*. (89), Lewis *et al*. (90) and Phyomaung *et al*. (91), studies that justify that cognitive aspects are strongly associated with musculoskeletal pain; however, it has not yet been possible to study whether it is a potential risk factor for musculoskeletal pain.

Regarding gender, the female population of working age has a higher tendency to develop musculoskeletal pain (45, 70). This is consistent with the results obtained by Paksaichol *et al*. (92), who showed that the female sex and the previous history of discomfort in the neck are predictive factors of the development of non-specific cervical pain. Racine *et al*. (93) tried to identify psychosocial factors that could contribute to differences in pain sensitivity between men and women. Their results show that depression does not explain differences, however, past individual history impacts on the painful response in women more than in men.

Based on the above, clinical assessments of general health should consider the screening of depressive symptoms and adverse life events to identify early those people at risk of developing chronic pain. Regarding prevention, it is necessary to promote the development of healthy social relationships in the population at risk, because relationships with partners, family life and contact with friends seem to be protective factors.

Regarding social factors related to work history, the results of the systematic review conducted by Ariens *et al*. (94) point out that the perception of heavy work, excessive control during the workday, the imbalance between work-family life associated with work of high physical demands are predictors of the development of musculoskeletal pain (73,74). Moreover, poor social support at work, low job satisfaction, poor ability to work within teams and the perception of work as a risk factor have been positively associated with musculoskeletal pain (61,77). Therefore, from the labor point of view, it is necessary to monitor the physical effort of the working days and the possible intervention to the population with physical labor activities. In addition, it is important to consider the evaluation of the perception of heavy work, the degree of control the person is undergoing and the level of work developed in the home, due to the predictive capacity of these variables on musculoskeletal pain. It is relevant to consider that social support at work could be considered as a protective factor for musculoskeletal pain, especially in women (62). Therefore, interventions

such as sponsorship or the creation of spaces for socialization at work could reduce the incidence of pain in this population. Other factors that could be considered protectors are high socioeconomic status (69) and economic independence (62).

Apparently, the perception of vulnerability or fragility related to health (95), the work (71, 72) or social (90) environment could determine a higher activity of the pain neuromatrix to the stimuli, which could increase the probabilities of developing musculoskeletal pain. This could be explained by a predominance of the perception of threat mediated by the cognitive and emotional dimensions of pain (15). The perception of the environment, the biological or psychological condition of a person has a preponderant role in the recovery of the person, therefore the healthcare team must be aware that the interventions should, in addition to seek biological changes, consider encouraging change in the perception of the reality of people. This highlights the importance of interventions on the biological dimension must be consistent with interventions on the psychosocial factors conducted by the entire healthcare team.

This review study has some limitations. First, the bias of individual studies was not evaluated by any scale, which makes it difficult to extract results for later applicability. In addition, there was no analysis of the results of the individual studies, so the scope of this review should be taken with caution.

Finally, it is important to consider that scientific and technological advances, changes in laws or public policies influence the psychosocial factors of the population in general. Therefore, when recognizing their significant in the musculoskeletal health, it is necessary to establish a periodic and systematic evaluation of cognitive-affective and social factors. Moreover, the development of qualitative research in the subject should be considered due to the role currently played by the massification of information on the cultural development of the population.

CONFLICTS OF INTEREST

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BIBLIOGRAPHY

1. Hoy D, Bain C, Williams G, March L, Brooks P, Blyth F, et al. A systematic review of the global prevalence of low back pain. Arthritis Rheum 2012;64(6):2028-37. DOI: 10.1002/art.34347.
2. Elliott AM, Smith BH, Penny KI, Smith WC, Chambers WA. The epidemiology of chronic pain in the community. Lancet 1999;354(9186):1248-52.
3. Jackson T, Thomas S, Stabile V, Han X, Shotwell M, McQueen K. Prevalence of chronic pain in low-income and middle-income countries: a systematic review and meta-analysis. Lancet 2015;385 (Supl. 2):S10. DOI: 10.1016/S0140-6736(15)60805-4.
4. Shiri R, Karppinen J, Leino-Arjas P, Solovieva S, Viikari-Juntura E. The Association between Smoking and Low Back Pain: A Meta-analysis. Am J Med 2010;123(1):87.e7-87.e35. DOI: 10.1016/j.amjmed.2009.05.028.
5. Scheele J, Luijsterburg PA, Ferreira ML, Maher CG, Pereira L, Peul WC, et al. Back Complaints in the Elders (BACE); design of cohort studies in primary care: an international consortium. BMC Musculoskelet Disord 2011;12(1):193. DOI: 10.1186/1471-2474-12-193.
6. Froud R, Patterson S, Eldridge S, Seale C, Pincus T, Rajendran D, et al. A systematic review and meta-synthesis of the impact of low back pain on people's lives. BMC Musculoskelet Disord 2014;15(1):50. DOI: 10.1186/1471-2474-15-50.
7. Lederman E. The fall of the postural-structural-biomechanical model in manual and physical therapies: exemplified by lower back pain. J Bodyw Mov Ther 2011;15(2):131-8. DOI: 10.1016/j.jbmt.2011.01.011.
8. Moseley GL. Teaching people about pain: why do we keep beating around the bush? Pain Manag 2012;2(1):1-3. DOI: 10.2217/pmt.11.73.
9. Wall PD, McMahon SB. Microneuronography and its relation to perceived sensation. A critical review. Pain 1985;21(3):209-29.
10. van Tulder MW, Assendelft WJ, Koes BW, Bouter LM. Spinal radiographic findings and nonspecific low back pain. A systematic review of observational studies. Spine (Phila Pa 1976) 1997;22(4):427-34.
11. Brinjikji W, Luetmer PH, Comstock B, Bresnahan BW, Chen LE, Deyo RA, et al. Systematic Literature Review of Imaging Features of Spinal Degeneration in Asymptomatic Populations. Am J Neuroradiol 2015;36(4):811-6. DOI: 10.3174/ajnr.A4173.
12. Christensen ST, Hartvigsen J. Spinal curves and health: a systematic critical review of the epidemiological literature dealing with associations between sagittal spinal curves and health. J Manipulative Physiol Ther 2008;31(9):690-714. DOI: 10.1016/j.jmpt.2008.10.004.
13. Thacker MA, Moseley GL. First-person neuroscience and the understanding of pain. Med J Aust 2012;196(6):410-1.
14. Janing W, Champman CR, Green PG. Pain and Body Protection Sensory Autonomic Neuroendocrine. In: International Association for study of pain in World congress on pain [Internet]. 2006. p. 331—48.
15. Jones LE, O'Shaughnessy DFP. The pain and movement reasoning model: introduction to a simple tool for integrated pain assessment. Man Ther 2014;19(3):270-6. DOI: 10.1016/j.math.2014.01.010.
16. Moseley GL. A pain neuromatrix approach to patients with chronic pain. Man Ther 2003;8(3):130-40.
17. Deus J. ¿Se puede ver el dolor? Reumatol Clínica 2009;5(5):228-32.
18. Brosschot JF. Cognitive-emotional sensitization and somatic health complaints. Scand J Psychol 2002;43(2):113-21.
19. Singla M, Jones M, Edwards I, Kumar S. Physiotherapists' assessment of patients' psychosocial status: Are we standing on thin ice? A qualitative descriptive study. Man Ther 2015;20(2):328-34. DOI: 10.1016/j.math.2014.10.004.
20. Quartana PJ, Campbell CM, Edwards RR. Pain catastrophizing: a critical review. Expert Rev Neurother 2009;9(5):745-58. DOI: 10.1586/ern.09.34.

21. Jussila L, Paananen M, Näyhä S, Taimela S, Tammelin T, Auvinen J, et al. Psychosocial and lifestyle correlates of musculoskeletal pain patterns in adolescence: A 2-year follow-up study. Eur J Pain 2014;18(1):139-46. DOI: 10.1002/j.1532-2149.2013.00353.x.
22. Condén E, Leppert J, Ekselius L, Åslund C. Type D personality is a risk factor for psychosomatic symptoms and musculoskeletal pain among adolescents: a cross-sectional study of a large population-based cohort of Swedish adolescents. BMC Pediatr 2013;13(1):11. DOI: 10.1186/1471-2431-13-11.
23. Ding H, Tang Y, Xue Y, Yang Z, Li Z, He D, et al. A report on the prevalence of depression and anxiety in patients with frozen shoulder and their relations to disease status. Psychol Health Med 2014;19(6):730-7. DOI: 10.1080/13548506.2013.873814.
24. Neupane S, Nygard CH, Oakman J. Work-related determinants of multi-site musculoskeletal pain among employees in the health care sector. Work 2016;54(3):689-97. DOI: 10.3233/WOR-162320.
25. Maakip I, Keegel T, Oakman J. Predictors of musculoskeletal discomfort: A cross-cultural comparison between Malaysian and Australian office workers. Appl Ergon 2017;60:52-7. DOI: 10.1016/j.apergo.2016.11.004.
26. Turner-Cobb JM, Michalaki M, Osborn M. Self-conscious emotions in patients suffering from chronic musculoskeletal pain: A brief report. Psychol Health 2015;30(4):495-501. DOI: 10.1080/08870446.2014.991735.
27. Chatkoff DK, Leonard MT, Maier KJ. Pain Catastrophizing Differs Between and Within West Haven-Yale Multidimensonal Pain Inventory (MPI) Pain Adjustment Classifications. Clin J Pain 2015;31(4):349-54. DOI: 10.1097/AJP.0000000000000117.
28. Benyon K, Muller S, Hill S, Mallen C. Coping strategies as predictors of pain and disability in older people in primary care: a longitudinal study. BMC Fam Pract 2013;14(1):67. DOI: 10.1186/1471-2296-14-67.
29. Slepian P, Bernier E, Scott W, Niederstrasser NG, Wideman T, Sullivan M. Changes in pain catastrophizing following physical therapy for musculoskeletal injury: The influence of depressive and post-traumatic stress symptoms. J Occup Rehabil 2014;24(1):22-31. DOI: 10.1007/s10926-013-9432-2.
30. Henderson LA, Akhter R, Youssef AM, Reeves JM, Peck CC, Murray GM, et al. The effects of catastrophizing on central motor activity. Eur J Pain (United Kingdom) 2016;20(4):639-51. DOI: 10.1002/ejp.781.
31. Vargas-Prada S, Martínez JM, Coggon D, Delclos G, Benavides FG, Serra C. Health beliefs, low mood, and somatizing tendency: Contribution to incidence and persistence of musculoskeletal pain with and without reported disability. Scand J Work Environ Heal 2013;39(6):589-98. DOI: 10.5271/sjweh.3377.
32. Lee JE, Watson D, Frey-Law LA. Psychological factors predict local and referred experimental muscle pain: A cluster analysis in healthy adults. Eur J Pain 2013;17(6):903-15. DOI: 10.1002/j.1532-2149.2012.00249.x.
33. Niederstrasser NG, Meulders A, Meulders M, Slepian PM, Vlaeyen JWS, Sullivan MJL. Pain Catastrophizing and Fear of Pain Predict the Experience of Pain in Body Parts Not Targeted by a Delayed-Onset Muscle Soreness Procedure. J Pain 2015;16(11):1065-76. DOI: 10.1016/j.jpain.2015.07.008.
34. Niederstrasser NG, Maxwell Slepian P, Mankovsky-Arnold T, Lariviére C, Vlaeyen JW, Sullivanz MJL. An experimental approach to examining psychological contributions to multisite musculoskeletal pain. J Pain 2014;15(11):1156-65. DOI: 10.1016/j.jpain.2014.08.007.
35. Archer KR, Abraham CM, Obremskey WT. Psychosocial Factors Predict Pain and Physical Health After Lower Extremity Trauma. Clin Orthop Relat Res 2015;473(11):3519-26. DOI: 10.1007/s11999-015-4504-6.
36. Pierik JGJ, Ijzerman MJ, Gaakeer MI, Vollenbroek-Hutten MMR, Van Vugt AB, Doggen CJM. Incidence and prognostic factors of chronic pain after isolated musculoskeletal extremity injury. Eur J Pain 2016;20(5):711-22. DOI: 10.1002/ejp.796.
37. Lewandowski Holley A, Wilson AC, Palermo TM. Predictors of the transition from acute to persistent musculoskeletal pain in children and adolescents. Pain 2016;158(5):794-801. DOI: 10.1097/j.pain.0000000000000817.
38. Airila A, Hakanen JJ, Luukkonen R, Lusa S, Punakallio A, Leino-Arjas P. Developmental trajectories of multisite musculoskeletal pain and depressive symptoms: The effects of job demands and resources and individual factors. Psychol Health 2014;29(12):1421-41. DOI: 10.1080/08870446.2014.945929.
39. Cotchett MP, Whittaker G, Erbas B. Psychological variables associated with foot function and foot pain in patients with plantar heel pain. Clin Rheumatol 2015;34(5):957-64. DOI: 10.1007/s10067-014-2565-7.
40. Hung C-I, Liu C-Y, Yang C-H, Wang S-J. Headache: an important factor associated with muscle soreness/pain at the two-year follow-up point among patients with major depressive disorder. J Headache Pain 2016;17(1):57. DOI: 10.1186/s10194-016-0648-3.
41. Tribble AG, Summers P, Chen H, Quandt SA, Arcury TA. Musculoskeletal Pain, Depression, and Stress among Latino Manual Laborers in North Carolina. Arch Environ Occup Health 2016;71(6):309-16.
42. Kim SH, Lee DH, Yoon KB, An JR, Yoon DM. Factors Associated with Increased Risk for Clinical Insomnia in Patients with Chronic Neck Pain. Pain Physician 2015;18(6):593-8.
43. Tsatali M, Papaliagkas V, Damigos D, Mavreas V, Gouva M, Tsolaki M. Depression and anxiety levels increase chronic musculoskeletal pain in patients with Alzheimer's disease. Curr Alzheimer Res 2014;11(6):574-9.
44. Coutu M-F, Durand M-J, Marchand A, Labrecque M-E, Berbiche D, Cadieux G. Factors associated with generalized anxiety in workers undergoing work rehabilitation for persistent musculoskeletal pain. Disabil Rehabil 2013;35(19):1599-607. DOI: 10.3109/09638288.2012.748833.
45. Losa Iglesias ME, Becerro de Bengoa Vallejo R. Musculoskeletal pain, job satisfaction, depression, and anxiety among spanish podiatric physicians. J Am Podiatr Med Assoc 2014;104(2):191-7. DOI: 10.7547/0003-0538-104.2.191.
46. Wong WS, Lam HMJ, Chen PP, Chow YF, Wong S, Lim HS, et al. The Fear-Avoidance Model of Chronic Pain: Assessing the Role of Neuroticism and Negative Affect in Pain Catastrophizing Using Structural Equation Modeling. Int J Behav Med 2015;22(1):118-31. Doi: 10.1007/s12529-014-9413-7.
47. Molina J, Flá Via Heloísa I, Santos D, Maria I, Terreri TRA, Fraga MM, et al. Sleep, stress, neurocognitive profile and health- related quality of life in adolescents with idiopathic musculoskeletal pain. Clinics 2012;67(10):1139-44.
48. Østerås B, Sigmundsson H, Haga M. Perceived stress and musculoskeletal pain are prevalent and significantly associated in adolescents: an epidemiological cross-sectional stu-

dy. BMC Public Health 2015;15(1):1081. DOI: 10.1186/s12889-015-2414-x.
49. Generaal E, Vogelzangs N, Macfarlane GJ, Geenen R, Smit JH, de Geus EJCN, et al. Biological stress systems, adverse life events and the onset of chronic multisite musculoskeletal pain: a 6-year cohort study. Ann Rheum Dis 2015;75(5):847-54. DOI: 10.1136/annrheumdis-2014-206741.
50. Generaal E, Milaneschi Y, Jansen R, Elzinga BM, Dekker J, Penninx BW. The brain-derived neurotrophic factor pathway, life stress, and chronic multi-site musculoskeletal pain. Mol Pain 2016; 12. pii: 1744806916646783. DOI: 10.1177/1744806916646783.
51. Sommer TG, Frost P, Svendsen SW. Combined musculoskeletal pain in the upper and lower body: associations with occupational mechanical and psychosocial exposures. Int Arch Occup Environ Health 2015;88(8):1099-110. DOI: 10.1007/s00420-015-1036-z.
52. Bonzini M, Bertu L, Veronesi G, Conti M, Coggon D, Ferrario MM. Is musculoskeletal pain a consequence or a cause of occupational stress? A longitudinal study. Int Arch Occup Environ Health 2015;88(5):607-12. DOI: 10.1007/s00420-014-0982-1.
53. Paananen M, O'Sullivan P, Straker L, Beales D, Coenen P, Karppinen J, et al. A low cortisol response to stress is associated with musculoskeletal pain combined with increased pain sensitivity in young adults: a longitudinal cohort study. Arthritis Res Ther 2015;17(1):355. DOI: 10.1186/s13075-015-0875-z.
54. Wong WS, Lam HMJ, Chow YF, Chen PP, Lim HS, Wong S, et al. The effects of anxiety sensitivity, pain hypervigilance, and pain catastrophizing on quality of life outcomes of patients with chronic pain: a preliminary, cross-sectional analysis. Qual Life Res 2014;23(8):2333-41. DOI: 10.1007/s11136-014-0683-y.
55. Sell L, Lund HL, Holtermann A, Søgaard K. The interactions between pain, pain-related fear of movement and productivity. Occup Med (Chic Ill) 2014;64(5):376-81. DOI: 10.1093/occmed/kqu056.
56. Gil-Martínez A, Grande-Alonso M, López-de-Uralde-Villanueva I, López-López A, Fernández-Carnero J, La Touche R. Chronic Temporomandibular Disorders: disability, pain intensity and fear of movement. J Headache Pain [Internet] 2016;17(1):103.
57. Fletcher C, Bradnam L, Barr C. The relationship between knowledge of pain neurophysiology and fear avoidance in people with chronic pain: A point in time, observational study. Physiother Theory Pract 2016;32(4):271-6. DOI: 10.3109/09593985.2015.1138010.
58. Lourenço S, Carnide F, Benavides FG, Lucas R. Psychosocial work environment and musculoskeletal symptoms among 21-year-old workers: a population-based investigation (2011-2013). Coyne J, editor. PLoS One 2015;10(6):e0130010. DOI: 10.1371/journal.pone.0130010.
59. Fischer N, Degen C, Li J, Loerbroks A, Müller A, Angerer P. Associations of psychosocial working conditions and working time characteristics with somatic complaints in German resident physicians. Int Arch Occup Environ Health 2016;89(4):583-92. DOI: 10.1007/s00420-015-1096-0.
60. Jacukowicz A. Psychosocial work aspects, stress and musculoskeletal pain among musicians. A systematic review in search of correlates and predictors of playing-related pain. Work 2016;54(3):657-68. DOI: 10.3233/WOR-162323.
61. Sembajwe G, Tveito TH, Hopcia K, Kenwood C, O'Day ET, Stoddard AM, et al. Psychosocial Stress and Multi-site Musculoskeletal Pain: A Cross-sectional Survey of Patient Care Workers. Workplace Health Saf 2013;61(3):117-25. DOI: 10.3928/21650799-20130226-01.
62. Baskan E, Yagci N, Telli Atalay O, Aslan Telci E. Quality of life, depression and musculoskeletal pain experience among employed women: A controlled study. J Back Musculoskelet Rehabil 2016;29(3):597-601. DOI: 10.3233/BMR-160682.
63. Tang NKY, McBeth J, Jordan KP, Blagojevic-Bucknall M, Croft P, Wilkie R. Impact of musculoskeletal pain on insomnia onset: a prospective cohort study. Rheumatology (Oxford) 2015;54(2):248-56. DOI: 10.1093/rheumatology/keu283.
64. Wilkie R, Blagojevic-Bucknall M, Belcher J, Chew-Graham C, Lacey RJ, McBeth J. Widespread pain and depression are key modifiable risk factors associated with reduced social participation in older adults. Medicine 2016;95(31):e4111. DOI: 10.1097/MD.0000000000004111.
65. Kim S-S, Okechukwu CA, Buxton OM, Dennerlein JT, Boden LI, Hashimoto DM, et al. Association between work-family conflict and musculoskeletal pain among hospital patient care workers. Am J Ind Med 2013;56(4):488-95. DOI: 10.1002/ajim.22120.
66. Bohlin A, Ahlgren C, Hammarstrom A, Gustafsson PE. Perceived gender inequality in the couple relationship and musculoskeletal pain in middle-aged women and men. Scand J Public Health 2013;41(8):825-31. DOI: 10.1177/1403494813498157.
67. Boonstra AM, Reneman MF, Stewart RE, Post MW, Schiphorst Preuper HR. Life satisfaction in patients with chronic musculoskeletal pain and its predictors. Qual Life Res 2013;22(1):93-101. DOI: 10.1007/s11136-012-0132-8.
68. Jensen MT, Rundmo T. Associations between work family conflict, emotional exhaustion, musculoskeletal pain, and gastrointestinal problems in a sample of business travelers. Scand J Psychol 2015;56(1):105-13. DOI: 10.1111/sjop.12177.
69. Dionne CE, Leclerc A, Carton M, Mediouni Z, Goldberg M, Zins M, et al. Social position modifies the association between severe shoulder/arm and knee/leg pain, and quality of life after retirement. Int Arch Occup Environ Health 2016;89(1):63-77. DOI: 10.1007/s00420-015-1052-z.
70. Mehlum IIS, Kristensen P, Veiersted KB, Wærsted M, Punnett L. Does the Threshold for Reporting Musculoskeletal Pain or the Probability of Attributing Work-Relatedness Vary by Socioeconomic Position or Sex? J Occup Environ Med 2013;55(8):901-9. DOI: 10.1097/JOM.0b013e31828dc8ec.
71. Jensen JC, Haahr JP, Frost P, Andersen JH. Do work-related factors affect care-seeking in general practice for back pain or upper extremity pain? Int Arch Occup Environ Health 2013;86(7):799-808. DOI: 10.1007/s00420-012-0815-z.
72. Herin F, Vézina M, Thaon I, Soulat J-M, Paris C. Predictive risk factors for chronic regional and multisite musculoskeletal pain: A 5-year prospective study in a working population. Pain 2014;155(5):937-43. DOI: 10.1016/j.pain.2014.01.033.
73. Sadeghian F, Kasaeian A, Noroozi P, Vatani J, Taiebi SH. Psychosocial and individual characteristics and musculoskeletal complaints among clinical laboratory workers. Int J Occup Saf Ergon 2014;20(2):355-61.

74. Maakip I, Keegel T, Oakman J. Workstyle and Musculoskeletal Discomfort (MSD): Exploring the Influence of Work Culture in Malaysia. J Occup Rehabil 2015;25(4):696-706. DOI: 10.1007/s10926-015-9577-2.
75. Koch P, Schablon A, Latza U, Nienhaus A. Musculoskeletal pain and effort-reward imbalance- a systematic review. BMC Public Health 2014;14(1):37. DOI: 10.1186/1471-2458-14-37.
76. Kim SS, Okechukwu CA, Dennerlein JT, Boden LI, Hopcia K, Hashimoto DM, et al. Association between perceived inadequate staffing and musculoskeletal pain among hospital patient care workers. Int Arch Occup Environ Health 2014;87(3):323-30. DOI: 10.1007/s00420-013-0864-y.
77. Oha K, Animägi L, Pääsuke M, Coggon D, Merisalu E. Individual and work-related risk factors for musculoskeletal pain: a cross-sectional study among Estonian computer users. BMC Musculoskelet Disord 2014;15(1):181. DOI: 10.1186/1471-2474-15-181.
78. Freimann T, Paasukesuke M, Merisalu E. Work-related psychosocial factors and mental health problems associated with musculoskeletal pain in nurses: a cross-sectional study. Pain Res Manag 2016:2016:9361016.
79. Jacukowicz A. Psychosocial work aspects, stress and musculoskeletal pain among musicians. A systematic review in search of correlates and predictors of playing-related pain.Work 2016;16;54(3):657-68. DOI: 10.3233/WOR-162323.
80. Lilje SC, Skillgate E, Anderberg P, Berglund J. Negative psychosocial and heavy physical workloads associated with musculoskeletal pain interfering with normal life in older adults: Cross-sectional analysis. Scand J Public Health 2015;43(5):453-9. DOI: 10.1177/1403494815580876.
81. Freimann T, Coggon D, Merisalu E, Animägi L, Pääsuke M. Risk factors for musculoskeletal pain amongst nurses in Estonia: a cross-sectional study. BMC Musculoskelet Disord 2013;14(1):334. DOI: 10.1186/1471-2474-14-334.
82. Neupane S, Miranda H, Virtanen P, Siukola A, Nygård CH. Do physical or psychosocial factors at work predict multi-site musculoskeletal pain? A 4-year follow-up study in an industrial population. Int Arch Occup Environ Health 2013;86(5):581-9. DOI: 10.1007/s00420-012-0792-2.
83. De Vries HJ, Reneman MF, Groothoff JW, Geertzen JHB, Brouwer S. Workers who stay at work despite chronic nonspecific musculoskeletal Pain: Do they differ from workers with sick leave? J Occup Rehabil 2012;22(4):489-502. DOI: 10.1007/s10926-012-9360-6.
84. Sertel Berk HÖ. The biopsychosocial factors that serve as predictors of the outcome of surgical modalities for chronic pain. Agri 2010;22(3):93-7.
85. Hinrichs-Rocker A, Schulz K, Järvinen I, Lefering R, Simanski C, Neugebauer EAM. Psychosocial predictors and correlates for chronic post-surgical pain (CPSP) - A systematic review. Eur J Pain 2009;13(7):719-30. DOI: 10.1016/j.ejpain.2008.07.015. .
86. Christensen JO, Johansen S, Knardahl S. Psychological predictors of change in the number of musculoskeletal pain sites among Norwegian employees: a prospective study. BMC Musculoskelet Disord 2017;18(1):140. DOI: 10.1186/s12891-017-1503-7.
87. Hruschak V, Cochran G. Psychosocial predictors in the transition from acute to chronic pain: a systematic review. Psychol Health Med 2018;1-17. DOI: 10.1080/13548506.2018.1446097.
88. Ramond A, Bouton C, Richard I, Roquelaure Y, Baufreton C, Legrand E, et al. Psychosocial risk factors for chronic low back pain in primary care-a systematic review. Fam Pract 2011;28(1):12-21. DOI: 10.1093/fampra/cmq072.
89. Somers TJ, Keefe FJ, Godiwala N, Hoyler GH. Psychosocial factors and the pain experience of osteoarthritis patients: new findings and new directions. Curr Opin Rheumatol 2009;21(5):501-6. DOI: 10.1097/BOR.0b013e32832ed704.
90. Lewis S, Holmes P, Woby S, Hindle J, Fowler N. The relationships between measures of stature recovery, muscle activity and psychological factors in patients with chronic low back pain. Man Ther 2012;17(1):27-33. DOI: 10.1016/j.math.2011.08.001.
91. Phyomaung PP, Dubowitz J, Cicuttini FM, Fernando S, Wluka AE, Raaijmaakers P, et al. Are depression, anxiety and poor mental health risk factors for knee pain? A systematic review. BMC Musculoskelet Disord 2014;15(1):10. DOI: 10.1186/1471-2474-15-10.
92. Paksaichol A, Janwantanakul P, Purepong N, Pensri P, Van Der Beek AJ. Office workers' risk factors for the development of non-specific neck pain: A systematic review of prospective cohort studies. Occup Environ Med. 2012 Sep;69(9):610-8. DOI: 10.1136/oemed-2011-100459.
93. Racine M, Tousignant-Laflamme Y, Kloda LA, Dion D, Dupuis G, Choinire M. A systematic literature review of 10 years of research on sex/gender and pain perception - Part 2: Do biopsychosocial factors alter pain sensitivity differently in women and men? Pain 2012;153(3):619-35. DOI: 10.1016/j.pain.2011.11.026.
94. Arins GAM, Van Mechelen W, Bongers PM, Bouter LM, Van Wal G Der. Psychosocial risk factors for neck pain: a systematic review. Am J Ind Med 2001;39(2):180-93.
95. Ramond-Roquin A, Bouton C, Bègue C, Petit A, Roquelaure Y, Huez J-F. Psychosocial Risk Factors, Interventions, and Comorbidity in Patients with Non-Specific Low Back Pain in Primary Care: Need for Comprehensive and Patient-Centered Care. Front Med 2015;2:73. DOI: 10.3389/fmed.2015.00073.