

The biopsychosocial effects of chronic pain on the patient: clinical implications

Andela Aračić
University of Zagreb
Faculty of Humanities and Social Sciences
Psychology Department
ORCID: 0000-0002-7824-5644

Abstract

Chronic pain is a widespread medical and social issue, yet it remains deeply misunderstood by many medical professionals. The biomedical model of pain fails to differentiate between acute and chronic conditions of pain, which often leads to unsuccessful treatment of patients. Unlike acute pain, chronic pain is associated with functional and structural changes in the brain. Structural and functional brain changes might make it more difficult for chronic pain patients to ignore uncomfortable sensations and make them prone to misattributing harmless sensations to tissue damage. Chronic pain conditions also carry certain psychological and social burdens which are often ignored in modern medicine despite research clearly showing there is a need to address them. Chronic pain patients often suffer from depression and anxiety, which makes them more prone to having irrational thoughts about the nature of their condition. Maladaptive thoughts impede the patient's ability to be consistent with their therapy and see improvement. These issues are often exacerbated by a lack of social support. Cognitive-behavioural therapy and its alternatives have proven useful in many cases of chronic pain, and something as simple as a short education program by primary physicians might improve the patient's symptoms. However, education of medical professionals on the intricacies of chronic pain is severely lacking. They are the first line of defence against the patient's warped perception after the initial injury, and it is necessary to change their approach to one which considers psychological and social aspects of the condition, and not merely biomedical. This review considers some of the major elements which add to the complexity of chronic pain conditions and aims to draw clinical implications based upon them.

Key words: biomedical model, biopsychosocial model, chronic pain, clinical implications

Introduction

Chronic pain has now been studied for decades, yet the cure for it seems as elusive as ever. It is estimated that at least 10% of the world's population suffers from chronic pain, while in certain countries this percentage climbs to 25% (Goldberg and McGee, 2011). That is millions of people who are suffering from chronic pain worldwide, with no clear knowledge of how to improve their condition. Chronic pain is most often defined as pain which lasts for more than three months and may be persistent or recurring (Scholz et al., 2019). Although it might seem logical to conclude that chronic pain is simply a prolonged version of acute pain, this does not seem to be the case. Unlike its acute form, chronic pain seems to lose its protective survival-enhancing purpose, hindering the patient's activity and becoming a disease of its own, separate from the injury which had caused the pain in the first place (Cohen et al., 2021). In other words, chronic pain often persists long after the initial injury has healed, and it might sometimes occur even when there has never been an apparent injury at all (such as in the example of fibromyalgia).

There is a growing body of evidence showing that the mechanisms involved in the experience of chronic pain (e.g., chronic lower back pain) are distinct from those in cases of acute pain (e.g., a sprained ankle) (Kuner and Flor, 2017). For example, it seems that there are patterns of brain activity observed in chronic pain patients which are not ordinarily observed in the presence of acute pain (Apkarian et al., 2005). Certain cortical and subcortical regions in the brain, commonly known as the "pain matrix", seem to be less active in chronic pain patients (Henry et al., 2011). Included in these areas are the anterior cingulate cortex and the insular cortex, which are responsible for high-level functions such as impulse control, attention allocation, and emotional regulation (Yang and Chang, 2019). The dysfunction of these, as well as other brain structures involved in nociception, indicates a suboptimal regulation of painful stimuli in chronic patients as opposed to the healthy subjects. Conversely, the activation in the areas of the prefrontal cortex (PFC) seems to heighten, indicating there might be a cognitive as well as an emotional and a memory component to the experience of chronic pain (Apkarian et al., 2005). It seems then that the response to painful stimuli in the mind of a patient who has been experiencing it for a long time shifts from a simple uncomfortable sensation to an emotional experience.

The aim of this review is to summarize the key structural and functional changes that happen in the brain as the pain becomes chronic, and to delve deeper into the psychosocial implications of chronic pain. The distinction between acute and chronic pain needs to be on the mind of every physician who is treating a long-suffering patient, since the usual medical treatments which seem to be highly effective in acute conditions fall short in the chronic ones (Cheatle, 2016). The awareness that chronic pain changes things on a neurological level, and seems to relate to malfunctioning emotion-

al regulation, as well as anxiety (Asmundson and Katz, 2009), is growing in the medical world, but it is often forgotten that these connections go both ways. In other words, it is important to remember that the relationship between maladaptive cognitive and emotional functioning is bidirectional, and the maladaptation could have existed long before the development of any chronic symptoms, predisposing the person for chronic pain. Bearing that in mind, it becomes clear why for some people the current medical model of focusing exclusively on pathophysiology of their condition is simply not enough. Shifting the focus to the whole person - including their biology, psychology, and sociology, as the biopsychosocial model suggests - might lead to better outcomes for the suffering patient (Cohen et al., 2021).

Functional and structural changes in the brain

To understand what cortical representation is, we can think of it as a network of neurons in the brain which represent something else, such as a word, or a part of the body (Wand et al., 2011). In that sense, when a person thinks about a particular word or experiences sensation in a particular part of the body, the brain shows activity in the areas which serve as the representation of those things. Researchers have long been aware that the brain allows functional reorganisation when an injury occurs. Due to its plasticity, the brain can allocate function previously held by an injured region to other healthy regions, such as in cases of brain injury (Wieloch and Nikolich, 2006). However, this ability of the brain is not necessarily beneficial. For example, the functional reorganisation is often seen in patients with phantom limb pain. In those patients, the brain's representations of the areas surrounding the amputated limb seem to seep into the representations of the non-existent limb, causing the patient to potentially interpret stimuli from surrounding parts of the body as painful and centred in the limb which is no longer there. These reorganisations are also seen in chronic back pain patients (May, 2008). The part of the brain which represents the back expands into the leg and foot areas, thereby confusing the interpretation of any stimuli coming from these regions (Wand et al., 2011). In a sense, the painful area seems to grow with the chronicification of pain, engulfing previously healthy regions, and it seems that this functional reorganization increases with time spent in chronic pain.

Besides the functional changes, it also appears that chronic pain can change the very structure of the brain regions (Kuner and Flor, 2017). The "pain matrix" is a term commonly used for regions in the brain which seem to be heavily involved in processing pain. These areas consist of the primary somatosensory cortex (S1), secondary somatosensory cortex (S2), anterior cingulate cortex (ACC), insular cortex (IC), prefrontal cortex (PFC), thalamus and the cerebellum (Bushnell et al., 2013). While these regions activate under both chronic and acute pain, as pain becomes chronic, the neurons un-

dergo synaptic changes which make them misfire at inappropriate times (Urien and Wang, 2019). For example, these regions might show activity which does not correlate with the peripheral stimuli being applied. In other words, the brain responds as though the body is in pain, when there might be no external nociceptive stimuli at all. Besides the unusual activity, there is also evidence of grey matter thinning in chronic pain patients in these regions of the brain (Rodriguez-Raecke et al., 2009). Interestingly, despite the wide range of chronic pain conditions and different parts of the body being affected, chronic pain patients all show similar abnormalities in the regions of the “pain matrix” (Henry et al., 2011).

Since the brain regions which seem to degenerate under chronic pain are also involved in nociception, i.e., the detection of painful stimuli, it can be assumed that chronic pain patients have more difficulties in ignoring uncomfortable sensations. Additionally, due to their proclivity to catastrophize (Naylor et al., 2017), as well as the changes in the activation of the prefrontal cortex which indicate an emotional and cognitive component of pain, they might be more likely to interpret the detected stimuli as harmful. This interpretation could further lead to the patient avoiding activities which might benefit their recovery long-term (such as walking vs. being inactive) out of fear of worsening their symptoms. Or if they have engaged in the activity, they might conclude that since the activity has led to pain, they must be doing something that is harmful to them. This positive association between fear avoidance beliefs (especially regarding work-related fears) and chronic pain disability has been observed for some time (Waddell et al., 1993). More recently, in a study by Fujii et al. (2019), nurses with chronic lower back pain who showed pain avoidance beliefs related to physical activity were 1.8 times more likely to have pain-related disability which interfered with their work. This association remained even after adjusting for pain severity or work hours. It seems that avoiding activities that patients regard as “potentially harmful” might lead to more long-term disability, not less (Zale and Ditre, 2015).

The question of whether these changes are permanent naturally presents itself. In a study conducted by Rodriguez-Raecke et al. (2009), 32 patients with chronic pain due to osteoarthritis were investigated for structural changes in the brain. As expected, they found a decrease in grey matter of these patients in the areas of ACC, insular cortex, the dorsolateral prefrontal cortex, amygdala, and the brainstem. Ten of these patients were followed up on after a surgery which made them completely pain-free, and grey matter in these patients significantly increased in comparison to their chronic pain imaging. This indicates that the structural changes in the brain are at least in part reversible with the cessation of pain, which is excellent news for any chronic condition that can be directly treated. If medical treatment is not possible or if it does not yield satisfactory

results in terms of pain reduction, there are other methods by which grey matter in the brain could be revitalized. For example, cognitive behavioural therapy (CBT) seems to be able to influence grey matter in the prefrontal cortex and somatosensory regions, and these changes also correlate with reduced pain catastrophizing (Seminowicz et al., 2013). Less catastrophizing might make it more likely for the patient to engage in beneficial activity (breaking the fear-avoidance cycle), and through positive reinforcement of non-catastrophic outcomes of these activities, it might increase the probability of engagement in further activities and the patient's ultimate recovery.

Psychological implications

Chronic pain is associated with significant psychological distress (Burke et al., 2015). Patients suffering from chronic pain conditions are more likely to also be suffering from depression (Fishbain et al., 1997). Some studies have also noted identical maladaptive neuroplasticity changes in both conditions, although the nature of the relationship between the two still is not fully understood (Sheng et al., 2017). It is possible that the demands of a chronic condition trigger the depressive episodes, but it might also be the case that depression makes people more susceptible to chronic pain in the first place. This bidirectional relationship is why it is so important to be aware of the psychological state the patient is in, even as early as the acute stage of pain. In the longitudinal study by Lerman et al. (2015), anxiety and depression in patients suffering from chronic pain predicted both pain and pain-induced disability in those patients. These results clearly demonstrate the importance of dealing with psychological issues in chronic patients. Furthermore, in a meta-analysis by Burke et al. (2015), researchers found that chronic pain strongly correlated with high levels of anxiety (even more strongly than with depression), that is, specifically with anxiety related to physical symptoms. The chronic pain groups often had higher incidence of pain-anxiety, fear of movement, catastrophizing, and somatization (extreme focus on physical symptoms). Interestingly, pain-related anxiety was not transferrable to regular pain outside of their condition (such as the fear of hitting their head), which led the authors to conclude that pain-related anxiety in these individuals was specifically tied to the chronicity of their pain.

When it comes to psychological factors, whether it is fear of pain which is part of general anxiety, or the learned helplessness we see in the depressive states, it seems that the central issue lies in the chronic patient's perception of their condition. Catastrophizing is a term which was already mentioned a few times, and it is a core example of maladaptive reaction to pain and disease. It can be defined as a negative cognitive response to perceived or anticipated painful stimuli, often leading to sub-optimal pain-related outcomes (Quartana et al., 2009). The catastrophizing scale typically con-

sists of a rumination component (“I keep thinking how badly it hurts”), a magnification component (“I wonder whether something serious may happen”), and a helplessness component (“I think it is never going to get any better”) (Sullivan et al., 1995). In one study, catastrophizing was strongly associated with both depression and anxiety, as well as decreased quality of life in children with chronic pain (Miller et al., 2018). Of course, correlation between these variables tells us nothing about their causality. The interconnectedness of anxiety, depression and catastrophizing makes it difficult to understand in what way they might influence one another and what the best way to address them is. In a meta-analysis by Marshall et al. (2017), the authors tried to elucidate the relationship between pain, fear, and disability in chronic pain by searching for mediating factors. The mediation model seeks to explain the way two variables influence one another indirectly, through the existence of a third, mediator variable. Their results show that fear and depression significantly mediate the relationship between pain and disability, and catastrophizing mediates the relationship between pain and fear, explaining 53% of the total effect that pain has on the experience of fear. Therefore, in this analysis, the sensation of pain might trigger a person’s catastrophizing thought patterns which, in turn, trigger a reaction of fear. This starts a vicious cycle in which the person tries to avoid pain out of fear (through fear avoidance behaviours) and depression (“Things cannot improve”), and in turn exacerbates their own disability. In that case, working on dismantling the patient’s catastrophic thinking and helping them learn more grounded and helpful interpretations of their condition (“It is just a sensation in my brain, it does not mean my body is being harmed” or “My body is able to heal”), might be the first line of defence against both depression and anxiety present with this population. Considering that most chronic conditions are not only painful, but debilitating, it is not surprising we would find such a host of psychological issues accompanying them. While dealing with the discomforts of recurring or even constant pain, patients must also go through the process of mourning for the loss of function which came naturally to them before the onset of the disease. It is obvious so far that the psychological comorbidities with chronic pain demand adequate psychological intervention, but it is important to remember that the patient’s experiences need to be validated. If the practitioner is not careful with how they approach the topic of psychotherapeutic intervention, the patient might feel as though it is implied that their pain is “only psychological” and therefore “not real” (Cheatle, 2016). It should be clear to anyone who reads this review that pain being influenced by psychological factors does not make it in any way “imaginary”. It is as “imaginary” as any other sensation; in that it is the product of our perception, processed and interpreted in the brain. There would be no sensation at all, had the brain not produced it. The better the patient understands this, the more likely they are to accept help.

Social support

In the meta-analysis by Che et al. (2018), the researchers concluded that perceived social support aids in ameliorating pain in chronic pain patients through the process of buffering negative effects of stress on the body. The feeling of social support might make patients perceive themselves as being able to cope with the condition better. There is also some evidence that social support (such as holding someone's hand while receiving painful stimuli) suppresses the physiological stress response when pain is present (lower blood-pressure and heart rate, even changes in cortical fMRI-observed activity) (Che et al., 2018). The feeling of safety, which is created by a good support system, might serve as a signal to the brain to change the perception of the painful stimuli from threatening to non-threatening, from something life-endangering to something the patient can handle well. Another recent analysis explored the association between social support, adherence to treatment, and disability in chronic back pain patients (Oraison and Kennedy, 2021). They found that patients who lived alone had a significantly higher degree of disability and did not participate in treatment as frequently as the patients who lived with others. The authors argue that a more multidisciplinary approach needs to be taken with chronic back pain patients. Such an approach would take into account both their physical and psychosocial attributes. Unfortunately, it seems that even when a biopsychosocial intervention is introduced, the social component of pain is inadequately explored in comparison to psychological or biological aspects (van Erp et al., 2019). That might be because the patient's social life is perceived to be the most outside of the therapist's or even the patient's control, and it therefore seems difficult to encourage a positive change. Still, that does not detract from its importance in regards to understanding and treating chronic pain conditions.

It is essential that physicians understand the importance of other people when it comes to their patient's improvement. If a patient is presumed to lack social support (which does not necessarily mean they live alone but may include unsupportive or abusive households) they need to be considered higher risk for disability and a lack of adherence to treatment. It might be good practice to spend more time engaging with such patients on a more individual level and to clarify the importance of following through on therapy. Ideally, medical environment would play the role of a support group for such individuals. Another important implication here is that chronic conditions are isolating in their very nature, since they often carry a certain level of disability which might discourage activity and social engagement. Therefore, even if the patient has good social support at the onset of their symptoms (such as a close friend group), there is a risk of losing that support with time. This might be important to keep in mind, since it may be enough to simply encourage the patients to continue engaging in social activities with their family and friends as much as they can. This would go hand in hand with work-

ing on dismantling their fear-avoidance beliefs if they exist, and making sure that they understand such activities will not harm them but aid their recovery.

Clinical implications

CBT has long been used as a psychotherapeutic approach to chronic pain, with new, more integrative iterations of it continually emerging (McCracken et al., 2022). Considering the host of cognitive issues associated with chronic pain conditions, it is not surprising that CBT interventions benefit patient recovery, with positive effects in relieving pain, and reducing disability and psychological distress (de C Williams et al., 2020). Interestingly, when working with chronic pain patients, it seems that CBT is more effective when it is group-based rather than individual (Niknejad et al., 2018), possibly accounting for their need for social support which is a crucial element in the biopsychosocial model of pain. Being able to engage with other patients of similar diagnosis might be an incredibly helpful experience, making the patients feel understood in their struggles. It would also be beneficial in the sense that when someone in the group recovers, it would send a clear signal to the others that healing is indeed possible. That said, the group approach might not work equally well for every patient, especially for those who might not feel as comfortable sharing personal information with other people in a clinical setting. Besides CBT, there are many other alternative therapies which show positive effects on chronic pain. There is some evidence that something as relatively simple as practicing mindfulness might reduce pain as well as symptoms of depression in chronic pain patients (Hilton et al., 2017). Mindfulness is a practice in which the practitioner strives to perceive their thoughts and sensations while at the same time separating themselves from them. The simplicity and the individual approach of this method might make it a viable solution for patients more inclined towards solitude, but more high-quality studies are needed to be able to fully understand the effect of this practice (Hilton et al., 2017).

Another CBT alternative is a relatively new therapy called the pain reprocessing therapy (PRT), which borrows some of the principles from CBT and narrows down on changing the perception regarding pain's harmfulness. In a randomized clinical trial carried out by Ashar et al. (2022), the authors posed the question of whether a psychological intervention which changes the patient's perception about the origin and meaning of their pain (pain reprocessing therapy) can lead to a significant pain relief in chronic back pain patients. Pain reprocessing therapy focuses on understanding chronic pain as a "misfiring" of signals in the central nervous system. One of the main aims of this therapy is to change the perception of pain in the mind of the patient, so that when pain occurs it is not automatically interpreted as peripheral tissue-damage. The results of the study showed that 66% of chronic back pain patients who participated in the pain

reprocessing therapy were pain-free or nearly pain-free by the end of the four-week treatment period, and the effect was largely maintained at one-year follow-up. Their results significantly differed from the results of the placebo group (which received a saline injection) where 20% of participants were pain-free and the control group (which received the usual medical care) where 10% of participants were pain free at the end of the treatment period. It is important to mention that PRT is still relatively new and so high-quality research on it is extremely scarce. That said, these results seem very promising.

Other ways to educate patients while trying to incorporate the biopsychosocial approach are multi-disciplinary (MD) interventions carried out by more than one specialist. These MD programs were recently explored in a meta-analysis by Joypaul et al. (2019). The analysis looked at 27 randomized controlled trial studies in which specialists (primarily physiotherapists, psychologists, and nurses) carried out weekly didactic education in the form of group seminars targeting any type of chronic pain, with most studies providing at least one supplementary tool like educational books, telephone calls with patients etc., to help participants revisit the content of the program. The sessions lasted for a minimum of two hours and spanned over a four-to-ten-week period. They covered aspects of physical activity and cognitive-behavioural strategies and were shown to have significant benefits for chronic pain patients of any aetiology which were either sustained or improved at follow-up. It is mentioned in the meta-analysis that the MD team in most of these studies could use additional members, such as social workers. As mentioned before, the social aspect is often forgotten when dealing with chronic pain patient. A social worker in this case might be useful in helping patients navigate their new social landscape (especially considering that many patients lose their jobs due to disability) and should therefore constitute a part of the team. Interestingly, pharmacists were involved in only two interventions the authors analysed. It is important not to forget the importance medication can have in allowing patients to live a more functional life. While we should be striving to widen the understanding of chronic pain, we should not neglect the value of classical medicine.

Despite the promising results on many of these interventions, they might not be available to everyone who would greatly benefit from them. Multi-disciplinary teams are not common in most state hospitals, and seeking out a private clinic or a specialized therapist, which can be expensive, is simply not an option for many people. The current state of the medical system therefore makes it even more important to ensure that primary physicians are aware of the intricacies of chronic pain, since they are likely to be the only professional the patient meets regarding their condition. The way they decide to speak to the patient about their condition and the prospect of improvement might make the difference between recovery and total regression.

In a meta-analysis performed by Tegner et al., (2018), the researchers found evidence that neurophysiological pain education for patients (NPE) improves symptoms of pain immediately after the intervention, as well as symptoms of pain and disability at 3-month follow-up. NPE is an intervention performed by a medical professional, in an individual or a group setting, where the goal is to provide information on neurophysiology of pain and, in doing so, reconceptualize the patient's beliefs about their pain and illness (such as removing catastrophizing thoughts, "This is a chronic condition, therefore it can never improve"). The most likely psychological disturbance in chronic patients is in physically focused areas (pain anxiety and movement anxiety) which involve catastrophizing (Burke et al., 2015), so it makes sense that focusing on that aspect would lead to less disability. In these studies, NPE was mostly combined with other medical treatment, and there was a tendency towards stronger effects when NPE was more intensive, pointing to the need for one-on-one interaction between the physician and the patient, and for multiple sessions. Multiple sessions might be particularly beneficial if an invasive surgical procedure is also involved in the treatment since surgery on its own poses a risk for the development of chronic pain (Fregoso et al., 2019). Similar studies have found biopsychosocial interventions by primary care physiotherapists more effective than standard advice given to patients, and at least as effective as physical activity interventions in reducing pain and functional disability in the short, medium and long-term (van Erp et al., 2019). These physician-patient conversations might be beneficial for a wide profile of patients because they touch upon all three cornerstones of the biopsychosocial model: the psychological (pain reprocessing, reducing catastrophic thinking), social (individualized contact with the physician and assurance; they are not going through this alone), as well as the physiological (being able to prescribe highly individualized therapy and medication with higher likelihood of success). Possible issues with the meta-analysis by Tegner et al., (2018), as also mentioned by the authors, is the small sample of studies that fit the criteria. Only seven studies were included, and among them only one had high-quality evidence. Even when the researchers lowered the criteria, no new studies could be acquired, pointing to the lack of quality research in this area. It was also noted that NPE was carried out on patients who were less disabled and experienced less pain than those that would be typically found in hospital settings. It would be interesting to test whether the effect would be greater or lower on the hospital patient population. Perhaps patients who end up in a hospital setting have a more impaired cognitive functioning and interpretation of pain, so the shift in the attitude around pain which is received through education might have a stronger impact than in those patients who are not as preoccupied with their pain in the first place.

It is important to mention that despite researching the biopsychosocial model of pain

for decades now, the progress of transforming our findings into real-life clinical results is slow. McCracken et al. (2023) argues this is because we need more personalized pain management. Results achieved on a group of people are not the same results we should expect to see in the individual. The biopsychosocial approach cannot be a generalization. Thinking of it as a template (or a single therapeutic approach) which should be successfully applied to every patient is illogical, since the biological, psychological, and social aspects of pain widely differ from person to person. Not every chronic pain patient is the same, just as not every person is the same. McCracken argues that the process needs to be more dynamic, with the therapist constantly adapting his approach based on continual assessments of the patient. Instead of trying to find the one right protocol which will perfectly fit everyone, the therapist must keep the patient at the forefront, utilizing whatever technique is most beneficial for that patient at that time, with the patient's personal goals as a measure of success.

Conclusion

Considering the comprehensive structural and functional changes, as well as the psychosocial effects of chronic pain on the patient, it is evident that aiding individuals in navigating through it is extremely challenging. It has become clear, however, that the current biomedical model which primarily focuses on treating bodily symptoms is not enough, seeing as how chronic conditions are intimately connected to misperception, pain anxiety, and other psychosocial issues, often disrupting the patient's core beliefs about themselves and the world. Ideally, we would want to screen these patients for maladaptive perception, depression and anxiety, and work with a multidisciplinary team to give all components of the chronic condition thoughtful and expert attention. The biopsychosocial model is currently the most holistic model for understanding chronic pain conditions, as it encompasses all the relevant domains of healthy functioning, treating physical symptoms as the outcome of a powerful interplay between biology, psychology and social factors (Cohen et al., 2021). Ideal treatment under such a model should include some sort of psychotherapy (ideally, one most suited for the individual patient), social support, physical therapy and exercise, pharmacological regimens, as well as advice on low-inflammatory nutrition (Cheatle, 2016). In combining these interventions, the chance of reducing pain, or at least altering maladaptive pain perception and normalizing the degenerated structures in the brain, might be significantly increased.

Understandably, while the biopsychosocial model seems to be the most effective way of treatment for chronic pain so far (Booth et al., 2017), what is ideal is not always practical or indeed possible to carry out. Issues in terms of healthcare funding and understaffing might make it impossible for a well-functioning multidisciplinary team

to exist in every hospital department that deals with chronic patients. To add to this issue, medical professionals are typically inadequately educated on chronic pain. Medical students mostly focus on the biomedical model of disease, ignoring psychological or social implications, and are not well educated on the difference between acute and chronic pain and how the former can regress into the latter (Loeser and Schatman, 2017). Chronic pain and acute pain are not one and the same, therefore chronic and acute patients should not be receiving the same treatment. That said, the knowledge on how and why the pain becomes chronic in some patients while it does not in others is useful even when dealing with initial acute injuries. It is at that stage that prevention is key, and understanding these mechanisms can allow us to predict a patient who might tilt towards the side of chronicity, and help us prevent it (Lavand'homme, 2011). Therefore, it is imperative to consider patient's psychology and social support, not only their primary medical complaint (Cheatle, 2016).

However, changes in the education and healthcare systems take time, money, and a genuine desire for improvement. It is not likely that these changes are going to occur on a large scale any time soon. That is why it is important to mention that there are ways in which medical professionals can improve their patient's outcome on their own, with something as simple as good communication and empathy. As discussed in the "Clinical implications" section, educating patients about their symptoms and the underlying mechanisms is a simple, time and cost-efficient method of potentially spontaneously resolving their maladaptive thinking and response to illness. Better communication between physicians and patients has been shown before to have a positive impact on patients' subjective and objective measures of health, outside of illness-specific interventions (Riedl and Schüßler, 2017). It is not a fix, but chronic pain is complex and this might be a small piece of the larger puzzle. Even without following any specific program, simply asking the patient to talk about their condition beyond their primary symptoms should help the well-educated physician to notice in what psychosocial state their patient is in. Questions such as, "Do you believe you can get better?" seem crucial to ask before starting any therapy program. If the answer to that question is, "No", as it often is in chronic pain patients with maladaptive thinking, how can we expect them to ever truly heal and regain control of their life? Changing people's core beliefs about their condition is the first step in the long road to recovery, and it is a necessary one.

References

- Apkarian, A. V., Bushnell, M. C., Treede, R. D., & Zubieta, J. K. (2005). Human brain mechanisms of pain perception and regulation in health and disease. *European Journal of Pain*, 9(4), 463-484. <https://doi.org/10.1016/j.ejpain.2004.11.001>
- Ashar, Y. K., Gordon, A., Schubiner, H., Uipi, C., Knight, K., Anderson, Z., Carlisle, J., Polisky, L., Geuter, S., Flood, T. F., Kragel, P. A., Dimidjian, S., Lumley, M. A., & Wager, T. D. (2022). Effect of pain reprocessing therapy vs placebo and usual care for patients with chronic back pain: a randomized clinical trial. *JAMA Psychiatry*, 79(1), 13-23. <https://doi.org/10.1001/jamapsychiatry.2021.2669>
- Asmundson, G. J., & Katz, J. (2009). Understanding the co-occurrence of anxiety disorders and chronic pain: state-of-the-art. *Depression and Anxiety*, 26(10), 888-901. <https://doi.org/10.1002/da.20600>
- Booth, J., Moseley, G. L., Schiltenswolf, M., Cashin, A., Davies, M., & Hübscher, M. (2017). Exercise for chronic musculoskeletal pain: a biopsychosocial approach. *Musculoskeletal Care*, 15(4), 413-421. <https://doi.org/10.1002/msc.1191>
- Burke, A. L., Mathias, J. L., & Denson, L. A. (2015). Psychological functioning of people living with chronic pain: A meta-analytic review. *British Journal of Clinical Psychology*, 54(3), 345-360. <https://doi.org/10.1111/bjc.12078>
- Bushnell, M. C., Čeko, M., & Low, L. A. (2013). Cognitive and emotional control of pain and its disruption in chronic pain. *Nature Reviews Neuroscience*, 14(7), 502-511. <https://doi.org/10.1038/nrn3516>
- Cheatle, M. D. (2016). Biopsychosocial approach to assessing and managing patients with chronic pain. *Medical Clinics*, 100(1), 43-53. <https://doi.org/10.1016/j.mcna.2015.08.007>
- Che, X., Cash, R., Ng, S. K., Fitzgerald, P., & Fitzgibbon, B. M. (2018). A systematic review of the processes underlying the main and the buffering effect of social support on the experience of pain. *The Clinical Journal of Pain*, 34(11), 1061-1076. <https://doi.org/10.1097/AJP.0000000000000624>
- Cohen, S. P., Vase, L., & Hooten, W. M. (2021). Chronic pain: an update on burden, best practices, and new advances. *The Lancet*, 397(10289), 2082-2097. [https://doi.org/10.1016/S0140-6736\(21\)00393-7](https://doi.org/10.1016/S0140-6736(21)00393-7)
- de C Williams, A. C., Fisher, E., Hearn, L., & Eccleston, C. (2020). Psychological therapies for the management of chronic pain (excluding headache) in adults. *Cochrane Database of Systematic Reviews*, (8). <https://doi.org/10.1002/14651858.CD007407.pub4>
- Fishbain, D. A., Cutler, R., Rosomoff, H. L., & Rosomoff, R. S. (1997). Chronic pain-associated depression: antecedent or consequence of chronic pain? A review. *The Clinical Journal of Pain*, 13(2), 116-137. <https://doi.org/10.1097/00002508-199706000-00006>
- Fregoso, G., Wang, A., Tseng, K., & Wang, J. (2019). Transition from acute to chronic pain: evaluating risk for chronic postsurgical pain. *Pain Physician*, 22(5), 479-488. <https://doi.org/10.36076/ppj/2019.22.479>
- Fujii, T., Oka, H., Takano, K., Asada, F., Nomura, T., Kawamata, K., Okazaki, H., Tanaka, S., & Matsudaira, K. (2019). Association between high fear-avoidance beliefs about physical activity and chronic disabling low back pain in nurses in Japan. *BMC Musculoskeletal Disorders*, 20(1), 1-10. <https://doi.org/10.1186/s12891-019-2965-6>
- Goldberg, D. S., & McGee, S. J. (2011). Pain as a global public health priority. *BMC Public Health*, 11(1), 1-5. <https://doi.org/10.1186/1471-2458-11-770>
- Henry, D. E., Chiodo, A. E., & Yang, W. (2011). Central nervous system reorganization in a variety of chronic pain states: a review. *PM&R*, 3(12), 1116-1125. <https://doi.org/10.1016/j.pmrj.2011.05.018>
- Hilton, L., Hempel, S., Ewing, B. A., Apaydin, E., Xenakis, L., Newberry, Colaiaco, B., Ruelaz Maher, A., Shanman, R. M., Sorbero, M. E., & Maglione, M. A. (2017). Mindfulness meditation for chronic pain: systematic review and meta-analysis. *Annals of Behavioral Medicine*, 51(2), 199-213. <https://doi.org/10.1007/s12160-016-9844-2>
- Joypaul, S., Kelly, F., McMillan, S. S., & King, M. A. (2019). Multi-disciplinary interventions for chronic pain involving education: A systematic review. *PLOS ONE*, 14(10), e0223306. <https://doi.org/10.1371/journal.pone.0223306>
- Kuner, R., & Flor, H. (2017). Structural plasticity and reorganisation in chronic pain. *Nature Reviews Neuroscience*, 18(1), 20-30. <https://doi.org/10.1038/nrn.2016.162>
- Lavand'homme, P. (2011). The progression from acute to chronic pain. *Current Opinion in Anesthesiology*, 24(5), 545-550. <https://doi.org/10.1097/coa.0b013e32834a4f74>
- Lerman, S. F., Rudich, Z., Brill, S., Shalev, H., & Shahar, G. (2015). Longitudinal associations between depression, anxiety, pain, and pain-related disability in chronic pain patients. *Psychosomatic Medicine*, 77(3), 333-341. <https://doi.org/10.1097/psy.0000000000000158>
- Loeser, J. D., & Schatman, M. E. (2017). Chronic pain management in medical education: a disastrous omission. *Postgraduate Medicine*, 129(3), 332-335. <https://doi.org/10.1080/00325481.2017.1297668>
- Marshall, P. W., Schabrun, S., & Knox, M. F. (2017). Physical activity and the mediating effect of fear, depression, anxiety, and catastrophizing on pain related disability in people with chronic low back pain. *PLOS ONE*, 12(7), e0180788. <https://doi.org/10.1371/journal.pone.0180788>
- May, A. (2008). Chronic pain may change the structure of the brain. *PAIN®*, 137(1), 7-15. <https://doi.org/10.1016/j.pain.2008.02.034>
- McCracken, L. M., Yu, L., & Vowles, K. E. (2022). New generation psychological treatments in chronic pain. *BMJ*, 376. <https://doi.org/10.1136/bmj-2021-057212>
- McCracken, L. M. (2023). Personalized pain management: Is it time for process-based therapy for particular people with chronic pain? *European Journal of Pain*. <https://doi.org/10.1002/ejp.2091>
- Miller, M. M., Meints, S. M., & Hirsh, A. T. (2018). Catastrophizing, pain, and functional outcomes for children with chronic pain: a meta-analytic review. *Pain*, 159(12), 2442. <https://doi.org/10.1097/j.pain.0000000000001342>
- Naylor, B., Boag, S., & Gustin, S. M. (2017). New evidence for a pain personality? A critical review of the last 120 years of pain and personality. *Scandinavian Journal of Pain*, 17(1), 58-67. <https://doi.org/10.1016/j.sjpain.2017.07.011>
- Niknejad, B., Bolier, R., Henderson, C. R., Delgado, D., Kozlov, E., Löckenhoff, C. E., & Reid, M. C. (2018). Association between psychological interventions and chronic pain outcomes in older adults: a systematic review and meta-analysis. *JAMA Internal Medicine*, 178(6), 830-839. <https://doi.org/10.1001/jamainternmed.2018.0756>
- Oraison, H. M., & Kennedy, G. A. (2021). The effect of social support in chronic back pain: number of treatment sessions and reported level of disability. *Disability and Rehabilitation*, 43(11), 1526-1531. <https://doi.org/10.1080/09638288.2019.1668969>
- Quartana, P. J., Campbell, C. M., & Edwards, R. R. (2009). Pain catastrophizing: a critical review. *Expert Review of Neurotherapeutics*, 9(5), 745-758. <https://doi.org/10.1586/ern.09.34>
- Riedl, D., & Schüßler, G. (2017). The influence of doctor-patient communication on health outcomes: a systematic review. *Zeitschrift für Psychosomatische Medizin und Psychotherapie*, 63(2), 131-150. <https://doi.org/10.13109/zptm.2017.63.2.131>
- Rodriguez-Raecke, R., Niemeier, A., Ihle, K., Ruether, W., & May, A. (2009). Brain gray matter decrease in chronic pain is the consequence and not the cause of pain. *Journal of Neuroscience*, 29(44), 13746-13750. <https://doi.org/10.1523/jneurosci.3687-09.2009>
- Scholz, J., Finnerup, N. B., Attal, N., Aziz, Q., Baron, R., Bennett, M. I., Benoliel, R., Cohen, M., Cruccu, G., Davis, K. D., Evers, S., First, M., Giampardino, M. A., Hansson, P., Kaasa, S., Korwisi, B., Kosek, E., Lavand'homme, P., Nicholas, M., ... & Treede, R. D. (2019). The IASP classification of chronic pain for ICD-11: chronic neuropathic pain. *Pain*, 160(1), 53. <https://doi.org/10.1097/j.pain.0000000000001365>
- Seminowicz, D. A., Shpaner, M., Keaser, M. L., Krauthamer, G. M., Mantegna, J., Dumas, J. A., Newhouse, P. A., Filippi, C. G., Keefe, F. J., & Naylor, M. R. (2013). Cognitive-behavioral therapy increases prefrontal cortex gray matter in patients with chronic pain. *The Journal of Pain*, 14(12), 1573-1584. <https://doi.org/10.1016/j.jpain.2013.07.020>
- Sheng, J., Liu, S., Wang, Y., Cui, R., & Zhang, X. (2017). The link between depression and chronic pain: neural mechanisms in the brain. *Neural plasticity*. <https://doi.org/10.1155/2017/9724371>
- Sullivan, M. J., Bishop, S. R., & Pivik, J. (1995). The pain catastrophizing scale: development and validation. *Psychological Assessment*, 7(4), 524. <https://doi.org/10.1037/1040-3590.7.4.524>
- Tegner, H., Frederiksen, P., Esbensen, B. A., & Juhl, C. (2018). Neurophysiological pain education for patients with chronic low back pain. *The Clinical Journal of Pain*, 34(8), 778-786. <https://doi.org/10.1097/ajp.0000000000000594>
- Urien, L., & Wang, J. (2019). Top-down cortical control of acute and chronic pain. *Psychosomatic Medicine*, 81(9), 851. <https://doi.org/10.1097/psy.0000000000000744>
- van Erp, R. M., Huijnen, I. P., Jakobs, M. L., Kleijnen, J., & Smeets, R. J. (2019). Effectiveness of primary care interventions using a biopsychosocial approach in chronic low back pain: a systematic review. *Pain Practice*, 19(2), 224-241. <https://doi.org/10.1111/papr.12735>
- Waddell, G., Newton, M., Henderson, I., Somerville, D., & Main, C. J. (1993). A Fear-Avoidance Beliefs Questionnaire (FABQ) and the role of fear-avoidance beliefs in chronic low back pain and disability. *Pain*, 52(2), 157-168. [https://doi.org/10.1016/0304-3959\(93\)90127-b](https://doi.org/10.1016/0304-3959(93)90127-b)
- Wand, B. M., Parkitny, L., O'Connell, N. E., Luomajoki, H., McAuley, J. H., Thacker, M., & Moseley, G. L. (2011). Cortical changes in chronic low back pain: current state of the art and implications for clinical practice. *Manual Therapy*, 16(1), 15-20. <https://doi.org/10.1016/j.math.2010.06.008>
- Wieloch, T., & Nikolich, K. (2006). Mechanisms of neural plasticity following brain injury. *Current Opinion in Neurobiology*, 16(3), 258-264. <https://doi.org/10.1016/j.con.2006.06.008>

org/10.1016/j.conb.2006.05.011

Yang, S., & Chang, M. C. (2019). Chronic pain: structural and functional changes in brain structures and associated negative affective states. *International Journal of Molecular Sciences*, 20(13), 3130. <https://doi.org/10.3390/ijms20133130>

org/10.3390/ijms20133130

Zale, E. L., & Ditre, J. W. (2015). Pain-related fear, disability, and the fear-avoidance model of chronic pain. *Current Opinion in Psychology*, 5, 24-30. <https://doi.org/10.1016/j.copsy.2015.03.014>