University of Aveiro School of Health Science
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Relatório de estágio apresentado à Universidade de Aveiro para cumprimento dos requisitos necessários à obtenção do grau de Mestre em Fisioterapia Musculoesquelética, realizada sob a orientação científica da Doutora Ana Rita Pinheiro, Professora Adjunta da Escola de Saúde da Universidade de Aveiro e coorientação do Mestre Gonçalo José Silva Félix, Assistente Convidado da Escola de Saúde da Universidade de Aveiro.

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Acknowledgment

I would like to thank my late mother for being my role model and my rock, my sister for keeping my child inside after all these years, and my husband for never complaining, and always being by my side, no matter what.

This work would never be possible, was not for my professors, Ana Rita and Gonçalo, that believed in me and kept me on track, leading and teaching me during all this time. Thank you so much, I really appreciate you.

Thanks to all and each teacher, mentor, professor, and instructor that ever crossed my way, for passing along your wisdom, because knowledge is the most amazing gift someone can offer and that can only grow and develop when shared.

Resumo

Enquadramento: Dor é uma experiência sensorial e emocional desagradável, que pode ser classificada como aguda ou crónica, e como nociceptiva (quando tecido não-neural sofre dano ou ameaça de dano), neuropática (quando o sistema nervoso somatosensorial sofre dano, ou tem uma doença), e nociplástica (surge de alteração da Nocicepção). O objetivo da educação em neurociéncia da dor é melhorar o conhecimento do utente na neurofisiologia e processos da dor, a focar nos aspetos biopsicossociais e as influências destes no controlo da dor. A pandemia da Covid-19 mostrou-nos a importância da telessaúde para o tratamento do utente com dor crónica, no qual se pode evitar o contacto não necessário durante momentos mais restritivos.

Objetivos: O objetivo do estudo foi descrever os efeitos de um programa de educação em neurociência da dor disponibilizado por telessaúde síncrona (telePNE) durante a pandemia da Covid-19.

Design: Casos em série

Local: Clínica de fisioterapia não-hospitalar em Aveiro, Portugal.

Sujeitos: 6 utentes com dor crónica, sendo 4 mulheres e 2 homens.

Intervenção: Educação em neurociéncia da dor, administrada em 4 sessões, por telessaúde síncrona por meio da aplicação Zoom.

Resultados: Apos telePNE, 5 utentes reportaram um valor de PGIC de 5 ou mais pontos, o que é considerada uma melhora clínica. Foi observado um valor acima da diferença mínima detetável (MDC) em 4 utentes no NPQ e em 1 utente para o PCS, 1 utente teve diminuído o valor do TSK de moderado to

leve. Uma diferença clínica importante (MCID) foi detetada no PDI para 3 utentes. 5 utentes expressaram disponibilidade para pagar pelo tratamento por telePNE.

Conclusão: Este estudo de casos em serie sugere que a implementação do telePNE em utentes com dor cronica musculosquelética, junto com terapia manual pode promover uma perceção de melhora clínica por parte do utente. De qualquer modo, mais estudos são necessários para esclarecer este efeito.

Palavras-chave: Educação, neurociéncia, dor, telessaúde.

Abstract

Background: Pain is an unpleasant sensory and emotional experience that can be classified as acute and chronic, and as nociceptive (non-neural tissue is damaged or threatened to be damage), neuropathic (caused when the somatosensory nervous system is injured or have a disease), and nociplastic (arising from altered nociception).

Pain neuroscience education (PNE) aims on improving patient's knowledge of neurophysiology and processes of pain, focusing on its biopsychosocial aspects and their influence on pain management. The Covid-19 pandemics highlighted the importance of telehealth on treating patient with chronic pain, while avoiding unnecessary contact during restrictive periods.

Purpose: This study aims to describe the effects of a PNE program delivered by telehealth (telePNE) during the Covid-19 pandemics.

Design: Case series

Setting: Physiotherapy outpatient clinical setting in Aveiro, Portugal.

Subjects: 6 chronic pain patients. 4 women and 2 men.

Intervention: Pain neuroscience education, delivered in 4 individual sessions of synchronous telehealth via Zoom application.

Results: After telePNE, 5 patients reported a PGIC value of 5 or above, which is considered as clinical improvement. A score above the Minimal Detectable Change (MDC) was observed in 4 patients for NPQ, in 1 patient for PCS, and 1 patient had a decrease on TSK from moderate to mild. A Minimal Clinically Important Difference (MCID) was found for PDI in 3 patients. Five patients expressed willingness to pay for this telePNE.

Conclusion: This case series suggests that the implementation of telePNE in musculoskeletal chronic pain patients, in addition to manual therapy, may promote patient's perception of clinical improvement. However, further studies are needed to clarify its isolated specific clinical effects

Keywords: Education, neuroscience, pain, telehealth.

Abbreviations

IASP: The International Association for the Study of Pain

IMMPACT: Initiative on Methods, Measurement, and Pain Assessment in Clinical Trials

MCID: Minimal Clinically Important Difference

MDC: Minimal Detectable Change

NPQ: Neurophysiology of Pain Questionnaire

PCS: Pain Catastrophizing Scale

PDI: Pain Disability Index

PGIC: Patients' Global Impression Scale

PNE: Pain neuroscience education

PROM: Patient-reported outcome measures

TSK: Tampa Scale of Kinesiophobia

TSK-13: Tampa Scale of Kinesiophobia – revised version containing 13 items

Contents

1. Introduction

The current definition of pain, defined by the International Association for the Study of Pain (IASP), is an unpleasant sensory and emotional experience associated with actual or potential tissue damage or described in terms of such damage.[1,2] It is always a subjective experience and can be reported even in the absence of tissue damage or any likely pathophysiological reasons.[1,2] There is usually no way to distinguish ones experience from that due to tissue damage if we take the subjective report.[2] If people regard their experience as pain, it should be accepted as pain".[2]

There are several classification methods for pain, and two of the most used of them are by temporal pattern (acute and chronic pain) or by pathophysiological mechanism (neuropathic, nociceptive and nociplastic).[1,2]

The World International Health Organization (WHO), in its eleventh revision of the International Statistical Classification of Disease and Related Health Problems (ICD-11), defined that acute pain refers to pain that has less than three months´ duration, whereas chronic pain is recurrent or persistent pain lasting longer than three months.[3–5] Besides being acute or chronic, the same pain can also be determined according to its pathophysiological mechanism.[6] Nociceptive pain occurs when a non-neural tissue is damaged or threatened to be damaged, what activates nociceptors.[4,7] Meanwhile, neuropathic pain is caused when the somatosensory nervous system is injured or have a disease.[4,7] Nociplastic pain, on the other hand, is pain arising from altered nociception, that does not depend on any sort of actual or threatened tissue damage, and its mechanisms are not yet completely understood.[7,8] It is believed that altered pain and sensory processing, such as allodynia, that is pain arising from non-painful stimuli, or hyperalgesia, that is increased sensitivity to painful stimuli, are both associated to nociplastic pain.[4,7,8] The literature uses a "mixed pain" terminology for a combination of nociplastic, nociceptive and neuropathic pain.[1,4,6,7]

Pain is one of the most frequent causes for patients to seek medical care".[2] Chronic, persistent pain, affects 37% of adults in Portugal, and approximately 20% of the adult population worldwide, costing more than $500 billion dollars annually just in the United

States.[1,2,9–13] Chronic non-specific pain is a common health issue, and a disabling condition, in which non-specific low back and neck pain stand out. Combined, these two types of spinal pain are the most prevalent kinds of chronic pain, affecting approximately one billion adults worldwide, with more than 13% of the world population experiencing persistent back or neck pain in 2013.[12,14,15] Moreover, there is a high human cost, from the decrease in quality of life, the psychological and social consequences, and the functional disability itself.[2,9–11,14]

The most up-to-date guidelines for non-specific pain frequently recommend modalities such as exercise, manual therapy and patient education for non-pharmacological intervention.[11,15–20] Although, patient education may cover a broad spectrum of knowledge, the traditional biomedical model of pain education, correlating pain to tissue or disease, focusing on anatomy, biomechanics and pathoanatomy, usually does not acknowledge relevant issues associated with persistent pain such as central and peripheral sensitization, facilitation and inhibition, neuroplasticity, immune and endocrine changes, or psychosocial aspects of pain, and may even increase patients' anxiety and fear of reinjury.[12,19,21] On the other hand, pain neuroscience education (PNE) is a promising therapeutic intervention that aims on improving patient's knowledge of neurophysiology and processes of pain, focusing on its biopsychosocial aspects and their influence on pain management.[10–12,18,19,21,22]

PNE is frequently used in association to other forms of therapy, commonly exercise, and/or manual therapy, and is usually indicated for chronic pain.[10,12,14,16,18,20,21,23,24] The educational content underlies the whole pain experience, and overall seeks to assist patients with their pain management, correlating biological occurrences such as pain plasticity, nociception, temporal and spatial summation, hyperalgesia, allodynia, release of substances such as cortisol and adrenaline, to psychosocial events as chronic stress, sleep disorders, depression, anxiety, cognitive impairment, and their relation to persistent pain.[9,10,18–20,22,25–32] It has been demonstrated that chronic pain has a great relationship to kinesiophobia - fear of movement, movement avoidance, anxiety, and pain catastrophizing behavior.[30,33–35] Even more, there is evidence that the perception and modulation of pain by the central nervous system involving memory,

and other executive functions, may lead to deficits on processing speed, problem-solving, memory. As for attention, it is still unclear whether pain influences attention or attention influences persistency of pain.[26,27,34,36–41]

A fundamental principle of PNE is to deconstruct patient's misconceptions and maladaptive thoughts and beliefs, that may increase the likelihood of pain chronification.[22,30,33]. By raising awareness to the vicious cycle of pain catastrophizing - where pain leads to catastrophic thoughts, leading to fear and avoidance of movement, that leads to more pain and so forth, or by giving strategies such as self-efficacy, self-management, and self-responsibility – either creating a sleep routine, or avoiding stressors, or practicing activity pacing, PNE, has shown promising results on reduction of pain, disability, catastrophizing, fear avoidance, prejudicial believes, stress, and also facilitating movement, all bringing a decrease in seeking health care, when combined with other therapies.[11,20,21,23,24,28,30,36,42–47]

PNE can be applied in individual or group sessions, and delivered in-person or virtually by telehealth.[10,18,20,21,48,49] Telehealth is a remote method of healthcare delivery that uses technology and enables long-distance care, potentially decreasing geographic, financial or temporal limitations.[48,49]

The COVID-19 pandemic restrictions around the world created a challenge for allied healthcare professionals, mostly for in-person assessment and treatment.[48,49] Telehealth has been recommended during the Covid-19 pandemic for pain management, for interviewing, observing, and counseling patients with chronic pain, although physical examination remains a challenge.[48,49] Evidence on the effects of telehealth provided by physical therapist exists, but is still limited.[48,49] Telehealth intervention, either live or recorded, can be more convenient, more accessible, cost-effective, and more enjoyable.[48,49] Overall, telehealth PNE interventions, live or recorded, may be a good fit for hesitant patients or those unable to be physically present, giving them an option for chronic pain management, even though for some individuals the technology involved may present a challenge due to technological illiteracy or lack of sufficient equipment.[48,49] No evidence was found on PNE administered by telehealth in Portugal.

2. Internship Framework

This internship is a requirement for obtaining a master's degree in physiotherapy, in the field of musculoskeletal specialization, at the University of Aveiro. In compliance with the field of specialization, the chosen clinical site is a musculoskeletal dedicated physiotherapy clinic. The internship took place at Saúde Positiva, located at Rua do Capitão Lebre 55, 3810-384 Aveiro, between October 7th, 2020, and January 4th, 2021, for a total of 420 hours, averaging 35 hours per week. Due to the current Covid-19 pandemic situation, the chosen format of practice was a mix of online and in-person assignments.

Saúde Positiva main focus is pain management, and there are two physical therapists, one practicing Bowen therapy, and the other exercise therapy. Patients' plan-of-treatment can incorporate both therapies. There is also a psychologist practicing at the same site. There are 10 appointments daily on average.

Before the internship the place did not offer PNE, and the head of the clinic wanted to develop such a program what led to its implementation during this internship.

Literature research on evidence and structure of PNE programs was performed, and patients were observed during their appointments with the physiotherapist, to determine the best work plan. Then, program content, delivery method, and selection criteria were defined. Literature presents individual and group sessions, with a wide range of number and duration of sessions. [9,10,18–20,22,24,28,30,50,51]

The program was based on the books "Therapeutic Neuroscience Education: Teaching patients about their pain"[46], and "Explain Pain"[52], with four individual sessions, 30 to 40 min each. The number and duration of sessions were defined to comprise all relevant information, based on the literature.[10,18,19,46] Individual in-person appointments are the usual practice at Saúde Positiva, so the initial idea was to have only presential sessions. Due to the current global situation, virtual sessions were chosen instead, to diminish the risk of contagion and to avoid the risk of interrupting the program midway due to government policies on lock-down, closures, or prophylactic isolations. Sessions were delivered via Zoom platform. Though virtual sessions can

increase adhesion and accessibility for a fraction of the cost, technical difficulties and distractions may compromise the program viability and success.[48,49]

To analyze the effect of the PNE implementation, the following assessment tools were used, based on current evidence: 1) a demographic questionnaire, to assess gender, age, socioeconomic aspects, pain duration, pain location, pain description, and pain medication usage; 2) the Pain Disability Index (PDI), to assess pain and disability correlation; 3) the Tampa Scale of Kinesiophobia (TSK), to assess fear of movement; 4) the Pain Catastrophizing Scale (PCS), to assess pain catastrophizing behavior; 5) the Patient Global Impression Scale (PGIC), to assess patients' opinion regarding treatment efficacy; 6) the Neurophysiology of Pain Questionnaire (NPQ), to assess retention of knowledge from the program content; and 7) a final questionnaire, to assess willingness to pay for treatment. Two assessment moments were performed, namely before starting and after finishing the program.[10,11,18,20,40] All questionnaires were combined in one Google forms document for practical reasons. The PGIC and the willingness to pay questions were included only at the final assessment.

To test program's content, the delivery method, and the timing, a pilot was performed with one individual posing as patient, leading to improvements of the final project, such as a more concise and patient-friendly content.

The selection criteria were defined in accordance to literature and clinical practicality.[9–11,18,28,30] Only patients on Bowen treatment at Saúde Positiva, with chronic pain lasting more than 3 months, with a VAS (visual analogic scale) of pain above 3 on onset of pain or at first screening at the clinic, whatever is greater, were selected (these data were obtained from patient's clinical history). Patients cognitively impaired with medical diagnosis were excluded.

Therapists reached participants during their consultation or by phone (via the WhatsApp platform). Participation on the program was voluntary, formalized by an informed consent. Participants were informed about the procedures and goals of the program and it was explained that they could withdraw the program at any time. Upon acceptance, every patient received the initial questionnaires via WhatsApp. Upon completing this initial assessment, sessions were scheduled. First session started with

brief presentations of both intern and patient, followed by initial content. One-week intervals were kept between sessions, and the last session comprised a review of all material. Then, final assessment was sent via WhatsApp, and, upon completion, a summary flyer was delivered to participants. Both Zoom and WhatsApp applications were chosen because of their data encryption, which guarantees confidentiality, data security and keep patient's privacy right.

Data from initial and final assessments were collected into a spreadsheet and analyzed to characterize participants and to determine whether clinical significance occurred. Data collection and analysis occurred in accordance with the "Regulamento Geral de Proteção de Dados (RGPD), from the University of Aveiro, and followed all the ethical assumptions of professional conduct. No Ethics Committee was consulted due to the limited duration of the internship, and lack of reasonable time to apply for it.

This report is the conclusion of the internship.

2.1. Timetable

	Oct 2020	Nov 2020	Dec 2020	Jan 2021
Literature Research	X			
Choice of format and delivery method	X			
Development of written material	X	X		
Test of presentation	X	X		
Content restructure	X	X		
Development of video sessions	X	X		
Video presentation rehearsal	X	X		
Pilot – session test		X		
Video restructure		X		
Patient selection		X		
Initial evaluation		X		
PNE start		X		
Sessions with patients		X	X	X
PNE end				X
Final evaluation				X

3. Thoughts on Competency Development

This work improved my skills and competencies in multiple areas such as literature review, neurophysiology knowledge, pain management interventions, evaluation of chronic pain patients and how to avoid my own bias toward patients, pedagogic methods and their usage, and telehealth, increasing my ability to deal with chronic pain patients and my educational skills as well.

3.1. Literature review competencies

A search was conducted on electronic databases such as Pubmed, Cochrane Library, EMBASE, Science Direct, PEDro, Scopus and Google Scholar using keywords as chronic, persistent, pain, neuroscience, education, telehealth, and virtual healthcare. Most of the studies chosen were limited to 2012 or newer, however, some studies that has historical importance were accepted regardless the year. Anatomy and physiology books were also searched to provide better understanding of the whole topic. That work improved my competency on electronic database scientific search, on keyword selection, and on the use of Boolean operators during the search. I have also gained skills on how to select online papers based on reliability, external and internal validity.

By realizing that reliability is a matter of consistency and reproducibility while validity determines the accuracy of a measure, I could evaluate the literature more critically to aid the development of the internship program.

Now I know the difference between test-retest, interrater, and internal consistency measurements, knowing that test-retest evaluate reproducibility across time or by repetition, and that interrater reliability is about the consistency of results when the experiment is performed by different people, and that internal consistency is more about the consistency between different parts of the same experiment, I am more capable of evaluating the results of a study. Moreover, by comprehending how to evaluate the validity of a study, its accuracy of construct and content, to understand whether there are external factors influencing its results, and to determine if it can be applied to other situations beyond the tested experiment, I became more aware of the relevance of the work I am reading nowadays.

I also gained skills on statistical analysis and the use of statistical software such as SPSS, which I have only used in theoretical classes before. But, in my opinion, this is a competency to be developed since I have just started using it. However, this internship helped me getting to know it, and experiencing a more practical use of that kind of tool, increasing my ability to analyze statistical data more confidently.

PNE is an intervention that aims on chronic pain management. It is used as supplementary treatment, that addresses some of the most challenging subjects of pain management such as fear, catastrophizing behavior, misinformation, beliefs, and costumes. At the beginning, the development of such a program sounds simple, it must contain information regarding neurophysiology, with relevant psychological and social interactions. Although physiotherapy programs provide literacy on those topics, in my opinion, to join all the information into one patient-friendly course requires extensive research and skills beyond the usual scope of physiotherapy.

Since the main goal of this internship was the viable implementation of PNE as a chronic pain therapeutic intervention, skills in financial feasibility and its influence on duration, number of sessions and method of delivery would be necessary for the project as well.

3.2. Neurophysiology competencies

One of the most difficult topics when dealing with a patient experiencing persistent pain is to talk about psychological and emotional states. Revision of neurophysiology gave me tools to provide solid evidence of biological processes that can contribute to persistency of pain, linking neurobiology to the psychological, affective, and social aspects of pain more directly.

Now, I feel more confident explaining how the release and lack of chemical substances in chronic stress, anxiety, and depression can lead to sensitization and persistency of pain. I can discuss the link between cognition and chronic pain and how memory, problem-solving, rationalization, multitasking, and attention sometimes share the same neural pathways as pain. Therefore, while talking about catastrophizing behavior, I can connect the cognitive distortion and intense emotional state to their

neurophysiological processes, clarifying the misconception of the usual phrase “pain is in your head”. My capacity to correlate socialization and pain also improved, as I am more versed on the role that attention and anxiety play in chronic pain. Now, more than just talk about sleep routine and how the lack of sleep can lead to pain and sensitization, I can discuss the biological effect of chronic stress and anxiety in pain. By revising neurophysiology, I became apt to discern between all the psychological, emotional, and social aspects of pain, their physiological implications, and how they can be mixed-up to one another sensitizing neural pathways and affecting pain perception. Even better, I can show neurophysiological reasons why a therapeutic modality can be beneficial, while relating all those aspects to practical activities and functions, to improve adherence to therapy.

3.3. Pain management competencies

I am more capable now to evaluate and address any risk of bias towards patients, and to look at their history and demographics carefully. I learned how much cultural competency and thorough screening are important to find aspects that can be addressed during education while avoiding stigmatizing patients or assuming things based on my own beliefs and thoughts. The classification of chronic pain as a disease by the IASP also helps on avoiding prejudice and discrimination toward patients, and becoming aware of that, during this internship, opened my mind for the need of more specific chronic pain treatments.

Therefrom, when considering treatment methods, exercise is usually prescribed, and there is good evidence of the effectiveness of physical activity on chronic pain management. In my practice I mostly include physical activity, and preferably I indicate an exercising routine more in line with the patient’s needs or choice. The best outcomes come from patients who accept to include exercise on their routine and who keep exercising after discharge. Yet, those not inclined to exercising have always being a challenge for me, and most of them would stop showing up before discharge.

In my opinion, PNE is a great associated therapeutic modality for non-active patients, not only to decrease fear and avoidance of movement, but to increase the

range of options for their pain management. One of the better competencies I got from this experience was to make sense of all the vicious cycles involved in chronic pain and how PNE can help break them.

I used to think of education as a way of getting patient's compliance with therapy, and I still believe in it, but one thing I have never thought before is that education can lead to greater changes. For example, exercise therapy may decrease pain, but PNE would help developing awareness of biopsychosocial aspects of pain, while presenting tools to manage the situation, acting on multiple conditions at the same time, decreasing pain and even improving adhesion to other therapies such as exercise, by acting on fear and avoidance of movement. During this program's presentation, patients were often interested on the influence of aspects such as chronic stress, sleep disorders, attention, or memory on nervous system sensitization specially allodynia and hyperalgesia. Some who though they had those behaviors said that it was beneficial to them making this correlation and to make sense of their pain, but for those who thought that their pain were only physical and had nothing to do with psychological or social aspects of their lives, correlating to that concept and accepting that their pain goes beyond physical injury was challenging. During the program I have decided to use the idea of vicious cycles that need to be broken, for example, how chronic stress releases substances that keeps us alert, leading to sensitization, that leads to persistent pain, that makes us even more alert, increasing stress, and there it goes. I used those cycles in most of my examples, to show that, sometimes breaking those cycles in other points can lead to decrease in pain. The cyclic examples were used for introducing the idea of self-awareness, self-management, and self-efficacy to patients, showing that chronic pain is a chronic disease, same as diabetes or hypertension, that must be managed by the patient too. After all, it was clear to me that changing patient's beliefs and misconceptions is very difficult, but at the same time doable if trust and candor from both sides can be achieved.

3.4. Pedagogic method and telehealth competencies

Reviewing neuroscience of pain was a rewarding experience, and creating educational material taught me a lot about pedagogic methods and how important it is to know and connect to the audience. I have a little bit of experience with public speaking, training, and creation of learning material, but I was in the learning process myself, while creating specialized material, and delivering it to untrained individuals. The first attempt failed because it was too dense even for people with some knowledge of neuroscience, and to tailor it to a more patient-friendly content was stressful, could say nerve racking. After long hours of study, a lot of guidance from advisor and co-advisor, lots of redoing and rehearsal, the program gained format and finally went well.

Then came the implementation per se, with a whole new challenge to be faced. Here the language barrier caught my attention, since I speak Brazilian Portuguese with a big accent and some diverse words and expressions. The written material was somewhat in European Portuguese, thanks to co-advisor's revision, but to speak is another level of fluency, and I did not have that. I rehearsed many times on an attempt to memorize words and expressions and to pick-upon a better accent, and I chose to speak slowly and as clearly as possible. Then, during the pilot we decided my speech was intelligible enough for the task.

On top of that, was the delivery method. Telehealth is a growing movement, but until now I have never thought on working virtually, because I prefer individual in-person practice. Due to hardships related to the Covid-19 pandemic, telehealth was deemed the best delivery method for the PNE program. To comply with patient privacy, I learned that the delivery platform must be encrypted, for that Zoom was the chosen platform for videoconferencing, and WhatsApp for calling, messaging, and sending documents. Another feature of telehealth is that everyone involved must have a minimum technical aptitude and an electronic device that can be used (in our case, a cell phone or computer with Zoom and WhatsApp applications installed). I had to manage technical issues, such as video not launching, or microphone not working, and it taught me that telehealth may not be for everyone, especially for people with low technological literacy. Moreover, I had to improve my own technological literacy in order to help patients

resolve their issues. Other important lesson from virtual appointments was that unlike in-person sessions, it is harder to keep audience's attention. The environment can be more relaxing or disruptive, and people may not be fully focused on the therapy. To get their attention I incorporated inquire-based learning, posing questions and scenarios that could relate to their own experiences.

3.5. Clinical research competencies

The internship was a clinical experiment and translating science into practice can be complex. The scientific evidence is often achieved in a controlled environment, and that is of paramount importance to control variables and avoid bias. There is a hardship to reproduce it in the clinical environment, but the main reason of researching is to solve real-world problems. That is why a scientific project that incorporates science to the clinic is so necessary, and because of that I am truly grateful for this wonderful experience.

4. Empirical study: A telehealth pain neuroscience education program for chronic musculoskeletal non-specific pain patients. A case series

4.1. Abstract

Background: Chronic pain is a major cause for seeking healthcare. Pain Neuroscience Education (PNE) is a therapeutic intervention that aims to empower patient's ability to manage chronic pain by increasing knowledge about the pain neuroscience, and it is often delivered by physiotherapists in-person, combined with other physical/movement approaches. In Portugal, similarly to all over the world, the early period of Covid-19 pandemics demanded several restrictive measures to minimize face-to-face contacts, in all sectors, including essential services such as health. This particular scenario highlighted the importance of telehealth in non-emergent clinical conditions, such as chronic pain. Though telehealth has evolved a lot during the last two decades, this context of service provision is still not routinely implemented in physiotherapy practice, namely PNE.

Purpose: This case series aims to describe the effects of a PNE program delivered by telehealth (telePNE) during the Covid-19 pandemics (October 2020-January 2021), in musculoskeletal non-specific pain patients attending a musculoskeletal-dedicated private clinic in Aveiro, Portugal. The telePNE was specifically designed to include 4 individual synchronous sessions via the Zoom application, with a one-week interval between sessions, complemented with an educational flyer at the end.

Method: Six musculoskeletal chronic pain patients fully completed the telePNE, in addition to the physiotherapy treatment that was being delivered prior the telePNE (1-2 sessions/month of individualized Bowen-based manual therapy). The main outcome measures assessed before and after the telePNE were the Pain Disability Index (PDI), the Tampa Scale of Kinesiophobia (TSK), and the Pain Catastrophizing Scale (PCS). Patient Global Impression Scale (PGIC), the Neurophysiology of Pain Questionnaire (NPQ), and and willingness to pay, were also measured post-program.

Results: After telePNE, 5 patients reported a PGIC value of 5 or above, which is considered as clinical improvement. A score above the Minimal Detectable Change

(MDC) was observed in 4 patients for NPQ, in 1 patient for PCS, and 1 patient had a decrease on TSK from moderate to mild. A Minimal Clinically Important Difference (MCID) was found for PDI in 3 patients. Five patients expressed willingness to pay for this telePNE.

Conclusion: This case series suggests that the implementation of telePNE in musculoskeletal chronic pain patients, in addition to manual therapy, may promote patient's perception of clinical improvement. However, further studies are needed to clarify its isolated specific clinical effects.

Keywords: Education, neuroscience, pain, telehealth.

4.2. Introduction

Pain is a normal sensory experience, and its unpleasantness is essential for survival, serving as a warning against tissue damage. [12,19] In the extremes, living without pain or living in constant pain have no biological value, and may cause suffering and disability.[5,12,19] As a multidimensional experience produced by the brain, the feeling of pain is determined by the perception of danger rather than the actual state of tissues.[5,12,44,53] Persistent pain not just is a major cause for seeking healthcare, but also accounts for high functional disability rates worldwide.[5,10–12,14,18–20,22–24,28,30,40,51,53,54] Pain is more than just unpleasant and emotional, it comprises a myriad of biopsychosocial aspects that interact directly with the pain experience itself.[1,2,12,22] Maladaptive thoughts and beliefs are linked to persistence of pain, and poor outcomes of functional disability and pain intensity.[11,12,18,21,24,30] Kinesiophobia, catastrophizing behavior, chronic stress, anxiety, depression, impaired executive functions, have all been linked to chronic non-specific pain and the need for intervention focused on those characteristics are well documented in scientific literature.[5,10,24,26,55–57]

There are multiple therapeutic guidelines for treating chronic, persistent pain, that often include multidisciplinary approaches such as pharmacological, preventative, educational, surgical, physical rehabilitation, psychological and behavioral interventions.[11,14–17,54] Educational interventions are usually associated to other therapeutic modalities, especially for non-specific chronic pain, and they can use a

neurophysiological model, including the biopsychosocial aspects of pain or a biomechanical model, including pathoanatomical and physiological explanations.[11,12,18,19,21,24,30]

Pain Neuroscience Education (PNE) is a therapeutic modality focusing on improving patient's knowledge about neuroscience and the biopsychosocial aspects of pain.[19,22,46,58] By reconceptualizing and demystifying pain processes, this educational approach seeks changing patient's beliefs and behaviors about their pain, empowering them against prejudice and discrimination from those around them dealing with maladaptive thoughts, misconceptions and beliefs, making patients capable of self-awareness, and self-management to take control of their situation.[5,16,40,43,59] By creating awareness on those topics, patients ultimately decrease fear-avoidance and catastrophizing behavior, looking for a positive effect on activity levels, pain perception and function, [11,19,20] therefore decreasing pain itself and disfunction and increasing movement.[9,18,19,21,46]

PNE is usually administered in-person, in association to other interventions such as exercising, and manual therapy. Another important focus of PNE is to improve adherence to such treatments, by showing the importance of physical activity, manual therapy and other forms of treatment, on desensitizing the nervous system and controlling persistent pain.[10,11,18,20,24,46,60]

Telehealth uses technology to increase healthcare, health-related education, public health and health administration accesses.[48,49] It can decrease distance for those living remotely, and it can be cost-effective for those on a low-resource setting, providing healthcare for those who otherwise would not have the means to attend an in-person consultation.[48,49] The current Covid-19 pandemic restrictions created an even greater challenge for chronic pain care, forcing healthcare professionals to readjust and rethink their treatment delivery methods.[48,49] In fact, physiotherapy delivered remotely by telehealth has been reported in literature with good effectiveness for several approaches and conditions.[48,49] Moreover, telehealth for pain care seems of potential high-value.[48,49] However, it is still unclear whether PNE administered through telehealth can be as effective as in-person sessions.

This study aims on assessing the effectiveness a pain neuroscience educational program, implemented by synchronous telehealth (e-conference) during the Covid-19 pandemics, on musculoskeletal non-specific pain patients attending a private clinic in Aveiro, Portugal, may present on pain and disability as primary outcomes, and on retention of the program's content, on kinesiophobia, pain catastrophizing behavior and patient's perception of change as secondary outcomes.

4.3. Methods

4.3.1. Study design

It was performed a case series.

4.3.2. Participants

Enrolled in this study patients with non-specific chronic pain, i.e., with three months or more since onset, independently from the pathophysiologic classification, scored with an analogic visual scale (AVS) above 3 on onset of pain or at the day of first screening, whatever was greater, who were already performing physiotherapy due to pain, and voluntarily were interested in integrating the telehealth PNE program (telePNE). To reach a greater number of possible candidates, the exclusion criteria to integrate the program was limited to the presence of cognitive impairment, confirmed by medical diagnosis.

Patients were recruited conveniently from one musculoskeletal-dedicated private clinic with a multidisciplinary care, mainly physiotherapy, placed at Aveiro, Portugal. All patients were previously performing physiotherapy, namely individualized Bowen-based manual therapy, 1-2 sessions per month.

To participate in this case series, the goals of this study, as well as its potential benefits and risks, were explained, and patients were encouraged to clarify any eventual doubts. Therefore, an informed consent following the World Medical Association Declaration of Helsinki was mandatory, and the withdrawal from the

program without any harm to the participant was guaranteed. Anonymity of data was assured by codifying participants identification.

4.3.3. Intervention

A telePNE has been developed to aid patients on their pain perception and how to manage it (further details on the Appendix 1). The content was created based on current guidelines and recent literature.[11,14,16,17,46,52,54] Figures, real world correlations, and questions were used to stimulate active participation and engagement of audience.

The program consisted of 4 sessions of about 30 to 40 minutes duration each, that were administered once a week for 4 weeks total. Further details about the contents of each session are described in table 1 The telePNE was administered by a physiotherapist using synchronous videoconferencing by the Zoom platform. After finishing the program, a flyer (Appendix 4) comprising all sessions was sent to the patient.

Table 1: Major contents of the telePNE sessions.

Sessions' description
Session 1
Program presentation
Pain process
Pain is different from injury
Chronic pain has no biological value
Pain is not linked to aging
Session 2
Brief revision of first session
Chronic pain process
Neuromatrix
Physical activity and its significance in pain management
Manual therapy in pain management
Fear-avoidance behavior and pain
Session 3
Brief revision of previous sessions
Cognition and pain
Emotion and pain
Sleep and pain
Relaxation techniques and pain
Session 4

4.3.4. Assessment

Before and after the telePNE, patients were assessed through a self-administered online questionnaire, delivered on a Google Forms link (Appendix 3) by WhatsApp. Both assessments comprised the Pain Disability Index (PDI), the Neurophysiology Pain Questionnaire (NPQ), the Tampa Scale of Kinesiophobia (TSK) and Pain Catastrophizing Scale (PCS). Additionally, the initial assessment (before telePNE) included a few questions to allow patients' characterization about the genre, age, socioeconomic aspects, pain duration, pain location, pain description, and pain medication usage, and the final assessment (after telePNE) included Patient Global Impression of Change (PGIC) and 2 further questions, one to assess patient's global perception about the program, and another to analyze patient's willingness to pay for it.

4.3.4.1. Primary outcomes

4.3.4.1.1. Pain Disability Index

The Pain Disability Index (PDI), a patient-reported outcome measure (PROM), was selected to assess pain impact on daily living and functional disability. This questionnaire was developed by Pollard, C. A. and Tait, R. C., and translated and validated for the Portuguese population by Azevedo, L. F. et al, with good psychometric properties [Cronbach α = 0.845, and ICC (IC 95%) = 0.762].[61]

The Questionnaire presents 7 daily activities with a 0 to 10 scale for each one, performing a total between 0 and 70 points. For each activity, 0 means that pain causes no disability whatsoever and 10 means that pain impede performing the daily living activity, being considered no disability from 0 to 1, mild disability from 2 to 4, moderate disability from 5 to 7, and severe disability from 8 to 10. Therefore, a higher total score means higher functional disability.[61–63] The classification must reflect the global impact of pain in patient's life, not just when maximum pain occurs. [61,62]

An overall 13 points difference is considered to be the minimum overall clinically important difference, however, for scores below 27 points, the minimal clinically important difference (MCID) is a decrease of 7 or more points, for scores between 28 and 42, the MCID is 15 or more points decrease, and for scores of 43 or more the MCID is set as 20 or more points decrease.[62]

4.3.5. Secondary Outcomes

4.3.5.1. Neurophysiology of Pain Questionnaire

The Neurophysiology of Pain Questionnaire (NPQ) was used to assess retention of the program's content.[10,18,64,65] This questionnaire was developed by O'Connell, C., Moseley, G.L. The Portuguese version of the questionary have been used before and has demonstrated acceptable internal consistency (Cronbach α=0.91), moderate test-retest reliability (ICC = 0.67; 95%, CI = 0.18, 0.86), and minimal detectable change (MDC) of 4.31.[10,18]

The questionnaire consists of 19 questions about pain neurophysiology and a score of true, false, or unsure for each one. Each correct answer is worth one point for a total between 0 and 19. A 4.31 points difference is considered minimal detectable change (MDC).

4.3.5.2. Tampa Scale of Kinesiophobia

To evaluate kinesiophobia, i.e. a disproportionate fear of movement, Tampa Scale of Kinesiophobia – revised version containing 13 items (TSK-13) has been chosen. This questionnaire was developed by Todd, D. D., and translated and validated for the Portuguese population by Cordeiro, N. et al, the Portuguese version of TSK-13 has shown an acceptable internal consistency (Cronbach's α = 0.82), and a high test-retest reliability (ICC = 0.99) for the total score.[66].

The scale is a PROM that contains 13 statements relating pain to fear of movement, each of them graded from 1 to 4 points, where 1 means totally disagree, 2 means

disagree, 3 means agree, and 4 means totally agree. Total scoring ranges from 13 to 52, where a higher score means greater kinesiophobia.[24,63,66]

The 13 items revised version has been chosen since it shows better psychometric properties than the original TSK containing 17 items.[63,66] The scale is subdivided by severity of reaction as subclinical (scores between 13 and 22), mild (scores between 23 and 32), moderate (scores between 33-42), and severe (scores of 43 and above).[63]

Correlation of TSK-13 to pain intensity, perceived disability and other pain related PROM have been shown on previous studies.[63]

4.3.5.3. Pain Catastrophizing Scale

Pain Catastrophizing Scale (PCS) was the chosen tool to determine patient's pain catastrophizing behavior. The scale has 13 affirmations about feelings and thoughts that may be associated to the individual's experience of pain. To each of them, a five-points score can be attributed, going from 0 (not at all), to 1 (to a slight degree), to 2 (to a moderate degree), to 3 (to a great degree), and to 4 (all the time). Total scoring ranges between 0 and 52, with higher scores meaning higher pain catastrophizing behavior.[61,67,68]

The statements are grouped in three domains, namely rumination, for repeated worry (4 items), magnification, for evaluation of pain as a threat (3 items), and helplessness, for the believe that nothing can help to resolve the pain (6 items).[61,67,68]

The scale has presented acceptable consistency, both at the full scale (Cronbach's α=0.92 [95%, CI=0.91-0.93]) and each subscales (Cronbach's α=0.89 for rumination, 0.77 for magnification, and 0.88 for helplessness), and high test-retest reliability ($r=0.75$, $p<0.001$).[67,68]

This questionnaire was developed by Sullivan, M. G. L., Bishop, S. R., Pivik, J., and translated and validated for the Portuguese population by Azevedo, L. F. et al. The Portuguese version of the PCS has also demonstrated acceptable internal consistency (Cronbach's $\alpha = 0.907$).[10,18]

4.3.5.4. Patients' Global Impression of Change

The Patients' Global Impression of Change (PGIC) scale was used to assess the individual's perception of change in activity limitations, symptoms, emotions, and quality of life related to her or his pain since the beginning of telePNE treatment. The scale consists of only one question on the perceived global change after treatment, with a 7-points scale, and the Portuguese version score goes from 1, meaning no change, to 7, meaning much better.[69,70] Significant correlation between PGIC rating and pain PROM have been demonstrated in the literature, with higher correlation coefficients linked to pain intensity in more than one study.[69,71] The Portuguese version of the scale has shown high and significant negative correlation with pain intensity on Pearson's test ($r=-0.822$; $p\leq0.001$), when correlating PGIC and NPS.[70] Scores of 5 or above in the PGIC are linked to clinically significant improvement in back and neck pain patients.[72]

This questionnaire was developed by Hurst, H. and Bolton, J. and translated and validated for the Portuguese population by Domingues, L and Crus, E.[61]

The Initiative on Methods, Measurement, and Pain Assessment in Clinical Trials (IMMPACT) includes participant ratings of global improvement and satisfaction with treatment on their 6 core outcomes domains of assessment for clinical research on chronic pain.[73]

4.4. Data analysis

The description of patients' characterization was performed in groups rather than individually to guarantee data a nonymity and protection.

To analyze the global perception of the patients about the program and their willingness to pay for it, as well as the effects of the telePNE itself, results obtained were presented individually, with patients numbered from 1 to 6. Data analyzes from the validated questionnaires was performed considering their clinical interpretation and the corresponding MCID and MDC described in the literature, whenever available (further details are summarized in table 2).

Table 2. Clinical interpretation of the outcome measures.

Outcome measure	Minimum score	Maximum score	Interpretation	MCID	MDC
PDI	0	70	A higher total score means higher functional disability.	Overall: ↓ ≥ 13 points. For scores below 27 points: ↓ ≥7 points. For scores between 28 and 42: ↓ ≥15 points. For scores of 43 or more: ↓ ≥ 20 points.	
NPQ	0	19	A higher total score means more correct answers.		↑ ≥ 4.31 points
TSK-13	13	52	A higher total score means higher kinesiophobia.	Change in stage	
PCS	0	52	A higher total score means greater catastrophizing behavior.		↓ ≥ 12.8 points
PGIC	1	7	A higher total score means better perception of change after intervention.	↓ ≥ 5 points	

Legend: PDI – Pain Disability Index; NPQ – Neurophysiology Pain Questionnaire; TSK-13 – Tampa Scale of Kinesiophobia; PCS – Pian Catastrophizing Scale; PGIC – Patient's Global Perception of Change.

4.5. Results

From 12 patients that were eligible candidates to integrate the telePNE, 7 patients agreed to enroll in this study. After the third session, 1 patient withdrew for family health reasons, remaining 6 patients that fully completed the program, two men and four women (Fig. 1).

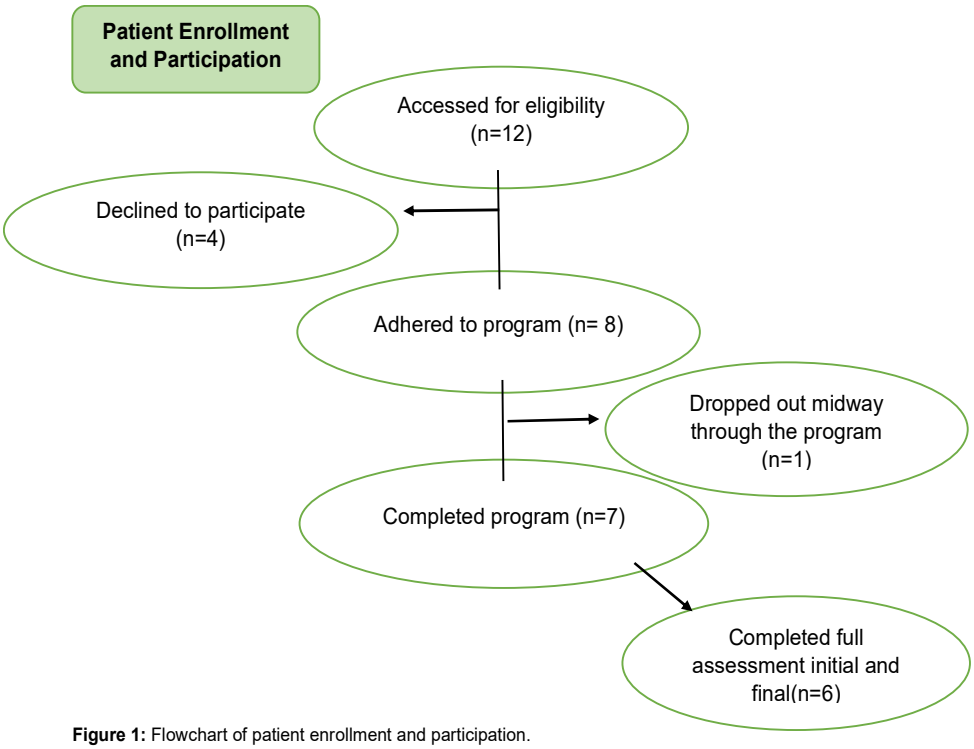

Figure 1: Flowchart of patient enrollment and participation.

The patients' age ranged between 23 to 63 years old, being two men and four women. One was single, one separated or divorced, and four were married or lived in a stable union. 5 of them had children and one did not. Literacy ranged from 11° grade to post-secondary education. As for pain duration, 1 patient reported pain for 12 months, 3 patients reported pain for 18 months, and 1 reported pain for 48 months. Most patients cited more than one pain location, with the most common being shoulders, cited by 3 patients, followed by low back, hands, feet and knees, that were cited by 2 patients each, and the neck was cited by one patient. 2 patients reported the use of pain medication (Mobilisin and Palexia).

4.5.1. Pain impact on daily living and functional disability by the PDI

As shown on table 3, before treatment 1 patient exhibited moderate pain-related disability (PDI=37; patient 2), 1 patient presented mild pain-related disability (PDI=24; patient 1), and the other 4 patients had no pain-related disability (PDI ranging from 6 to 13; patients 3-6). After telePNE, the patient with moderate pain-related disability

(patient 2) showed a MCID by decreasing 17 points. Though it was rated as having no pain-related disability due to their low total scores, patients 3 and 4 decreased 9 and 7 points, respectively, which reflects a MCID. Despite all the other patients decreased their total scores after telePNE, no MCIDs were reached, including for patient 1 (differences ranged from 1 to 5).

Table 3: Individual scoring of PDI before and after telePNE and its clinical significance.

Patient code	Total score of PDI BEFORE telePNE (0-70)	Total score of PDI AFTER telePNE (0-70)	Difference of PDI between AFTER and BEFORE telePNE	MCID reference	Clinical interpretation of MCID (YES/NO)
1	24	19	-5	≤ 27; ↓ ≥7	MCID – NO
2	37	20	-17	28 – 42; ↓ ≥15	MCID – **YES***
3	13	4	-9	≤ 27; ↓ ≥7	MCID – **YES***
4	11	4	-7	≤ 27; ↓ ≥7	MCID – **YES***
5	11	9	-2	≤ 27; ↓ ≥7	MCID – NO
6	6	5	-1	≤ 27; ↓ ≥7	MCID – NO

4.5.2. Pain neuroscience knowledge by the NPQ

As shown on table 4, 4 patients (patients 2, 4, 5 and 6) increased their pain neuroscience knowledge after telePNE, once they showed a difference of NPQ above the reported 4.31 MCD (differences ranging from 5 to 11 points). Though the other 2 patients (patients 1 and 3) increased their total score of the NPQ, the difference didn't reach the reported MCD (ranged between 2 and 4).

Table 4: Individual scoring of NPQ before and after telePNE and its clinical significance.

Patient code	Total score of NPQ BEFORE telePNE (0-19)	Total score of NPQ AFTER telePNE (0-19)	Difference of NPQ between AFTER and BEFORE telePNE	MDC reference	Clinical interpretation of MDC (YES/NO)
1	10	12	2	↑ ≥ 4.31	MDC – NO
2	4	10	6		MDC – **YES***
3	10	14	4		MDC – NO
4	6	11	5		MDC – **YES***
5	7	13	6		MDC – **YES***
6	3	14	11		MDC – **YES***

4.5.3. Kinesiophobia by the TSK-13

As shown on table 5, before telePNE 1 patient (patient 6) exhibited moderate kinesiophobia (TSK-13=34), 3 patients (patients 1, 2 and 4) had mild kinesiophobia (TSK-13 of 28, 32 and 32, respectively), and the other 2 patients (patients 3 and 5) showed subclinical kinesiophobia (TSK-13 of 20 and 22, respectively). After telePNE, patient 6 changed kinesiophobia severity, decreasing from moderate to mild severity (TSK-13=23), patient 5 didn't change his total score after telePNE, and the other 4 patients (patients 1 to 4) decreased their total score, however, not enough to change severity stage.

Table 5: Individual scoring of TSK-13 before and after telePNE and its clinical significance.

Patient code	Total score of TSK-13 BEFORE telePNE (13-52)	Total score of TSK-13 AFTER telePNE (13-52)	Reference for the stages of severity of reaction	Change in Stage (YES/NO (Level))
1	28	23	Subclinical: 13-22 Mild: 23-32 Moderate: 33-42 Severe: 43-52	NO (Mild)
2	32	31		NO (Mild)
3	20	17		NO (Subclinical)
4	32	29		NO (Mild)
5	22	22		NO (Subclinical)
6	34	23		**YES* (Moderate to mild)**

4.5.4. Pain catastrophizing behavior by the PCS

As shown on table 6, 1 patient (patient 6) showed a MDC by decreasing 13 points on the Pain Catastrophizing Scale, changing from 19 to 6 points after telePNE (MCD of 12.8 points or greater). 1 patient (patient 5) decreased 8 points from 15 to 7, but the difference didn't reach the reported MCD. 2 patients (patients 2 and 3) showed no change in score, and 2 patients (patients 1 and 4) showed an increase in their score ranging from 2 to 7 points greater after PNE.

Table 6: Individual scoring of PCS before and after telePNE and its clinical significance.

Patient code	Total score of PCS BEFORE telePNE (0-52)	Total score of PCS AFTER telePNE (0-52)	Difference of PCS between AFTER and BEFORE telePNE	MDC reference	Clinical interpretation of MDC (YES/NO)
1	16	23	7	↓ ≥ 12.8	MDC – NO
2	28	28	0		MDC – NO
3	11	11	0		MDC – NO
4	17	19	2		MDC – NO

5	15	7	-8	MDC – NO
6	19	6	-13	MDC – **YES***

4.5.5. Patient's global perception of change after intervention by PGIC

PGIC scores were assessed only post-intervention, and except for patient 4, a score above a clinically significant difference was chosen from the participants (table 7).

Table 7: PGIC scores

Patient code	Total score of PGIC (1-7)	MCID reference	Clinical interpretation of MCID (YES/NO)
1	6	≥ 5	MCID – **YES***
2	6		MCID – **YES***
3	7		MCID – **YES***
4	4		MCID – NO
5	5		MCID – **YES***
6	6		MCID – **YES***

4.5.6. Patient's willingness to pay for the intervention

Willingness to pay scores were most positive, except for patient 6 who would not pay for such treatment, even though have found the program a good tool for managing the pain (table 8).

Table 8: Willingness to pay outcome

Patient code	Good tool	Would pay for it
1	**Yes**	**Yes**
2	**Yes**	**Yes**
3	**Yes**	**Yes**
4	**Yes**	**Yes**
5	**Yes**	**Yes**
6	**Yes**	No

The main results described above about the patients' clinical improvements and perceptions are summarized in table 9. From 4 patients that showed increase above MDC on the NPQ (change above 4.31 points) after intervention, 2 have had a significant change on the PDI, 1 of them (patient 6), who had the lowest pain related disability on

the PDI score before intervention, have had significant change in the psychosocial aspects of kinesiophobia (change from moderate to mild on the TSK) and catastrophizing behavior (change above 12.8 on the PCS), and 3 have also showed favorable PGIC scores (above 5 points). Patient 3 did not increase significantly the NPQ score, however, a MCID was achieve (change greater than 7 in this case) and a significant global perception was shown. Even though patient 1 did not showed significative change on pain neurophysiology knowledge, disability related to pain, kinesiophobia, nor catastrophizing behavior, the perception of global change after intervention was above the MCID.

Table 9: Global overview of patients' clinical improvements and perceptions. Clinically significant improvement of pain neuroscience knowledge (assessed by NPQ), pain-related disability (assessed by PDI), kinesiophobia (assessed by TSK-13), pain catastrophizing behavior (assessed by PCS), and patients' global impression of change (assessed by PGIC) are marked with YES*.

Patient code	NPQ	PDI	TSK-13	PCS	PGIC	Global perception of the telePNE	Willingness to pay to the telePNE (YES/NO)
1					**YES***	Positive	**YES***
2	**YES***	**YES***			**YES***	Positive	**YES***
3		**YES***			**YES***	Positive	**YES***
4	**YES***	**YES***				Positive	**YES***
5	**YES***				**YES***	Positive	**YES***
6	**YES***		**YES***	**YES***	**YES***	Positive	NO

4.6. Discussion

The results show that 4 patients had a change above the MDC on their neurophysiology of pain knowledge, suggesting retention of the program's content. Most studies show their results in mean percentages, as reported by Andias, R.; Neto, M. and Silva, A. G. of 9.8 ± 3.2 (mean ± standard deviation).[18]

Pain and disability outcomes were positive for 3 patients, based on their PDI score, what can be seen as a positive impact if considering that all but patient 2 had the minimal score for the PDI (≤ 27 points). Pires D. et al, reported no significant difference between experimental and control group, with 62.0% of the experimental group showing a MCID in functional disability post-intervention.[24]

For psychosocial aspects of kinesiophobia and catastrophizing behavior only one patient (patient 6) had a decrease from one stage as it can be seen on Tables 5 and 6. Anyhow, the patient who showed a change in TSK was the only one above the mild score, all the others showed mild or subclinical scores at baseline, what could be the reason for that. No relevant information corroborating this idea could be retrieved from literature.

The most significant clinically meaningful change occurred on patient's global impression of treatment, with 5 out of 6 respondents scoring above the MCID of 5 or more points. One study by Andias, R; Neto, M. and Silva, A. G. reported 85.7% of the participants scoring 5 or above in the PGIC, however a study by Perrot, S. and Lanteri-Minet, M. shows only 14% of respondents scoring 5 points or above in the PGIC.[18,72]

The questionnaire of willingness to pay for treatment is not a validated tool, but it presented a good acceptance for paying for the PNE program, with 5 out of the 6 respondents attesting they would pay for the treatment they just have had.

Subjects 2 and 4 showed improvements on functional disability related to pain, and on neurophysiology knowledge retention, and good perception of the treatment as same as willingness to pay for a treatment like that. Subject 6 showed significant difference in all but pain disability, however showed no intention to pay for treatment, even though she or he considered the program a good tool for managing her or his pain.

All those results raise some questions on how the inclusion criteria could play a role on the expected outcomes. For future studies, would be better to redefine the disability level, or kinesiophobia, or catastrophizing behavior of the participants? Could pain neuroscience education be a better fit for patients with a greater score on those assessment tools at baseline?

We could not correlate any change in score with age, literacy, or other factors, in part because of the small sample size and in part because the patients with better outcomes did not show any demographic or socioeconomic factor that could lead to correlations of that nature. The lack of a control group impedes correlating those

changes to any specific cause, since it is not possible to affirm that any change occurred by the means of the program.

4.6.1. Study limitations

There are multiple limitations that can be pointed out on this work. The most concerning, are the sample size, the lack of control group and randomization. The nature of the study is a limitation itself, as case series are susceptible to a high risk of bias, cannot stablish a relationship between cause and effect, and lack generalizability to large populations.

For the sample size, it is worth stating that the study has been conducted on patients of one physiotherapy clinic, what makes the total population from which the sample could be retreated also pretty small too. Another important factor for the sample size has been the voluntary characteristic of the study that limit the sample to those interested in participating. However, by considering that the study's objective was to evaluate the effectiveness of the PNE program implementation on the very clinic where this work happened, it makes sense to develop such program not despite the small sample size, but even because of it, as assessing the willingness of that clinical site's patients in undergoing that kind of intervention was one of the goals of the study per se.

The lack of control group was a consequence from the already small sample size that limited the researcher's ability to split the sample in two even smaller groups. With no control group it is not possible to evaluate whether changes occurred based on intervention or any other external influence that may have happened midway through intervention. Once again, it was worth the effort to proceed with the intervention for the originality of it, and its focus not only on implementing a PNE program in a clinical site, but by the fact that it occurred during a pandemic of such proportions. Afterall, this study may open the way to generating new hypothesis, both on PNE as an associated intervention on the clinical environment and on the use of telehealth as a delivery method of such treatment.

4.7. Conclusions

The results suggest low impact on functional disability, with no direct impact on kinesiophobia and pain catastrophizing behavior. The retention of neurophysiology knowledge appeared to be improved post-intervention. A good global impression of change and high willingness to pay for such treatment show a positive impact on patient's perception of treatment, that may suggest a positive inclination for undergoing telehealth PNE intervention on the clinic, showing possibility of financial viability and good accessibility for the target-population. Further randomized, controlled studies on evaluating implementation of PNE programs on clinical sites, in-person or by telehealth, should be performed to investigate overall viability and accessibility, as well as its impact on functional disability, kinesiophobia, and pain catastrophizing behavior.

5. Internship Report's Conclusions

This internship increased my knowledge on electronic database search, and how to evaluate the quality of the literature I am reading. It also improved my knowledge on pedagogic methods, and on telehealth as a therapy delivery method. I also developed a better understanding of pain physiology, and its correlation to affective, emotional, and social aspects of one's life. I even learned about self-awareness, self-efficacy and self-management, and their relationship to a better management of a chronic disease, as chronic pain.

One of the most important outcomes of this work has been the assessment of my own bias as a professional, and how it can affect the results of treatment.

Overall, this internship had a positive impact on my clinical and scientific abilities, increasing my competency related to the care of chronic pain patients.

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6. Appendix

All documents on this appendix will be available at the link: https://drive.google.com/drive/folders/1hmYjxlTZzRwisGQXor0dxmFkQXt5Fd6P?usp=sharing

Appendix 1 - Pain neuroscience education program (video comprising the entire program).
Appendix 2 - Initial Assessment
Appendix 3 - Final Assessment
Appendix 4 - Flyer
Appendix 5 - Term of Consent