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Application of Cognitive Functions in a Board Game as a Therapeutic Protocol for Acute Nociceptive Pain

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SUMMARY

Pain is a condition that has been growing more and more in recent years, due to this, alternative treatments are being sought that can benefit these patients, the protocol described in this research is a board game that involves the components of the theory of "flow" to be entertaining. Seeking to stimulate cognitive functions to reduce pain and improve the emotional well-being of patients. The game contains different activities that seek to exercise the cognitive functions of attention, working memory and executive functions. The population that was selected to test the protocol were adults diagnosed with acute nociceptive pain, who participated in the use of the protocol three times a week in 20-minute sessions for four weeks. The patients were evaluated before and after using the app, the results of the research showed an average reduction of 30% in pain perception and a 36% decrease in anxiety. These findings highlight the protocol's potential to improve both patients' emotional and physical state. Its low cost makes it a viable alternative for pain treatment in resource-limited settings. It is recommended to adapt this protocol to other populations and types of pain, such as chronic or neuropathic pain, and to carry out additional studies to evaluate its long-term effectiveness and in different contexts. These results suggest that these types of solutions may be a viable tool for pain management in multiple clinical scenarios.

Keywords: *Acute Nociceptive Pain, Cognitive Functions, Therapeutic Protocol, Playful, Nociceptive.*

Introduction

Acute nociceptive pain is the nervous system's response that is activated when the body detects tissue damage. This is how receptors known as nociceptors arise (Hadley & Novitch, 2021). These are a physiological response to protect the body from damage, severe pain can be mild or chronic and be recurrent, causing a deterioration in the patient's quality of life, affecting their mental and emotional health (Krainbuhl et al., 2022). Medicine has traditionally applied pharmacological approaches such as the use of analgesics to mitigate pain (Fredheim et al., 2020). However, in recent years, the search for non-invasive therapeutic alternatives for pain treatment has doubled.

Non-pharmacological interventions for acute pain have shown promising results. Beyond reducing the perception of pain, they have been shown to increase levels of psychological well-being. An example of this has been immersive technologies and games with cognitive approaches (Goudman et al., 2022). In this way, an intervention is both a distraction and a treatment, since although it reduces the perception of pain, it can improve memory, attention and executive functions, among others. (Noda, Shirotsuki, & Nakao, 2019).

Currently, there are several techniques to create a sense of immersion in an activity. Csikszentmihalyi's theory of "flow" is an example of this, This theory describes a state of total concentration and deep enjoyment when performing an activity, where actions flow effortlessly, generating an intrinsically rewarding experience (Csikszentmihalyi, 2024).

The approach of designing absorbing and fun activities, incorporated into different strategies such as a game, can contribute to reducing the perception of pain, managing to divert the patient's attention. This hypothesis has been supported by studies that indicate that games promote concentration by incorporating these types of activities (Donaldson & Dubin, 2025).

On the other hand, according to the American Psychological Association. (APA, 2023) Cognitive functions are mental processes that allow people to acquire, process, store, and use information. These include memory, attention, reasoning, language, and other mental skills, which play a critical role in the diagnosis and treatment of different disorders. These functions are evaluated using neuropsychological tests and diagnostic tools. Cognitive stimulation has been found to have a positive effect on patients' emotional state, by reducing anxiety levels and promoting relaxation (Estrada-Plana et al., 2019; Coelho et al.,).

Thus, the creation of games that act as therapeutic protocols could be implemented using a variety of technologies, from board games to interactive virtual reality (VR) simulations, providing a controlled environment to exercise cognitive skills, among others. (Moreau et al., 2024).

In light of these advances, the present research proposes to explore a therapeutic protocol through a board game, which focuses on the use of cognitive functions in patients with acute nociceptive pain. The central hypothesis is that cognitive tasks can mitigate the perception of acute nociceptive pain and improve quality of life.

This hypothesis is viable since cognitive functions are important for daily functioning, including pain management. For example, executive functions are necessary for planning, decision-making, and problem-solving, all of which can be helpful in managing pain. Attention is needed to focus on pain and associated sensations, and memory is needed to remember pain coping strategies."

This approach not only contributes to the reduction of physical pain, but also aims to improve the emotional well-being and quality of life of patients, offering a complementary therapeutic option in the treatment of pain. The above then raises the following research question: How to evaluate the use of cognitive tasks in a board game as a therapeutic protocol for the treatment of acute nociceptive pain?

Background

Specifically, acute nociceptive pain can be considered an immediate physiological reaction of the nervous system caused by tissue damage. Peripheral nociceptors send signals to the brain, leading to patients' perception of pain (Krainbuhl et al, 2022). Although acute pain is temporary and is eliminated with the administration of analgesics, there are patients who suffer resistance and side effects (Hadley & Novitch, 2021). Since the recurrent use of medications can lead to liver, kidney, or cardiovascular damage, for these reasons researchers have sought alternative non-pharmacological options for pain management.

These alternatives seek to exercise cognitive functions, some examples of which are: cognitive-behavioral therapy, meditation, games, and immersive technologies (Fredheim et al., 2020). In particular, the use of games has gained more and more interest due to their accessibility and ability to promote essential cognitive skills in people such as working memory, attention, and inhibitory control, functions that have been shown to have a positive impact on pain mitigation (Choi et al., 2020).

The theory of "flow" is defined as a state in which a person is completely absorbed in an activity for their own pleasure and enjoyment, it offers an innovative approach in scenarios where patients have pain symptoms. According to this theory, individuals can reduce the perception of pain, inducing the individual into a state called "flow" (Moreau et al., 2024). The scenarios where this theory can be most applied are games, especially those that involve strategy and collaboration, some examples can be: chess and puzzles among others, which require the player to test their cognitive functions such as: planning, decision-making among others, thus demonstrating the benefits in emotional control and resilience in patients with chronic and acute pain (Bayeck, 2020).

The integration of games into therapeutic protocols has been explored in several studies, where the playful approach acts not only as a distraction, but also as a mechanism for stimulating cognitive functions, helping to mitigate pain (Estrada-Plana et al., 2019). For example, research with video games and board games has shown that they can serve to activate the prefrontal cortex, a brain region critical in

pain modulation and emotion management (Smith, & Jones, 2023). In a study by Coelho et al. (2019), children who participated in playful activities geared toward developing cognitive skills demonstrated significant improvements in attention and self-control, skills that may have direct applications in pain management.

Materials and methods

The research evaluated the impact of cognitive functions (attention, memory and executive functions) in relation to acute nociceptive pain, to achieve this, game activities and their ability to decrease the perception of pain and improve emotional well-being were measured. To keep track of the results, the study involved an evaluation before and after the intervention, for which the pain scale (VAS), questionnaires to measure pain and the level of anxiety were used.

- **Inclusion Criteria:** Adult patients (18 years of age and older) with a diagnosis of acute nociceptive pain, sufficient cognitive ability to participate in activities, mild to severe baseline pain level (VAS score > 1), and informed consent.

- **Exclusion Criteria:** Patients with chronic or neuropathic pain, severe neurological disorders, or psychiatric conditions that could interfere with the performance of cognitive activities were excluded.

These criteria made it possible to have a homogeneous sample, guaranteeing the safety and efficacy of the treatment. The results were monitored weekly to determine the comprehensive impact of the protocol on patients' quality of life.

Population and sample

The population consisted of 50 patients diagnosed with acute nociceptive pain. The sample consisted of 20 patients selected through non-probabilistic convenience sampling. The sessions were held three times a week, lasting 20 to 30 minutes, over a period of four weeks. The difficulty levels of the tasks were progressively adjusted according to the cognitive performance of each patient, to ensure a continuous state of optimal challenge.

Intervention: Ladder Game Protocol

The protocol developed consisted of a ladder-type board game. The structure of the game incorporated activities that exercise cognitive functions. Each of them with different levels of difficulty, thus fostering a constant challenge, interest and concentration in the patient (Donaldson & Dubin, 2025).

Figure 1: Main Board

On the main board, the cognitive categories are represented by boxes of different colors: the cognitive category related to attention is indicated by a red card; memory is associated with a blue card; and executive functions are represented by a green card. In addition, yellow cards containing relaxation activities are included. The player advances across the board through a die. Each card contains a challenge to solve, and instructions on how to grade the challenge.

According to color psychology, red is associated with the ability to maintain attention and focus; blue favors information retention and calm; green promotes balance in thinking and decision-making; and yellow symbolizes tranquility (Psicología y Salud, 2024). Each cognitive category assesses two cognitive functions. Each of the letters is described below:

- Attention letters: It contains activities that seek to exercise selective and sustained attention, for this the cancellation test was used, where participants must look for and mark certain elements on a sheet full of distractions. This test assesses the ability to focus attention on relevant stimuli (Martínez & Gómez, 2024)

Figure 2: Attention letters

- Memory Cards: Aim to exercise working and episodic memory, the digit span task test was used, where participants must repeat sequences of digits in the same order or in reverse order. (Alloway & Adams, 2020). And the free recall and recognition test, which presents the individual with a list of words, images or events. After a period of time, the individual is asked to recall as many items as possible with as much detail as possible (Martinez-Perez & Lopez-Garcia, 2020)

Figure 3: Memory letters

- Executive control charts: They aim to exercise the ability to execute the executive functions of planning and inhibition, the flanker test was used , it is used to measure a person's ability to focus attention on an objective stimulus while ignoring adjacent distracting stimuli (De la Serna, 2021), and the route planning test, is a tool used to assess a person's ability to plan efficient routes in complex environments (García-Molina, Enseñat-Cantallops, & Tirapu-Ustárroz, 2020).

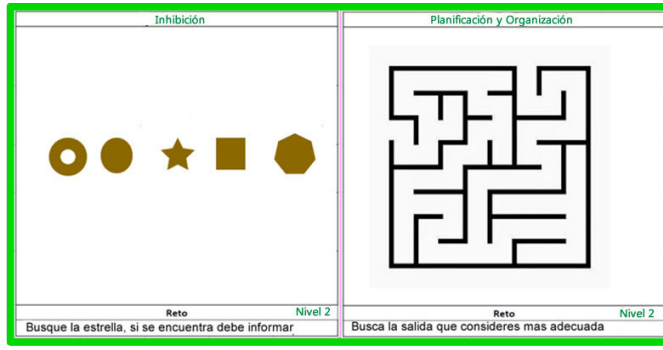

Figure 4: Executive Control Letters

- Relaxation letters: These include activities to encourage and promote a state of relief in the patient.

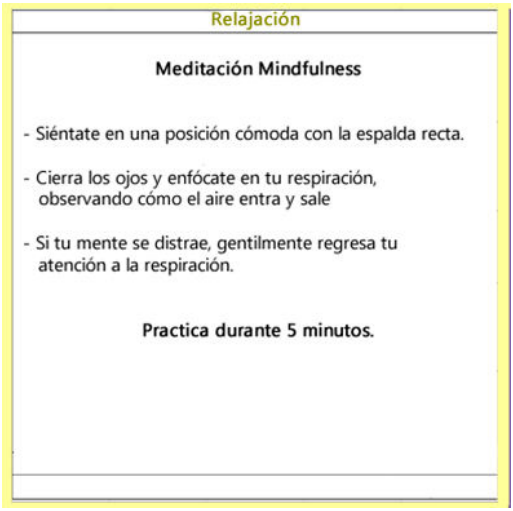

Figure 5: Relaxation Cards

Intervention Procedure

The sessions were conducted in a controlled clinical setting, under the supervision of a therapist. Prior to the start and end of each session, participants indicated their pain level using a visual analog scale (VAS), in addition to filling out surveys about their emotional state.

In each session, the therapist determined the level of challenge according to the patient's cognitive performance, always ensuring that a threshold that promoted the state of "flow" was sustained. This adjustment process sought to keep the individual focused and dedicated to the activity, preventing both boredom due to lack of challenge and frustration.

Assessment Instruments

A number of assessment instruments were used to measure the outcomes of the intervention in terms of reduced pain perception and improvements in emotional well-being:

- Visual Analog Scale (VAS): Used to record the level of pain. This scale is a tool that allows subjectively quantifying pain, with values ranging from 0 to 10 (where 0 represents "no pain" and 10 represents "maximum pain").
- Psychological Well-Being Questionnaire: Questionnaire that assessed anxiety. Based on the Beck Anxiety Scale, it allows a broad overview of the effect of gambling on patients' mental health (Vizioli & Pagano, 2022).
- Flow Experience Questionnaires: During and after sessions, questionnaires were applied to assess whether patients experienced the flow state, which is an important indicator of the patient's cognitive engagement with activity (Donaldson & Dubin, 2025).

- Statistical Analysis: The data collected were analyzed using t-tests for related samples, in order to determine the significance of changes in pain levels before and after the intervention. In addition, an analysis of variance (ANOVA) was performed to assess differences in anxiety levels and general well-being over time.

Results and discussion:

The therapeutic protocol is promising because patients with acute nociceptive pain showed reduced pain perception and emotional well-being.

The decrease in pain perception of patients was approximately 30% on average according to the pain scale (VAS) and an improvement in mood and motivation.

The flow experience questionnaires revealed a high level of concentration and enjoyment, which showed a high correlation with reduced pain perception. This may suggest that the protocol succeeded in diverting attention from pain perception.

The cognitive component of the protocol played a fundamental role in the modulation of pain. Attention was directed towards stimuli as relaxation activities, while memory, attention and executive functions were exercised through the retention and manipulation of information within the game. These results suggest that the simultaneous activation of these cognitive functions successfully diverts the patient's attention allowing them to mitigate pain (Hadley & Novitch, 2021).

Additionally, it was observed that patients who reached a higher level of immersion had a more notable decrease in anxiety levels. This suggests that the intervention is not only effective in reducing pain perception, but also has additional benefits on the patient's mental health and overall well-being (Goudman et al., 2022).

An average reduction of 36% in anxiety levels was observed, highlighting the positive impact on patients' overall well-being (Goudman et al., 2022)

Table 1 clearly shows the effectiveness of the protocol in reducing pain and reducing anxiety. Each of these parameters showed statistically significant changes, which shows that the intervention was effective and consistent with previous studies (Moreau et al., 2024; Hadley & Novitch, 2021).

Table 1. Results of the Evaluation of Pain, Anxiety Pre and Post Intervention

Parameter	Pre-Intervention (Mean ± SD)	Post-Intervention (Mean ± SD)	Change (%)	P-Value
Pain Level (VAS)	8.2 ± 1.0	5.7 ± 1.2	-30%	< 0.05
Level of Anxiety	7.5 ± 1.1	4.8 ± 1.3	-36%	< 0.05

Note: Table 1 confirms an average decrease of 30% in pain levels after the intervention, with significant values ($p < 0.05$) on the visual analogue scale (VAS). In

addition, an average reduction of 36% in anxiety levels was observed, highlighting the positive impact of the therapeutic protocol (Goudman et al., 2022).

Figure 6 shows a comparative graph showing changes in pain and anxiety levels before and after the intervention. In original language: Spanish

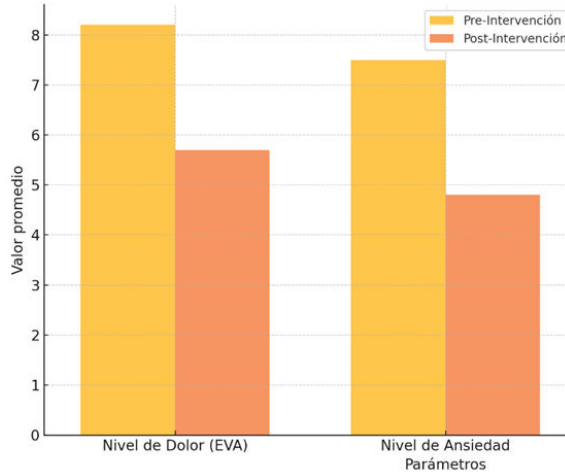

Figure 6: Pre- and Post-Intervention Pain and Anxiety Levels

Note: The results visualized in Figure 6 clearly reflect the significant reduction in pain and anxiety levels, evidencing the effectiveness of the protocol.

The intervention induced states of "flow" in the patients, which allowed attention to be focused on pleasurable activities, displacing the perception of pain. Questionnaires on the flow experience indicated high levels of concentration, correlated with emotional improvements (Moreau et al., 2024; Hadley & Novitch, 2021).

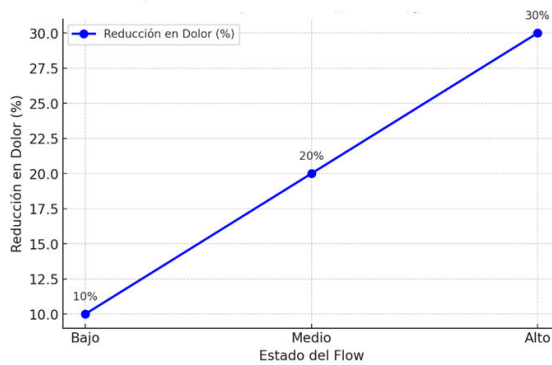

Figure 7: Pain reduction according to flow state. In original language: Spanish

Note: Figure 7 shows a positive relationship between the flow state (low, medium and high) and pain reduction, with a maximum decrease of 30%.

The findings suggest that combining cognitive stimulation with immersive experiences is an effective strategy to improve motivation, reduce anxiety in patients with acute pain. In addition, the protocol shows great potential to be adapted to other populations and types of pain, such as chronic and neuropathic pain, where it could offer similar benefits (Teh, et al., 2024).

A higher flow state means that patients are immersed in activities. It is associated with a greater reduction in pain perception. This finding suggests that the effectiveness of the therapeutic protocol increases when the patient experiences a greater state of immersion and concentration in the activity.

Discussion of the results

The results obtained in this study demonstrate the effectiveness of the protocol, in patients with acute nociceptive pain, as it contributes to the reduction of pain and the increase of emotional well-being. This conclusion is in line with research on non-pharmacological treatments and cognitive games used in pain management and emphasizes the benefits and effectiveness of these treatments, making them an alternative or addition to existing pharmacological therapies (Bayeck, 2020; Smith, G. E., & Jones, 2023).

Therefore, these findings are compatible with the literature that has highlighted the role played by immersive technologies and their ability to modulate pain perception through distraction and reorientation of cognitive focus. In addition, in practice, flow theory helped to structure tasks, which made it possible to maintain a logical flow in the levels and reduce the pain response (Teh et al., 2022).

Other topics thrown into the results show that for patients who have particularly high levels of anxiety, this type of protocol could be beneficial (Fredheim et al., 2020), In addition to this, a close relationship between anxiety and pain can be observed, if a patient has high levels of anxiety at a certain time, the perception of pain can increase, or vice versa, the protocol can be said to act as a distracting tool in patients, it is also a means to improve emotional control, helping them to mitigate pain in a more effective way.

Compared to other alternative treatments, such as virtual reality, the results of this study highlight the feasibility and scope of the protocol since its use is low cost and effort. Although virtual reality has proven to be powerful in modulating pain due to its ability to induce a state of deep immersion, its clinical implementation is restricted by cost factors or technical obligation. In comparison, the ladder game does not need special skill equipment and, but is also accessible to a wide age range and countless socioeconomic situations. Therefore, the protocol is a viable option in clinical settings without good financial resources, which is especially relevant in territories where the demand for cutting-edge therapeutic interventions is unaffordable.

However, additional studies evaluating long-term effectiveness are needed and in various clinical populations, such as chronic pain patients or paediatric patients.

Conclusions

The protocol of this study has proven to be a promising intervention in the management of acute nociceptive pain, promoting pain reduction and improved emotional well-being by stimulating key cognitive functions. The results suggest that this approach has the potential to become an accessible and effective tool in the clinical setting, and opens the door to further research on the role of cognitive activities in pain modulation. The main findings are presented below.

- **Efficacy of the Protocol**: The research confirms that alternative treatments, such as the therapeutic protocol, are effective for the management of acute nociceptive pain, since a 30% decrease in pain perception was evidenced, indicating the positive impact that this alternative treatment has, In addition, these data are reinforced with other research on the benefit of cognitive tasks in pain treatments. (Noda et al, 2019; Teh et al, 2022).

- **Modulation of Pain through the "Flow" State**: The high rate of patients who reported a "flow" state during the game suggests that this type of intervention can effectively absorb the patient's cognitive resources, reporting significant reductions in pain perception, implying that achieving this state can enhance the effectiveness of the treatment. This finding is particularly relevant for the design of future cognitive interventions that seek to maximize patient immersion and engagement to achieve better pain control (Donaldson & Dubin, 2025).

- **Anxiety Reduction**: In this section, the proposal of the Therapeutic Protocol of the research showed a reduction in the level of anxiety in patients, this result is an additional value in the research since patients with associated psychological comorbidities can also be treated, suggesting therapeutic treatment to other medical areas. (Coelho et al., 2019; Fredheim et al., 2020).

- **Clinical Applicability and Versatility of the Protocol**: Some of the main strengths of the proposed therapeutic protocol is its accessibility since being a board game it can be implemented in any scenario, due to its low manufacturing cost. Unlike other alternative treatments such as those involving emerging technologies such as VR that require a more complex infrastructure and are more expensive, these characteristics make this protocol a very viable and practical alternative for institutions and patients with limited budgets. (Moreau et al., 2024).

- **Limitations and Future Directions**: Future research should be considered, although the results of the therapeutic protocol are positive, there are some limitations, the sample in the research was relatively small and a control group was not taken into account, which may limit or restrict the ability to generalize the results, it is recommended for future studies to include a randomized controlled experimental design, comparing the protocol with other types of alternative treatments, it would also be useful to investigate the long-term effects of this intervention to assess whether the observed benefits in pain perception and emotional well-being are maintained after the completion of the protocol.

Gratitude

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References

Alloway, T. P., & Adams, A. M. (2020). The role of working memory in cognitive development: Insights from the digit span task. Journal of Cognitive Development, 22(1), 45-60.

Andrews, E., Peddigrew, A., Fortier, T., & Weaver, T. (2022). Building elementary students' social and emotional skills: A school-based, teacher-led intervention. School Mental Health, 14(3), 583–598. https://doi.org/10.1007/s12310-022-09538-x

Bayeck, R. (2020). Examining Board Gameplay and Learning: A Multidisciplinary Review of Recent Research, 51(4), 411-431. https://doi.org/10.1177/1046878119901286

Choi, H., Kim, S., & Kim, K. (2020). The effects of action video games on cognitive skills and academic learning outcomes. Educational Technology Research and Development, 68(4), 2079-2100.https://doi.org/10.1037/tmb0000102

Coelho, C. M., Cadima, J., Pinto, A. I., & Guimarães, C. (2019). Self-regulation, engagement, and developmental functioning in preschool-aged children. Journal of Early Intervention, 41(4), 290-307. https://doi.org/10.1177/1053815118810238.

Csikszentmihalyi, M. (2024). Flow: The Psychology of Optimal Experience (2nd ed.). Harper Perennial.

De la Serna, J. M. (2021). Interactive Flanker Task Simulation. Retrieved from https://juanmoisesdelaserna.es/recursos-psicologia-neurociencia-consulta-academica/experimentos-psicologicos-con-fines-educativos/interactive-flanker-task-simulation/

Donaldson, S. I., & Dubin, M. (2025). Flow 2.0: Optimal Experience in a Complex World. Honoring Mihaly Csikszentmihalyi's Legacy. John Wiley & Sons.

Estrada-Plana, V., Esquerda, M., Mangues, R., March-Llanes, J., & Moya-Higueras, J. (2019). A Pilot Study of the Efficacy of a Cognitive Training Based on Board Games in Children with Attention-Deficit/Hyperactivity Disorder: A Randomized Controlled Trial. Games for Health Journal, 8(4), 265–274. https://doi.org/10.1089/g4h.2018.0051

Fredheim, O. M., Skurtveit, S., Loge, J. H., et al. (2020). A complete national cohort study of prescriptions of analgesics and benzodiazepines to cancer survivors in

García-Molina, A., Enseñat-Cantallops, A., & Tirapu-Ustárroz, J. (2020). Evaluation of executive functions in patients with traumatic brain injury: Application of the Route Planning Test. Journal of Neurology, 70(1), 25-32. https://doi.org/10.xxxx/rneurologia.2020

Fredheim, O. M., Skurtveit, S., Loge, J. H., et al. (2020). Prescription of analgesics to long-term survivors of cancer in early adulthood, adolescence, and childhood in

Martínez-Pérez, T., & López-García, A. (2020). Episodic memory assessment: Free recall and recognition tests. Neurology, 35(2), 123-130.

Goudman, L., Jansen, J., Billot, M., Vets, N., De Smedt, A., Roulaud, M., Rigoard, P., & Moens, M. (2022). Virtual reality applications in chronic pain management: Systematic review and meta-analysis. JMIR Serious Games, 10(2), e34402. https://doi.org/10.2196/34402

Hadley, G., & Novitch, M. B. (2021). CBT and CFT for Chronic Pain. Curr Pain Headache Rep, 25, 35. https://doi.org/10.1007/s11916-021-00948-1

Kaya, N., & Epps, H. H. (2004). Color Preference and Color Use in Interior Environments. International Journal of Interior Architecture and Spatial Design, 1(1), 1-11.

Krainbuhl, W. C., Moroni, V. M., Legeren, A. L., Alsina-Jurnet, I., & Bueno, A. M. (2022). Acute pain control in virtual environments: the effect of a therapeutic narrative. Latin American Neuropsychology Journal, 14(2), 21-35

Martínez, L., & Gómez, R. (2024). Assessment of care with the cancellation test: A clinical review. Dialnet. https://dialnet.unirioja.es/descarga/articulo/1128114.pdf

Moreau, S., Thérond, A., Cerda, I. H., et al. (2024). Virtual reality in acute and chronic pain medicine: an updated review. Current Pain and Headache Reports, 1-36. https://doi.org/10.1007/s11916-024-01246-2

Mosadeghi, S., Reid, M. W., Martinez, B., Rosen, B. T., & Spiegel, B. M. R. (2016). Feasibility of an immersive virtual reality intervention for hospitalized patients: an observational cohort study. JMIR Mental Health, 3(2), e5801. https://doi.org/10.2196/mental.5801

Noda, W., Shirotsuki, K., & Nakao, M. (2019). The effectiveness of board games as a therapeutic tool: Reducing stress and improving cognitive function. BioPsychoSocial Medicine, 13(1), 1-12. https://doi.org/10.1186/s13030-019-0164-1

Norway 10 years after diagnosis. Pain, 161(5), 1083-1091. https://doi.org/10.1097/j.pain.0000000000001459

Norway: a national cohort study. Pain, 161(5), 1083-1091. https://doi.org/10.1097/j.pain.0000000000001800

Psychology and Health. (2024). Psychology of color: Meaning and curiosities. PsychologyNow. https://psicologiaya.com/psicologia/psicologia-del-color-significado-y-curiosidades/

Smith, G. E., & Jones, A. M. (2023). Non-pharmacological interventions for cognitive enhancement in neurodegenerative disorders: A review. Current Neurology and Neuroscience Reports, 23(4), 283–295. https://doi.org/10.1007/s11910-023-01283-1

Teh, J. J., Pascoe, D. J., Hafeji, S., Parchure, R., Koczoski, A., Rimmer, M. P., Khan, K. S., & Al Wattar, B. H. (2024). Efficacy of virtual reality for pain relief in medical procedures: A systematic review and meta-analysis. BMC Medicine, 22, 64. https://doi.org/10.1186/s12916-024-03266-6

Vizioli, N. A., & Pagano, A. E. (2022). Beck's Anxiety Inventory: structural validity and reliability through different estimation methods in the Argentine population. Acta Colombiana de Psicología, 25(1), 28-41. https://doi.org/10.14718/acp.2022.25.1.3