Brain correlates of pain perception in older adults suffering from chronic pain

A. Dorado[1], C. Sitges[1], J.L. Terrasa [1], M. Van der Meulen[2], F. Anton[2], A.M. González-Roldán[1].

[1]Instituto Universitario de Investigación en Ciencias de la Salud (IUNICS), Institut d'investigació Sanitaria Illes Balears (IdISBa), Universidad de las Islas Baleares, Palma, España

[2]Institute of Health and Behaviour, Department of Behavioural and Cognitive Sciences, University of Luxembourg, Esch-sur-Alzette, Luxembourg

Introduction

The prevalence of chronic pain is known to increase with advancing age (Patel et al., 2013). Moreover, aging seems to be associated with altered pain perception (increased pain thresholds, but reduced amplitudes in pain-related evoked potentials) (Lautenbacher et al., 2017). However, few studies have investigated how aging and chronic pain combined to produce enhanced pain perception. The present study compared pain event-related potentials (pain-ERPs) of older participants (>60 years old) with and without chronic musculoskeletal pain, as well as pain-free younger adults (<25 years old).

The objective was to examine the brain processing of painful stimuli in older adults with chronic pain, to better understand how chronic pain and aging combines.

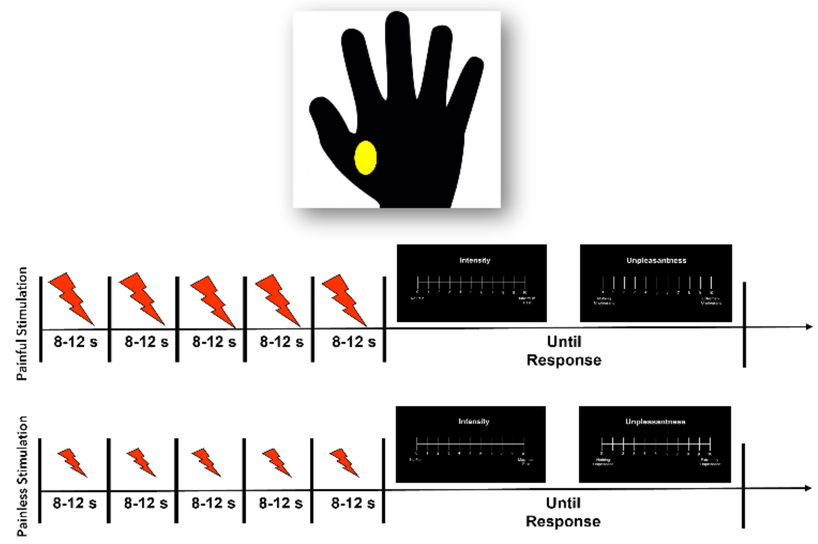
Materials and Methods

Participants. 27 pain-free older adults (13 male, mean age = 70.4, SD = 4.4), 9 older adults with chronic pain (1 male, mean age = 70.7, SD = 4,2), and 23 pain-free younger adults (10 male, mean age = 21.4, SD = 1.7).

Experimental design (see Figure 1). Pain perception (subjective ratings) and pain-ERPs were recorded. Participants received, in the thenar eminence of the non-dominant hand, 6 blocks of 5 trains of painful electrical stimulation (3 stimulus of 1ms duration, separated by 5ms) individually adjusted to elicit a pain intensity of 4 in a 0-10 numerical rating scale (NRS). There was an ISI of 8-12 s between stimulations. Moreover, a similar block but with non-painful stimuli was presented. At the end of each block, participants assessed the pain intensity and unpleasantness felt.

Data analysis. 1. Sensory and pain threshold, as well as pain intensity eliciting a NRS=4 were analyzed with a Univariate ANOVA (young vs. older VS. older with pain). **2.** Pain intensity and unpleasantness ratings were analyzed with a repeated measures ANOVA using STIMULATION (painful vs. non-painful) as within-subject factor and GROUP (younger vs. older vs. older with pain) as between-subject factor.**3.** P1, N1 and P300 amplitudes were analyzed with the same factors plus LATERALITY (left (C3), midline (Cz), right (C4). Bonferroni corrections were performed when necessary.

Fig. 1. Experimental design



Results

1. **Thresholds.** We found significant differences in pain thresholds analyses, showing reduced pain thresholds in older adults with chronic pain in comparison to pain-free older participants (p <.05) (see Figure 2).
2. **Pain experiment.** The painful condition was always evaluated as more intense and unpleasant than the non-painful condition (all ps<.001) (see Figure 3). In agreement, pain stimuli elicited larger N1, P1 and P300 amplitudes than the non-painful stimuli in all participants (all ps<.005) (see Figure 4). Regarding group differences, we found non-significant effects in pain intensity and unpleasantness ratings (all ps>.05). However, pain-free younger participants showed larger N1 (p=.052) and P1 (p=.01) amplitudes than pain-free older adults (regardless of the stimulation condition), while no significant differences were found between pain-free younger and older adults with chronic pain (p>.05). In P300 we found that in the painful stimulation condition, pain-free younger participants and older adults with chronic pain showed larger P300 amplitudes than pain-free older adults (significant trend p=.06, p=.016, respectively). Finally pain-free younger showed larger P300 apmplitudes in the non-painful condition than pain-free older adults (p<.015).

Fig. 2. Sensory and pain threshold and intensity eliciting a NRS=4

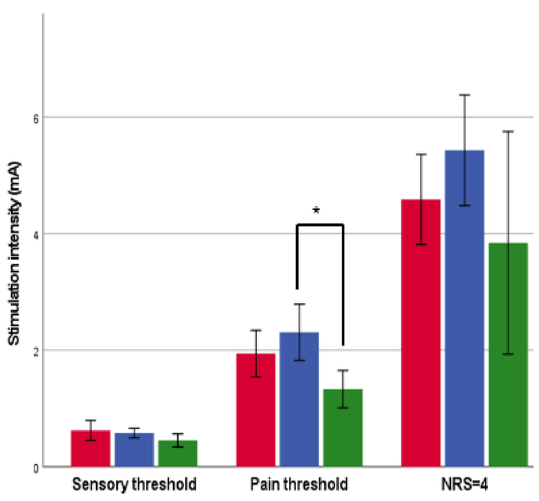


Fig. 3. Intensity and unpleasantness pain ratings

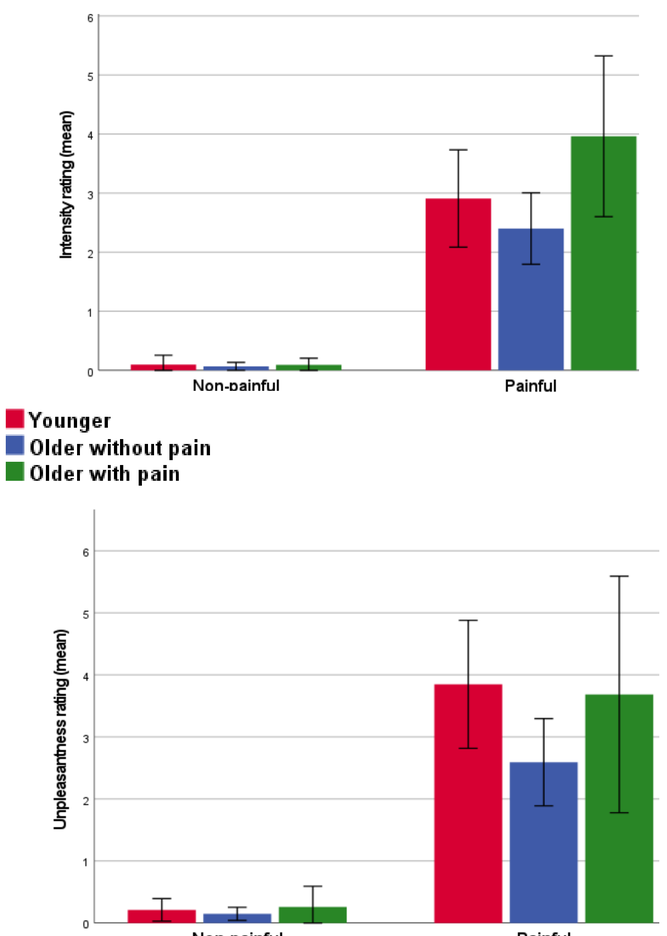
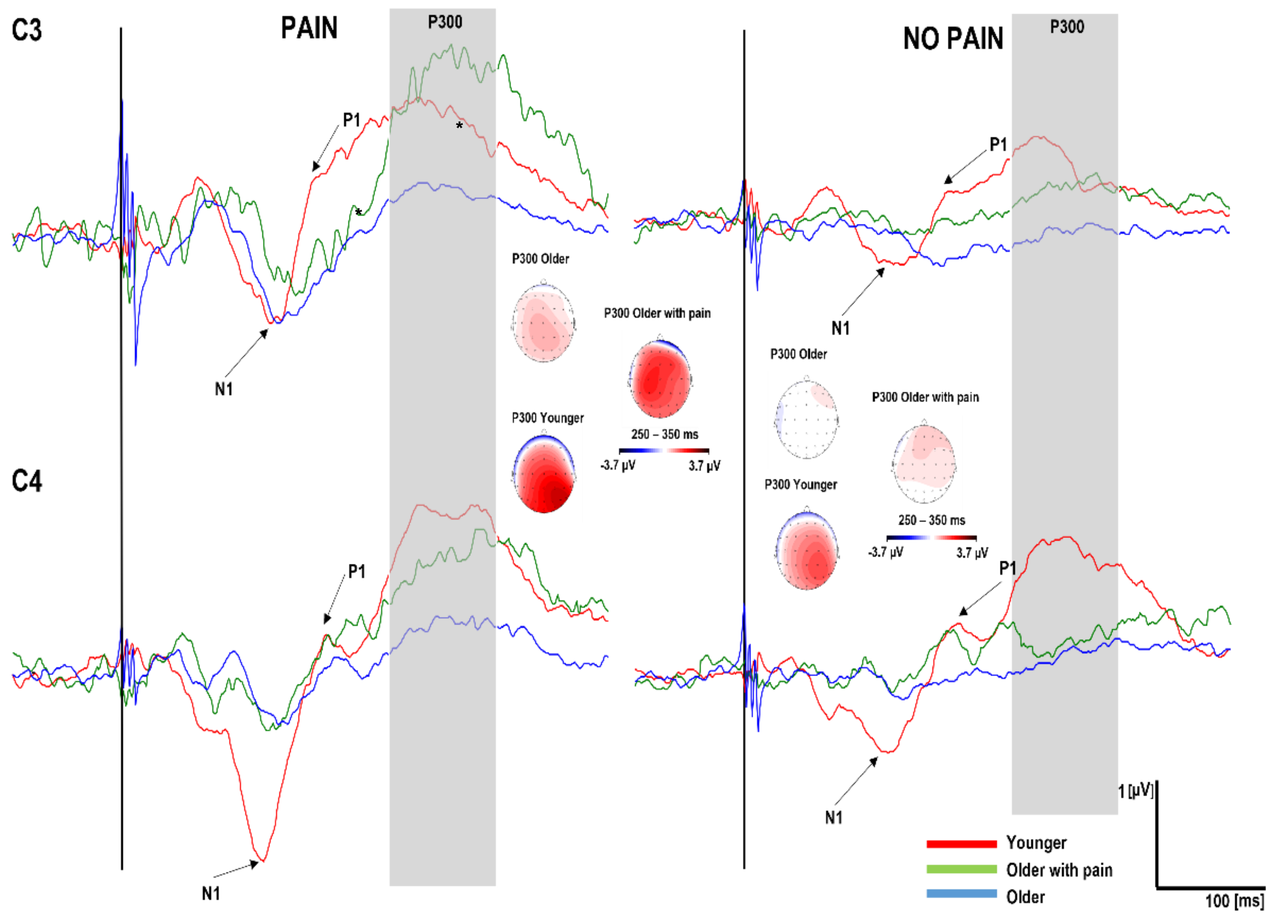


Fig. 4. ERPs by painful and non-painful stimulation



Conclusions

Older participants suffering from chronic pain showed a similar ERP pattern, for both painful and non-painful conditions, as older participants without pain in early latencies (flattened response in comparison to younger adults), but increased amplitudes in late evoked potentials. It is possible that the increased P300 amplitudes showed by the chronic pain group may be mirroring an augmented alarm/orienting response to the pain stimulation. Altogether, results suggest that plastic changes driven by suffering from long-lasting pain outweigh those triggered by the normal aging process, when both conditions coexist.

References

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e-mail: alejandro.dorado1@estudiant.uib.cat

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