Chronic pain is not associated with accelerated structural brain aging

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Submission Type:

Abstract Submission

Authors:

Peter Sörös[1], Carsten Bantel[1]

Institutions:

[1]University of Oldenburg, Oldenburg, Germany

Introduction:

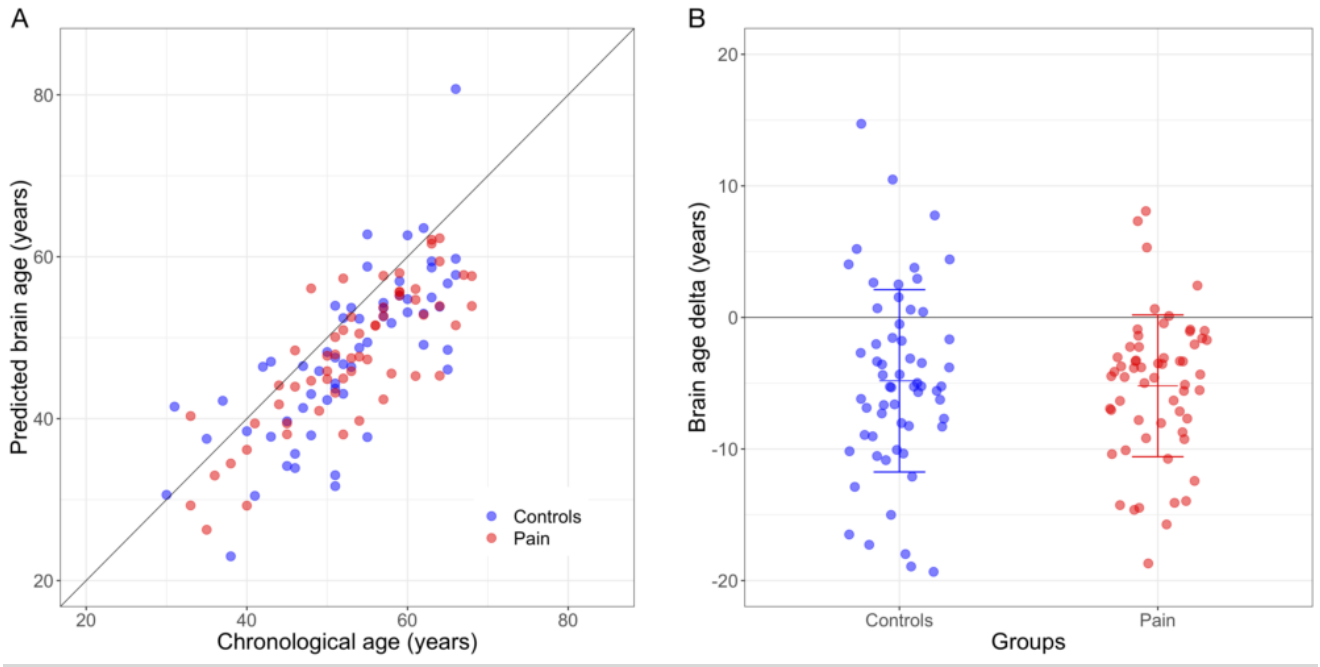
Chronic pain is often associated with changes in brain structure, brain function, and cognitive and emotional processes. Although chronic pain is a highly prevalent and relevant health care issue, its pathophysiology remains unclear. In particular, the functional significance of gray and white matter changes in the brains of patients with chronic pain is still unresolved. It has been noted that structural changes of the brain found in patients with chronic pain may resemble changes found in healthy aging and thus may represent accelerated or premature aging of the brain (Cruz-Almeida 2019, Kuchinad 2007, Moayedi 2012). Here, we test the hypothesis that patients with chronic pain demonstrate accelerated brain aging compared with healthy control subjects.

Methods:

59 patients with chronic noncancer pain (mean chronological age ± SD: 53.0 ± 9.0 years; 43 women) and 60 pain-free healthy controls (52.6 ± 9.0 years; 44 women) were investigated. Chronic pain was defined as persistent pain on most days of a month for at least 12 months of mild to severe intensity. Pain duration was 16 ± 11 years (minimum 1 year, maximum 50 years). Mean pain intensity on an 11-point numerical rating scale (0 representing "no pain" and 10 "worst pain imaginable") on the day of the measurement was 5 ± 2. T1-weighted MR images of the entire brain were acquired on a Siemens MAGNETOM Prisma whole-body scanner (Siemens, Erlangen, Germany) at 3 Tesla with a 64-channel head/neck receive-array coil with an MPRAGE sequence. Based on this image, brain age was predicted using the software brainageR. This software segments the individual T1-weighted structural MR images into gray and white matter and compares gray and white matter images with a large (n = 2001) training set of structural images, using machine learning (Cole 2017, Cole 2018). Finally, brain age delta, which is the predicted brain age minus chronological age, was calculated and compared across groups.

Results:

This study provided no evidence for the hypothesis that chronic pain is associated with accelerated brain aging. Brain age delta was -4.8 ± 6.9 years in the control group and -5.2 ± 5.4 years in the chronic pain group (Welch t-test, P = 0.74, Cohen's d = 0.061; Figure 1). A Bayesian independent-samples t-test indicated moderate evidence in favor of the null hypothesis (BF01 = 4.875, i.e., group means were equal).



·Relationship between chronological age and predicted brain age.

Conclusions:

Our results have important implications for the pathogenesis of structural alterations of the brain and, ultimately, cognitive deficits in patients with chronic pain. Our results suggest that chronic pain does not induce widespread neural and glial degeneration, presumably the leading cause of age-related structural brain changes. Our results indirectly support recent alternative models of regional, network-specific structural and functional brain alterations in chronic pain (Cauda 2014, Farmer 2012). These models also suggest that the frequently observed cognitive deficits in chronic pain are the direct consequence of persistent nociceptive input, mediated by the aforementioned network-specific structural and functional changes, rather than the result of generalized accelerated aging of the brain.

Lifespan Development:

Aging

Modeling and Analysis Methods:

Multivariate Approaches [2]
Segmentation and Parcellation

Perception, Attention and Motor Behavior:

Perception: Pain and Visceral [1]

Keywords:

Aging
Machine Learning
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Pain
STRUCTURAL MRI
White Matter

[1|2]Indicates the priority used for review

My abstract is being submitted as a Software Demonstration.

No

Please indicate below if your study was a "resting state" or "task-activation" study.

Other

Healthy subjects only or patients (note that patient studies may also involve healthy subjects):

Patients

Was any human subjects research approved by the relevant Institutional Review Board or ethics panel? NOTE: Any human subjects studies without IRB approval will be automatically rejected.

Yes

Was any animal research approved by the relevant IACUC or other animal research panel? NOTE: Any animal studies without IACUC approval will be automatically rejected.

Not applicable

Please indicate which methods were used in your research:

Structural MRI
Other, Please specify - machine learning

For human MRI, what field strength scanner do you use?

3.0T

Which processing packages did you use for your study?

SPM
FSL

Provide references using author date format

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