



High-resolution T1-weighted MRI combined with Principal Component Analysis and k-Nearest Neighbors classification distinguishes former professional soccer players exposed to repetitive head impacts from healthy controls

Poster

Neurobiología de enfermedades - Neurobiology of disease

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Background: Repetitive head impacts (RHI) in contact sports are a public health concern because of their association with chronic traumatic encephalopathy (CTE), a neurodegenerative disease¹⁻³. The gold standard for CTE diagnosis remains *post-mortem*^{4,5}. Thus, *in vivo* markers are needed. CTE is defined neuropathologically by focal perivascular p-tau in cortical sulcal depths. Early stages I-II involve the frontal and temporal cortices; advanced stages extend further, with obvious atrophy^{6,7}. Soccer is a globally relevant RHI model: a worldwide sport, where heading exposes players to high-velocity impacts. Former professional soccer players show increased neurodegenerative mortality¹⁰. Structural-MRI studies in former American football players report morphometric alterations overlapping with frontotemporal vulnerability¹¹, but evidence in soccer players remains scarce, particularly in Latin America, where soccer is the most popular sport.

Methods: We studied 14 former Chilean professional soccer players and 11 controls.

T1-weighted images, acquired in a 3T Philips Ingenia MRI scanner, were processed with FreeSurfer 7.4.1¹²⁻¹⁴ and SynthSeg¹⁵. We include clinical and neuropsychological evaluations. PCA+kNN evaluated group discrimination.

Results: Neurological and cognitive functions were mostly preserved. However, former players showed greater depressive symptoms ($p < 0.017$) and motor symptoms ($p < 0.022$). MRI showed nominal thinning in the temporal and frontal cortices, not significant after FDR-correction. However, our PCA+kNN approach, using only structural-MRI, could discriminate players from controls with 86% sensitivity, 73% specificity, 80% PPV, and 80% NPV.

Conclusion: This proof-of-concept study suggests that PCA+kNN may capture distributed structural MRI patterns using high-resolution T1-weighted MRI, a routinely acquired sequence with high access and translational potential.

Financiamiento:

Funding: This study was funded by FONDECYT 1190620 and 1260578; and Instituto Milenio iHEALTH (ICN2021_004), Agencia Nacional de Investigación y Desarrollo (ANID), Chile.