Sleep fragmentation alters brain structure, especially in women

- **A new study led by the Barcelonaβeta Brain Research Center (BBRC), research center of the Pasqual Maragall Foundation, reveals the relationship between sleep fragmentation and brain structure in cognitively healthy adults, with more pronounced effects in women.**
- **This research achieved a more precise and ecologically valid measurement of sleep quality thanks to the combined use of actigraphy, brain MRI scans, and biomarker analysis.**
- **The study, published in the journal Alzheimer's & Dementia, the study involved 171 cognitively healthy adults from the BBRC's ALFA+ longitudinal cohort, with support from the "la Caixa" Foundation.**

Barcelona, 22 July 2025 - Poor sleep may affect the brain long before the first signs of Alzheimer's disease appear. A new study from the ALFASleep project, led by the **Barcelonaβeta Brain Research Center** (BBRC)—the research center of the **Pasqual Maragall Foundation**—in collaboration with the **"la Caixa" Foundation**, shows **that poor sleep quality**, specifically increased fragmentation, **is associated with structural brain changes in regions vulnerable to Alzheimer's disease**, even in individuals with no cognitive impairment and regardless of Alzheimer's pathology.

The study, published in *Alzheimer's & Dementia*, stands out for its methodological rigor, combining objective sleep monitoring with multimodal brain assessments, including cerebrospinal fluid (CSF) biomarkers and MRI imaging.

The research was led by **Dr. Laura Stankeviciute**, first author of the study, and **Dr. Oriol Grau**, group leader of the Clinical and Risk Factors for Neurodegenerative Diseases Research Group at BBRC. The findings reinforce growing evidence that poor sleep can compromise brain structure independently of Alzheimer's pathology—and that **women may be more susceptible to these effects.**

"Sleep disturbances are common in aging and even more pronounced in individuals with Alzheimer's disease. Our results not only support previous findings but also reveal a particularly striking pattern: we observed measurable brain structure changes that occur independently of classical Alzheimer's biomarkers. This suggests that sleep fragmentation may contribute to disease-related brain changes through mechanisms not solely explained by established pathology," explains Dr. Oriol Grau.

A study that stands out for its methodological robustness

The study included **171 cognitively healthy adults**, most at higher risk of developing Alzheimer's, from the ALFA+ cohort, part of the BBRC's ALFA study promoted by the "la Caixa" Foundation. Unlike prior studies relying on subjective self-reports, this research used **actigraphy**— a non-invasive device that tracks sleep patterns in participants' natural environments over periods of up to two weeks, offering **more accurate and ecologically valid insights.**

Participants also underwent **brain MRI scans and cerebrospinal fluid analysis** to measure amyloid and tau proteins, the main **biomarkers of Alzheimer's disease**. By combining objective sleep data with biomedical tests, the research team was able to **isolate the independent role of sleep disturbances** in relation to brain structure.

Using **actigraphy**, researchers found **that lower sleep efficiency** and **greater sleep fragmentation** were associated with **reduced cortical thickness** in the medial temporal lobe and other areas typically affected in early Alzheimer's disease. These patterns were especially pronounced in women, who—despite sleeping longer on average—showed a stronger link between disrupted sleep and thinner brain regions.

Implications for brain health and prevention

These findings add to growing evidence **that poor sleep quality is a modifiable risk factor** for age-related brain changes and neurodegeneration. The study suggests **that monitoring and improving sleep during midlife and later years could help protect brain health**, even among individuals who have not yet shown any clinical signs of Alzheimer's. The stronger effects observed in women further underscore the importance of **sex-specific research and early prevention strategies.**

"It is important to highlight that our study is among the first to show that the effects of objectively measured poor sleep differ by sex, with women showing greater vulnerability. As women are at a higher lifetime risk of developing Alzheimer's, identifying modifiable factors such

as sleep that may drive early neurobiological changes is a crucial step to improve risk prediction and develop more targeted prevention strategies," adds Dr. Laura Stankeviciute.

While causality cannot yet be confirmed, the study supports a growing body of evidence positioning **sleep as both a marker and a potential contributor to neurodegeneration**. Longitudinal and interventional studies are needed to determine whether improving sleep can help reduce brain vulnerability and lower the long-term risk of cognitive decline.

Reference

Stankeviciute L, Tort-Colet N, Fernández-Arcos A, Sánchez-Benavides G, Minguillón C, Fauria K, Holst SC, Garcés P, Mueggler T, Zetterberg H, Blennow K, Iranzo Á, Suárez-Calvet M, Gispert JD, Molinuevo JL, Grau-Rivera O; ALFA Study. Associations between objective sleep metrics and brain structure in cognitively unimpaired adults: interactions with sex and Alzheimer's biomarkers. Alzheimers Dement. 2025 Jun;21(6):e70353. doi: 10.1002/alz.70353. PMID: 40566790; PMCID: PMC12198473.

About ALFASleep

The aim of the ALFASleep project is to characterize sleep patterns with subjective and objective measures in middle-aged adults without cognitive impairment and with an increased risk of developing Alzheimer's in the future, and relate them to biomarkers and state-of-the-art neuroimaging data. Thanks to its multimodal approach and the study participant cohort, enriched by risk factors, the project will contribute to the understanding of the mechanisms underlying the association between sleep and cognitive impairment. Thus, the project aims to develop non-invasive biomarkers and preventive strategies aimed at sleep. ALFASleep has the participation of 200 people from the ALFA+ cohort.

Alzheimer's disease in numbers

It is currently estimated that Alzheimer's disease and neurodegenerative diseases affect 900,000 people, a figure that translates to one in ten of those over 65 years of age and a third of those over 85. These diseases are one of the main causes of mortality, disability, and dependency. If an effective cure is not found and life expectancy continues to increase, the number of cases worldwide could triple by 2050, exceeding one and a half million people in Spain alone, a situation that could lead to the collapse of healthcare and care systems.

About the BarcelonaBeta Brain Research Center and the Pasqual Maragall Foundation

The BarcelonaBeta Brain Research Center (BBRC) is the research centre of the Pasqual Maragall Foundation, supported by the "la Caixa" Foundation since its creation, dedicated to the prevention of Alzheimer's disease and the study of cognitive functions affected in healthy and pathological aging. BBRC research focuses on the preclinical phase of Alzheimer's disease, the period before the first symptoms appear, when changes in the brain associated with the disease already occur. The BBRC has more than 100 professionals dedicated to contributing to the forefront of research into Alzheimer's disease and other neurodegenerative diseases.

The Pasqual Maragall Foundation is a non-profit organization founded in April 2008 in response to the commitment made by Pasqual Maragall, former mayor of Barcelona and former president of the Generalitat de Catalunya, when he publicly announced that he had been diagnosed with Alzheimer's disease. The Foundation's mission is to promote research to prevent Alzheimer's disease and offer solutions that improve the quality of life of those affected and their families.

The Pasqual Maragall Foundation has the support of more than 93,000 members and of:

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