# Analysis of the Effect of Stretching Exercises on Alzheimer's Disease

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*Abstract*—In this research, we examined the effect of low-intensity stretching exercise intervention in Alzheimer's disease over a period of 12 months—consisting of a 6-month intervention period and a 6-month follow-up period. Our analysis indicated that stretching exercises may help reduce the progressive decline in, or may even slightly increase, the neuronal activity, functional connectivity, and the global cognition in older adults with mild-to-moderate AD dementia, especially during the 6-month follow-up period.

## I. INTRODUCTION

Alzheimer's disease (AD) is the most common form of dementia and causes problems with memory, thinking, and behavior. It is a degenerative brain disorder, characterized by progressive deterioration of nerve cells, eventually leading to cell death. Alzheimer's drugs might be one strategy to help reduce cognitive impairment in AD. However, Alzheimer's drugs may not work for everyone and their effects may wear off over time. As an alternative approach to alleviate AD symptoms, non-pharmacological interventions are attracting more attention from the research community. In this paper, we examined the immediate and longitudinal effects of 6-month light-intensity stretching on cognition in older adults with AD dementia over a period of 12 months—consisting of a 6-month intervention period and a 6-month follow-up period. Joint analysis on the resting-state fMRI images and Alzheimer's Disease Assessment Scale-Cognitive (ADAS-Cog) scores indicated that—stretching exercises may help reduce the progressive decline in, or even slight slightly increase the neuronal activity, functional connectivity, and global cognition in older adults with mild-to-moderate AD dementia, especially during the 6-month follow-up period.

## II. METHODS AND RESULTS

Twenty-one community-dwelling older adults 66 + years old with mild-to-moderate AD dementia participated the experiment, where the participants went through supervised low-intensity intervention sessions (20–50 min, included primarily seated movements and static stretches) three times a week for six months, and they were followed for another 6 months. The AD Assessment Scale-Cognition Subscale test (ADAS-Cog) and the resting-state fMRI scan were performed at baseline, 6, and 12 months. 18 subjects completed all the three times. [1]. AFNI and FreeSurfer were used for fMRI image preprocessing. The fMRI scans of 3 out of 18 subjects failed to pass the pre-processing procedure due to excessive motion during the fMRI scan, and hence were discarded in data analysis. As a result, our analysis was based on 15 subjects.

We selected four brain regions—the left and right isthmus of the cingulate cortex (ICC), and the left and right hippocampus—as our ROI network [2]. We evaluated: (i) the power of the BOLD signal at each ROI, which reflects the neural activity level of the brain region; (ii) the functional connectivity (in terms of mutual information) among all the region pairs in the ROI network, which reflects the amount of successful information exchange between the brain regions. The sum of mutual information corresponding to each region pair is referred to as the overall ROI network throughput. Relatively strong connectivity duration denotes the overall time period where the connectivity level is above the mean connectivity level during the first scan. All the results were averaged over the 15 subjects.

| Averaged results over 15 subjects | Baseline | 6 months | 12 months |
|---|---|---|---|
| Left ICC BOLD signal power | 13.0649 | 10.0649 | 10.6351 |
| Right ICC BOLD signal power | 10.4063 | 8.2295 | 8.9090 |
| Relatively strong connectivity duration (sec): Left and right ICC | 344.6667 | 258.1333 | 299.2000 |
| Left hippocampus BOLD signal power | 2.0155 | 2.0089 | 2.0312 |
| Right hippocampus BOLD signal power | 2.1797 | 3.4840 | 2.2501 |
| Relatively strong connectivity duration (sec): Left and right hippocampi | 308.0000 | 297.7333 | 322.6667 |
| ROI Network throughput | 3.2317 | 3.4250 | 3.4211 |
| ADAS-Cog | 18.0007 | 17.0453 | 19.7107 |

Our results indicated that stretching exercises may help reduce the progressive decline in neuronal activity, functional connectivity, and global cognition in older adults with mild-to-moderate AD dementia, especially during the 6-month follow-up period. In some regions, even slight increase was observed in the BOLD signal power level and functional connectivity, which echoes the slight increase in the average ADAS-Cog score in the 6-month follow-up period.

## REFERENCES

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