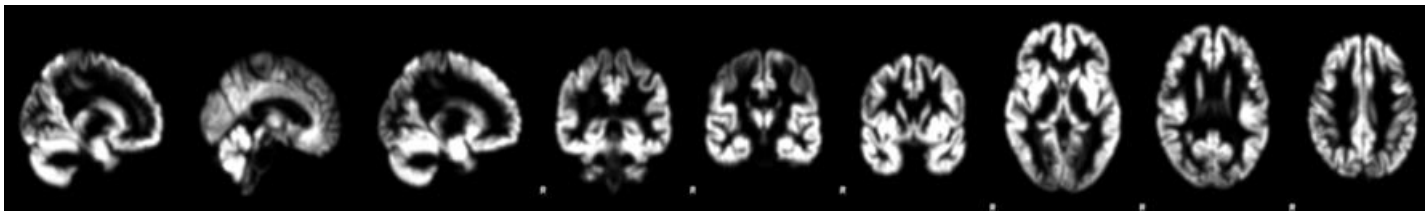

Decoding Brain Health: The Interplay of Fitness, Fatness, Sleep, and Physical Activity on Structure and Network Connectivity in Aging Brains

DAVID WING

PUBLIC PHD DEFENSE FOR THE DEGREE OF
DOCTOR IN MOVEMENT AND SPORT SCIENCES

TUESDAY APRIL 1ST, 2025 AT 17:30
PROMOTIEZAAL AUDITORIUM I.0.0.02, CAMPUS ETTERBEEK

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ABSTRACT OF THE RESEARCH

Brain health is a critical determinant of cognitive function and emotional regulation, particularly as individuals age. This dissertation, *Decoding Brain Health: The Interplay of Fitness, Fatness, Sleep, and Physical Activity on Structure and Network Connectivity in Aging Brains*, explores how modifiable lifestyle factors influence brain aging at both structural and functional levels. Specifically, it examines the relationships between fitness, body composition, physical activity, and sleep with brain structure and functional connectivity, aiming to clarify whether targeted interventions can slow or reverse age-related brain function decline. Additionally, the research investigates how exercise and mindfulness interventions affect functional connectivity within key brain networks and highlights methodological challenges in studying these effects.

The dissertation begins with a foundational overview of brain structures, functional networks, and neurochemical compounds critical for maintaining physiological homeostasis, emotional stability, and higher-order cognition. This is followed by a narrative review of the literature on exercise and mindfulness-based interventions, emphasizing the methodological inconsistencies in neuroimaging studies and proposing standardized best practices.

A novel method for estimating brain health, BrainAge, is then introduced as a tool for assessing age-related changes using empirical analyses. Both cross-sectional and longitudinal analyses are used to explore associations between BrainAge and key lifestyle factors including fitness, fatness, physical activity and sleep. The analyses combine to explore the potential for how changes in these modifiable variables may be linked to brain aging that is slower (or faster) than can be explained by chronology alone. Key findings suggest that (reducing) visceral fatness may be means to slow brain aging.

Functional connectivity is also explored, with the present research replicating and extending prior work on how modifiable behaviors influence connectivity in networks associated with aging, emotional regulation, and cognitive processing. Findings suggest that fitness, and sleep are independently associated with functional connectivity in critical brain regions associated with successful ageing, including the Default Mode and Salience Networks. Finally, this work emphasizes the complexity of brain health and the need for personalized lifestyle interventions. Recommendations for future research include standardizing neuroimaging methodologies, refining intervention strategies, and investigating the long-term interplay between behavioral factors and neurobiological aging. Collectively, this work contributes to a growing body of evidence that supports targeted lifestyle interventions as a viable means to promote cognitive resilience and healthy brain aging.

CURRICULUM VITAE

Over the past 13 years, I have gained in-depth knowledge and experience in various aspects of clinical and population health research. In this role I have had the opportunity to provide research support to faculty across a wide variety of academic disciplines including engineering, psychology, internal medicine, pediatrics, geriatrics, and public health.

As this dissertation work shows, I am particularly passionate about understanding the brain and successful aging. Doing this research, and now presenting it to the larger world, is a dream come true and I am thrilled to have the opportunity to prove myself an expert in the field. You can learn more about my larger body of work by clicking here.