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博士の専攻分野の名称 博士 (医 学)
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Studies on associations between gait and cognitive function among community-dwelling
older adults in Japan

(日本地域在住高齢者における歩行と認知機能の関連に関する研究)

Background and objectives: The number of older people along with prevalence of dementia is rapidly growing all over the world. By the end of 2050, 40% of the Japanese population will consist of older people and more than 25% of them are anticipated to have dementia (Nakahori et al., 2021). To help further evaluations and interventions, identifying early markers of cognitive decline and dementia is important (Verghese et al., 2007).

Gait has been proved to be strongly related with cognitive function, and the internal mechanism can be explained as some shared central nervous system deficits (Tian et al., 2021a). However, existing studies only included part of the gait characteristics and cannot capture the full picture of gait performance. In addition, redefining poor gait as direct indicator of the central nervous system problem instead of other impairments is necessary to detect deeper mechanism, yet scarcely mentioned in previous studies (Tian et al., 2023).

Meanwhile, more recent studies claimed combined characteristics of gait and cognition (such as dual decline in gait speed and memory) has an even higher risk of developing dementia than the single gait or cognitive characteristics, but the internal mechanism remains largely unknown (Montero-Odasso et al., 2020; Tian et al., 2023; Montero-Odasso et al., 2018). What's more, similar study targets Japanese older adults at the same time with a rather long follow-up period is scarce.

Therefore, in this study, I conducted two separate sub-studies to explore the association between gait performance with cognitive function in Japanese community-dwelling older adults.

Chapter 1 aimed to find out both the cross-sectional and longitudinal associations between comprehensive gait and cognitive function in Japanese community-dwelling older adults.

Chapter 2 used the data from an on-going age-specific cohort study and aimed to find out if dual decline in gait and domain-specific cognition had higher risk of developing dementia after a 15-year follow-up in Japanese community-dwelling older adults.

Chapter 1. Association between comprehensive gait and cognitive function

Hypothesis: Several gait factors are independently associated with cognitive function, and they may provide a new insight into finding the potential mechanism of cognitive pathology.

Methodology: Data was obtained from the Cognition and Activity in Rural Environment of Hokkaido Senior Study. 236 participants lived in six towns in Hokkaido were recruited at baseline in 2018, among them, 131 participants attended the follow-up study in 2021. All the participants underwent physical examinations, gait and cognitive assessments, and self-administered questionnaires at both baseline and follow-up. Gait was measured using two validated inertial sensors (Physilog®, GaitUp®, Switzerland) fixed on each foot and asking participants to walk a round trip of a 6-meter straight path at a self-preferred walking speed in baseline. 19 gait parameters were obtained and summarized into 4 gait domains using factor analysis. Cognitive function was evaluated using the Japanese version of the Montreal Cognitive Assessment through face-to-face interviews in follow-up by trained investigators. Cross-sectional and longitudinal associations between gait and cognitive function were evaluated using generalized linear models.

Results: Factor analysis yielded four gait factors: general cycle, initial contact, propulsion, and mid-swing. The general cycle factor was associated with both baseline MoCA-J score and score after three-year follow-up. In substudy of MoCA-J, general cycle and initial contact were related with baseline executive function, but significance disappeared in longitudinal associations.

Discussion: Poor gait is significantly associated with worse cognitive function in older adults, especially with executive function. However, simple gait indicators may be insufficient on predicting future cognition.

Chapter 2. Dual decline in gait speed and domain-specific cognition, and the relationship with incident dementia.

Hypothesis: dual decline in gait speed and cognitive function will have a higher risks of incident dementia than single or no decline in either aspect among community-dwelling older adults.

Methodology: Data was obtained from the New Integrated Suburban Seniority Investigation Project. Participants included are those who were about to reach the age of 65 years between 1997 and 2001 and finished health check-ups and self-administered questionnaires at both 65 and 70 years old. Gait speed decline was defined as subjective speed change from “fast” to “normal” or “slow”, or from “normal” to “slow” in 70-year questionnaire compares to the 65’s. Cognitive tests included the word recall and the delayed word recall from the Alzheimer’s Disease Assessment Scale, the digit span forwards and backwards from Wechsler Adult Intelligence Scale-revised, and the Stroop color and word test. Cognitive decline was defined as being in the lowest tertile of a 5-year change in each cognitive test. Dementia was diagnosed as the cognitive disability greater than IIa in the Japanese Long-term Care Insurance system. Cox proportional hazard models were used to estimate risk of dementia adjusting for covariates, with death as competing risk.

Results: After a mean follow-up period of 12.5-years, 111 participants developed dementia. Older adults with dual decline are more likely to have hyperlipidemia, diabetes, and smoking habits. It was found that dual decline in gait speed and domain-specific cognition was associated with a higher risk of dementia compared with no decline in most cognitive tests, with the highest risk observed for gait speed combined with memory (subdistribution hazard ratio:3.9, 95 %, confidence intervals: [1.7–9.0]). However, significant differences only existed in men after stratification by sex.

Discussion: Dual decline can predict dementia from more than a decade ago and can be an efficient target of dementia prevention with its easily recognizable features. However, subjective gait speed decline is also a good low-costing marker in predicting future incident dementia and can be considered of adding into clinical assessments.