Original Study

Gait Performance Trajectories and Incident Disabling Dementia Among Community-Dwelling Older Japanese

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ABSTRACT

Keywords:
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Objectives: Initial gait speed is a good predictor of dementia in later life. This prospective study used repeated measures analysis to identify potential gait performance trajectory patterns and to determine whether gait performance trajectory patterns were associated with incident disabling dementia among community-dwelling older Japanese.
Design: A prospective, observational, population-based follow-up study.
Setting: Japan, 2002 to 2014.
Participants: A total of 1686 adults without dementia (mean [SD] age, 71.2 [5.6] years; women, 56.3%) aged 65 to 90 years participated in annual geriatric health assessments during the period from June 2002 through July 2014. The average number of follow-up assessments was 3.9, and the total number of observations was 6509.
Measurements: Gait performance was assessed by measuring gait speed and step length at usual and maximum paces. A review of municipal databases in the Japanese public long-term care insurance system revealed that 196 (11.6%) participants developed disabling dementia through December 2014.
Results: We identified 3 distinct trajectory patterns (high, middle, and low) in gait speed and step length at usual and maximum paces in adults aged 65 to 90 years; these trajectory patterns showed parallel declines among men and women. After adjusting for important confounders, participants in the low trajectory groups for gait speed and step length at usual pace were 3.46 (95% confidence interval 1.88–6.40) and 2.12 (1.29–3.49) times as likely to develop incident disabling dementia, respectively, as those in the high trajectory group. The respective values for low trajectories of gait speed and step length at maximum pace were 2.05 (1.02–4.14) and 2.80 (1.48–5.28), respectively.
Conclusions: Regardless of baseline level, the 3 major trajectory patterns for gait speed and step length tended to show similar age-related changes in men and women in later life. Individuals with low trajectories for gait speed and step length had a higher dementia risk, which highlights the importance of interventions for improvements in gait performance, even among older adults with low gait performance.

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The number of people with dementia will double by 2030 and more than triple by 2050[1]; dementia is thus a growing public health concern worldwide. Performance-based physical function, such as gait speed, hand-grip strength, and standing balance for older adults are good predictors of dementia.[2,3] Wang and colleagues[2] reported that a person with 1 point lower in performance-based physical function score was 1.08 times as likely to develop incident dementia and 1.06 times as likely to develop incident Alzheimer disease (AD). Among physical performance measures, gait performance was reported to be an independent predictor of incident dementia.[4–6] Moreover, gait performance measures independently predict cognitive decline (CD), which is strongly associated with onset of mild cognitive impairment and AD and is the prodromal stage of AD.[4,7–9] We previously measured step length, in addition to gait speed, and showed that step length at usual and maximum paces was better than gait speed as a predictor of future CD.[10] As compared with the respective participants in the highest tertiles, older women in the lowest tertile of usual step length were 5.8 times as likely to develop CD and men in the lowest tertile of maximum step length were 4.4 times as likely to develop CD.

A recent repeated measures analysis used data from longitudinal studies to examine usual gait speed trajectory for a period of 8 years.[11] Our previous study of usual gait speed trajectory identified 3 distinct patterns, which indicated that, regardless of baseline level, usual gait speed showed similar age-related changes in later life.[12] However, trajectory patterns of maximum gait speed and step length at usual and maximum paces have not been established.

Initial gait performance is an independent risk factor for dementia,[4–6] which suggests that gait speed and step length trajectory patterns, as determined by repeated measured analysis of longitudinal data, might be good predictors of incident dementia. Nevertheless, to date, no such investigation has been conducted. Analyzing associations of gait performance measure trajectories (ie, gait speed and step length) with dementia risk might clarify the characteristics of abnormal aging trajectories and facilitate dementia prevention.

In this prospective study of community-dwelling older adults without dementia, we used repeated measures data from gait speed and step length at usual and maximum paces, which were obtained as part of a 13-year longitudinal study launched in Kusatsu Town, Japan, in 2002. In addition, we reviewed records from the Japanese long-term care insurance system database to identify cases of incident disabling dementia after the initial examination. This study had 2 objectives: to identify potential gait speed and step length trajectories at usual and maximum paces and to determine whether potential gait speed and step length trajectories were associated with incident disabling dementia after adjustment for important confounders among community-dwelling Japanese elders.

Methods

Participants

In collaboration with local governments in Kusatsu Town, Gunma Prefecture, Japan (total population, 7618; residents aged ≥65 years, 1512), we launched a longitudinal study of aging and health in 2001. In addition to an annual preventive health check-up for residents aged 40 years or older, participants aged 65 years or older underwent a geriatric assessment from 2002 through 2014. All annual assessments were performed at the same local public health center and in the same manner. The details of the study design have been previously reported.[10,12–15] All participants provided written informed consent under conditions approved by the Ethics Committee at Tokyo Metropolitan Institute of Gerontology.

The data source for the present study was 1686 adults without dementia aged 65 to 90 years who underwent baseline examinations conducted during the period from June 2002 through July 2014. To be eligible for the study, individuals had to complete assessments of usual and maximum gait performance measures. The average number of follow-up assessments was 3.9, and the total number of observations was 6509. There were 196 (11.6%) cases of incident dementia among the 1686 participants during the period through December 2014. The median (SD) duration of follow-up for incident dementia was 2638 (1048) days (range, 265–4463 days).

Measurement of Gait Performance

Gait speed was measured over a straight 11-m walkway marked with tape at 3 m and 8 m, on a flat floor.[10,12–14,16–19] Participants were requested to walk at their usual pace and maximum pace (without running). Well-trained staff measured the time required to walk 5 m and calculated gait speed (expressed as m/s). Gait speed is the product of step length and step frequency,[20] so step length was also measured by 2 other staff members. Mean step length (in centimeters) was measured by marking the heel points with sticky notes near the tape at 3 m and 8 m and dividing the distance between the 2 heel points by the number of steps required. Usual gait performance was measured once, and maximum gait performance was measured twice, and the better of the 2 results was included in the analysis.

Dementia

As part of the Japanese long-term care insurance system, which covers most persons with dementia,[21] the Ministry of Health, Labor, and Welfare of Japan requires that a physician provide an observer-based rating for elderly adults with dementia. This scale is used throughout the country.[22,23] The categories for the scale are as follows: no dementia, some dementia but almost independent in daily life (level I), dementia with some difficulty communicating but with independence in daily living with minimal observation (level II), dementia with some difficulty communicating and a need for partial care (level III), and severe dementia with difficulty communicating and a need for complete care (level IV). In this study, disabling dementia was defined as a classification of level II or higher, as this is the level at which applicants are entitled to receive insurance benefits, including institutional, home, respite and/or day care, and loans of equipment.[24–28]

Other Variables

The covariates analyzed were sex, age, years of education, history of chronic diseases, history of hospitalization during the past year, frequency of going outdoors,[29] self-rated health, body height and weight, body mass index (BMI), hand-grip strength, 1-leg standing time, blood testing (white blood cell count, red blood cell count, hemoglobin, hematocrit, hemoglobin A1c, total cholesterol, high-density lipoprotein cholesterol, triglycerides, creatinine, and albumin), Tokyo Metropolitan Institute of Gerontology Index of Competence (TMIG-IC) score,[30] Geriatric Depression Scale (GDS) Short-version score,[31] and the Mini-Mental State Examination (MMSE) score.[32]

Chronic diseases evaluated included clinically relevant medical conditions, namely, hypertension, hyperlipidemia, cerebral vascular disease, heart disease, diabetes mellitus, and cancer. For each of these conditions, participants were asked if they had received a physician diagnosis (yes or no). A summary variable (0–6) was created to indicate the number of chronic diseases. Hand-grip strength (kg) of the dominant hand was measured using a standard hydraulic hand-grip dynamometer.[10,12,13,33] One-leg standing time (in seconds) was assessed for the participant's preferred leg.[10,16,34] Participants were requested to place their hands on their waist while looking straight ahead, lift 1 leg, and maintain a standing posture for as long as