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Original Article

Association between cognitive function and olfactory identification ability in community-dwelling older individuals

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Abstract. [Purpose] We investigated whether olfactory identification ability may be useful for early detection of cognitive decline. [Participants and Methods] The study included 55 community-dwelling older individuals without a history of mild cognitive impairment or dementia, who were capable of living independently. Cognitive function was evaluated using the Japanese versions of the Mini-Mental State Examination and the Montreal Cognitive Assessment tools. The olfactory identification ability was evaluated using the Odor Stick Identification Test for the Japanese. We also investigated the association between olfactory identification ability and cognitive function. [Results] Based on the Japanese version of the Mini-Mental State Examination, all participants were categorized into the noncognitive decline group, and based on the Japanese version of the Montreal Cognitive Assessment tool, 21 participants were categorized into the cognitive decline group. With regard to olfactory discrimination ability, we observed a significant difference between participants with and without cognitive decline based on the Japanese version of the Montreal Cognitive Assessment scores. Furthermore, we observed a significant positive correlation between the Japanese version of the the Montreal Cognitive Assessment scores and the Odor Stick Identification Test for the Japanese scores, although no significant correlation was observed between the Japanese version of the Mini-Mental State Examination and the Odor Stick Identification Test for the Japanese scores. [Conclusion] Olfactory identification ability may be useful to detect early-stage cognitive decline in community-dwelling older individuals.

Key words: Alzheimer's disease, Cognitive dysfunction, Dementia

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INTRODUCTION

The Japanese population has continued to age, along with which the prevalence of dementia in people aged >65 years has also been increasing[1)]. Thus, early detection and response to mild cognitive impairment (MCI), which is the pre-stage of dementia, is important for preventing dementia[2)].

Studies have shown that Alzheimer's disease (AD), the most common type of dementia, is associated with a high rate of olfactory deficits[3)], especially in the ability to identify various odors[4)]. Like other sensory organs, the sense of smell declines with age[5)]. However, considering that the decline in olfactory discrimination appears at the early stages of MCI or AD, olfactory discrimination tests are attracting attention as an early screening tool for AD[6)]. Furthermore, the decline in olfactory

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discrimination becomes more severe as dementia progresses[3]. However, the relationship between cognitive function and olfactory discrimination in community-dwelling older people without a history of MCI or dementia remains unclear. Thus, clarifying the relationship between the two may allow for earlier identification of those at high risk of MCI or dementia.

The Japanese version of Montreal Cognitive Assessment (MoCA-J)[7], a cognitive function test, has been used as a screening test for MCI. Although the MoCA-J can detect MCI at an earlier stage, only a few reports have been available on the relationship between olfactory identification ability and MoCA-J. Thus, this study investigated whether the olfactory identification ability of community-dwelling older people could contribute to the early detection of cognitive decline detected by the MoCA-J and MMSE-J.

PARTICIPANTS AND METHODS

Among the 57 community-dwelling older people who participated in the community salon, 55 who were independent in their daily activities, had never been diagnosed with MCI or dementia, and had no causative disease affecting their sense of smell were included in the study.

The participant's age ranged from 62 to 82 years (mean ± SD; 72.1 ± 5.1 years), with 16 males and 39 females. Moreover, 50 and 5 of the participants were right- and left-handed, respectively, with their educational history ranging from 9 to 16 years (mean ± SD; 13.1 ± 2.0 years).

Cognitive function and olfactory tests were conducted on the participants to examine the relationship between cognitive function and olfaction.

The Japanese version of Mini-Mental State Examination (MMSE-J) and MoCA-J were used to assess cognitive function. MMSE-J is a screening test for cognitive function comprising items on disorientation, memorization, attention, calculation, reproduction, and language, with a score of less than 24 out of 30 indicating suspicion of dementia. The MoCA-J is a screening test for cognitive function that includes items on visuospatial and executive systems, naming, attention, language, abstract concepts, delayed replay, and disorientation, with a score of less than 26 out of 30 indicating cognitive decline. The MoCA-J can better identify milder cognitive decline than the MMSE-J[7].

The Odor Stick Identification Test for Japanese (OSIT-J) (Daiichi Pharmaceutical Co., Ltd., Tokyo, Japan) was used as the olfactory test. This test assesses olfactory identification ability. During the test, the participants smelled 12 odors and had to select one of six options: one card with the correct odor; three cards with the wrong odor, odor detectable but unidentifiable, or no odor. One point is added for each correct answer, resulting in a total score of 12, with a score of less than 8 indicating a decline in olfactory identification[8]. The types of odors used were India ink, wood, rose, menthol, orange, curry, gas leak, rose, Japanese cypress, sweaty socks, condensed milk, and roasted garlic.

JMP14 (SAS Institute Inc, Cary, NC, USA) was used for statistical processing. The relationship between age, MoCA-J, and OSIT-J was examined using Spearman's rank correlation coefficient. A χ^2 test was performed to examine the relationship of cognitive decline with the presence of olfactory decline. When significant differences were observed in the Kruskal–Wallis test, multiple comparisons were performed using the Steel–Dwass test.

This study was approved by the Research Ethics Committee of Kinjo University (No. 2020-02). All procedures involving human participants conformed to the ethical standards of institutional research committee and with the 1964 Helsinki declaration.

RESULTS

The median score of the MMSE-J was 29 (range, 25–30), with none of the participants having a total score of less than 24. The median score of the MoCA-J was 27 (range, 17–30), with 21 (38.2%) participants having a total score of less than 26. No significant correlation was observed between age and total MoCA-J scores (rs=−0.18, n.s.).

The median score of the OSIT-J was 10 (0–12). Fifteen participants (27.3%) had scores of less than 8 of the OSIT-J, indicating decreased olfactory identification ability.

No one responded "no odor" to all 12 items of the OSIT-J. No significant correlation was noted between age and the total OSIT-J score (rs=−0.18, n.s.).

A total of 28 participants (50.9%) had MoCA-J and OSIT-J scores above the cutoff value. In contrast, 6 participants (10.9%) had MoCA-J scores >26 but OSIT-J scores <8, 12 participants (21.8%) had MoCA-J scores <26 but OSIT-J scores >8, and 9 participants (16.4%) had MoCA-J and OSIT-J scores less than the cutoff value. No differences in age (p=0.558), gender (p=0.230), or education (p=0.295) were found among the four groups (Fig. 1).

Regarding the ability of olfactory discrimination, a significant difference was observed between participants with and without cognitive decline by the MoCA-J (χ^2 test, $p<0.05$).

No significant correlation was noted between the total MMSE-J score and the total OSIT-J score (rs=0.20, n.s.). Meanwhile, a significant positive correlation was observed between the total MoCA-J and OSIT-J scores (rs=0.35, $p<0.01$).

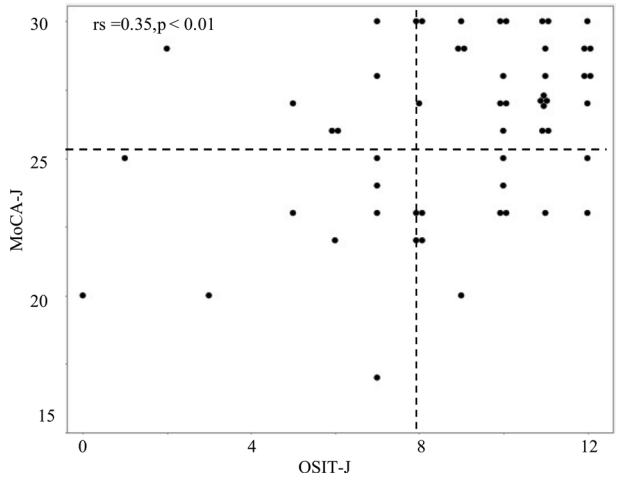

Fig. 1. Score distribution of MoCA-J and OSIT-J.
There was a significant positive correlation between the total scores of MoCA-J and OSIT-J.
MoCA-J: Japanese version of the Montreal Cognitive Assessment; OSIT-J: Odor Stick Identification Test for Japanese.

DISCUSSION

This study examined the relationship between cognitive function and olfactory identity in a community-dwelling older population.

Although all participants had an MMSE-J score of 24 or higher, 21 (38%) participants had mild cognitive decline with an MoCA-J score of 26 or lower. Previous studies have reported that 64.1% of community-dwelling older people with an MMSE score of 24 or higher have a MoCA-J score of 26 or lower[9], and that around 25% of the general community-dwelling older people have MCI or dementia[1]; hence, the participants included in the current study can be considered an average group of older people.

Mikuniya et al.[10] reported a significant negative correlation between OSIT-J score and age in participants ranging from 40 to 80 years; however, our findings showed that age had no effect on olfactory discrimination. This could be because the age range of the participants was 62–82 years, i.e., the covered age range was narrower in this study than in the previous studies.

Jimbo et al.[11] revealed a significant correlation between dementia severity and olfactory discrimination, and Sanke et al.[4] reported a significant relationship between scores of MMSE and those of olfactory discrimination in moderate dementia. However, only a few reports have been available on the relationship between olfactory discrimination and cognitive function in community-dwelling older people not diagnosed with MCI or AD.

Although Yanagimachi et al.[12] reported a correlation between scores of MMSE and olfactory discrimination tests in healthy older participants, it remains unclear whether mild cognitive decline impairs olfactory discrimination; therefore, this study examined the relationship between cognitive function and olfactory discrimination ability using the MoCA-J, which can detect even a more minor cognitive decline and found a positive correlation between MoCA-J and OSIT-J scores. However, the MMSE-J is not good at detecting mild cognitive function. Therefore, it was thought that there was no relationship between the MMSE-J and OSIT-J. Furthermore, a significant difference was noted in the decline in olfactory discrimination ability between participants with and without cognitive decline. These results suggest that older people with reduced olfactory discrimination ability exhibit mild cognitive decline. Reports have revealed that the older people with decreased olfactory discrimination were 1.5 times more likely to transition to MCI after 5 years compared to those without decreased olfactory discrimination[13]. Moreover, a study revealed that MCI with impaired olfactory discrimination was associated with a higher risk of conversion to AD. Moreover, in our study, participants who had reduced olfactory discrimination but were classified as having preserved cognitive function may have been at a higher risk of developing MCI and AD in the future and required careful observation.

However, this study found that 21.8% of the participants exhibited cognitive decline despite having no decline in olfactory identification. Some reports have suggested that cognitive impairment in amnesic but not non-amnesic MCI was associated with olfactory impairment[14]. Therefore, the possibility of non-amnesic MCI should be considered in participants with normal olfactory identification but MoCA-J scores below the cutoff value.

One of the limitations of this study is that the participants were not medically diagnosed with dementia or MCI as they were community residents attending a senior citizen's salon, and it was impossible to prove that the participants did not have dementia or MCI. However, both the MoCA-J and OSIT-J tests can be performed easily. We believe that these tests can detect

community-dwelling older people with early-stage cognitive decline and facilitate medical consultation facilities that will ultimately establish an appropriate diagnosis and early treatment.

The olfactory identification ability of community-dwelling older people may help to detect early-stage cognitive decline.

Funding and Conflict of interest

The authors declare no conflict of interest.

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