BMJ Open

Relationships between cognitive leisure activities and cognitive function in older adults with depressive symptoms: a cross-sectional study

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ABSTRACT

Objectives The current study aimed to elucidate the associations between cognitive leisure activities and cognitive function in an older population stratified by having or not having depressive symptoms.

Design A retrospective cross-sectional study based on a self-report questionnaire.

Setting Annual health check-ups in a rural community in Japan.

Participants A total of 11,010 community-dwelling older adults aged ≥65 years (mean age: 74.0±5.4 years) was examined. Participants with missing data for the main outcome (n=1630) were excluded.

Outcome measures Cognitive impairment was defined as at least 1.5 SD below the reference threshold (age-adjusted and education-adjusted score) on two of more of the tests in the National Center for Geriatrics and Gerontology-Functional Assessment Tool. Depressive symptoms were defined by a 15-item Geriatric Depression Scale score ≥6. We assessed the frequency of participation in cognitive leisure activities using the validated scale (score: 0–42). A score of ≥8 points was defined as frequent participation in cognitive leisure activities.

Results A total of 12.6% (n=1,186) of the participants had depressive symptoms. There was a significant association between cognitive leisure activities and cognitive impairment in older adults (adjusted OR=0.77, 95% CI=0.65 to 0.94). In older adults with depressive symptoms, a higher frequency of cognitive leisure activities was negatively associated with cognitive impairment (adjusted OR=0.45, 95% CI=0.28 to 0.70). In contrast, there was no significant association in older adults without depressive symptoms (adjusted OR=0.85, 95% CI=0.70 to 1.02).

Conclusions Engaging in cognitive leisure activities in late life is associated with better cognitive function in older adults with depressive symptoms.

INTRODUCTION

The prevention of cognitive decline in community-dwelling older adults is a crucial health concern as the population ages. The worldwide societal costs of dementia were estimated to be US$818 billion in 2015, an increase of 35% since 2010, and a threshold of US$1 trillion was crossed in 2018.1 Given the high worldwide cost of dementia, it is important to prevent cognitive decline among older people, which leads to the onset of dementia. Depressive symptoms are associated with both cognitive decline and dementia.2–4 Furthermore, depressive symptoms are associated with the development of Alzheimer’s disease.5 Prompt management of depressive symptoms could prevent further cognitive decline or be helpful for improving impaired cognition in older adults.

Emerging evidence indicates that cognitive leisure activities have a positive effect on both cognitive function and mental health, including depressive symptoms, among older people. A systematic review reported that participation in cognitively stimulating leisure activities may reduce the risk of dementia and cognitive impairment.6 Similarly, leisure activities such as reading newspapers or books were found to be associated with a lower risk of depression in older adults.7 However, it is still unclear whether cognitive leisure activities also have a positive impact on cognitive
function in community-dwelling older adults with depressive symptoms.

Therefore, we primarily aimed to clarify the association between cognitive leisure activities and cognitive function among older people in a large population-based cohort study. We also aimed to investigate the association between cognitive leisure activities and cognitive function in older adults according to the presence of depressive symptoms.

MATERIALS AND METHODS
Participants
We enrolled 11,010 community-dwelling older adults (aged ≥65 years) in the National Center for Geriatrics and Gerontology Study for Geriatric Syndromes (NCGG-SGS), a cohort study whose primary goal was to establish a screening system for geriatric syndromes in the Japanese community-dwelling population.8 9 Participants were recruited from Nagoya and Obu, Japan. The inclusion criteria included residence in Obu (May 2013–June 2013 or February 2015–August 2016) or Nagoya at the time of examination (July 2013–December 2013). Meanwhile, the exclusion criteria were as follows: (1) history of neurological diseases such as depression, dementia, stroke and Parkinson’s disease (n=1,076); (2) Mini-Mental State Examination score of <18 (n=71); (3) requiring support or care according to the Japanese public long-term care insurance system (n=118); (4) impaired performance in basic activities of daily living (n=14); (5) missing outcome or missing data (n=351). Finally, 9,380 participants were included in this study (figure 1). Written informed consent was obtained from all participants in the study.

Depressive symptoms
Depressive symptoms were assessed via the 15-item Geriatric Depression Scale (GDS). The participants responded with a ‘yes’ or ‘no’ to each item (range from 0 to 15), and the cut-off score was six points or higher.10

Cognitive leisure activities
We assessed the frequency of participation in cognitive leisure activities using the cognitive activity scale.11 This scale comprises six cognitive leisure activities commonly performed by older adults, namely, reading books or newspapers, writing for pleasure, doing crossword puzzles, playing board games or cards, participating in organised group discussions and playing musical instruments. Participants reported the frequency of participation as ‘daily,’ ‘several days per week,’ ‘once weekly,’ ‘monthly,’ ‘occasionally’ or ‘never.’ Total scores ranged from 0 to 42,
with higher scores indicating more frequent participation in cognitive activities. According to a previous study, the cut-off point was a score of 8 or higher.\textsuperscript{11}

### Cognitive impairment

Cognitive function was measured using the NCGG-Functional Assessment Tool (FAT).\textsuperscript{12} The NCGG-FAT consists of four domains: memory (word list memory-I (immediate recognition) and word list memory-II (delayed recall)), attention (an electronic table version of the Trail Making Test (TMT), TMT-part A), executive function (an electronic table version of the TMT-part B) and processing speed (an electronic table version of the Symbol Digit Substitution Test). High test–retest reliability and moderate to high validity of the NCGG-FAT have been confirmed in community-dwelling older adults.\textsuperscript{12} Major cognitive impairment was defined as at least 1.5 SD below the reference threshold (age-adjusted and education-adjusted score) on two or more tests in the NCGG-FAT.

### Covariates

Age, sex, educational level, body mass index (BMI), employment status, current smoking habit, current alcohol use, grip strength and low back or knee pain were recorded as demographic data. Medication use was measured as the number of medications taken. Grip strength was measured in kilograms in the participant’s dominant hand using a Smedley-type handheld dynamometer (GRIP-D; Takei, Niigata, Japan).\textsuperscript{13}

### Statistical analyses

Student’s test and Pearson’s $\chi^2$ test were used to test the differences in characteristics between participants with and without cognitive impairment. The objective variable was set as cognitive impairment, and the explanatory variable was frequent participation in cognitive leisure activities in the model. First, the relationship between cognitive impairment and cognitive leisure activities was examined using logistic regression analysis. We constructed two logistic regression models: a crude model and an adjusted model (adjusted for age, sex, educational level, BMI, employment status, medication use, current smoking habit, current alcohol use, grip strength, low back or knee pain). We then examined the association between six cognitive leisure activities and cognitive impairment in community-dwelling older adults with and without depressive symptoms using logistic regression analysis.

Participants were classified by age into two categories: above 75 years of age or below 75 years of age. Educational level was classified as over 10 years or less than 10 years. BMI was classified as over 25 kg/m$^2$ or below 25 kg/m$^2$. Employment status was classified as unemployed or employed. Current smoking habit was classified as current smoker or non-smoker. Current alcohol use was classified as current alcohol user or non-user. Low back and knee pain were classified as having pain or no pain. A cut-off point of grip strength was used to determine whether participants were weak or strong, with a grip strength threshold based on previous studies of 26.0 kg in men and 18.0 kg in women.\textsuperscript{14} Participants were then classified into those with and without depressive symptoms, and two logistic regression models were constructed: a crude model and an adjusted model (adjusted for age, sex, educational level, BMI, employment status, medication use, low back or knee pain, current smoking habit, current alcohol use, grip strength and low back or knee pain). The OR and 95% CI for the prevalence of maintaining cognitive function was estimated in each model using logistic regression analysis. All analyses were conducted using IBM SPSS Statistics V.24.0, and the level of significance was set at $p<0.05$.

### RESULTS

The overall response rate was 26% (11 315/43 466). The partial response rates of the 2013 and 2015 Obu, and 2013 Nagoya samples were 26.2% (524/1997), 32% (5534/17 198) and 21.6% (5257/24 271), respectively. The cohort comprised 52.3% (n=4908) women, and the mean age of the participants was 74.0±5.4 years. The mean cognitive leisure activities score and GDS score were 10.9±5.5 and 2.6±2.6, respectively. Of the 9380 participants, 621 (6.6%) participants were classified as having cognitive impairment. Participants with cognitive impairment were significantly older, had lower levels of education, higher levels of unemployment and lower grip strength than those without cognitive impairment. Moreover, the number of current alcohol users among participants with cognitive impairment was lower than in those without. Importantly, participation in cognitive leisure activities, and GDS scores were lower among participants with cognitive impairment compared with those without (table 1).

Table 2 shows the results of the univariate and multivariate logistic regression models for investigating the association between cognitive impairment and cognitive leisure activities among the participants. Among the covariates, current alcohol use was most attenuated in the overall participants group (OR=0.80, 95% CI=0.67 to 0.95). Higher frequency of cognitive leisure activities had a significant negative association with cognitive impairment in both the crude model (OR=0.73, 95% CI=0.62 to 0.87) and the adjusted model (OR=0.77, 95% CI=0.65 to 0.94).

The association between the frequency of cognitive leisure activities and cognitive impairment among participants with and without depressive symptoms is shown...
Table 1  Comparisons of demographic and clinical variables in older adults with and without cognitive impairment

| Demographics | Overall (n=9380) | Without cognitive impairment (n=8759) | With cognitive impairment (n=621) | P value |
|--------------|-----------------|-------------------------------------|----------------------------------|---------|
| Age, mean (SD), years | 74.0 (5.4) | 73.9 (5.4) | 75.3 (5.5) | <0.001 |
| Sex, male, n (%) | 4472 (47.7) | 4171 (47.6) | 301 (48.5) | 0.708 |
| Educational level, mean (SD), years | 11.9 (2.5) | 12.0 (2.6) | 11.4 (2.4) | <0.001 |
| BMI, kg/m² | 23.1 (3.1) | 23.1 (3.1) | 22.8 (3.2) | 0.011 |
| Employment status, employed, n (%) | 2368 (25.2) | 2250 (25.7) | 118 (19.0) | <0.001 |
| Medication use, mean (SD) | 3.0 (2.7) | 3.0 (2.7) | 3.1 (2.7) | 0.338 |
| Pain (low back or knee), yes, n (%) | 3498 (37.3) | 3284 (37.5) | 214 (34.5) | 0.144 |
| Current smoker, n (%) | 716 (7.6) | 662 (7.6) | 54 (8.7) | 0.309 |
| Current alcohol user, n (%) | 4037 (43.0) | 3807 (43.5) | 230 (37.0) | 0.002 |
| Grip strength, mean (SD), kg | 1.13 (0.23) | 26.9 (7.70) | 25.10 (7.83) | <0.001 |
| Cognitive leisure activities score, mean (SD) | 10.9 (5.5) | 11.0 (5.5) | 9.9 (5.6) | <0.001 |
| GDS score, mean (SD) | 2.6 (2.6) | 2.6 (2.6) | 3.0 (2.7) | <0.001 |

All p values were generated from Student’s t-test or χ² test.
BMI, body mass index; GDS, Geriatric Depression Scale.

Table 2  Association between cognitive leisure activities and cognitive impairment in older adults

| Crude | Adjusted model |
|-------|---------------|
| Frequent cognitive leisure activities (reference: infrequent) | 0.73 (0.62 to 0.87) | <0.001 | 0.77 (0.65 to 0.94) | 0.006 |
| Age (reference ≤74 years) | 1.09 (0.88 to 1.32) | 0.593 |
| Male (reference female) | 1.14 (1.71 to 2.85) | <0.001 |
| Educational level (reference ≤9 years) | 0.94 (0.79 to 1.14) | 0.558 |
| BMI (reference ≤25 kg/m²) | 0.96 (0.81 to 1.22) | 0.974 |
| Employment status (reference: employed) | 1.33 (1.08 to 1.65) | 0.008 |
| Medication use | 0.99 (0.95 to 1.02) | 0.344 |
| Current smoking habit (reference: not current smoker) | 1.17 (0.83 to 1.53) | 0.445 |
| Current alcohol use (reference: not alcohol user) | 0.80 (0.67 to 0.95) | 0.013 |
| Grip strength (reference: high grip strength) | 1.81 (1.50 to 2.18) | <0.001 |
| Pain (reference: not having low back or knee pain) | 0.85 (0.71 to 1.02) | 0.072 |
| GDS score | 1.04 (1.00 to 1.07) | 0.032 |

The objective variable was cognitive impairment, and the explanatory variable was frequent cognitive leisure activities. Except for GDS score and medication use, all of the variables were dichotomised. Cognitive leisure activities: frequent or infrequent; age: above 75 years or below; educational level: over 10 years or below; BMI: over 25 kg/m² or below; employment status: unemployed or employed; smoking, drinking: current or none; grip strength: low or high; pain: having low back or knee pain or not having pain.
BMI, body mass index; GDS, Geriatric Depression Scale.

In Table 3, among the covariates, current alcohol use was most attenuated in both groups (without depressive symptoms: OR=0.83, 95% CI=0.69 to 1.00; with depressive symptoms: OR=0.63, 95% CI=0.38 to 1.02). Among participants with depressive symptoms, the frequency of cognitive leisure activities had an independent negative association with cognitive impairment in both the crude model (OR=0.45, 95% CI=0.29 to 0.70) and the adjusted model (OR=0.45, 95% CI=0.28 to 0.70). In contrast, among participants without depressive symptoms, there was no significant association in the adjusted model (OR=0.85, 95% CI=0.70 to 1.02), while the frequency of cognitive leisure activities had an independent negative association with cognitive impairment in the crude model (OR=0.82, 95% CI=0.68 to 0.99).

Table 4 shows the associations between six cognitive leisure activities and cognitive impairment in older adults. Among these cognitive leisure activities, reading books or newspapers, writing for pleasure, doing crossword puzzles and playing board games or cards were significantly related to lower cognitive impairment in both the crude and adjusted models. The objective variable was cognitive impairment, and the explanatory variable was frequent cognitive leisure activities. Except for GDS score and medication use, all of the variables were dichotomised. Cognitive leisure activities: frequent or infrequent; age: above 75 years or below; educational level: over 10 years or below; BMI: over 25 kg/m² or below; employment status: unemployed or employed; smoking, drinking: current or none; grip strength: low or high; pain: having low back or knee pain or not having pain.
Table 3  Association between cognitive leisure activities and cognitive impairment in older adults with and without depressive symptoms

|                                | Without depressive symptoms | With depressive symptoms |
|--------------------------------|----------------------------|--------------------------|
|                                | OR (95% CI) | P value | OR (95% CI) | P value |
| Frequent cognitive leisure activities (reference: infrequent) | 0.85 (0.70 to 1.02) | 0.085 | 0.45 (0.28 to 0.70) | <0.001 |
| Age (reference: ≤74 years) | 1.09 (0.90 to 1.33) | 0.367 | 1.16 (0.73 to 1.87) | 0.530 |
| Male (reference: female) | 1.14 (0.94 to 1.38) | 0.180 | 1.15 (0.73 to 1.81) | 0.550 |
| Educational level (reference: ≤9 years) | 0.88 (0.72 to 1.08) | 0.215 | 1.20 (0.76 to 1.91) | 0.435 |
| BMI (reference: ≤25 kg/m²) | 0.96 (0.77 to 1.20) | 0.727 | 0.96 (0.56 to 1.63) | 0.877 |
| Employment status (reference: employed) | 1.25 (1.00 to 1.56) | 0.052 | 2.38 (1.16 to 4.89) | 0.018 |
| Medication use | 1.00 (0.96 to 1.03) | 0.996 | 0.97 (0.90 to 1.05) | 0.437 |
| Current smoking habit (reference: not current smoker) | 1.14 (0.81 to 1.59) | 0.461 | 1.44 (0.71 to 2.93) | 0.310 |
| Current alcohol use (reference: not alcohol user) | 0.83 (0.69 to 1.00) | 0.053 | 0.63 (0.38 to 1.02) | 0.058 |
| Grip strength (reference: high grip strength) | 1.76 (1.43 to 2.17) | <0.001 | 2.18 (1.38 to 3.44) | 0.001 |
| Pain (reference: not having low back or knee pain) | 0.85 (0.70 to 1.04) | 0.112 | 0.89 (0.57 to 1.38) | 0.589 |

The objective variable was cognitive impairment, and the explanatory variable was frequent cognitive leisure activities. Except for medication use, all the variables were dichotomised. Cognitive leisure activities: frequent or infrequent; age: above 75 years or below; educational level: over 10 years or below; BMI: over 25 kg/m² or below; employment status: unemployed or employed; smoking, drinking: current or none; grip strength; low or high; pain: having low back or knee pain or not having pain.

BMI, body mass index.

Table 4  Association between cognitive leisure activities and cognitive impairment in older adults

| Cognitive leisure activities                              | Crude                 | Adjusted model* |
|-----------------------------------------------------------|-----------------------|-----------------|
|                                                           | OR (95% CI) | P value | OR (95% CI) | P value |
| Reading books or newspapers (reference: infrequent)       | 0.74 (0.57 to 0.96) | 0.023 | 0.76 (0.59 to 1.00) | 0.047 |
| Writing for pleasure (reference: infrequent)              | 0.80 (0.67 to 0.96) | 0.015 | 0.80 (0.68 to 0.96) | 0.016 |
| Doing crossword puzzles (reference: infrequent)           | 0.57 (0.47 to 0.96) | <0.001 | 0.59 (0.48 to 0.72) | <0.001 |
| Playing board games or cards (reference: infrequent)      | 0.66 (0.45 to 0.97) | 0.034 | 0.66 (0.45 to 0.98) | 0.037 |
| Participating in organised group discussions (reference: infrequent) | 0.86 (0.72 to 1.04) | 0.130 | 0.89 (0.74 to 1.08) | 0.247 |
| Playing musical instruments (reference: infrequent)       | 0.85 (0.59 to 1.24) | 0.404 | 0.89 (0.61 to 1.30) | 0.560 |

The objective variable was cognitive impairment, and the explanatory variable was six cognitive leisure activities.

*Adjusted for age, sex, educational level, BMI, employment status, medication use, current smoking habit, current alcohol use, grip strength, pain and GDS score. Except for medication use, all the variables were dichotomised.

BMI, body mass index; GDS, Geriatric Depression Scale.

associated with cognitive impairment in both the crude and adjusted models (all p<0.05) (table 4). Table 5 shows the associations between six cognitive leisure activities and cognitive impairment, between two groups. Among older adults without depressive symptoms, the frequency of doing crossword puzzles and playing board games was associated with better cognitive function (all p<0.05), whereas the frequency of participating in crossword puzzles and organised group discussions was associated with better cognitive function in older adults with depressive symptoms (all p<0.05) (table 5).

In another subanalysis (not displayed as a table), the frequency of cognitive leisure activities among participants with and without depressive symptoms was compared via a χ² test. A total of 54.0% (641) and 68.1% (5580) of participants with and without depressive symptoms exhibited a higher frequency of cognitive leisure activities, respectively. Moreover, 46.0% (545) and 31.9% (2614) of participants with and without depressive symptoms had a lower frequency of cognitive leisure activities. GDS scores were significantly associated with the frequency of cognitive leisure activities (p<0.001).

DISCUSSION

Key results

The current cross-sectional large-population study revealed a prevalence rate of 12.6% for depressive symptoms among Japanese community-dwelling older adults. A higher frequency of cognitive leisure activities associated with cognitive impairment in both the crude and adjusted models (all p<0.05) (table 4). Table 5 shows the associations between six cognitive leisure activities and cognitive impairment, between two groups. Among older adults without depressive symptoms, the frequency of doing crossword puzzles and playing board games was associated with better cognitive function (all p<0.05), whereas the frequency of participating in crossword puzzles and organised group discussions was associated with better cognitive function in older adults with depressive symptoms (all p<0.05) (table 5).

In another subanalysis (not displayed as a table), the frequency of cognitive leisure activities among participants with and without depressive symptoms was compared via a χ² test. A total of 54.0% (641) and 68.1% (5580) of participants with and without depressive symptoms exhibited a higher frequency of cognitive leisure activities, respectively. Moreover, 46.0% (545) and 31.9% (2614) of participants with and without depressive symptoms had a lower frequency of cognitive leisure activities. GDS scores were significantly associated with the frequency of cognitive leisure activities (p<0.001).
Cognitive decline. However, this study did not focus on reporting that depression is a symptom of subjective performance across various cognitive domains. 

The relationships between depressive symptoms and cognitive impairment had higher GDS scores than those without. The explanatory variable was six cognitive leisure activities. All models were adjusted for age, sex, educational level, BMI, employment status, medication use, current smoking habit, current alcohol use, grip strength, pain, and GDS score. Except for medication use, all of the variables were dichotomised. BMI, body mass index.

Cognitive impairment and depressive symptoms

Our results revealed that older adults with cognitive impairment had higher GDS scores than those without. The objective variable was cognitive impairment, and the explanatory variable was six cognitive leisure activities.

Cognitive leisure activities and cognitive impairment in older adults

Several previous studies reported that active participation in cognitive leisure activities in late life may be beneficial for preventing the risk of dementia among elderly individuals. Furthermore, previous cross-sectional studies and longitudinal studies have shown that cognitive leisure activities are beneficial for cognitive function among community-dwelling older adults. Our results confirm that more engagement in cognitive leisure activities was associated with less cognitive impairment in community-dwelling Japanese older adults. Specifically, frequently reading books and newspapers, writing for pleasure, doing crossword puzzles and playing board games were associated with less cognitive impairment. Frequent participation in leisure activities, such as reading newspapers or books and engaging in outdoor building projects, has previously been reported to be associated with a lower risk of depression relative to low participation in leisure activities. Moreover, participation in cognitive activities involving games and puzzles is reported to be related to better cognitive abilities and lower volumes in Alzheimer Disease (AD)-vulnerable brain structures. The current results, using a leisure activity scale, are in accord with these previous findings. However, the mechanisms underlying the association between leisure activities and cognitive function are currently unclear. One potential explanation is that leisure activities influence neural processing and synaptic organisation by enabling neurological processes to become better at coping with progressing dementia pathology. Further research is needed to clarify these mechanisms.

Cognitive leisure activities and cognitive impairment in older adults with depressive symptoms

In the current study, we performed stratified analyses for older adults with and without depressive symptoms. Two previous studies suggested that late-onset depression may be associated with more cognitive impairment than early-onset depression. As mentioned above, the causal relationship between depression and cognitive impairment is considered to be complex, but interventions

Table 5  Association between cognitive leisure activities and cognitive impairment in older adults with and without depressive symptoms

| Cognitive leisure activities                                      | Without depressive symptoms* |  | With depressive symptoms* |
|------------------------------------------------------------------|-----------------------------|---|--------------------------|
|                                                                  | OR (95% CI)                 | P value | OR (95% CI) | P value |
| Reading books or newspapers (reference infrequent)               | 0.81 (0.60 to 1.10)         | 0.175  | 0.65 (0.37 to 1.14)     | 0.134  |
| Writing for pleasure (reference: infrequent)                    | 0.84 (0.69 to 1.02)         | 0.081  | 0.59 (0.34 to 1.02)     | 0.060  |
| Doing crossword puzzles (reference: infrequent)                 | 0.60 (0.48 to 0.74)         | <0.001 | 0.55 (0.32 to 0.95)     | 0.032  |
| Playing board games or cards (reference: infrequent)             | 0.66 (0.43 to 0.99)         | 0.047  | 0.74 (0.26 to 2.15)     | 0.585  |
| Participating in organised group discussions (reference: infrequent) | 0.98 (0.80 to 1.20)         | 0.844  | 0.34 (0.14 to 0.79)     | 0.013  |
| Playing musical instruments (reference: infrequent)              | 0.93 (0.63 to 1.37)         | 0.697  | 0.65 (0.15 to 2.81)     | 0.566  |

The objective variable was cognitive impairment, and the explanatory variable was six cognitive leisure activities. *All models were adjusted for age, sex, educational level, BMI, employment status, medication use, current smoking habit, current alcohol use, grip strength, pain, and GDS score. Except for medication use, all of the variables were dichotomised.
targeting older adults with depressive symptoms may have the potential to help maintain cognitive health. In the current results, higher engagement in cognitive leisure activities was negatively associated with cognitive impairment in older adults with depressive symptoms. Playing board games was associated with less cognitive impairment in older adults without depressive symptoms. It has been reported that board game players have a 15% lower risk of developing dementia than non-players. The current results are consistent with these previous studies. In addition, participating in organised group discussions was associated with less cognitive impairment in older adults with depressive symptoms. In accord with this finding, interpersonal communication was previously found to be correlated with social self-efficacy, and self-efficacy was negatively associated with depressive symptoms. Older adults with a socially integrated lifestyle might have more opportunities to engage with others, leading to positive emotional states, including social competence, consequently leading to less stress.

In the current study, group discussion, as a form of frequent interaction to achieve a set of goals, was associated with cognition in older adults with depressive symptoms. Cognitive leisure activities might alleviate depressive symptoms that accelerate cognitive impairment, and this could result in delayed cognitive impairment. In future, longitudinal research will be needed to determine the associations between cognitive function, cognitive leisure activities and depression among older adults with depressive symptoms. Leisure activities may protect people against cognitive impairment through synergistic effects. In accord with this notion, cognitive leisure activities were both directly and indirectly associated with cognitive function via depressive symptoms in the current study. Moreover, cognitive leisure activities were not associated with cognitive impairment among older adults without depressive symptoms. Differences in engagement in cognitive activities could potentially explain this finding, with a higher proportion of participants exhibiting more engagement in cognitive leisure activities in older adults without depressive symptoms compared with those with depressive symptoms.

Limitations of this study
Several limitations of the current study should be noted. First, we used a cross-sectional design. Thus, it was not possible to draw conclusions about the effectiveness of cognitive leisure activities in the management of depressive symptoms. The causal relationships between cognitive leisure activities and cognitive function should be clarified in a prospective study in future. Although we were unable to clarify the causal relationships between depressive symptoms and cognitive impairment, the current results highlight the importance of managing older adults with depressive symptoms in terms of cognitive preservation. This is particularly important because depressive symptoms are a stronger risk factor for community-dwelling older adults and are associated with an increased risk of incident dementia and Alzheimer’s disease in older adults over a long period of time. Second, participants were not randomly recruited. Rather, we recruited relatively healthy elderly persons who were able to receive health check-ups. Third, the cognitive leisure activities and depressive symptoms used for the analyses were based on a self-report questionnaire, increasing the possibility of recall bias. Fourth, owing to the limitations of the questionnaires, the analysis only included six cognitive leisure activities. The specific contribution of many common cognitive leisure activities to overall cognitive health during ageing remains unclear. Fifth, we did not investigate whether participants were taking antidepressants. We only investigated the number of medications taken based on the previous finding that polypharmacy increased cognitive impairment even after controlling for the effects of comorbidities and other confounding variables. Finally, we did not examine cognitive functions other than memory, attention, executive function and processing speed. However, the NCGG-FAT assessment is considered a reliable and valid tool for Japanese adults aged 65 years or older. We measured cognitive impairment using the NCGG-FAT because it is a specialised assessment system for evaluating multidimensional neurocognitive function in large populations of older adults. The current study revealed that more frequent cognitive leisure activities were negatively associated with cognitive impairment in older adults with depressive symptoms. The main strength of the current study was its large sample size and the comprehensive nature of our assessments. Future studies with a prospective design will enable the causal relationships between cognitive leisure activities and cognitive impairment in older adults with depressive symptoms to be addressed.

CONCLUSION
In conclusion, frequent participation in cognitive leisure activities was associated with lower levels of cognitive impairment in older adults with depressive symptoms, whereas no significant associations were found in older adults without depressive symptoms. These findings support the hypothesis that cognitive leisure activities are associated with a decreased risk of cognitive impairment in older adults with depressive symptoms.

Acknowledgements We thank the Obu City office for assistance with participant recruitment. We thank Benjamin Knight, MSc, from Edanz Group (https://en-author-services.edanzgroup.com/) for editing a draft of this manuscript. This work was supported by Japan Society for the Promotion of Science KAKENHI Grant Numbers 18F18413.

Collaborators none.

Contributors MJK analysed the data, interpreted the findings and wrote the manuscript. MJK, KT, TD, SN, SK and HM acquired the data. KT, TD, SN, SK and HM interpreted data and critically revised the manuscript. HS is guarantor for the study. All authors approved the final version of the paper.

Funding This study was funded by the Health Labour Sciences Research Grants from the Japanese Ministry of Health, Labour and Welfare (H24-kyouju-ippan-004); by the Obu City Local Government; Research Funding for Longevity Sciences (25-26 and 26-33) from the National Center for Geriatrics and Gerontology and the
Strategic Basic Research Programs (RISTEX Redesigning Communities for Aged Society), Japan Science and Technology Agency.

Disclaimer  The funder/sponsors did not have any role in the study design, analysis or interpretation of data nor in the writing of the report or the decision to submit this article for publication.

Competing interests  None declared.

Patient consent for publication  Not required.

Ethics approval  This study received ethical approval from the ethics committee of the National Center for Gerontology and Geriatrics (approval number 637-3 in 2013 Obu and Nagoya examination and 791 in 2015 Obu examination).

Provenance and peer review  Not commissioned; externally peer reviewed.

Data availability statement  No data are available.

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