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ORIGINAL ARTICLE

Association between frequency of going out and mild cognitive impairment in community-dwelling older adults: a pilot study in frailty prevention groups

Kazuma MINAKI,[1] Hiroki AMANO,[1] Toshio MASUMOTO,[1] Shinji OTANI,[2] Katsuya URAKAMI[3] and Youichi KUROZAWA[1]

[1]Division of Health Administration and Promotion, Department of Social Medicine, School of Medicine and [3]Department of Dementia Prevention, School of Health Science, Tottori University Faculty of Medicine, Yonago and [2]International Platform for Dryland Research and Education, Tottori University, Tottori, Japan

Correspondence: Hiroki Amano PhD, Division of Health Administration and Promotion, Department of Social Medicine, School of Medicine, Tottori University Faculty of Medicine, Yonago 683-8503, Japan. Email: h-amano@tottori-u.ac.jp

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Abstract

Background: Clarifying the role of physical limitations in the relationship between frequency of going out and mild cognitive impairment (MCI) may be useful in supporting early detection and prevention of MCI. However, few studies have explored relatively active populations that are continuously active throughout the year. This study aimed to determine the relationship between frequency of going out and MCI among non-homebound older adults who participated in group activities to prevent frailty.

Methods: This prospective cohort study used frequency of going out as the exposure and MCI as the outcome. The Touch Panel-type Dementia Assessment Scale and questionnaires about daily life were completed by 153 community-dwelling older adults aged ≥65 years participating in frailty prevention groups in a rural town. The baseline survey was conducted from December 2017 to March 2018 and analysed cross-sectionally. Follow-up surveys were conducted at 1- and 2-years and analysed longitudinally.

Results: Univariate and binomial logistic regression analyses at baseline showed no association between MCI and frequency of going out in older adults with physical limitations. However, there was a significant association in older adults without physical limitations. A binomial logistic regression analysis of the frequency of going out at baseline and cognitive function at the 2-year follow-up showed no association between MCI and frequency of going out in older adults with physical limitations, but there was a significant association in those without physical limitations.

Conclusion: Our results suggest that frequency of going out may not be a useful indicator of MCI in older adults with physical limitations, although low frequency of going out may be an indicator of MCI in older adults without physical limitations.

Key words: *frailty, homebound person, mild cognitive impairment, physical functional performances, preventative medicine.*

INTRODUCTION

Dementia, for which aging is a risk factor, is becoming a problem worldwide, especially given improvements in medical care and increased life expectancy. Japan, where 28.8% of the population is aged 65 years or older (as of 1 October 2020),[1] has the world's most super-aged society and reducing the incidence of dementia is an urgent issue. However, there has been no breakthrough in the development of therapies or medicines for dementia, meaning prevention remains the key to reducing the rate of dementia.[2] As dementia may be preventable,[3] there is growing interest in early diagnosis and intervention.[4–6]

Mild cognitive impairment (MCI) is the stage preceding dementia. This refers to a condition in which memory loss is increasing and cannot be considered normal, but does not yet interfere with the person's daily or social life and does not meet the diagnostic

criteria for dementia.[7,8] It may be possible to reverse such decline and return to a normal range of cognitive function in the MCI stage; programmes to prevent dementia in this stage may improve symptoms and delay the transition to dementia.[9,10]

Detection of MCI can lead to early detection and prevention of dementia.[9,11–13] However, understanding about the population of older adults with MCI and those who should be targeted for MCI prevention remains limited. This has delayed development of effective, concrete measures to prevent MCI. This may be because MCI is a condition rather than a disease, which makes it difficult to use clinical methods for detailed and burdensome examinations. Therefore, there is a need for indicators that can be implemented (and confirmed) for individuals based on their lifestyle. Going out versus being homebound is a lifestyle habit that has been suggested as important for maintaining cognitive function through social contact.[14–18] Being homebound has also been reported to have a differential effect on cognitive function depending on physical function.[19] However, to our knowledge, no studies have investigated whether the influence of the frequency of going out on the transition from normal cognitive status to MCI is affected by physical function.

The purpose of this analysis was to clarify whether the relationship between the frequency of going out and MCI differed between older adults with and without limitations in physical function. Most previous studies defined homebound as going out 'less than once a week' or 'about once a week or less',[18,20,21] and it remains unclear how the frequency of going out affects cognitive function in older adults that require nursing care or healthy older adults who are not homebound. Therefore, we focused on older adults who participated in frailty prevention groups and were not homebound to investigate the effects of physical function and frequency of going out on cognitive function. This will support efforts to detect cognitive decline at an early stage and develop preventive measures to maintain cognitive function in older adults.

PARTICIPANTS AND METHODS

Study design and participants

This was a population-based prospective cohort study. We enrolled 153 participants aged ≥65 years who belonged to frailty prevention groups in Kotoura town, which is located on the Japan Sea coast of Tottori Prefecture. The town is a rural community from both a population and economic standpoint. The population is 16 365, and 6028 are 65 years old or older (as of 2020).[22] The town has 36.8% of the population over 65 years old,[22] compared to 28.8% overall in Japan.[1] The average annual per capita income in Japan is 3 317 000 yen (25 515.38 USD at 130 yen to the dollar),[23] while the average income in Tottori Prefecture, to which this area belongs, is 2 515 000 yen (19 346.15USD at 130 yen to the dollar).[23,24] Kotoura Town implements and supports various programmes to prevent frailty and dementia, and the Frailty Prevention Group programme is one such effort supported by the town.[25] Frailty prevention groups aim to prevent frailty, alleviate the homebound conditions of older adults who need assistance, and promote social participation and companionship through activities that improve their motivation in living.[25] The participants of frailty prevention groups are relatively healthy elderly people who live in the community, not in a nursing home. There are as many different types of frailty prevention groups as the number of activities, because the participants themselves take the lead in these groups. Participants in this study were recruited from 18 frailty prevention groups. There were three surveys in total. First, a baseline survey was conducted from December 2017 to March 2018, which involved a cross-sectional analysis. Next, longitudinal analyses were performed using data from a 1-year follow-up survey that was conducted from January 2019 to March 2019, and a 2-year follow-up survey that was conducted from January 2020 to October 2020. However, COVID-19 disruptions in the second year of follow-up meant that we had to conduct the second follow-up survey at 2 years and 6 months (6 months later than the planned study period) for 14 of the 82 patients who participated in all surveys. The surveys included cognitive function screening tests and self-administered questionnaires, and were conducted by visiting each frailty prevention group. Data for all analyses excluded two individuals who were unable to complete the cognitive function screening test. In the cross-sectional study, we also excluded five participants who were assessed as having 'suspected dementia' at the baseline survey, leaving 146 participants. The longitudinal study

included 82 participants, after excluding 33 older adults who were rated as 'suspected dementia' or 'MCI' at baseline (significance level: 5%), 30 older adults who did not participate in the follow-up surveys at 1- and 2-years, and one participant who failed to complete the cognitive function screening test (Fig. 1).

Measurement of MCI

MCI was used as an outcome. MCI is usually defined by cognitive function and functional activity.[7] However, in this study, MCI was defined only by cognitive decline, since the functional activities could not be adequately assessed by the subjective questionnaire in this study. Cognitive function was

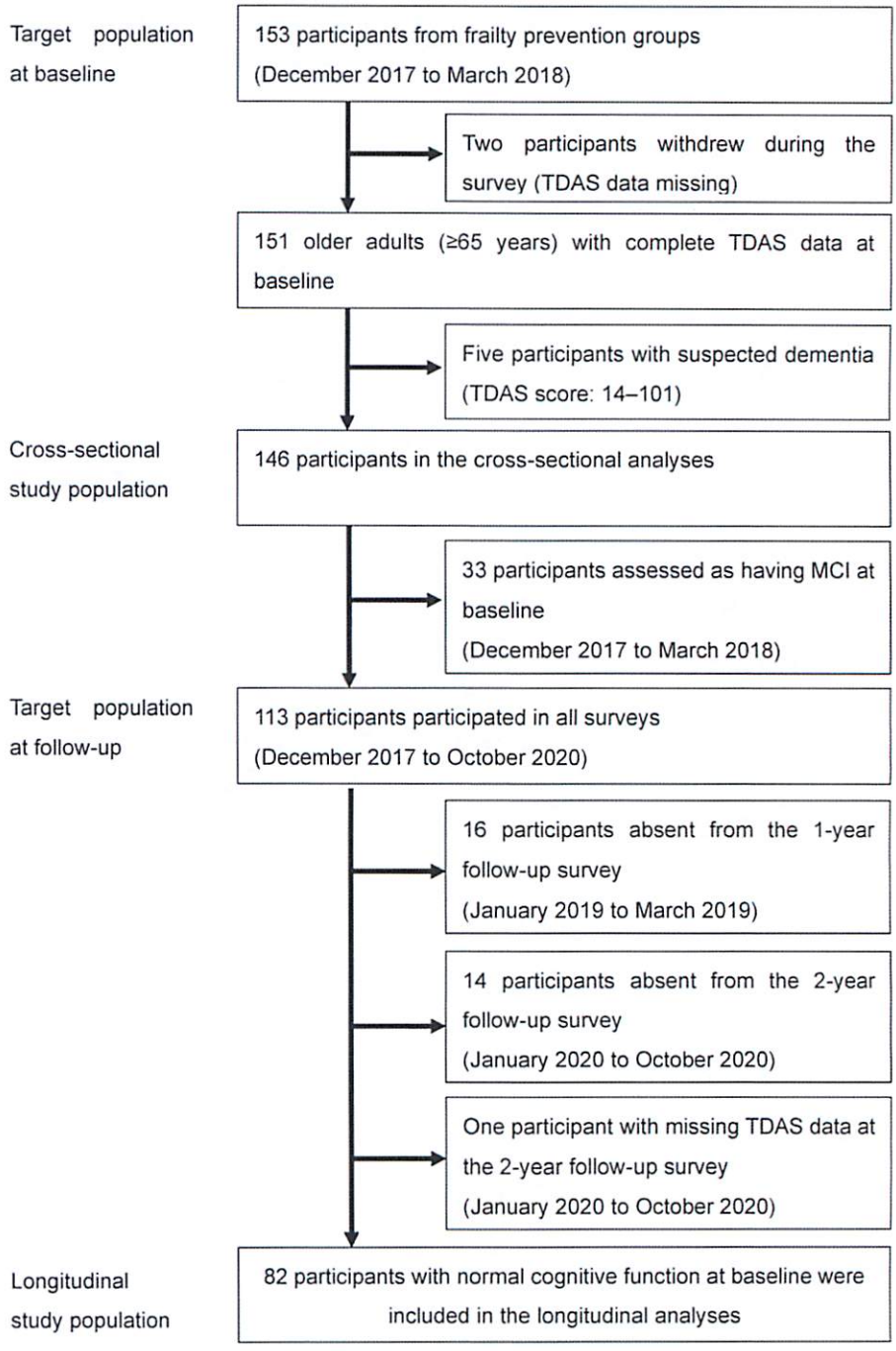

Figure 1 Extraction of participants for the analyses. MCI, mild cognitive impairment; TDAS, Touch Panel-type Dementia Assessment Scale.

assessed using a touch panel equipped with the Touch Panel-type Dementia Assessment Scale (TDAS; Nihon Kohden Corporation, Tokyo, Japan) programme.[26] The TDAS is a modified version of the Alzheimer's Disease Assessment Scale (ADAS), which is a globally trusted indicator of Alzheimer's disease. The TDAS comprises nine tasks: Word-recognition, Following a command, Orientation, Visual–spatial perception, Naming fingers, Object recognition, Accuracy of the order of a process, Money calculation, and Clock time recognition (non-digital). Participants independently follow voice instructions from a touch panel-type computer and enter their answers directly by touching the panel. However, if they had hearing difficulties, we provided help by reading the instructions aloud. Incorrect answers were expressed as a score, with 0–6 points indicating normal cognitive function, 7–13 points indicating MCI and 14–101 points indicating suspected dementia.

Measurement of frequency of going out

Frequency of going out was used as the main exposure. This was assessed using a self-administered questionnaire. In the univariate analyses, for simplicity, the frequency of going out was evaluated using a two-step scale and used to search for related factors: Going out 'rarely' or 'once a week' was defined as low frequency, and '2–4 times a week' or '5 or more times a week' was defined as high frequency. On the other hand, in the binomial logistic regression analysis, the frequency of going out was evaluated as a quartile with a dummy variable to examine the association between frequency of going out and cognitive function in more detail.

Other covariates

Other covariates were obtained from the self-administered questionnaire. The questionnaire covered participants' basic characteristics (sex, age, family structure, Long-term Care Insurance status, occupation, years of education), living conditions (subjective economic status, motivation in living, need for assistance, going out alone, instrumental activities of daily living, role in the household), activities (frequency of meeting people, frequency of socialising with neighbours, frequency of group activities, frequency of going out), lifestyle (hobbies, sleeping hours, sleep problems, experience of working at night, frequency of exercise, frequency and experience of smoking and drinking), and health status (subjective health status, blindness, deafness, ease of falling, memory loss, depression, enjoyment, apathy, medical history [none, hypertension, stroke, heart disease, diabetes, dyslipidaemia, liver disease, kidney disease, back pain/arthritis pain, fracture, osteoporosis, gastrointestinal disease, respiratory disease, cataract, anaemia, eye disease, ear disease, cancer, others], and medication). Type of frailty prevention group is a self-administered survey item in which participants are asked to name the frailty prevention circle to which they belong. In the binomial logistic regression analysis, the covariates were sex, age, back pain/joint pain, bone fracture, and depression, plus the items that were found to be associated with cognitive function in the univariate analyses, with the exception of frequency of going out. In the age category, the respondents were divided into two groups: aged 65–74 years and aged ≥75 years. In the family structure category, we defined going out alone as involving 'one family member', 'with partner', and 'with son or daughter', and going out with others as involving 'two or more family members'. Education of ≤12 years was defined as low education and ≥13 years as high education. In the motivation in living category, the respondents were asked whether they currently have things that make their lives worthwhile and that they look forward to. In the socialising with neighbours category, 'usually' was defined as high frequency of socialising with neighbours, and 'often', 'sometimes', and 'rarely' as low frequency of socialising with neighbours. In the learning and culture circles category, 'four or more times a week', 'two to three times a week', 'once a week', and 'one to three times a month' were defined as high frequency, whereas 'several times a year' and 'do not participate' were defined as low frequency. The item about experience of working at night was asked in the subjective questionnaire as 'Do you have experience of working at night?' The options for this question were (i) 'I am currently working', (ii) 'I used to work', and (iii) 'I have never worked before'. Two modes of classification were used to handle the night shift experience as a binary opposition. One mode grouped options (ii) and (iii) together make the contrast between 'I am currently working' versus 'I am not currently working' the night shift, while the other mode grouped options (i) and (ii) together as 'I have worked the night shift' in opposition to 'I have never

worked the night shift'. In the ease of falling category, respondents were asked in a subjective questionnaire whether they felt more prone to falling. We classified responses of 'often' and 'sometimes' as falling easily, and 'not often', 'hardly ever' and 'never' as not falling easily. The assessment of depression included two items: 'Have you been feeling down and depressed for the past month or so?' and 'Have you recently been unable to do or enjoy anything that you used to enjoy doing?' If participants selected 'yes' to one or both of these questions, they were defined as depressed; those who did not select 'yes' to either question were defined as not depressed.

Physical limitations

In the cross-sectional analysis, those who satisfied both the criteria of 'no Long-term Care Insurance certification' and 'not falling easily' at baseline were classified as without physical limitations, and all others as with physical limitations. To compensate for the difference between the subjective evaluation of the questionnaire and the objective evaluation of Long-term Care Insurance certification in the longitudinal analysis, those who satisfied both the criteria of 'not falling easily' at baseline and 'no Long-term Care Insurance cerification' at the 1-year follow-up were defined as without physical limitations, and all others as with physical limitations.

Table 1 Association between MCI and survey items in the univariate analysis (excluding participants suspected dementia) ($N = 146$)

		All Participants $n = 146$		Normal cognitive status $n = 113$		MCI $n = 33$		
	Characteristic	*n*	%	*n*	%	*n*	%	*P*-value[†]
Age (years)	Mean (SD)	75.5(7.2)		74.2 (7.0)		79.9 (6.1)		<0.001***
	Min, max	65,99		65, 99		70, 92		
	60	35		35		0		
	70	66		52		14		
	80	40		23		17		
	90	5		3		2		
Sex	Male	34	23.3	27	23.9	7	21.2	0.748
	Female	112	76.7	86	76.1	26	78.8	
Family environment	Alone	28	19.3	20	17.9	8	24.2	0.401
	With partner	48	33.1	38	33.9	10	30.3	
	With son or daughter	33	22.8	22	19.6	11	33.3	
	Others	36	24.8	32	28.6	4	12.1	
Long-term Care Insurance	Certified	6	4.1	5	4.4	1	3	1
	Not certified	139	95.2	107	94.7	32	97	
	Not sure	1	0.7	1	0.9	0	0	
Education level (years)	<6	0	0.0	0	0	0	0	0.007**
	6–9	36	24.7	20	17.7	16	48.5	
	10–12	82	56.2	66	58.4	16	48.5	
	>12	28	19.2	27	23.9	1	3	
Communicate among neighbours	Usually	81	55.9	55	49.1	26	78.8	0.003**
	Often	43	29.7	39	34.8	4	12.1	
	Sometimes	21	14.5	18	16.1	3	9.1	
	Rarely	0	0.0	0	0	0	0	
Attend study and culture groups	At least 4 times a week	5	3.5	5	4.5	0	0	0.018*
	2–3 times a week	9	6.3	8	7.3	1	3.1	
	Once a week	8	5.6	7	6.4	1	3.1	
	1–3 times a month	14	9.9	13	11.8	1	3.1	
	A few times a year	22	15.5	17	15.5	5	15.6	
	Not participating	84	59.2	60	54.5	24	75	
Go out	Rarely	0	0.0	0	0	0	0	0.002**
	Once a week	13	9.0	5	4.5	8	24.2	
	2–4 times a week	63	43.4	50	44.6	13	39.4	
	≥5 times per week	69	47.6	57	50.9	12	36.4	

***$P < 0.001$, **$P < 0.01$, *$P < 0.05$. [†] Each item tested as follows: When the minimum expected frequency was less than 5, a Fisher's exact test was used; when the minimum expected frequency was greater than 5, a chi-square test was used. MCI, mild cognitive impairment; SD, standard deviation.

Statistical analyses

Factors associated with MCI were determined using univariate analyses such as chi-square tests and Fisher's exact tests in the cross-sectional analysis. To confirm the effect of physical limitations on the association between MCI and frequency of going out, we conducted a binomial logistic regression analysis (increasing variable method: likelihood ratio) cross-sectionally using MCI as the outcome and frequency of going out as the exposure. Associated factors obtained from the univariate analysis and sex, age, back/arthritis pain, fracture, and depression were used as covariates. For the longitudinal analysis, MCI at the 2-year follow-up was the outcome and frequency of going out at baseline was the exposure. Binomial logistic regression analysis (variable increasing method: likelihood ratio) was performed longitudinally using the same covariates as in the cross-sectional analysis. $P < 0.05$ was considered statistically significant. Statistical analyses were performed using SPSS version 25 (SPSS statistics; IBM Corp, Armonk, NY).

Ethical considerations

Informed consent was obtained from all participants. This study was approved by the Institutional Review Board of the Faculty of Medicine, Tottori University (No. 17A057). The study was conducted in accordance with the ethical standards set out in the 1964 Declaration of Helsinki.

RESULTS

Participants' survey data

Table 1 shows the baseline characteristics of the 146 participants by cognitive function. The mean age was 75.5 ± 7.2 years. Details of the 146 study subjects are as follows. By age, 35 were in their 60s, 66 in their 70s, 40 in their 80s, and 5 in their 90s. Females accounted for 76.7% of the total study population. Univariate analysis of baseline data showed significant associations between the TDAS scores and five questionnaire items (Table 1, and Table S1 in the Supporting Information): age ($P < 0.001$), years of education ($P = 0.007$), frequency of socialising with neighbours ($P = 0.003$), frequency of participating in study and culture groups ($P = 0.018$), and frequency of going out ($P = 0.002$).

Association between TDAS and frequency of going out in the binomial logistic regression analysis

Binomial regression analysis was conducted to assess cross-sectional and longitudinal associations between the frequency of going and MCI, with the following results.

First, an examination of multicollinearity showed that the items 'How often do you socialise with your neighbours?' and 'How often do you participate in study and culture groups' were not correlated with the frequency of going out ($P = 0.555$, $r = -0.050$, and $P = 0.107$, $r = -0.136$, respectively). Regarding the relationship at baseline between frequency of going out and MCI (based on TDAS results), there was no association between low TDAS performance and low frequency of going out in older adults with physical limitations (Table 2). In contrast, there was a significant association between low cognitive function and low frequency of going out in older adults without physical limitations, with an odds ratio (OR) of 27.359 (95% confidence interval [CI]: 2.360–317.237) (Table 2).

Second, to examine the effect of frequency of going out at baseline on the TDAS at the 2-year

Table 2 Logistic regression analysis of MCI in people with and without physical limitations

	MCI incidence (*n/N*)	Model† Adjusted odds ratio (95% CI)
With physical limitations		
Frequency of going out (≥5 times a week)	4/23	Reference‡
Frequency of going out (2–4 times per week)	5/22	1.273 (0.214–7.552)
Frequency of going out (once a week)	2/4	2.000 (0.171–23.358)
Without physical limitations		
Frequency of going out (≥5 times a week)	8/46	Reference‡
Frequency of going out (2–4 times per week)	8/41	1.209 (0.357–4.102)
Frequency of going out (once a week)	6/8	27.359 (2.360–317.237)

† In this model, age and sex were adjusted using the forced entry method, and years of education, frequency of socialising with neighbours, frequency of participation in study and educational groups, depression, fracture and back/arthritis pain were adjusted using the variable increase method (likelihood ratio). ‡ 'Reference' refers to the hazard ratio of 1.00 for controls; that is, participants with a frequency of going out of ≥5 times a week for comparisons of going-out-related risk. *N*, number of individuals; *n*, number of MCI cases at investigation; CI, confidence interval; MCI, mild cognitive impairment.

Table 3 Logistic regression analysis for MCI at the 2-year follow-up in older adults with and without physical limitations

	MCI incidence *n/N*	Model 1[†] Adjusted odds ratio (95% CI)	Model 2[‡] Adjusted odds ratio (95% CI)
Without physical limitations			
Frequency of going out (5 times a week or more)	3/30	Reference[§]	Reference[§]
Frequency of going out (2–4 times per week)	3/25	1.205 (0.220–6.615)	1.262 (0.229–6.955)
Frequency of going out (once a week)	2/3	21.738 (1.057–446.838)	21.991 (1.070–452.090)

[†] Model 1 was adjusted for age and sex. [‡] Model 2 was additionally adjusted for presence of depression, bone fracture, back/arthritis pain, years of education, frequency of socialising with neighbours and frequency of participating in study/education groups. [§] 'Reference' refers to the hazard ratio of 1.00 for controls; that is, participants with a frequency of going out of ≥5 times a week for comparisons of going-out-related risk. *N*, number of individuals; *n*, number of MCI cases at investigation; CI, confidence interval; MCI, mild cognitive impairment.

follow-up for those with and without physical limitations, binomial logistic regression analysis (increasing variable method: likelihood ratio) was conducted for each group. There was no association between low cognitive function at the 2-year follow-up and low frequency of going out at baseline in older adults with physical limitations. Conversely, there was a significant association between low cognitive function at the 2-year follow-up and low frequency of going out at baseline in older adults without physical limitations (OR 21.991, 95% CI: 1.070–452.090) (Table 3).

DISCUSSION

This was a population-based prospective cohort study. This study examined the relationship between the frequency of going out and MCI both cross-sectionally and longitudinally in older adults with and without physical limitations. All participants were engaged in frailty prevention groups and went out at least once a week. The results showed there were longitudinal and cross-sectional associations between frequency of going out and MCI in older adults without physical limitations. We found that compared with going out five times a week, going out once a week was associated with MCI at the 2-year follow-up in older adults without physical limitations. In contrast, no longitudinal or cross-sectional association was found between frequency of going out and MCI in older adults with physical limitations.

Previous studies reported physical limitations as having a role in the association between homebound older adults (defined as going out less than once a week) and dementia.[19] However, no study specifically examined this association in a population that went out more than once a week; this is the first such study to evaluate cognitive function at the MCI stage. In addition, there are several reports that outdoor activity was related to cognitive function.[27,28] However, to our knowledge, no previous studies evaluated the relationship between frequency of going out and cognitive impairment in the MCI stage. We assessed MCI using the TDAS and examined the relationship between MCI and frequency of going out. Next, using longitudinal data, we confirmed whether frequency of going out was a risk factor for incident MCI.

In addition, only about 10% of older adults in Japan go out less than once a week,[29–32] and it is important to investigate the relationship between frequency of going out and MCI among most older adults. For this reason, we focused on frailty prevention groups that had regular activities and met at least once a week. Therefore, our objective of investigating the association between frequency of going out and MCI in older adults who went out at least once a week by physical function and using longitudinal data complements previous findings. The main finding of this study was that in the group who went out more than once a week, a low frequency of going out was associated with incident MCI 2 years later. This finding indicates that for many older adults who are not homebound, a low frequency of going out can help predict future MCI in the absence of physical limitations.

It remains unclear how the frequency of going out affects cognitive function. However, going out involves social contact,[33] and there is increasing evidence that social activities are beneficial for cognitive function.[17,18,34–39] Therefore, in those without physical limitations, going out may contribute to maintaining cognitive function by increasing social contact and enhancing neural plasticity. In addition, the social aspect of frequency of going out may be

influenced by physical limitations.[40] In our study, we found no longitudinal or cross-sectional associations between frequency of going out and MCI in the group with physical limitations. This means that in this group, the frequency of going out may have been significantly influenced by physical factors. However, our survey did not examine the purpose of going out. Further research is needed to determine whether the social aspect of going out influences incident MCI.

In a previous study, Harada *et al.* reported that there was a cross-sectional association between being homebound and dementia in a group with physical limitations, but no such association in a group without physical limitations.[19] There are three possible reasons for the difference between their findings and ours: (i) participants in their study included homebound individuals; (ii) their study defined cognitive impairment using a Mini-Mental State Examination (MMSE) score < 24, which is an indication of dementia[41]; and (iii) our study was a longitudinal study. Therefore, our results suggest that in those with physical limitations, going out more than once a week is important for maintaining cognitive function compared with being homebound, but increasing the frequency of going out may have a limited effect on cognitive function. This study only included older adults who went out more than once a week, and it is necessary to conduct a further survey of all older adults.

In addition, the present survey was interrupted in the second year of follow-up by COVID-19. However, as there were no affected people in Kotoura town during this period, this phenomenon is not expected to have had a direct effect on cognitive function. In Japan, the government requested that people refrained from going out as a COVID-19 countermeasure, and this policy may have indirectly affected the frequency of going out. Related issues included lack of exercise, fear of infectious diseases, and extreme restriction of neighbourhood networks. However, as there was no remarkable difference in the results of that questionnaire compared with the baseline survey in this study, it can be assumed that older adults who participated in frailty prevention groups could resolve the lack of exercise on their own.

Apathy, which plays an important role in frailty, was not associated with cognitive function in univariate analysis. This could be due to two reasons: the small number of subjects in the study, and the bias of the study population.

There may have been a bias in that those who participated in frailty prevention circles represented a group more interested in frailty and less likely to be apathetic participants. This may have led to an underestimation of the association between apathy and cognitive function. In this longitudinal study, we did not include the apathy item as a covariate for the association between cognitive function and frequency of going out, which may have overestimated the association between cognitive function and frequency of going out.

Our study had three strengths. First, physical functioning was easy to assess because limitations in physical functioning were assessed by the items of easily falling and Long-term Care Insurance certification. Second, to our knowledge, this was the first study to examine the role of physical limitations in the relationship between early cognitive decline and frequency of going out by focusing on MCI. Third, we used the TDAS to assess MCI. The MMSE has been shown to be less effective in detecting dementia in the early stages,[42] and the ADAS has been reported to be a more sensitive measure of cognitive function than the MMSE.[43] Therefore, in this study, we used the TDAS,[26] which can be considered a substitute for the ADAS in determining MCI.

This study had the five main limitations. First, this study had several biases due to the fact that it only included older adults who were participating in frailty prevention groups. In this study, the sample size was small, which may have introduced bias, because only older adults in frailty prevention groups were included. In addition, the subjects may have been interested in or focused on frailty, which may have biased their health status, including apathy. Second, since MCI was assessed only by cognitive decline in this study, MCI may include those who were actually impaired by functional activities. Further research is needed to assess functional activities. Third, we cannot exclude the possibility that the cognitive function of the 31 participants who were excluded from the study in the first- and second-year follow-up surveys differed from those of the 82 participants in the 2-year follow-up survey. In other words, we cannot deny the possibility that the 31 participants who were not included in this study did not participate in the follow-up survey because of their low cognitive function, and therefore the results of this study may be underestimated. Fourth, as this questionnaire was

self-administered, there is a possibility of recall bias. In further studies, it will be necessary to objectively determine each item through functional assessment based on actual measurements. Fifth, we could not show whether high frequency of going out delays incident MCI because of the observational nature of our study. Further intervention studies are needed to examine whether frequency of going out delays incident MCI in the elderly.

In conclusion, among older adults who participate in frailty prevention group activities, less frequent going out is significantly associated with MCI among those without physical limitations both cross-sectionally and longitudinally. In addition, there is no significant association between low frequency of going out and MCI in older adults with limited physical function. This result suggests that low frequency of going out may predict the incidence of MCI in relatively healthy older adults who participate in group activities. Further research is required to clarify the relationship between cognitive function and frequency of going out in the prevention of cognitive decline.

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DISCLOSURE

Author K.M., H.A., T.M., S.O., and Y. K. declare no conflicts of interest. Author K.U. owns a patent on the Touch Panel-type Dementia Assessment Scale and receives royalties from the Nihon Kohden Corporation (Tokyo, Japan). The funding for this study was provided by JSPS. The funding source had no role in the design, practice, or analysis of this study.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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SUPPORTING INFORMATION

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Table S1. associations between MCI and subjective questionnaire items in univariate analysis (excluding those with suspected dementia) ($N = 146$).[†]