Table 3. Continued

Reference	Population	Number studied (M/F)	Age, years, mean (SD) [range]	PEDro Score	Intervention (duration)	Outcomes measured	Main results
Stout *et al.* [36]	Community-dwelling	98 (49/49)	73 (±1 SEM) [≥65]	9	Phase I: HMB; PLA (24 weeks) Phase II: PLA + RET; HMB + RET (24 weeks)	MM (DEXA), MS (isokinetic leg strength, HS), PP (get up and go)	HMB alone significantly improved some, but not all measures of MS versus PLA. No significant changes were found in MM and PP with HMB versus PLA Adding HMB to RET did not improve any parameters over RET alone
Vukovich *et al.* [39]	Community-dwelling	31 (15/16)	70 (±1)	10	HMB + RET; PLA + RET (8 weeks)	MM (DEXA, CT scan), MS (misc. upper and lower body strength press, flexion and extension measurements)	MM improved with HMB + RET versus PLA + RET, but not significantly ($P = 0.08$) MS did not improve with HMB + RET versus PLA + RET
Cornish and Chilibeck [31]	Community-dwelling	51 (28/23)	65.4 (±0.8)	10	ALA + RET; PLA + RET (12 weeks)	MM (DEXA, US), MS (leg press, chest press)	ALA + RET had minimal effect on MM or MS versus PLA + RET

ALA, α-linolenic acid; ARG, arginine; BIA, bioelectrical impedance analysis; CON, controls; CT, computerised tomography; DEXA, dual X-ray absorptiometry; EAA, essential amino acid; F, female; FFM, fat-free mass; HE, health education; HIS, histidine; HMB, β-hydroxy β-methylbutyrate; ILE, isoleucine; HS, hand-grip strength; KE, knee extension; LE, leg extension; LEU, leucine; LYS, lysine; M, male; min, minute; MET, methionine; MM, muscle mass; MP, muscle power; MS, muscle strength; NS, not significant; PHE, phenylalanine; PLA, placebo; PP, physical performance; RET, resistance exercise training; SD, standard deviation; SPPB, standard physical performance battery; SUPP, nutritional supplement; THR, threonine; VAL, valine; WPS, whey protein supplement.

used. The prevalence of sarcopenia in the community using a definition consistent with EWGSOP was 1–33% across different populations (male and female data combined), with higher prevalence, as expected, in settings where older, more complex or acutely ill individuals are cared for. Ethnicity may also play a role, especially if the reference and study populations do not match.

After careful consideration of the methodological limitations and scope of these studies, the ISI group proposes certain recommendations for the design of future studies (expert advice):

- Studies with sufficient sample size to identify prevalence and risk factors for sarcopenia, including subpopulation analyses, are needed.
- Studies should focus on standardised, well-defined, reproducible populations, namely community-dwelling individuals, individuals living in nursing homes/care homes, and acutely ill or physically frail inpatients. These populations should be clearly described so that studies can be compared for external validity.
- Standardised models and cut-off points should be used for each domain of the definition of sarcopenia to allow comparison between studies.
- Longitudinal studies on the incidence of sarcopenia are needed, again using standard methods.

Exercise intervention

Exercise interventions appear to have a role in increasing muscle strength and improving physical performance, although they do not seem to consistently increase muscle mass, in frail, sedentary, community-dwelling older individuals. Investigations in other populations are still anecdotal. No trials were found that recruited individuals based on their sarcopenic status. The results suggested that combining various types of exercise into a programme may also improve muscle strength and physical performance. Most exercise studies involved limited participants and were mainly conducted within a single country.

Recommendations for the design of exercise studies (expert advice):

- Improved standardisation of exercise interventions is needed, to allow for replication and contrast.
- Studies should have common outcome measures, along with similar time points for assessment (e.g. 4 weeks, 8 weeks, 3 months, 6 months, 1 year), so that valid comparisons across studies can be made. The short physical performance battery, gait speed, 400-m walking distance and grip strength are proposed as useful measures of physical performance that are able to determine clinically significant changes. Grip strength, chair rise and knee extension may be used to measure muscle strength.
- Exercise interventions should focus on well-defined populations, with well-defined sarcopenia.

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Nutrition intervention

Although nutrition intervention is considered one of the mainstays of intervention in sarcopenia, much of the evidence is based on short-term protein synthesis studies, and large clinical trials are still lacking. Our review has failed to show a consistent effect of protein supplementation, although the number of studies found using our strict selection criteria was very low. EAAs (with ~2.5 g of leucine) and HMB seem to have some effects on muscle mass and muscle function that need to be confirmed in larger trials. Vitamin D studies were evaluated as part of the review process; while some epidemiological studies link vitamin D levels with muscle parameters, there were no intervention studies meeting the criteria for inclusion in this review. Similarly, there is a large literature on the effects of omega 3-fatty acids on muscle parameters, especially in cachexia, but only one negative study was found in this review [31]. Interventions that evaluated the combined effects of exercise and nutrition sometimes suggested a potential additive effect, although this needs further research. However, solid evidence on which to base recommendations for patients with sarcopenia is not available.

Recommendations for the design of nutrition studies (expert advice)

- Further studies are needed to determine the effect of different nutrition interventions on muscle mass and function using robust, multi-centre and standardised approaches with single or complex nutrition interventions and clinically relevant outcomes (muscle strength, physical performance).
- Studies using four arms (exercise, nutrition, both or none) should also be conducted. The choice of exercise and nutrition interventions should be based on the singular effect of each intervention.
- Outcome measures for such studies should not differ from those used for individual components, and reporting should allow for individual group comparisons to also evaluate the role of each component.
- Timing of nutrition intervention before or after exercise should be explored in clinical trials comparing different times of administration, as basic studies suggest there may be time-associated differences in the effect of nutrition intervention over exercise.
- Baseline nutritional status and physical frailty of the population should be considered when doing nutrition intervention studies.

Practice recommendations

Sarcopenia is a common clinical problem in people over 50 years of age, and one that leads to severe adverse outcomes. Research on management interventions is advancing quickly, but questions still remain. Based on our current understanding, the expert group agreed some general recommendations for clinical practice (expert opinion):

(1) Sarcopenia, defined as low muscle mass and low muscle function and/or reduced physical performance, occurs in at least 1 in 20 community-dwelling individuals, and prevalence may be as high as 1 in 3 in frail older people living in nursing homes (Table 1).
   - Owing to the consequences of sarcopenia on quality of life, disability and mortality, it is recommended that physicians should consider screening for sarcopenia, both in community and geriatric settings.
   - The new definitions of sarcopenia, based on muscle mass and function, should be preferred to definitions based on muscle mass alone.

(2) Exercise interventions, especially those based on resistance training, may have a role in improving muscle strength and physical performance (moderate quality evidence), but not muscle mass. Moreover, exercise has been shown to improve other common conditions in adults and older patients, as well as being safe.
   - Supervised resistance exercise or composite exercise programmes may be recommended for frail or sedentary community-dwelling individuals.
   - Time of intervention of at least 3 months and probably longer may be needed to obtain significant improvement in relevant clinical parameters (muscle strength and physical performance). Increased physical activity in daily life may also be recommended in these individuals.

(3) Some nutrition interventions such as EAAs (with ~2.5 g of leucine) and HMB may improve muscle parameters. Although our findings did not appear to support this approach, increasing protein intake to 1.2 g/kg body weight/day, either by improving diet or adding protein supplements, has been recommended for adults and older people by an expert group [40]. Evidence to recommend specific interventions is yet to be established.

Key points

- The reported prevalence of sarcopenia in the community is up to 33%, with higher prevalence in long-term and acute care settings.
- This underscores the importance of preventative and clinical management strategies for managing sarcopenia.
- While further research is needed on interventions, we provide recommendations for clinical practice.
- The ISI included representatives of the European Working Group on Sarcopenia in Older People (EWGSOP), the International Working Group on Sarcopenia (IWGS) and international experts.

Conflicts of interest

Abbott had no role in the choice of members of the group, but had the right to have an observer member at the meetings. Members of the Working Group received no salary or other incomes from the European Union Geriatric medicine Society (EUGMS), Abbott Nutrition (AN) or any other

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organisation for any of the tasks involved in the preparation of this manuscript or for attending the meetings of the group. An individual COI form has been filled by each member of the International Sarcopenia Initiative group. Medical writing support was provided by Mike Musialowski at Lucid with funding from AN.

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Supplementary data

Supplementary data mentioned in the text is available to subscribers in *Age and Ageing* online.

References

The full list of references is available on Supplementary data available in *Age and Ageing* online, Appendix S3.

1. Morley JE, Baumgartner RN, Roubenoff R, Mayer J, Nair KS. Sarcopenia. J Lab Clin Med 2001; 137: 231–43.
3. Fielding RA, Vellas B, Evans WJ *et al.* Sarcopenia: an undiagnosed condition in older adults. Current consensus definition: prevalence, etiology, and consequences. International Working Group on Sarcopenia. J Am Med Dir Assoc 2011; 12: 249–56.
6. Landi F, Cruz-Jentoft AJ, Liperoti R *et al.* Sarcopenia and mortality risk in frail older persons aged 80 years and older: results from ilSIRENTE study. Age Ageing 2013a; 42: 203–9.
7. Landi F, Liperoti R, Russo A *et al.* Association of anorexia with sarcopenia in a community-dwelling elderly population: results from the ilSIRENTE study. Eur J Nutr 2013b; 52: 1261–8.
8. Lee WJ, Liu LK, Peng LN, Lin MH, Chen LK. Comparisons of sarcopenia defined by IWGS and EWGSOP criteria among older people: results from the I-Lan longitudinal aging study. J Am Med Dir Assoc 2013; 14: 528.e1–7.
9. Legrand D, Vaes B, Mathei C, Swine C, Degryse JM. The prevalence of sarcopenia in very old individuals according to the European consensus definition: insights from the BELFRAIL study. Age Ageing 2013; 42: 727–34.
12. Murphy RA, Ip EH, Zhang Q *et al.* Transition to sarcopenia and determinants of transitions in older adults: a population-based study. J Gerontol A Biol Sci Med Sci 2014; 69: 751–8.
13. Patel HP, Syddall HE, Jameson K *et al.* Prevalence of sarcopenia in community-dwelling older people in the UK using the European Working Group on Sarcopenia in Older People (EWGSOP) definition: findings from the Hertfordshire Cohort Study (HCS). Age Ageing 2013; 42: 378–84.
16. Tanimoto Y, Watanabe M, Sun W *et al.* Association between sarcopenia and higher-level functional capacity in daily living in community-dwelling elderly subjects in Japan. Arch Gerontol Geriatr 2012; 55: e9–13.
18. Volpato S, Bianchi L, Cherubini A *et al.* Prevalence and clinical correlates of sarcopenia in community-dwelling older people: application of the EWGSOP definition and diagnostic algorithm. J Gerontol A Biol Sci Med Sci 2014; 69: 438–46.
20. Bastiaanse LP, Hilgenkamp TI, Echteld MA, Evenhuis HM. Prevalence and associated factors of sarcopenia in older adults with intellectual disabilities. Res Dev Disabil 2012; 33: 2004–12.
21. Landi F, Liperoti R, Fusco D *et al.* Prevalence and risk factors of sarcopenia among nursing home older residents. J Gerontol A Biol Sci Med Sci 2012; 67: 48–55.
22. Gariballa S, Alessa A. Sarcopenia: prevalence and prognostic significance in hospitalized patients. Clin Nutr 2013; 32: 772–6.
23. Binder EF, Yarasheski KE, Steger-May K *et al.* Effects of progressive resistance training on body composition in frail older adults: results of a randomized, controlled trial. J Gerontol A Biol Sci Med Sci 2005; 60: 1425–31.
24. Bonnefoy M, Cornu C, Normand S *et al.* The effects of exercise and protein-energy supplements on body composition and muscle function in frail elderly individuals: a long-term controlled randomised study. Br J Nutr 2003; 89: 731–9.
25. Bunout D, Barrera G, de la Maza P *et al.* The impact of nutritional supplementation and resistance training on the health functioning of free-living Chilean elders: results of 18 months of follow-up. J Nutr 2001; 131: 2441s–6s.
26. Goodpaster BH, Chomentowski P, Ward BK *et al.* Effects of physical activity on strength and skeletal muscle fat infiltration in older adults: a randomized controlled trial. J Appl Physiol (1985) 2008; 105: 1498–503.
27. Kemmler W, von Stengel S, Engelke K, Haberle L, Mayhew JLKalender WA. Exercise, body composition, and functional ability: a randomized controlled trial. Am J Prev Med 2010; 38: 279–87.
28. Rydwik E, Lammes E, Frandin K, Akner G. Effects of a physical and nutritional intervention program for frail elderly people over age 75. A randomized controlled pilot treatment trial. Aging Clin Exp Res 2008; 20: 159–70.
29. Suetta C, Andersen JL, Dalgas U *et al.* Resistance training induces qualitative changes in muscle morphology, muscle architecture, and muscle function in elderly postoperative patients. J Appl Physiol (1985) 2008; 105: 180–6.
30. Chale A, Cloutier GJ, Hau C, Phillips EM, Dallal GE, Fielding RA. Efficacy of whey protein supplementation on resistance exercise-induced changes in lean mass, muscle strength, and physical function in mobility-limited older adults. J Gerontol A Biol Sci Med Sci 2013; 68: 682–90.
31. Cornish SM, Chilibeck PD. Alpha-linolenic acid supplementation and resistance training in older adults. Appl Physiol Nutr Metab 2009; 34: 49–59.
32. Deutz NE, Pereira SL, Hays NP *et al.* Effect of beta-hydroxy-beta-methylbutyrate (HMB) on lean body mass during 10 days of bed rest in older adults. Clin Nutr 2013; 32: 704–12.
33. Dillon EL, Sheffield-Moore M, Paddon-Jones D *et al.* Amino acid supplementation increases lean body mass, basal muscle protein synthesis, and insulin-like growth factor-I expression in older women. J Clin Endocrinol Metab 2009; 94: 1630–7.
34. Flakoll P, Sharp R, Baier S, Levenhagen D, Carr C, Nissen S. Effect of beta-hydroxy-beta-methylbutyrate, arginine, and lysine supplementation on strength, functionality, body composition, and protein metabolism in elderly women. Nutrition 2004; 20: 445–51.
35. Kim HK, Suzuki T, Saito K *et al.* Effects of exercise and amino acid supplementation on body composition and physical function in community-dwelling elderly Japanese sarcopenic women: a randomized controlled trial. J Am Geriatr Soc 2012; 60: 16–23.

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36. Stout JR, Smith-Ryan AE, Fukuda DH *et al.* Effect of calcium beta-hydroxy-beta-methylbutyrate (CaHMB) with and without resistance training in men and women 65+yrs: a randomized, double-blind pilot trial. Exp Gerontol 2013; 48: 1303–10.
37. Tieland M, Dirks ML, van der Zwaluw N *et al.* Protein supplementation increases muscle mass gain during prolonged resistance-type exercise training in frail elderly people: a randomized, double-blind, placebo-controlled trial. J Am Med Dir Assoc 2012a; 13: 713–9.
38. Tieland M, van de Rest O, Dirks ML *et al.* Protein supplementation improves physical performance in frail elderly people: a randomized, double-blind, placebo-controlled trial. J Am Med Dir Assoc 2012b; 13: 720–6.
39. Vukovich MD, Stubbs NB, Bohlken RM. Body composition in 70-year-old adults responds to dietary beta-hydroxy-beta-methylbutyrate similarly to that of young adults. J Nutr 2001; 131: 2049–52.
40. Bauer J, Biolo G, Cederholm T *et al.* Evidence-based recommendations for optimal dietary protein intake in older people: a position paper from the PROT-AGE Study Group. J Am Med Dir Assoc 2013; 14: 542–59.

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A systematic review of outcomes following emergency transfer to hospital for residents of aged care facilities

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Abstract

Background: residential aged care facility (RACF) resident numbers are increasing. Residents are frequently frail with substantial co-morbidity, functional and cognitive impairment with high susceptibility to acute illness. Despite living in facilities staffed by health professionals, a considerable proportion of residents are transferred to hospital for management of acute deteriorations in health. This model of emergency care may have unintended consequences for patients and the healthcare system. This review describes available evidence about the consequences of transfers from RACF to hospital.
Methods: a comprehensive search of the peer-reviewed literature using four electronic databases. Inclusion criteria were participants lived in nursing homes, care homes or long-term care, aged at least 65 years, and studies reported outcomes of acute ED transfer or hospital admission. Findings were synthesized and key factors identified.
Results: residents of RACF frequently presented severely unwell with multi-system disease. In-hospital complications included pressure ulcers and delirium, in 19 and 38% of residents, respectively; and up to 80% experienced potentially invasive interventions. Despite specialist emergency care, mortality was high with up to 34% dying in hospital. Furthermore, there was extensive use of healthcare resources with large proportions of residents undergoing emergency ambulance transport (up to 95%), and inpatient admission (up to 81%).
Conclusions: acute emergency department (ED) transfer is a considerable burden for residents of RACF. From available evidence, it is not clear if benefits of in-hospital emergency care outweigh potential adverse complications of transfer. Future research is needed to better understand patient-centred outcomes of transfer and to explore alternative models of emergency healthcare.

Keywords: *emergency, nursing homes, older people*

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ORIGINAL ARTICLE: EPIDEMIOLOGY, CLINICAL PRACTICE AND HEALTH

Effect of physical activity on memory function in older adults with mild Alzheimer's disease and mild cognitive impairment

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Aim: It is very important to maintain cognitive function in patients with mild cognitive disorder. The aim of the present study was to determine whether the amount of physical activity is associated with memory function in older adults with mild cognitive disorder.

Methods: A total of 47 older adults with mild cognitive disorder were studied; 30 were diagnosed with mild Alzheimer's disease and 17 with mild cognitive impairment. The global cognitive function, memory function, physical performance and amount of physical activity were measured in these patients. We divided these patients according to their walking speed (<1 m/s or >1 m/s). A total of 26 elderly patients were classified as the slow walking group, whereas 21 were classified as the normal walking group.

Results: The normal walking group was younger and had significantly better scores than the slow walking group in physical performance. Stepwise multiple linear regression analysis showed that only the daily step counts were associated with the Scenery Picture Memory Test in patients of the slow walking group ($\beta = 0.471$, $P = 0.031$), but not other variables. No variable was significantly associated with the Scenery Picture Memory Test in the normal walking group.

Conclusions: Memory function was strongly associated with the amount of physical activity in patients with mild cognitive disorder who showed slow walking speed. The results show that lower physical activities could be a risk factor for cognitive decline, and that cognitive function in the elderly whose motor function and cognitive function are declining can be improved by increasing the amount of physical activity. **Geriatr Gerontol Int 2014; 14: 758–762.**

Keywords: memory function, mild cognitive disorder, older adults, physical activity, physical performance.

Introduction

Mild cognitive impairment (MCI) is a condition of objective cognitive impairment based on neuropsychological testing in the absence of clinically overt dementia.[1] This condition is of interest for identifying the prodromal and transitional stages of Alzheimer's disease (AD)[2,3] and other types of dementia. Indeed, a study shows that more than half of MCI cases progress to dementia within 5 years.[1] However, it is reported that the cognitive function of people with MCI can recover to normal.[4,5] Indeed, one study showed that 38.5% of older adults with MCI recovered to normal within 5 years.[6] Therefore, it is very important to prevent the deterioration of MCI to dementia. Because no consensus has been established regarding pharmacological intervention for MCI, non-pharmacological intervention is expected. Accordingly, we need to establish a way to prevent deterioration or even improve cognitive function in MCI patients.

Recently, it has attracted attention that increasing the amount of physical activity can prevent the decline of cognitive function. Many studies reported that global cognitive function is associated with the amount of physical activity. Furthermore, previous reports have shown that physical frailty is associated with an increased risk of developing AD and MCI,[8,9] and can predict a future cognitive decline in older adults.[10] Additionally, people with dementia have been shown to be

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frail because of their poor mobility and body composition.[11,12] Thus, cognitive function and physical frailty are interrelated.

Accordingly, the cognitive decline in frail elderly patients can cause further decline of cognitive function and motor function. Therefore, it is important to maintain and improve the cognitive function of the frail elderly with mild cognitive disorder.

Several studies have shown the relationship between cognitive decline that can be observed at the early stage of dementia and the amount of physical activity. However, no study has addressed whether the association between cognitive function and the amount of physical activity depends on the level of motor function in MCI or mild AD patients.

Therefore, the aim of the present study was to determine whether there is an association between memory function and the amount of physical activity in older adults with mild cognitive disorder, stratified by their motor function.

Methods

Participants

We recruited patients from the memory clinic of the Department of Geriatric Medicine in Kyoto University Hospital, Kyoto, Japan. The diagnosis of AD or MCI was made according to the following criteria: AD, *Diagnostic and Statistical Manual of Mental Disorders*, 4th edition, and the National Institute of Neurological and Communicative Disorders and Stroke and the Alzheimer's Disease and Related Disorders Association;[13,14] and MCI, Petersen's criteria.[15] Of the 47 patients with cognitive disorder, 30 were classified as mild AD and 17 as MCI by the criteria. In the present study, we did not set the upper and lower limits of the Mini-Mental State Examination (MMSE) for the diagnosis of MCI. The exclusion criteria used in the present study were vascular dementia, dementia with Lewy bodies, lacunar infarcts, Fazekas grade 3 periventricular hyperintensity/deep white-matter hyperintensity,[16] severe cardiac, pulmonary or musculoskeletal disorders, or the presence of comorbidities associated with an increased risk of falls, such as Parkinson's disease and stroke.

Written informed consent for the trial was obtained from each participant or his/her family members in accordance with the guidelines approved by the Kyoto University Graduate School of Medicine and the Declaration of Human Rights, Helsinki, 1975.

Walking speed

Comfortable 10-m walking time (walking time) is a simple test developed to screen basic mobility performance in frail older adults. It has been reported that the elderly with a walking score greater than 10.0 s can suffer an increased risk of falling.

Therefore, we divided the participants into two groups according to their walking speed (cut-off: 1 m/s); 26 of the older adults were classified as the normal walking group, whereas 21 of the older adults were classified as the slow walking group.

Cognitive function measures

Cognitive function was assessed by the MMSE and the Scenery Picture Memory Test (SPMT). MMSE is a global cognitive test that can be used to systematically and thoroughly assess mental status. It is an 11-question measure that tests five areas of cognitive function: orientation, registration, attention and calculation, recall, and language. The maximum score is 30. A score of 23 or lower is indicative of cognitive impairment. SPMT is a short and simple memory test assessing the visual memory encoded as scenery, combined with verbal answers. Briefly, it uses a line drawing scenery picture of a living room in a house where 23 objects commonly observed in daily life are drawn on an A4 piece of paper. The examinee is instructed to look at the picture for 1 min and remember the items. After this encoding period, we distracted participants by asking them to carry out a brief digits forward test. Participants were then asked to recall the objects in the picture without time limitation. This recall time usually takes less than 1 min. The number of items recalled is the score for SPMT. Higher scores indicate better cognitive function. We have previously shown that SPMT is a quick and effective screen for MCI.[17]

Physical performance measures

The participants were asked to carry out the three motor function tests that are widely used to identify the frail elderly. For each performance task, the participants carried out two trials, and the better performance of the two was used for the analysis. Physical performance assessments, such as walking time,[18] the Timed Up & Go (TUG) test,[19] the Functional Reach test,[20] the one-leg stand (OLS) test,[21] and the five chair stand test (5CS)[22] were carried out as previously described.

Physical activity measures

In physical activity, a valid, accurate and reliable pedometer, the Yamax Power walker EX-510, was used to measure the free-living step counts.[23] The participants were instructed to wear the pedometer in their pocket on the side of their dominant leg for 14 consecutive days except when bathing, sleeping or carrying out water-based activities. This pedometer has a 30-day data storage capacity. We calculated the averages of their daily step counts for 2 weeks.

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Table 1 Comparison of demographic characteristics and measurements with the overall group, normal walking group, and slow walking group

	All (= 47)	Normal walking (= 26)	Slow walking (= 21)	*P*-value
Age (years)	76.9 ± 7.0	74.7 ± 7.2	79.6 ± 5.9	0.016*
Female sex, *n* (%)	28 (59.6%)	17 (65.4%)	11 (52.4%)	0.38
BMI	21.7 ± 3.7	22.1 ± 3.7	21.1 ± 3.8	0.36
Loneliness	5 (10.6%)	2 (7.7%)	3 (14.3%)	0.64
Donepezil treatment	41 (87.2%)	24 (92.3%)	17 (81.0%)	0.39
MMSE	23.4 ± 3.6	23.0 ± 3.1	24.0 ± 4.2	0.37
SPMT	6.5 ± 4.7	6.7 ± 5.1	6.1 ± 4.4	0.68
Physical activity	4371.9 ± 3605.9	5264.0 ± 3476.9	3267.4 ± 3532.5	0.06
10 m walking time	9.9 ± 2.3	8.2 ± 1.0	12.3 ± 1.6	<0.001***
TUG time	9.5 ± 2.7	7.9 ± 1.4	11.4 ± 2.6	<0.001***
OLS	11.9 ± 15.8	16.9 ± 19.3	5.8 ± 6.1	0.01*
5CS	11.1 ± 3.5	10.0 ± 2.2	12.4 ± 4.2	0.016*

5CS, five chair stand test; BMI, body mass index; MMSE, Mini-Mental State examination; OLS, one leg standing; SPMT, Scenery Picture Memory Test; TUG, Timed Up & Go test. *$P < 0.05$ ***$P < 0.001$.

Statistical analysis

The *t*-test and χ^2-test were used to compare the data between the normal and slow walking groups. Multiple linear regression analysis using a stepwise method was carried out to investigate whether physical activity, age, sex, body mass index, TUG, OLS and 5CS were independently associated with SPMT. The data were analyzed using SPSS software Windows version 20.0 (SPSS, Chicago, IL, USA). A *P*-value <0.05 was considered statistically significant for all analyses.

Results

The demographic characteristics of the overall, normal and slow walking groups are summarized in Table 1. A total of 26 patients were classified as the normal walking group, and 21 patients as the slow walking group. There were no significant differences in sex, body mass index, loneliness, donepezil treatment, SPMT or physical activity between the two groups ($P > 0.05$). The normal walking group was younger (normal walking group 74.7 ± 7.2, slow walking group 79.6 ± 5.9, $P = 0.016$), and had significantly better scores than the slow walking group in TUG (normal walking group 7.9 ± 1.4 s, slow walking group 11.4 ± 2.6 s, $P < 0.001$), OLS (normal walking group 24.3 ± 24.3 s, slow walking group 5.8 ± 6.1 s, $P = 0.006$), 5CS (normal walking group 10.0 ± 2.2 s, slow walking group 12.4 ± 4.2 s, $P = 0.016$; Table 1). In the slow walking group, physical activity was significantly correlated with SPMT ($r = 0.471$, $P = 0.031$), as shown in Figure 1, but this correlation was absent in the normal walking group. In addition, there was a correlation between SPMT and physical activity after adjusted by age and sex in the slow walking group ($r = 0.493$, $P = 0.032$).

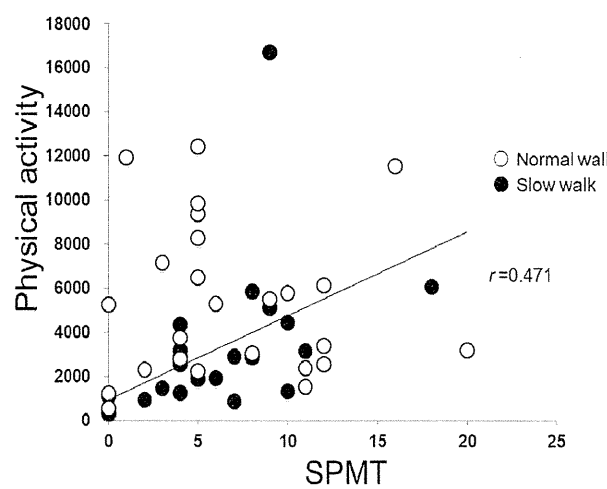

Figure 1 Relationship between physical activity and the Scenery Picture Memory Test (SPMT) in the normal walking and slow walking groups. In the slow walking group, physical activity was correlated significantly with SPMT ($r = 0.471$, $P = 0.031$).

Stepwise multiple linear regression analysis showed that no item was significantly associated with SPMT in the normal walking group, whereas only physical activity ($\beta = 0.471$, $P = 0.031$) was significantly associated with SPMT in the slow walking group (Table 2).

Discussion

The present study showed that memory function is strongly associated with the amount of physical activity

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Table 2 Stepwise multiple regression analysis for Scenery Picture Memory Test

	Normal walking		Slow walking	
	β estimates	*P*-value	β estimates	*P*-value
Daily step counts	–	–	0.471	0.031*
Age	–	–	–	–
Sex	–	–	–	–
BMI	–	–	–	–
TUG time	–	–	–	–
OLS	–	–	–	–
5CS	–	–	–	–

Note: 5CS, five chair stand test; BMI, body mass index; OLS, one leg standing; TUG, Timed Up & Go test. $*P < 0.05$.

only in the slow walking group with mild cognitive disorder. The present results show that lower physical activity could be a risk factor for cognitive decline in the elderly, and would strengthen the evidence to show the relationship between the amount of physical activity and cognitive function, as previously reported.[24] Additionally, the present study might show that the cognitive function of the elderly whose motor function and cognitive function are declining can be improved by increasing the amount of physical activity.

Physical activity might have an impact on cognitive function. The reasons why the SPMT, not MMSE, showed a correlation with physical activity might be explained as following. First, SPMT has been developed to screen mild cognitive disorder, whereas the MMSE is usually used for a broad range of cognitive impairment from normal to severe dementia. Because we only included patients with mild cognitive disorder, SPMT might be better to detect small correlated changes with other functions than MMSE. Second, SPMT shows good correlation not only with memory tests, but also with frontal function tests including word fluency test (Takechi *et al.* unpubl. observation). We speculate that efficient reminding of many objects from the scene requires the frontal function. Third, SPMT uses a line drawing scenery picture of a living room familiar to the elderly. It has been reported that aerobic exercise induces beneficial changes in brain structure and function that are correlated with improvements in cognition,[25,26] even in AD patients.[27,28] Physical activity, such as walking in and out of doors, might concomitantly give the patients visual stimulation. Because SPMT uses a picture of a living room familiar to the elderly, the degree of visual stimulation in daily living might have affected the results of SPMT. Thus, physical activity and the capacity to remember a visual scene might have shown a correlation. We suggest that increasing the amount of physical activity might result in beneficial biological changes to the brain structure and function or in beneficial physical changes to mobility and body composition. Therefore, increasing the step counts in a day could help to maintain and improve the cognitive function of older adults with mild cognitive disorder.

In the normal walking group with mild cognitive disorder, we found no significant association between memory function and the other variables. Other studies also show a lack of association of cognitive function with the amount of physical activity in older adults with similar ages to those in the present study.[7,29] Therefore, we need to consider effective strategies for patients with higher physical function.

There were several limitations of the present study. First, our limited sample size might introduce some error of inference, reduce the power of the analysis and limit generalization. Second, the present study was a cross-sectional study. Therefore, the relationship between the memory function and physical activity needs further investigation, such as an increase in physical activity levels for a certain period can improve the scores of SPMT, MMSE and other cognitive tests. Third, the definition of the normal walking group depended only on walking time in the present study. We might have to measure a frailty index, such as the Edmonton frail scale[30] or the Fried frailty assessment,[31] if we can extend our results to the frail elderly. Fourth, we used the SPMT, a visual memory test, as a cognitive test. However, we did not measure other factors, such as visual function and attention, that might have affected the present results. Therefore, it might be impossible to evaluate properly the relationship between physical activity and memory function. Thus, the results of the present study should be interpreted with caution.

In conclusion, the present study shows that cognition is associated with higher levels of physical activity only in patients with mild cognitive disorder who showed a slow walking speed. Our results suggest that increasing the amount of physical activity might prevent the deterioration of cognitive function. Further investigation, such as a prospective study, is required to confirm our results.

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Disclosure statement

None of the authors have conflicts of interest or financial disclosures.

References

1 McGough EL, Kelly VE, Logsdon RG *et al.* Associations between physical performance and executive function in older adults with mild cognitive impairment: gait speed and the Timed "Up & Go" test. *Phys Ther* 2011; **91**: 1198–1207.
2 Petersen RC, Doody R, Kurz A *et al.* Current concepts in mild cognitive impairment. *Arch Neurol* 2001; **58**: 1985–1992.
3 Winblad B, Palmer K, Kivipelto M *et al.* Mild cognitive impairment – beyond controversies, towards a consensus: report of the International Working Group on Mild Cognitive Impairment. *J Intern Med* 2004; **256**: 240–246.
4 Larrieu S, Letenneur L, Orgogozo JM *et al.* Incidence and outcome to mild cognitive impairment in a population-based prospective cohort. *Neurology* 2002; **59**: 1594–1599.
5 Matthews FE, Stephane BC, McLeith IG, Bond J, Brayne C. Two-year progression from mild cognitive impairment to dementia: to what extent do different definitions agree? *J Am Geriatr Soc* 2008; **56**: 1424–1433.
6 Ishikawa T, Ikeda M, Matsumoto N, Shigenobu K, Brayne C, Tanabe H. A longitudinal study regarding conversion from mild memory impairment to dementia in a Japanese community. *Int J Geriatr Psychiatry* 2006; **21**: 134–139.
7 Winchester J, Dick MB, Gillen D *et al.* Walking stabilizes cognitive functioning in Alzheimer's disease (AD) across one year. *Arch Gerontol Geriatr* 2013; **56** (1): 96–103.
8 Boyle PA, Buchman AS, Wilson RS, Leurgans SE, Bennett DA. Physical frailty is associated with incident mild cognitive impairment in community-based older persons. *J Am Geriatr Soc* 2010; **58**: 248–255.
9 Deshpande N, Metter EJ, Bandinelli S, Guralnik J, Ferrucci L. Gait speed under varied challenges and cognitive decline in older persons: a prospective study. *Age Ageing* 2009; **38**: 509–514.
10 Auyeung TW, Lee JS, Kwok T, Woo J. Physical frailty predicts future cognitive decline – a four-year prospective study in 2737 cognitively normal older adults. *J Nutr Health Aging* 2011; **15**: 690–694.
11 Cronin-Stubbs D, Beckett LA, Scherr PA *et al.* Weight loss in people with Alzheimer's disease: a prospective population based analysis. *BMJ* 1997; **314**: 178–179.
12 Scarmeas N, Albert M, Brandt J *et al.* Motor signs predict poor outcomes in Alzheimer's disease. *Neurology* 2005; **64**: 1696–1703.
13 American Psychiatric Association. *Diagnostic and Statistical Manual of Mental Disorders*, 4th edn. Washington, DC: American Psychiatric Association, 1994.
14 McKhann G, Drachman D, Folstein M, Katzman R, Price D, Stadlan EM. Clinical diagnosis of Alzheimer's disease: report of the NINCDS-ADRDA Work Group under the auspices of Department of Health and Human Services Task Force on Alzheimer's Disease. *Neurology* 1984; **34**: 939–944.
15 Petersen RC, Smith GE, Waring SC, Ivnik RJ, Tangalos EG, Kokmen E. Mild cognitive impairment: clinical characterization and outcome. *Arch Neurol* 1999; **56**: 303–308.
16 Fazekas F, Chawluk JB, Alavi A, Hurtig HI, Zimmerman RA. MR signal abnormalities at 1.5 T in Alzheimer's dementia and normal aging. *Am J Roentgenol* 1987; **149**: 351–356.
17 Takechi H, Dodge HH. Scenery Picture Memory Test: a new type of quick and effective screening test to detect early stage Alzheimer's disease patients. *Geriatr Gerontol Int* 2010; **10**: 183–190.
18 Lopopolo RB, Greco M, Sullivan D, Craik RL, Mangione KK. Effect of therapeutic exercise on gait speed in community-dwelling elderly people: a meta-analysis. *Phys Ther* 2006; **86**: 520–540.
19 Podsiadlo D, Richardson S. The timed "Up & Go": a test of basic functional mobility for frail elderly persons. *J Am Geriatr Soc* 1991; **39**: 142–148.
20 Duncan PW, Weiner DK, Chandler J, Studenski S. Functional reach: a new clinical measure of balance. *J Gerontol* 1990; **45**: M192–M197.
21 Vellas BJ, Wayne SJ, Romero L, Baumgartner RN, Rubenstein LZ, Garry PJ. One-leg balance is an important predictor of injurious falls in older persons. *J Am Geriatr Soc* 1997; **45**: 735–738.
22 Guralnik JM, Simonsick EM, Ferrucci L *et al.* A short physical performance battery assessing lower extremity function: association with self-reported disability and prediction of mortality and nursing home admission. *J Gerontol* 1994; **49**: M85–M94.
23 Crouter SE, Schneider PL, Karabulut M, Bassett DR Jr. Validity of 10 electronic pedometers for measuring steps, distance, and energy cost. *Med Sci Sports Exerc* 2003; **35**: 1455–1460.
24 Abbott RD, White LR, Ross GW, Masaki KH, Curb JD, Petrovitch H. Walking and dementia in physically capable elderly men. *JAMA* 2004; **292**: 1447–1453.
25 Cotman CW, Berchtold NC. Exercise: a behavioral intervention to enhance brain healthy and plasticity. *Trends Neurosci* 2002; **25**: 295–301.
26 Nichol KE, Parachikova AI, Cotman CW. Three weeks of running wheel exposure improves cognitive performance in the aged Tg2576 mouse. *Behav Brain Res* 2007; **184**: 124–132.
27 Yu F, Kolanowski AM. Facilitating aerobic exercise training in older adults with Alzheimer's disease. *Geriatric Nursing* 2009; **30**: 250–259.
28 Yu F, Kolanowski AM, Strumpf NE, Eslinger PJ. Improving cognition and function through exercise intervention in Alzheimer's disease. *J Nurs Scholarsh* 2006; **38**: 358–365.
29 Petersen RC. Mild cognitive impairment as a diagnostic entity. *J Intern Med* 2004; **56**: 183–194.
30 Rolfson DB, Majumdar SR, Tsuyuki RT, Tahir A, Rockwood K. Validity and reliability of the Edmonton Frail Scale. *Age Ageing* 2006; **35**: 526–529.
31 Fried LP, Tangen CM, Walston J *et al.* Frailty in older adults: evidence for a phenotype. *J Gerontol A Biol Sci Med Sci* 2001; **56A**: M146–M156.

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Review

Sarcopenia in Asia: Consensus Report of the Asian Working Group for Sarcopenia

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A B S T R A C T

Sarcopenia, a newly recognized geriatric syndrome, is characterized by age-related decline of skeletal muscle plus low muscle strength and/or physical performance. Previous studies have confirmed the association of sarcopenia and adverse health outcomes, such as falls, disability, hospital admission, long term care placement, poorer quality of life, and mortality, which denotes the importance of sarcopenia in the health care for older people. Despite the clinical significance of sarcopenia, the operational definition of sarcopenia and standardized intervention programs are still lacking. It is generally agreed by the different working groups for sarcopenia in the world that sarcopenia should be defined through a combined approach of muscle mass and muscle quality, however, selecting appropriate diagnostic cutoff values for all the measurements in Asian populations is challenging. Asia is a rapidly aging region with a huge population, so the impact of sarcopenia to this region is estimated to be huge as well. Asian Working Group for Sarcopenia (AWGS) aimed to promote sarcopenia research in Asia, and we collected the best available evidences of sarcopenia researches from Asian countries to establish the consensus for sarcopenia diagnosis. AWGS has agreed with the previous reports that sarcopenia should be described as

The authors declare no conflicts of interest.

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