Received: 14 August 2018 | Revised: 30 October 2018 | Accepted: 6 November 2018

DOI: 10.1111/sms.13336

ORIGINAL ARTICLE

WILEY

Exercise type and activities of daily living disability in older women: An 8-year population-based cohort study

Yosuke Osuka[1] | **Narumi Kojima**[1] | **Miji Kim**[2] | **Chang Won Won**[3] | **Takao Suzuki**[4] | **Hunkyung Kim**[1,3]

[1]Research Team for Promoting Independence of the Elderly, Tokyo Metropolitan Institute of Gerontology, Tokyo, Japan

[2]Department of Biomedical Science and Technology, College of Medicine, East-West Medical Research Institute, Kyung Hee University, Seoul, Korea

[3]Department of Family Medicine, College of Medicine, Kyung Hee University, Seoul, Korea

[4]Institute of Gerontology, J.F. Oberlin University, Tokyo, Japan

Correspondence
Yosuke Osuka, Tokyo Metropolitan Institute of Gerontology, Tokyo, Japan.
Email: osuka@tmig.or.jp

Funding information
Grants-in-Aid for Scientific Research, Grant/Award Number: Grants-in-Aid for Scientific Research B [19300236], Grants-in-Aid for Scientific Research B [22300243] and Grants-in-Aid for Scientific Research B [26282201]

Background: Exercise may reduce the risk of disability for activities of daily living (ADL), but the degree of associations between specific exercise types and such a risk remains unclear. This study aimed to examine the longitudinal associations between exercise types and the incidence of ADL disability in older women.

Methods: This 8-year population-based prospective cohort study enrolled 1003 community-dwelling older Japanese women without ADL disability in the baseline surveys. In the baseline surveys, all participants were asked whether or not they participated in any of 16 exercise types through a face-to-face interview. ADL were assessed using a modified form of the Katz index that comprised five ADL tasks. ADL disability was defined as dependence in at least one ADL task during the 8-year follow-up period. Binary logistic regression analyses were applied to obtain adjusted odds ratios (ORs) and 95% confident intervals (CIs) for the incidence of ADL disability based on participation or non-participation in each exercise type.

Results: Activities of daily living disability was noted in 130 participants (13.0%) over the 8-year follow-up period. After adjustment for confounders and other exercise types, participation in dancing, compared to non-participation, was associated with a significantly lower OR (0.27; 95% CI: 0.09-0.75) for incident ADL disability. There were no significant associations between other exercise types and incident ADL disability.

Conclusion: Dancing was significantly and independently associated with a lower incidence of ADL disability. Thus, dancing may solely contribute to a reduced risk of ADL disability in older women.

KEYWORDS
dance, epidemiology, exercise, functional capacity

1 | INTRODUCTION

Several epidemiological studies have shown that exercise or physical activity may reduce the risk of disability for activities of daily living (ADL) in the older population.[1-5] These studies were systematically reviewed and revealed the existence of an inverse dose-response relationship between a higher level of physical activity, including exercise, and the risk of incident ADL disability.[6] According to this review, moderate levels of physical activity (eg, normal walking or gardening, 3-5 day/wk and 30 minutes per day) reduced the risk of ADL disability by 50%. Thus, physical activity, including exercise, is often reported as a contributory factor for the reduced risk of incident ADL disability, but the effects of specific exercise types on such a risk remain unclear. To encourage participation in a specific exercise type, it is important to determine the effect of different types of exercise on health outcomes.

Over the last two decades, there has been a gradual accumulation of exercise epidemiology studies, focused mainly on the effect of different types or domains of exercise and physical activity on health outcomes.[7-14] For example, in the adult population, the associations between different physical activity domains or exercise types and mortality were analyzed, and work, household, and leisure-time activities were associated with a significant reduction in mortality[10]; cycling, swimming, racquet sports, and aerobics were also associated with a significant reduction in mortality.[13] In the older population, the associations between different physical activity types and coronary heart disease or mortality were analyzed, and domestic work and cycling were associated with a decreased risk of coronary heart disease,[7] while walking, cycling, domestic work, gardening, and sports were associated with a significant reduction in mortality.[14] Thus, the focus of exercise epidemiology seems to be changing from "Does exercise have health benefits?" to "What kind of exercise is more beneficial to health?"[15]

In order to further promote active aging in the older population, it may be important to identify the usefulness of various types of exercise, considering not only stereotyped recommendations focused on the amount of exercise, but also the needs of individuals (eg, the kind of exercise older individuals want to do to maintain ADL independence). However, the association between exercise types and incidence of ADL disability in older adults has not been examined by previous investigators. This is important especially for older women because physical disabilities have been reported to occur more frequently in older women than in older men.[16]

The purpose of this study was to examine the association between exercise types and the risk of incident ADL disability in community-dwelling older women. Identifying the exercise types that are associated with a reduced risk of ADL disability would contribute to independent living in the older population.

2 | MATERIALS AND METHODS

2.1 | Participants

This was an 8-year population-based prospective cohort study. The target area of this study was the Itabashi ward, located in the northwest area of 23 special wards of Tokyo. We conducted a baseline survey in 2007 and 2008 at the Tokyo Metropolitan Institute of Gerontology, Itabashi, Tokyo, Japan. The survey in 2007 was conducted as the second survey of the cohort and started in 2006. In 2006, 5935 women aged 70-84 years were randomly selected from the basic resident register; of these, 957 women participated in the first survey. In this study, we enrolled 641 women who participated in the second survey in 2007. The survey in 2008 was conducted as the first survey. We randomly selected 10 948 women aged 75-84 years from the basic resident register and 1289 of these participated in the baseline survey in 2008.

In all, 1930 women participated in the baseline survey in 2007 and 2008. A follow-up survey was conducted onsite by the Tokyo Metropolitan Institute of Gerontology or via a postal interview survey in October 2015 and 2016. Figure 1 shows a flowchart of participant enrollment in the study. During the 8-year follow-up period, 910 people were lost to follow-up. Ultimately, a total of 1020 individuals participated in the follow-up survey. After excluding 3 individuals with ADL disability at the baseline survey and 14 individuals with missing values in ADL, 1003 participants were included in the analysis. This study complied with the guidelines of the Declaration of Helsinki. The study protocol was approved by the Ethics Committee of the Tokyo Metropolitan Institute of Gerontology. All participants provided a written informed consent.

2.2 | Measurements

2.2.1 | Exercise type

Exercise types were selected via a face-to-face interview at the baseline survey. We specifically asked about exercise types that were considered to be commonly performed on a daily basis. We asked individuals whether or not they

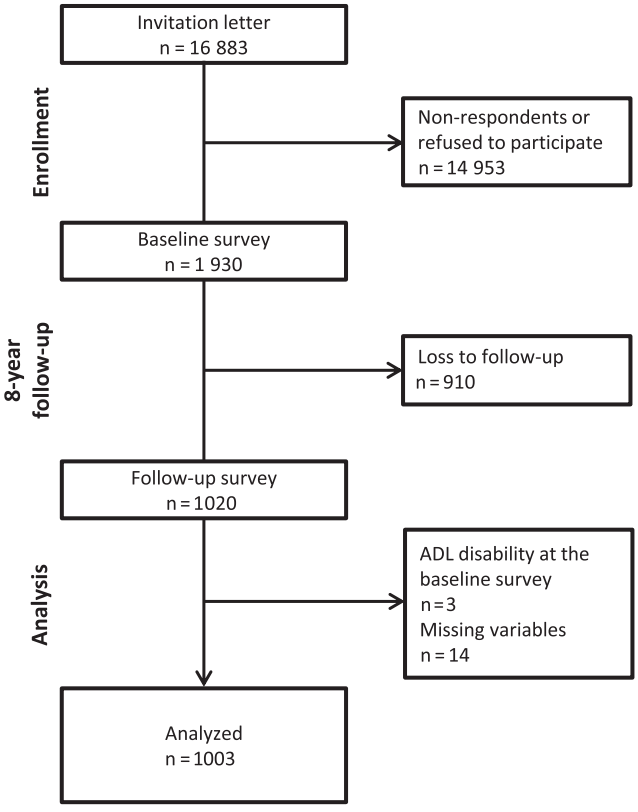

FIGURE 1 Flowchart of the study participants. ADL, activities of daily living

participated in 16 exercise types including walking (not for outing or transportation), calisthenics, Japanese croquet, jogging, golf, ball games, hiking, dancing, aqua exercise, martial art, yoga, bicycling, Tai Chi, bowling, quoits, and strength exercise; the participants answered either "yes" or "no."

2.2.2 | ADL disability

ADL were assessed using a modified form of the Katz index.[17,18] In the baseline survey, we evaluated participants regarding five ADL tasks (walking, eating, bathing, dressing, and toileting) through face-to-face interviews and asked them to select from three choices (intact, partially dependent, and completely dependent) regarding each of the five tasks. For the follow-up survey, ADL data were collected through face-to-face interviews or postal mailed survey. We defined ADL disability as partial or complete dependence in at least one ADL task during the 8-year follow-up period.[18] Participants who experienced ADL disability were considered as having disability.

2.2.3 | Other variables

We also investigated age, years of education, and number of housemates as sociodemographic factors, medical history as a medical factor, drinking and smoking statuses as lifestyle factors, depression as a psychological factor, and gait speed as a physical factor. We classified years of education into a binary variable: ≥9 years (graduation from junior high school or higher) and <9 years. We asked participants about their medical history including hypertension, stroke, heart disease, diabetes, hyperlipidemia, osteoporosis, and lower-back pain, over the past year. Participants were asked about their current smoking and drinking status if they were "current" or "past or never." Participants who answered "current" were defined as drinkers and/or smokers. Depression was assessed using the Mini-international Neuropsychiatric Interview that comprised two questions.[19] We defined participants who answered "yes" to either question as having depression.[19] Gait speed was calculated at a steady state by including only 5 meters of the center of the 11-meter pathway.[20] We defined gait speed <0.8 m/s as gait impairment.[21]

2.3 | Statistical analysis

First, chi-squared test or Fisher's exact test for categorical variables was applied to compare differences in the baseline characteristics between the participants with and without ADL disability in the 8-year follow-up period. Next, we applied the chi-squared or Fisher's exact test to compare the incidence of ADL disability between each exercise participant and non-participant during the 8-year follow-up period. Finally, we applied binary logistic regression analyses to compare adjusted odds ratios (ORs) and 95% confidence intervals (CIs) for incident ADL disability based on participation or non-participation in each exercise type. We adjusted for age, years of education, hypertension, diabetes, lower-back pain, and gait impairment because these covariates were used as confounders in previous studies.[2,4] We examined the association between the incidence of ADL disability and

TABLE 1 Comparison of baseline characteristics between participants with and without ADL disability after 8 years

	Without disability n = 873	With disability n = 130	*P*-value
Age, ≥80 years	185 (21.2%)	60 (46.2%)	<0.01[a]
Years of education, ≥9 years	735 (84.2%)	98 (75.4%)	0.01[a]
Medical history			
Hypertension	443 (50.7%)	79 (60.8%)	0.03[a]
Stroke	34 (3.9%)	17 (13.1%)	<0.01[a]
Heart disease	164 (18.8%)	36 (27.7%)	0.02[a]
Diabetes	62 (7.1%)	15 (11.5%)	0.08[a]
Hyperlipidemia	346 (39.6%)	54 (41.5%)	0.68[a]
Osteoporosis	243 (27.8%)	46 (35.4%)	0.08[a]
Lower-back pain	207 (23.7%)	52 (40.0%)	<0.01[a]
Gait impairment	9 (1.0%)	16 (12.3%)	<0.01[b]
Depression	45 (5.2%)	18 (13.8%)	<0.01[a]
Smoker	30 (3.4%)	5 (3.8%)	0.81[b]
Drinker	220 (25.2%)	24 (18.5%)	0.10[a]

Values are indicated as n (%). *P*-values were calculated via the chi-square test (a) and Fisher's exact test (b).
ADL, activities of daily living.

seven exercise types with a participation of ≥3% at the baseline survey, as other exercise types did not have sufficient statistical power due to low-participation rate.

All analyses were performed using IBM SPSS version 25.0 (IBM Corp., Armonk, New York, USA). $P < 0.05$ was considered statistically significant.

3 | RESULTS

Activities of daily living disability was observed in 130 participants (13.0%) during the 8-year follow-up period. Table 1 shows the comparison of baseline characteristics between participants who did and did not experience ADL disability in the 8-year follow-up period. There were significant differences in age, years of education, hypertension, stroke, heart disease, lower-back pain, gait impairment, and depression; the participants with disability were older, had higher prevalence rates of these diseases or impairment, and had a lower education level compared with the participants without disability.

Table 2 summarizes the numbers and rate of participation in each exercise type in a descending order and the numbers and rate of exercise types. The most common exercise was calisthenics (n = 596, 59.4%), followed by walking (n = 581, 57.9%), dancing (n = 107, 10.7%), aqua exercise (n = 75, 7.5%), yoga (n = 66, 6.6%), strength exercise (n = 36, 3.6%), and Tai Chi (n = 31, 3.1%). Although the rates of participation in calisthenics and walking exceeded 50%, those for the other exercise types were <11%.

TABLE 2 Exercise characteristics among the 1003 participants at the baseline survey

	n (%)
Exercise types	
Calisthenics	596 (59.4)
Walking	581 (57.9)
Dancing	107 (10.7)
Aqua exercise	75 (7.5)
Yoga	66 (6.6)
Strength exercise	36 (3.6)
Tai Chi	31 (3.1)
Hiking	21 (2.1)
Bicycling	21 (2.1)
Japanese croquet	19 (1.9)
Quoits	17 (1.7)
Ball games	14 (1.4)
Golf	8 (0.8)
Jogging	6 (0.6)
Bowling	3 (0.3)
Martial art	2 (0.2)
The number of exercise types	
0	144 (14.4)
1	341 (34.0)
2	351 (35.0)
3	120 (12.0)
4	37 (3.7)
5 and more	10 (1.0)

Figure 2 shows the comparisons of the incidence of ADL disability between participants and non-participants for 7 exercise types. Participation in dancing and aqua exercise was associated with a significantly lower incidence of ADL disability compared to non-participation in those exercises ($P < 0.05$). There were no significant differences in the incidence of ADL disability between participation and non-participation in other exercises.

Figure 3 shows the adjusted ORs and 95% CIs for incident ADL disability based on the participation or non-participation in the 7 exercise types. After adjusting for covariates and the 7 exercise types, only participation in dancing demonstrated a lower OR (0.27 95% CI [0.09-0.75]) compared to non-participation in dancing. However, there were no significant differences in ORs for ADL disability between participation and non-participation in other exercise types.

4 | DISCUSSION

To the best of our knowledge, this study is the first to prospectively examine associations between various exercise types and the risk of disability for ADL in the older population. After adjustment for covariates and the seven exercise types, participation in dancing remained significantly associated with a reduced risk of incident ADL disability. These

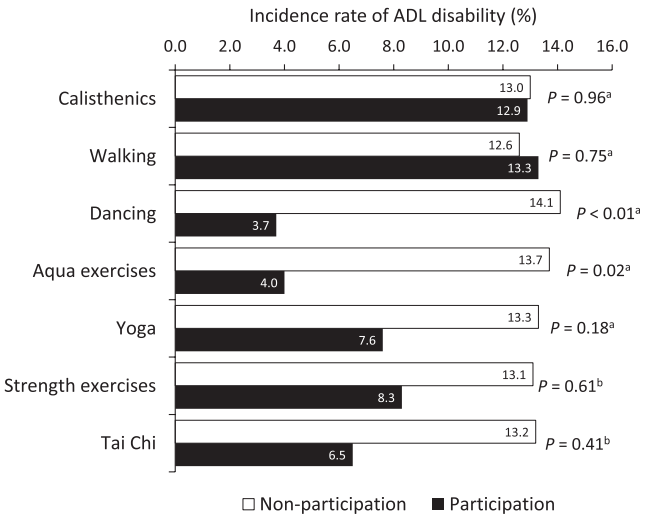

FIGURE 2 Comparison of the rates of ADL disability between participation and non-participation groups in 7 exercise types. *P*-values were calculated via the chi-square test (A) and Fisher's exact test (B). ADL: activities of daily living

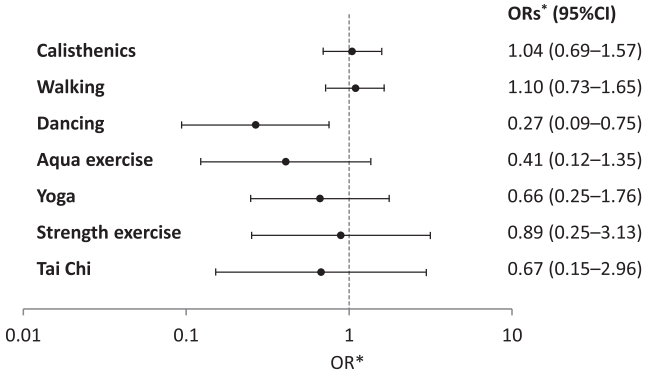

FIGURE 3 Adjusted odds ratios (ORs) and 95% confidence intervals (CIs) for the incidence of ADL disability based on participation or non-participation in seven exercise types. *Adjusted for age, years of education, hypertension, diabetes, lower-back pain, gait impairment, and the seven exercise types. ADL: activities of daily living

results suggest that dancing may contribute to maintaining ADL among older women.

Dancing has various beneficial effects on psychophysiological and physical conditions in the older population.[22-24] Habitual dancing may potentiate these effects and contribute to a reduced risk of ADL disability. Although it is unclear why dancing alone reduced the risk of ADL disability, recent dance-based exercise intervention studies emphasized the marked effects of dancing on brain plasticity and balance ability.[25,26] Burzynska et al randomly allocated 174 healthy but low-activity older adults into four groups (dancing, walking, walking + nutrition, and control) and examined the effects of each intervention on white matter integrity during a 6-month period. There was a time × group interaction of change in white matter integrity in the fornix; integrity increased only in the dance group but decreased in the other groups over the 6-month period. Rehfeld et al compared the effects of 18 months of dancing and traditional exercising (endurance, strength-endurance, and flexibility training) on volumes of the hippocampal subfields and balance abilities. Although in both groups, the left hippocampal volume was significantly increased, significant increases in the left dentate gyrus and right subiculum, as well as in the balance score, were found in the dance group alone. These two studies suggest that dancing is a more useful exercise for maintaining brain structure and balance ability in older adults compared to walking, strength, and flexibility exercise. This superiority may be influenced by the multiple characteristics contained in dancing. Although we could not identify what kind of dancing the participants did mainly and could not find statistical data regarding dancing participation in older Japanese women, social dancing or traditional Japanese dancing might be performed. Dancing requires not only balance, strength, and endurance ability,[23] but also cognitive ability: adaptability and concentration to move according to the music and partner, artistry for graceful and fluid motion, and memory for choreography. These various elements may contribute to the superiority of dancing in maintaining a higher ADL capacity.

Our results did not show a lower risk of ADL disability for participation in calisthenics, walking, aqua exercise, yoga, strength exercise, and Tai Chi. We did not expect these non-significant associations since evidence from other observational and intervention studies has suggested that participation in such exercises is useful for maintaining higher physical function and functional capacity in the older population. For example, our previous study identified that participation in calisthenics was significantly associated with a delay in instrumental ADL decline.[27] Other exercise types such as aerobic, muscle strengthening, flexibility, and balance exercises would also contribute to improving or maintaining cardiovascular and musculoskeletal function in older adults.[28,29] We have considered two possible explanations for the non-significant associations noted in the present study. First, the effects of each exercise type on the risk of incident ADL disability were analyzed using binary variables. We could not assess the level of each exercise type as we did not collect data regarding each exercise intensity, duration, and frequency. Thus, we could not examine the association by analyzing dose-response relationships. Second, there were relatively few ADL disability events regarding participation in some exercise types including aqua exercise (n = 3), yoga (n = 5), strength exercise (n = 3), and Tai Chi (n = 2), which contributed to wide CIs for incident ADL disability. Consequently, these two reasons may reflect the weaker statistical power for detecting the significant effects of such exercise types on the reduced risk of incident ADL disability. Koolhaas et al conducted a well-designed epidemiological study and found a significant association between reduced mortality risk and all physical activity types including walking, cycling, domestic work, gardening, and sports. In their study, they assessed each physical activity level and examined the effects of each physical activity type on mortality based on three physical activity levels. Additionally, they observed sufficient mortality events (n = 3261) to detect significant associations. Thus, future studies should analyze the association between exercise types and incident ADL disability using a larger sample size and assessing each exercise frequency.

The major strength of this study is that it is the first to examine the association between various exercise types and the risk of disability for ADL among older women. Furthermore, a population-based sampling, a relatively large sample size, and a long follow-up period helped to more clearly identify the effects of dancing on the reduced risk of incident ADL disability in this population.

This study has several limitations. First, although we prospectively identified the effects of dancing on the reduced risk of ADL disability using population-based sampling, individuals in poor health might have participated less in

TABLE 3 Comparison of the rate of participation in seven exercise types in baseline survey between participants who were followed up and those lost to follow-up after 8 y

	Follow-up n = 1019	Lost to follow-up n = 910	*P*-value
Calisthenics	604 (59.3%)	455 (50.0%)	<0.01
Walking	590 (57.9%)	486 (53.4%)	<0.05
Dancing	109 (10.7%)	64 (7.0%)	<0.01
Aqua exercise	75 (7.4%)	47 (5.2%)	<0.05
Yoga	66 (6.5%)	26 (2.9%)	<0.01
Strength exercise	37 (3.6%)	32 (3.5%)	0.90
Tai Chi	32 (3.1%)	22 (2.4%)	0.34

Values are indicated as n (%). *P*-values were calculated via the chi-square test. Missing values (n = 1).

dancing compared with individuals in good health. It should be noted that 88.6% of eligible women did not participate in the baseline survey and 47.2% of participants were lost to follow-up. Participants who were involved in some exercise were more likely to participate in the follow-up survey (see Table 3). These problems limited generalizability to the overall older population. Second, the small number of ADL disability events reduced the statistical power in some exercise types. Thus, the reliability of the observed association between those exercise types and the risk of incident ADL disability is unclear. Third, we could not collect information about the frequency of each exercise and about other physical activity types such as domestic work, transportation, and occupational physical activity. This unmeasured information may have been another potential confounder. Therefore, it is unclear whether dancing is associated with a reduced risk of ADL disability, independent of other physical activities. Finally, the definition of exercise participation based on self-reporting may have caused recall and instrument biases.

5 | CONCLUSIONS AND PERSPECTIVES

Participation in dancing was significantly and independently associated with a reduced risk of incident ADL disability among older Japanese women. In this sense, dancing should be a useful exercise for maintaining functional capacity in this population. This finding may encourage participation in dancing among the older population. To demonstrate the effects of other exercise types on ADL maintenance in the older population, future studies should reanalyze these effects using a larger sample size and assessing the frequency of each exercise type.

ACKNOWLEDGEMENTS

We are grateful to the participants and staff of the Tokyo Metropolitan Institute of Gerontology.

CONFLICTS OF INTEREST

The authors have no conflicts of interest.

ORCID

Yosuke Osuka https://orcid.org/0000-0002-5744-1961

REFERENCES

1. Wu SC, Leu SY, Li CY. Incidence of and predictors for chronic disability in activities of daily living among older people in Taiwan. *J Am Geriatr Soc*. 1999;47:1082-1086.
2. Stessman J, Hammerman-Rozenberg R, Maaravi Y, Cohen A. Effect of exercise on ease in performing activities of daily living and instrumental activities of daily living from age 70 to 77: the Jerusalem longitudinal study. *J Am Geriatr Soc*. 2002;50:1934-1938.
3. Leveille SG, Guralnik JM, Ferrucci L, Langlois JA. Aging successfully until death in old age: opportunities for increasing active life expectancy. *Am J Epidemiol*. 1999;149:654-664.
4. Boyle PA, Buchman AS, Wilson RS, Bienias JL, Bennett DA. Physical activity is associated with incident disability in community-based older persons. *J Am Geriatr Soc*. 2007;55:195-201.
5. Wang L, van Belle G, Kukull WB, Larson EB. Predictors of functional change: a longitudinal study of nondemented people aged 65 and older. *J Am Geriatr Soc*. 2002;50:1525-1534.
6. Paterson DH, Warburton DE. Physical activity and functional limitations in older adults: a systematic review related to Canada's Physical Activity Guidelines. *Int J Behav Nutr Phys Act*. 2010;7:38.
7. Koolhaas CM, Dhana K, Golubic R, et al. Physical Activity Types and Coronary Heart Disease Risk in Middle-Aged and Elderly Persons: The Rotterdam Study. *Am J Epidemiol*. 2016;183:729-738.
8. Andersen LB, Schnohr P, Schroll M, Hein HO. All-cause mortality associated with physical activity during leisure time, work, sports, and cycling to work. *Arch Intern Med*. 2000;160:1621-1628.
9. Besson H, Ekelund U, Brage S, et al. Relationship between subdomains of total physical activity and mortality. *Med Sci Sports Exerc*. 2008;40:1909-1915.
10. Autenrieth CS, Baumert J, Baumeister SE, et al. Association between domains of physical activity and all-cause, cardiovascular and cancer mortality. *Eur J Epidemiol*. 2011;26:91-99.
11. Samitz G, Egger M, Zwahlen M. Domains of physical activity and all-cause mortality: systematic review and dose-response meta-analysis of cohort studies. *Int J Epidemiol*. 2011;40:1382-1400.
12. Wanner M, Tarnutzer S, Martin BW, et al. Impact of different domains of physical activity on cause-specific mortality: a longitudinal study. *Prev Med*. 2014;62:89-95.
13. Oja P, Kelly P, Pedisic Z, et al. Associations of specific types of sports and exercise with all-cause and cardiovascular-disease mortality: a cohort study of 80 306 British adults. *Br J Sports Med*. 2017;51:812-817.

14. Koolhaas CM, Dhana K, Schoufour JD, et al. Physical activity and cause-specific mortality: the Rotterdam Study. *Int J Epidemiol*. 2018;47:1705-1713.
15. Oja P, Titze S, Kokko S, et al. Health benefits of different sport disciplines for adults: systematic review of observational and intervention studies with meta-analysis. *Br J Sports Med*. 2015;49:434-440.
16. Murtagh KN, Hubert HB. Gender differences in physical disability among an elderly cohort. *Am J Public Health*. 2004;94:1406-1411.
17. Katz S, Ford AB, Moskowitz RW, Jackson BA, Jaffe MW. Studies of illness in the aged: The index of ADL: a standardized measure of biological and psychosocial function. *JAMA*. 1963;185:914-919.
18. Suzuki T, Yoshida H, Kim H, et al. Walking speed as a good predictor for maintenance of I-ADL among the rural community elderly in Japan: A 5-year follow-up study from TMIG-LISA. *Geriatr Gerontol Int*. 2003;3:S6-S14.
19. Sheehan DV, Lecrubier Y, Sheehan KH, et al. The Mini-International Neuropsychiatric Interview (M.I.N.I.): the development and validation of a structured diagnostic psychiatric interview for DSM-IV and ICD-10. *J Clin Psychiatry*. 1998;59(Suppl 20):22–33. quiz 34–57.
20. Shinkai S, Watanabe S, Kumagai S, et al. Walking speed as a good predictor for the onset of functional dependence in a Japanese rural community population. *Age Ageing*. 2000;29:441–446.
21. Chen LK, Liu LK, Woo J, et al. Sarcopenia in Asia: consensus report of the Asian Working Group for Sarcopenia. *J Am Med Dir Assoc*. 2014;15:95–101.
22. Vankova H, Holmerova I, Machacova K, Volicer L, Veleta P, Celko AM. The effect of dance on depressive symptoms in nursing home residents. *J Am Med Dir Assoc*. 2014;15:582–587.
23. Keogh JW, Kilding A, Pidgeon P, Ashley L, Gillis D. Physical benefits of dancing for healthy older adults: a review. *J Aging Phys Act*. 2009;17:479–500.
24. Fong Yan A, Cobley S, Chan C, et al. The Effectiveness of Dance Interventions on Physical Health Outcomes Compared to Other Forms of Physical Activity: A Systematic Review and Meta-Analysis. *Sports Med*. 2018;48:933–951.
25. Burzynska AZ, Jiao Y, Knecht AM, et al. White Matter Integrity Declined Over 6-Months, but Dance Intervention Improved Integrity of the Fornix of Older Adults. *Front Aging Neurosci*. 2017;9:59.
26. Rehfeld K, Muller P, Aye N, et al. Dancing or Fitness Sport? The Effects of Two Training Programs on Hippocampal Plasticity and Balance Abilities in Healthy Seniors. *Front Hum Neurosci*. 2017;11:305.
27. Osuka Y, Suzuki T, Kim M, et al. Association between exercise type and the decline in instrumental activities of daily living in community-dwelling older women: A 4-year prospective study. *Prev Med*. 2018;112:23–30.
28. Nelson ME, Rejeski WJ, Blair SN, et al. Physical activity and public health in older adults: recommendation from the American College of Sports Medicine and the American Heart Association. *Med Sci Sports Exerc*. 2007;39:1435–1445.
29. Liu CJ, Latham NK. Progressive resistance strength training for improving physical function in older adults. *Cochrane Database Syst Rev*. 2009;Cd002759.

How to cite this article: Osuka Y, Kojima N, Kim M, Won CW, Suzuki T, Kim H. Exercise type and activities of daily living disability in older women: An 8-year population-based cohort study. *Scand J Med Sci Sports*. 2018;00:1–7. https://doi.org/10.1111/sms.13336