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Three-year changes in physical activity and subsequent loss of ability to walk 400-m in older adults: The InCHIANTI study

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Abstract

We examined the associations of maintaining or increasing physical activity (PA) over a 3-year follow-up with subsequent incident inability to complete the 400-m walk test (i.e. mobility disability) over 6 years of follow-up in older adults. This study included 421 participants aged 65 years. The 400-m walk test was assessed at baseline and at 3-, 6-, and 9-year follow-up. PA was self-reported through a 6-point rating scale at baseline and 3-year follow-up. Three-year cumulative PA (i.e. average at baseline and at 3-year follow-up) and its changes (i.e. from baseline to 3-year follow-up) were linked to subsequent incidence of mobility disability over 6 years of follow-up (i.e. from 3- to 9-year follow-up), after adjustment for potential covariates. After the 3-year period, incidence of mobility disability over the subsequent 6 years of follow-up occurred in 129 participants. The odds ratio (95%CI) of incident mobility disability associated with 1-category increase in cumulative PA was 0.63 (0.41–0.97, $P=0.036$). The odds ratio (95%CI) of incident mobility disability associated with 1-category increase in changes in PA was 0.56 (0.38–0.84, $P=0.005$). Hence, maintaining or increasing PA levels are associated with a reduced risk of mobility disability among older adults.

Keywords

physical activity; older adults; mobility disability; longitudinal

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Introduction

Mobility in old age is critical for living independently and maintaining active participation in the community.¹ Older adults who lose the ability to walk long distance without assistance have greater risk of disability, multimorbidity, and death than those who preserve this ability.² Considering the magnitude and speed of population aging, to prevent or delay the onset of mobility disability is, therefore, a public health priority.^{3,4} It has been shown that physical activity (PA) have beneficial effect on major hallmarks of aging, including some mechanisms that trigger mobility disability.^{5,6} The Lifestyle Interventions and Independence for Elders (LIFE) randomized clinical trial have showed that over 2.6 years of follow-up, structured PA reduced incident mobility disability among older adults.⁷ However, LIFE was performed in ideal conditions and the eligibility criteria were careful to avoid confounding factors (i.e. individuals were inactive, at risk for mobility disability according to the Short Physical Performance Battery, had no major cognitive impairment and could safely participate in the PA intervention). Population-based longitudinal studies on aging could provide valuable information in realistic conditions, longer follow-up periods and representativeness of all community-dwelling older adults.⁸ Hence, we examined the associations of maintaining or increasing PA over a 3-year follow-up with subsequent incident inability to complete the 400-m walk test (hereafter mobility disability) over 6 years of follow-up in a large population-based sample of community-dwelling older adults.

Methods

Participants

The present study includes a total of 1,155 older adults aged ≥65 years who participated in the *Invecchiare in Chianti* (InCHIANTI) study.^{9,10} The study design and protocols were published previously.⁹ Briefly, the InCHIANTI study is a population-based longitudinal study carried out in two Tuscany towns located in the Chianti geographic area in Italy. The baseline data were collected in 1998–2000, with three follow-up assessments at 3 (2001–2003), 6 (2004–2006) and 9 (2007–2008) years to date (see Supplementary Figure 1). Participants received a detailed description of the study and were included after providing written informed consent. The study protocol was approved by the Italian National Institute of Research and Care on Aging Ethical Committee. This study conforms to all STROBE guidelines and reports the required information accordingly (see Supplementary Checklist)

Measurements

PA was assessed through an interviewer-administered questionnaire at baseline and at each 3-year follow-up.^{9,10} Participants were asked to rate their average level of PA during the past year with a 6-point scale. The response categories were 1) hardly any PA, 2) mostly sitting or some walking, 3) 2–4 hours/week of light PA, 4) 1–2 hours/week of moderate PA or >4 hours/week of light PA, 5) ≥3 hours/week of moderate PA, and 6) physical exercise performed regularly. To evaluate certain maintained levels of PA over time, a continuous score was computed as the average of PA at baseline and at 3-year follow-up.¹⁰ Also, participants who scored <3, 3 to <4 and ≥4 in the cumulative score were classified as ‘mostly inactive’, ‘mostly minimally active’ (i.e. active older adults but far to meet PA

guidelines) and ‘mostly active’ (i.e. active older adults who meet PA guidelines or close to meeting them), respectively.¹⁰ To evaluate the effect of increasing PA over 3 years, we calculated a score of changes in PA as the measure at 3-year follow-up minus the measure at baseline. A score of 0 indicates no changes in PA, and positive and negative scores indicate increases and decreases in PA, respectively.

The 400-m walk test was performed at baseline and at 3-, 6- and 9-year follow-up.¹¹ For the 400-m walk, participants were asked to complete 20 laps of 20-m each as fast as possible and were allowed up to two rest stops during the test. Participants were classified as unable to complete the walk if they (i) attempted but failed the 400-m walk, during the previous clinical interview they self-reported (ii) difficulty walking 8-m without help, (iii) severe dyspnea, (iv) dyspnea at rest in the past 3 months, (v) angina or chest pain with intense dyspnea, or in the physical performance tests had (vi) difficulty keeping their balance with feet together for 10 seconds or were (vii) not tested but had evidence of inability to complete the walk (inability to complete a 4-m walk or a 4-m walk gait speed of <0.6 m/s at usual pace).^{11,12} Incident mobility disability for the present study was calculated during the subsequent 6 years of follow-up after the initial 3-year follow-up (i.e. at 6- and 9-year follow-up assessments in the InCHIANTI design); participants who died during this period were retained if they had at least one of the two follow-up measures.¹¹

Statistical analyses

From the total sample in the InCHIANTI study, 484 participants were able to complete the 400 m walk test at 3-year follow-up and had PA information both at baseline and 3-year follow-up. Since 63 participants did not have information on the 400-m walk test during the subsequent 6-year follow-up, the final analytic sample included 421 participants (226 women). Logistic regression was used to examine the association of 3-year cumulative PA as a continuous variable and by groups (mostly inactive, mostly minimally active, mostly active) in two separate models with subsequent incident mobility disability, after adjustment for sex, age, education (years), body mass index (kg/m²), smoking (never, former, currently), alcohol intake (<30 and ≥30 g/day), coronary heart disease (yes, no), stroke (yes, no), peripheral arterial disease (yes, no), cancer (yes, no), lung disease (yes, no), lower extremity osteoarthritis (yes, no), and at risk for clinical depression (yes, no). Logistic regression was also performed to examine the association of 3-year changes in PA separately as a continuous variable and by groups (decreased PA, no change, increased PA) with subsequent incident mobility disability, adjusted for the aforementioned covariates plus baseline PA. All tests were 2-sided and statistical significance was set at $P<0.05$. Analyses were performed with STATA v.14 for Macintosh.

Results

Over 3-year of follow-up, most participants maintained a mostly minimally active lifestyle (57.2%). Although there was a small decrease in PA during the 3-year period (−0.25 score, 95%CI: −0.34 to −0.17; 34.9% decreased their PA levels) a total of 64 participants (15.2%) increased their PA. Baseline characteristics of the study population according to PA groups are shown in Table 1.

After the 3-year period, incidence of mobility disability over the subsequent 6 years of follow-up occurred in 129 participants (30.5%). The odds ratio (OR [95% CI]) of incident mobility disability associated with 1 category increase in cumulative PA was 0.63 (0.41 to 0.97, P for trend=0.036). Compared with the most active participants, and after adjustment for potential covariates, being minimally active (OR=1.25, 95%CI: 0.69 to 2.28) and mostly inactive (OR=2.21, 95%CI: 1.01 to 4.87) was associated with a greater risk of incident mobility disability (Figure 1A). Analyzing changes in PA during the first 3 years of follow-up, the OR (95% CI) of incident mobility disability associated with 1 category increase in changes in PA was 0.56 (0.38 to 0.84, P for trend=0.005); participants who decreased (OR=1.73, 95%CI: 0.98 to 3.07) and increased PA levels (OR=0.72, 95%CI: 0.34 to 1.52) tended to have greater and lower risk of mobility disability compared to those who no change PA levels, respectively (Figure 1B).

We performed a final analysis that reexamined the main associations limited to the 345 participants who were still alive and with information on the 400-m walk test at the end of the 6 years of subsequent follow-up and the results were substantially similar (e.g. cumulative PA per 1-category increase OR=0.54, 95%CI: 0.32 to 0.90, P for trend=0.018, and changes in PA per 1-category increase OR=0.53, 95%CI: 0.34 to 0.85, P for trend=0.008)

Discussion

In this population-based observational study we found that maintaining a certain level of PA over time, as well as increasing PA could prevent mobility disability as measured with the 400-m walk test among older adults. Our results are in keeping and support the main findings from the LIFE study⁷ regarding the protective role of regular PA in mobility disability and extend such observations using a population-based longitudinal design; it is of note that the LIFE clinical trial (i) excluded high-functioning and physically active older adults, (ii) taken into account its recruitment the representativeness is unclear, and (iii) the follow-up period was 2.6 years, which could be considered relatively short as compared to the 9-year life expectancy of the LIFE cohort. Also, these findings extend our previous work that exposed the potential benefit of maintaining and increasing PA to prevent lower extremity function decline (i.e. balance, gait, strength, and endurance) in older adults.¹⁰

Overall, only a few older adults meet the PA guidelines for people aged 65 years and above (i.e. 150 min/week in moderate PA or 75 min/week in vigorous PA)^{13,14}, and according to our results, the recommendation of “avoiding inactivity and being as physically active as their abilities and conditions allow” seems to be relevant in this population.^{6,15} Also, since changes in PA were adjusted for baseline PA, it also indicates that it is never too late to increase PA levels to gain some health benefits such as delaying mobility disability; it is important take into account that increasing PA should be always done gradually and under medical supervision, especially in older adults.

Physically inactive older adults had certain characteristics (i.e. women, the oldest people, those with lower education, and multimorbidity; see Table 1) and the proportion of older adults who increased their PA was relatively small (15%). Consequently, strategies focused

on both maintaining PA levels in active or minimally active people as well as increasing PA among persistently inactive are likely to achieve a greater impact at the population level.

Study Limitations

One limitation in this study was the relatively small sample size, which affects statistical power, after excluding those with mobility disability at 3-year follow-up to calculate subsequent incidence. Also, information on PA in this study was self-reported and our findings must be interpreted with caution.

Conclusions

In this longitudinal study of Italian community-dwelling older adults, maintaining or increasing PA may prevent mobility disability. Further longitudinal studies with objective assessments of PA (e.g. accelerometers) should be developed to confirm or refute these findings.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Figure 1.

Associations of 3-year cumulative physical activity (A) and its changes (B) with incident inability to complete the 400-m walk over 6 years of subsequent follow-up in older adults. Analyses were adjusted for sex, age, education, body mass index, smoking, alcohol intake, coronary heart disease, stroke, peripheral arterial disease, cancer, lung disease, lower extremity osteoarthritis, and depression. Information on baseline physical activity was adjusted when examining changes in physical activity.

Table 1

Baseline characteristics of the study population, by categories of physical activity

	3-year cumulative physical activity				P	3-year changes in physical activity			
	Mostly inactive		Mostly minimally active	Mostly active		Decreased	No change	Increased	P
n	61	241	119			147	210	64	
Women, %	82.0	61.4	23.5		<0.001	54.4	52.4	56.3	0.842
Age, years	72.9 (4.6)	71.2 (5.0)	70.5 (4.0)		0.035	71.6 (5.1)	70.9 (4.5)	71.5 (4.6)	0.237
Education, years	5.8 (3.6)	5.9 (3.3)	6.2 (3.4)		0.521	6.0 (3.5)	6.0 (3.3)	5.8 (3.1)	0.865
Body mass index, kg/m ²	25.3 (8.0)	26.9 (5.3)	26.6 (3.6)		0.122	25.9 (6.2)	27.1 (4.7)	26.3 (5.6)	0.086
Smoking, %									
Never	59.0	61.0	42.9			54.4	56.2	56.3	
Former	21.3	24.1	37.0			28.6	26.2	28.1	
Current	19.7	14.9	20.1		0.016	17.0	17.6	15.6	0.985
Alcohol intake 3 g/day, %	13.1	15.8	29.4		<0.001	21.1	20.0	12.5	0.321
Coronary heart disease, %	8.2	7.1	6.7		0.934	7.5	6.7	7.8	0.932
Stroke, %	3.3	2.9	3.4		0.968	2.0	2.9	6.2	0.257
Peripheral arterial disease, %	8.2	3.7	5.9		0.313	5.4	3.8	7.8	0.415
Diabetes, %	6.6	7.9	14.3		0.105	7.5	11.0	9.4	0.546
Cancer, %	4.9	4.2	6.7		0.573	4.8	5.7	3.1	0.698
Lung disease, %	4.9	8.3	5.0		0.417	7.5	5.2	10.9	0.271
Lower extremity osteoarthritis, %	13.1	7.9	3.4		0.054	8.2	5.2	12.5	0.135
Depression, %	45.9	23.7	17.7		<0.001	27.9	22.9	26.6	0.538