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Longitudinal Physical Activity Changes Among Older Men in the Osteoporotic Fractures in Men Study (MrOS)

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Abstract

OBJECTIVES—To describe the change in physical activity (total, leisure, household, occupational) among men over a mean five year follow-up period, and to identify socio-demographic and health factors associated with change in physical activity.

DESIGN—Prospective cohort study; Osteoporotic Fractures in Men Study (MrOS); data collected March 2000 through May 2006.

SETTING—Six US clinical centers.

PARTICIPANTS—Volunteer sample of ambulatory community dwelling men, 65 years and older (n=5161)

MEASUREMENTS—Self-reported physical activity assessed at baseline and Visit 2 (V2) (5 years apart) by the Physical Activity Scale for the Elderly (PASE) (unit less, relative measure of physical activity).

RESULTS—At baseline, PASE scores averaged 17±36 for occupational, 37±34 for leisure, 96±43 for household, and 150±68 for total physical activity. Occupational (−6±34), leisure (−3±37), household (−10±44), and total (−19±68) physical activity change scores declined, on average, from baseline to V2. On average, change in total PASE scores declined more with age: −16±72 (mean ± SD), −16±67, −21±67, and −30±61 for men <70, 70–74, 75–79, and 80+ years old, respectively. Living alone, smoking cigarettes, poor health and higher blood pressure were associated with greater declines in physical activity over time. Although average scores declined, some older men (n=1335, 26%) reported increasing physical activity levels. Better physical and mental health, living with others, and being younger were associated with the probability of increasing physical activity over time.

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Conflict of Interest: CAJ: Ms. Janney has served as a Pfizer legal consultant for work performed as a biostatistician while employed at Parke-Davis Pharmaceutical Co.

JAC: Dr. Cauley has received research support from Novartis Pharmaceuticals.

PMC: Dr. Cawthon is a consultant for Merck & Company, and has received research support from Amgen.

CONCLUSION—Over the 5-year period, the majority of men reported declines in total physical activity. Older men in poor health who live alone have a high risk of physical activity declines and may be an important group to target for exercise interventions.

Keywords

exercise; PASE; longitudinal; cohort; physical activity

INTRODUCTION

Physical activity has been shown to be related to the health status and quality of life in older adults(1,2). The American College of Sports Medicine and the American Heart Association recommend that older adults engage in adequate physical activity levels and provide general physical activity guidelines for this age group(1). Unfortunately, despite the benefits of physical activity, the majority of older US adults (aged 75 years or older) are inactive (40%) or irregularly active (25%) as estimated by the Behavioral Risk Factor Surveillance System, 2000(3) and spend a majority of their day (approximately 60%) in sedentary behaviors (4).

Cross-sectionally, physical activity levels declined with age in many investigations(5–11). However, longitudinal data on physical activity changes over time are limited, particularly among older adults(12). In elderly men living in Zutphen, Netherlands, total time spent in physical activity levels decreased by 33% over a ten-year period(12). However, while the time spent gardening and bicycling declined, the time spent walking (~18 min/day) remained stable over the ten year period(12).

The Osteoporotic Fractures in Men (MrOS) Study(13) provided the opportunity to examine change in self-reported physical activity longitudinally in a large cohort of older men. The MrOS study population represents community dwelling, ambulatory men aged 65 years or older and provides one of the largest samples in which physical activity was measured with a questionnaire designed specifically for older adults. The aims of the present analyses are 1) to describe the change in physical activity levels (total, leisure, household, occupational) among men aged 65+ years over a mean follow-up of five years, and 2) to identify socio-demographic and health factors that are associated with changes in physical activity levels among older men. A better understanding of changes in physical activity levels over time may facilitate effective interventions that promote and maintain health and quality of life in this population and to identify populations at high risk for decline.

METHODS

Participants

From March 2000 through April 2002, 5995 men who were at least 65 years of age were recruited for participation in the Osteoporotic Fractures in Men Study (MrOS)(13). Men were recruited from six US centers; Birmingham, AL; Minneapolis, MN; the Monongahela Valley near Pittsburgh, PA; Palo Alto, CA; Portland, OR; and San Diego, CA(14). Men were excluded if they had a bilateral hip replacement or were unable to walk without the assistance of another person. The second visit (V2) was conducted between March 2005 and May 2006, an average of 4.6 ± 0.4 years after baseline. This report is restricted to 5161 men (95% of the surviving men) who provided data for Physical Activity Scale for the Elderly (PASE) scores at both baseline and V2. Overall, PASE scores were missing for 834 participants for the following reasons: 3 men did not answer all PASE baseline questions; 174 men were living but did not complete the PASE questionnaire at V2 (109 men refused V2 and 65 men did not answer all PASE V2 questions); 571 participants died before V2; and 86 participants terminated participation in MrOS before V2. The Institutional Review

Board at each center approved the study protocol, and written informed consent was obtained from all participants.

Physical Activity Measurements

PASE(15) was self-administered at baseline and V2, and measured total, occupational, household and leisure physical activities. Participants were asked about the intensity, frequency, and duration of a variety of activities including walking; strenuous, moderate and light sports; muscle strength and endurance; occupation activities that include standing or walking; lawn work and gardening; caring for another person; home repairs; and heavy and light housework over the previous seven days. The frequency and duration of each activity is multiplied by an empirically derived item weight and summed to compute the total PASE score activity(15). PASE scores are unit less and provide a relative rather than absolute measure of physical activity levels. Along with the total PASE score, PASE subscales were computed for occupational, household, and leisure physical activities. Total PASE scores at baseline and V2 were categorized as limited (≤ 50), low (50.1–200), and high (>200) physical activity to allow comparisons with previously reported PASE results based on cross-sectional studies (15,17–19). The PASE has been validated with objective measures of physical activity including doubly-labeled water method(20), accelerometry(15,17,21), and pedometers(19). In addition, the PASE has high test-retest reliability compared to other physical activity surveys(15,21).

In this report, change in physical activity was investigated as a continuous and categorical outcome since this is the first investigation to report longitudinal changes in physical activity using the PASE. The continuous outcome, total PASE change score, was computed by subtracting baseline total PASE scores from V2 PASE scores for each participant. PASE subscale change scores were computed similarly to the total PASE change score. Symmetrized percent change $[(V2 - \text{Baseline Score}) * 100 / (V2 + \text{Baseline Score})]$ was calculated for total PASE scores since the maximum response is defined and bounded (± 100)(16). The categorical outcome was defined as ≥ 20 versus < 20 PASE change score since it may represent a clinically relevant change in physical activity among older adults (personal communication with RA Washburn); 20-point change in PASE score equates to either 1) 13% change in physical activity for an older man with a baseline PASE score of 150 or 2) a shift from never to some leisure physical activity (either 1–2 days for more than 4 hours, 3–4 days for 2–4 hours, or 5–7 days for 1–2 hours); approximately one hour change in occupational activity; or indicating one additional or one less household activity. The 20-point change in PASE score also represented the top quartile of the distribution of change in PASE scores from baseline to V2 in the MrOS study.

Sociodemographic and Health Measurements

At baseline, data regarding demographics, medical history and lifestyle information were collected. Race was self-declared and dichotomized from seven race categories into Caucasian or non-Caucasian. Caucasians who identified themselves as multi-racial were coded as non-Caucasians. Categorical variables were created for education (high school or less, some or completed college, or some graduate school or more), age at baseline (65–69, 70–74, 75–79, and 80+ years), living arrangement (alone or with others), and smoking status (never, former, current). Participants completed the 12-item Short Form Health Survey (SF-12) and summary scores for physical and mental health were derived from this questionnaire(22). SF-12 physical and mental health scores were analyzed as binary variables with the median value of all men at baseline defining the categories. Body mass index was calculated using weight (kg)/height (m^2) and analyzed as a categorical variable (<25 , 25–29.9, $\geq 30 \text{ kg/m}^2$). Systolic blood pressure was measured by a trained technician

during assessment of the ankle brachial index and analyzed as a categorical variable (≤ 140 mmHg, >140 mmHg) defined by the median of all men at baseline.

Statistical Methods

Comparisons of PASE total and subscale scores at baseline and V2 by baseline age groups were performed using ANOVA for normally distributed scores and the Kruskal-Wallis test for skewed scores. The least squared means procedure was used to examine the change in total PASE score (continuous variable) and baseline demographics, health history, health habits and status, and quality of life measures modeled as categorical variables. Based on these results, main effect candidates were identified for the model-building phase if the significance level was ≤ 0.10 . SF12 mental and physical health were selected to represent the various clinical and self-reported health conditions associated with the PASE change scores. All main effect candidates were added simultaneously to the main-effects model. Sequential backwards elimination of the main effect candidates with p-values > 0.10 was used to obtain the final main effects multivariate model. Interaction terms considered biologically plausible based on the final main effects were added individually to the final main effects model and were considered candidates for the final model building phase if the p-value < 0.05 . Finally, all significant interaction candidates were added simultaneously to the main effects model, and backwards elimination of main effects and interactions were used to obtain the final linear regression model ($p < 0.05$). Logistic regression was used to characterize men that increased their physical activity over time (≥ 20 PASE change score) compared to those men that maintained or decreased their physical activity over time (< 20 PASE change score). All analyses were performed using SAS 9.1 (SAS Institute, Cary, NC) or Stata (version 9.2; StataCorp, College Station, TX).

RESULTS

The study population included 5161 older men with the majority being Caucasian (90%), living with others (87%), and having education beyond high school (41% some college or college degree and 36% graduate school). The mean age $\pm$ SD of the study population was 73.1 ± 5.5 years. Participants had a median number of 3 out of 20 possible clinical or self-reported health conditions at baseline.

PASE total and subscale scores at baseline and visit 2 are summarized in Table 1. At baseline, PASE scores averaged 17 ± 36 for occupational, 37 ± 34 for leisure, 96 ± 43 for household, and 150 ± 68 for total physical activity. On average, occupational (-6 ± 34), leisure (-3 ± 37), household (-10 ± 44), and total (-19 ± 68) physical activity scores declined from baseline to V2 ($p < 0.01$). The corresponding symmetrized percent changes were $-8 \pm 52\%$ for occupational, $-7 \pm 50\%$ for leisure, $-7 \pm 35\%$ for household, and $-9 \pm 29\%$ for total physical activity. The distribution of change in PASE scores from baseline to V2 approximated a normal distribution. Using the limited, low, and high definitions for physical activity, the majority of the men (69%, $n=3553$) remained in the same physical activity category at V2 and baseline. Ten percent ($n=519$) increased and 21% ($n=1089$) decreased their physical activity category from baseline to V2. The percentage of men categorized as engaging in limited physical activity (total PASE score ≤ 50) doubled over the 5-year period (6% versus 12% at baseline and V2, respectively). Among the subsample of men ($n=1335$, 26%) whom increased their physical activity (PASE scores ≥ 20) from baseline to V2 ($n=1335$), median change scores (interquartile range) were 0 (0,9) for occupational, 14 (0,38) for leisure, 30 (0,50) for household, and 51 (33,78) for total physical activity scores. The corresponding median symmetrized percent changes (interquartile range) were 0% (0,33%) for occupational, 25% (0,52%) for leisure, 14% (0,29%) for household, and 19% (12,29%) for total physical activity.

On average, younger men had higher total and subscale PASE scores at both baseline and V2 than the older men (Table 1). On average, total PASE scores declined more with age: -16 ± 72 (mean $\pm$ SD) for men <70 , -16 ± 67 for men 70–74, -21 ± 67 for men 75–79, and -29 ± 61 for men 80+ years old (Figure 1). The corresponding symmetrized percent changes were $-6 \pm 26\%$ for men <70 , $-7 \pm 28\%$ for men 70–74, $-10 \pm 30\%$ for men 75–79, and $-17 \pm 33\%$ for men 80+ years old. Change in PASE subscales also varied by age; declines in total physical activity were primarily attributed to occupational changes in 65–70 years old and household changes in 70+ years old.

The majority of baseline demographics, health history, health habits and status, and quality of life measures were statistically associated with the change in total PASE scores in the univariate models (data not shown; available upon request from corresponding author). Except for SF12 mental health, all the candidates (living arrangement, age, smoking status, BMI, systolic blood pressure, and SF12 physical and mental health) for the main effects multivariate model were significantly associated with change in PASE scores and included in the final multivariate model (Table 2). None of the interaction terms were significantly associated with change in PASE scores ($p > 0.05$).

On average, the men exhibited a greater decline in physical activity if they lived alone and/or smoked cigarettes (Table 2). Higher systolic blood pressure was associated with greater declines in PASE change scores (Table 2). Men with better physical but not mental health as assessed by the SF12 exhibited smaller declines in physical activity from baseline (Table 2). Declines in leisure (-7 vs. -3), household (-15 vs. -9) as well as occupational (-8 vs. -6) physical activities contributed to the overall greater decline in total physical activity in men who lived alone compared to those that lived with others (data not shown). Odds of increasing compared to maintaining or decreasing their physical activity over time were greater for those men who lived with others (OR=1.53, 95%CI=1.24, 1.89) compared to those who lived alone (OR=1.00, reference group), with better SF12 physical (OR=1.23, 95%CI=1.09, 1.40 for men above the median versus OR=1.00 (reference) for men below the median) and SF12 mental (OR=1.14, 95%CI=1.00, 1.29 for men above the median versus OR=1.00 (reference) for men below the median) health, and younger age (OR=1.74, 95%CI=1.40, 2.16 for age <70 ; OR=1.58, 95%CI=1.27, 1.96 for age 70–74; OR=1.47, 95%CI=1.17, 1.85 for age 75–79; and OR=1.00 for age ≥ 80 (reference group)) based on the logistic regression model.

DISCUSSION

This study provides longitudinal evidence that self-reported physical activity declined, on average, over a 5 year period in community dwelling older men aged 65+ years. On average, every component of physical activity (occupational, leisure-time, and household) declined with age, but the patterns of the physical activity declines varied by age. Specifically, occupational activities primarily declined for 65–69 year olds and household activities primarily declined for 70+ year olds. As expected, physical activity decreased, on average, with declining overall health.

These longitudinal findings provide the first evidence that average declines in physical activity are greater in older men who live alone than older men who lived with others. It is noteworthy that declines in leisure, household as well as occupational physical activities contributed to the overall greater decline in total physical activity in older men who lived alone. Living alone may encompass a constellation of sociodemographic and health risk factors that places the older adult at high risk of inactivity. Physical activity interventions that target older adults that live alone may be an effective and efficient method to improve the health, functional and emotional status of these high risk older individuals.

These longitudinal results support previous cross-sectional findings(5,6,11,23–25) that physical activity tends to decline with age. It is noteworthy that, on average, the decline in physical activity varied by age groups. Smaller declines in physical activity were noted in men between 65–75 years of age while men over 80 years had substantial declines in physical activity. The PASE subscales also suggested that the average decline in physical activity with age may be sequential, with occupational physical activity initially declining followed by household physical activities and eventually leisure-time physical activities.

Even among relatively healthy community dwelling older men, these declines in physical activity were observed. Our findings suggest that poor health may be a primary factor in this decline of physical activity. It is a paradox that health conditions that benefit from physical activity may also limit or restrict physical activity. For instance, physical activity has been shown to have a therapeutic role in type 2 diabetes, osteoarthritis, the prevention of falls(1), and Parkinson's disease(26,27). Yet these health conditions were significantly associated with the decline in physical activity among older men in the present study, and the primary reason given for the limitation or avoidance of physical activity by older men in a community-based sample in Sonoma, CA(28). Tailoring physical activity interventions to address the specific needs and concerns of older adults with health conditions may be necessary. Maintaining or increasing the physical activity levels of older adults with health conditions may prevent or delay not only the progression of the disease/condition but also the associated disability and functional impairments(29,30).

Approximately, 90% of the total study population was white, non-Hispanic. Asian and Hispanic men only comprised 5% of the study population. Further research is warranted among ethnic minorities and older women to determine if similar associations and patterns are observed for physical activity levels over time. On average, the MrOS volunteer sample were more active than a representative sample of community dwelling older men in Western Massachusetts(15); baseline PASE scores were approximately 11% and 27% higher in 65–69 and 70+ year olds, respectively.

One strength of this study is that physical activity levels were measured longitudinally in a large cohort of community-dwelling, ambulatory older men. These longitudinal findings extend previous cross-sectional studies by estimating not only changes in total physical activity levels but also changes in the components of physical activity levels (leisure, occupational and household physical activities) over a 5-year period in older men. In addition, physical activity levels were measured in a validated instrument specifically developed for older adults.

Over the 5-year period, the majority of men reported declines in total physical activity levels that were attributed to declines in occupational, leisure-time and household physical activities. In contrast, approximately one-quarter of the men reported significant increases in total physical activity scores, primarily attributed to increases in leisure-time and household physical activities. Age, physical health, and living arrangements were predictors of change in total PASE scores as well as the probability of increasing physical activity over the 5-year period. Specifically, greater declines in physical activity were observed among older men with poor physical health whom lived alone. The probability of increasing physical activity over time was greater among younger men with better physical health whom lived with others. Greater declines in physical activity levels were also observed among men whom smoked cigarettes and had higher blood pressure. In contrast, better mental health was associated with the probability of increasing physical activity levels over time. This report not only provides a description of change in physical activity patterns over time among older men but also identifies characteristics of older men at risk for physical activity declines.

These novel longitudinal findings may aid efforts to target, design, and implement effective physical activity interventions for older men.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Figure 1.

Mean change in total and subscale PASE scores* over a mean five year follow-up period by baseline age groups in men (n=5161).

*Possible PASE occupational, leisure, household, and total scores range from 0–300, 0–516, 0–171, and 0–987. In this sample, PASE occupational, leisure, household, and total scores ranged from 0–297, 0–343, 0–171, and 0–514.

Table 1

PASE change, total, and subscale scores by baseline age groups (n=5161) in older men in the MrOS study.

Baseline age (yrs)	PASE scores (mean ± SD)				
	Visit	Occupational	Leisure	Household	Total
≤ 69 (n=1624)	Baseline	25 ± 44	38 ± 35	100 ± 42	163 ± 71
	V2	15 ± 33	36 ± 37	95 ± 43	147 ± 69
	Change	-9 ± 42	-2 ± 39	-5 ± 44	-16 ± 72
70-74 (n=1548)	Baseline	17 ± 35	39 ± 35	98 ± 42	153 ± 66
	V2	11 ± 27	37 ± 37	89 ± 44	137 ± 69
	Change	-6 ± 35	-2 ± 38	-8 ± 43	-16 ± 67
75-79 (n=1231)	Baseline	12 ± 28	35 ± 31	95 ± 43	142 ± 63
	V2	7 ± 22	31 ± 33	82 ± 46	121 ± 68
	Change	-5 ± 27	-4 ± 35	-13 ± 45	-21 ± 67
80+ (n=758)	Baseline	6 ± 20	35 ± 32	85 ± 45	127 ± 61
	V2	5 ± 18	27 ± 30	66 ± 46	97 ± 64
	Change	-2 ± 21	-8 ± 35	-20 ± 45	-29 ± 61
<i>p-value testing for differences between age groups</i>					
	Baseline	<0.001 [†]	0.06 [†]	<0.001 [*]	<0.001 [*]
	V2	<0.001 [†]	<0.001 [†]	<0.001 [*]	<0.001 [*]
	Change	<0.001 [*]	0.001 [*]	<0.001 [*]	<0.001 [*]
All ages (n=5161)	Baseline	17 ± 35	37 ± 34	96 ± 43	150 ± 68
	V2	11 ± 27	34 ± 35	86 ± 46	130 ± 70
	Change	-6 ± 34	-3 ± 37	-10 ± 44	-19 ± 68
	<i>p-value</i>	<0.001 [†]	<0.001 [†]	<0.001 [†]	<0.001 [†]

Abbreviations: MrOS, Osteoporotic Fractures in Men Study; PASE, Physical Activity Scale for the Elderly. Possible PASE occupational, leisure, household, and total scores range from 0-300, 0-516, 0-171, and 0-987, respectively. In this sample, PASE occupational, leisure, household, and total scores ranged from 0-297, 0-343, 0-171, and 0-514, respectively.

* Analysis of variance.

[†] Based on Kruskal-Wallis test due to skewed data.

[‡] Paired t-test
V2= visit 2

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Table 2

Descriptive statistics and final multivariate model for change in total PASE scores over a mean five year follow-up period in older men in the MrOS study.

Independent variable	Descriptive statistics (n=5161)		Multivariate Model (n=5063)	
	N (%)	Baseline median PASE scores (IQR)	LSM (95% CI)	p-value
Living arrangements				<0.001
With Others	4492 (87)	146 (106, 190)	-23 (-19, -28)	
Alone	669 (13)	138 (95, 184)	-34 (-28, -41)	
Age range (yrs)				<0.001
< 70	1624 (31)	156 (115, 206)	-25 (-20, -30)	
70-74	1548 (30)	149 (110, 193)	-25 (-20, -30)	
75-79	1231 (24)	140 (100, 180)	-30 (-24, -36)	
80+	758 (15)	121 (83, 163)	-36 (-30, -43)	
Smoking status				0.02
Never	1982 (38)	143 (105, 187)	-23 (-20, -27)	
Former	3019 (59)	146 (105, 191)	-28 (-25, -31)	
Current	159 (3)	149 (91, 198)	-35 (-24, -46)	
SF12 Physical health score				<0.001
≤ 53	2480 (48)	138 (96, 182)	-26 (-21, -30)	
>53	2680 (52)	151 (112, 196)	-32 (-27, -37)	
Systolic blood pressure				0.01
≤ 140 mmHg	2956 (57)	147 (106, 191)	-26 (-22, -31)	
>140 mmHg	2110 (41)	144 (104, 188)	-31 (-26, -36)	
BMI (kg/m ²)				0.04
< 25	1370 (27)	148 (108, 193)	- 30 (-25, -35)	
25-29.9	2673 (52)	146 (105, 187)	-26 (-21, -30)	
≥ 30	1116 (22)	138 (100, 187)	-31 (-25, -37)	

PASE= Physical Activity Scale for the Elderly;

MrOS= Osteoporotic Fractures in Men Study;

LSM= Least squared means; SF12= 12-item Short Form Health Survey; BMI= Body Mass Index;

IQR = Interquartile Range