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Physical activity trajectories during midlife and subsequent risk of physical functioning decline in late mid-life: The Study of Women's Health Across the Nation (SWAN)

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Abstract

The purpose of this study was to examine the importance of midlife physical activity on physical functioning in later life. Data are from 1771 Study of Women's Health Across the Nation (SWAN) participants, aged 42–52 (46.4 ± 2.7) years at baseline (1996–97). Latent class growth analysis was used to identify physical activity trajectory groups using reported sports and exercise index data collected at seven time-points from baseline to Visit 13 (2011–13); objective measures of physical functioning performance were collected at Visit 13. The sports and exercise index (henceforth: *physical activity*) is a measure of moderate to vigorous intensity physical activity during discretionary periods of the day. Multivariable linear regression analyses were used to model each continuous physical performance measure as a function of the physical activity

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Conflicts of interest

The authors declare there is no conflict of interest.

Author contributions

K. Pettee Gabriel conceptualized the study and wrote the paper. B. Sternfeld conceptualized the study and contributed to revising the paper. A. Colvin provided statistical expertise, performed the statistical analysis, and contributed to revising the paper. A. Stewart performed the statistical analysis and contributed to revising the paper. E. Strotmeyer contributed to revising the paper. J. Cauley contributed to revising the paper. S. Dugan provided clinical guidance and contributed to revising the paper, and C. Karvonen-Gutierrez conceptualized the study and contributed to revising the paper.

trajectory class. Across midlife, five physical activity trajectory classes emerged, including: lowest (26.2% of participants), increasing (13.4%), decreasing (22.4%), middle (23.9%), and highest (14.1%) physical activity. After full adjustment, women included in the middle and highest physical activity groups demonstrated 5% better physical functioning performance than those who maintained low physical activity levels (all comparisons; $p < 0.05$). Statistically significant differences were also noted when physical activity trajectory groups were compared to the increasing physical activity group. Results from the current study support health promotion efforts targeting increased (or maintenance of) habitual physical activity in women during midlife to reduce future risk of functional limitations and disability. These findings have important public health and clinical relevance as future generations continue to transition into older adulthood.

Keywords

Exercise; Physical performance; Cohort study; Women

1. Introduction

In 2011, the baby-boomer generation began transitioning into older adulthood, which will continue until 2030, resulting in 88.5 million older adults in the United States (U.S.) population (Vincent and Velkoff, 2010). This demographic shift will put tremendous strain on the U.S. health care system (Keehan et al., 2012) with disability contributing significantly to overall public health burden. While medical advances have increased life expectancy, a recent study shows that baby-boomers have more disability than the previous generation (King et al., 2013). Yet, impaired physical function is not an inevitable part of the aging process. Rather, habitual physical activity, a modifiable risk factor, has been shown to be an effective primary prevention strategy to attenuate age-related declines in physical function (U.S. Department of Health and Human Services, 2008a; Pahor et al., 2014).

While evidence supports the beneficial role of physical activity for improved physical function in older adults (U.S. Department of Health and Human Services, 2008a), less is known about whether susceptibility to functional decline in older adulthood (> 65 years) varies by timing of the physical activity exposure across the lifespan. Physical activity during midlife (45–64 years) may be particularly important because it corresponds to a period when risk of disability begins to increase (Ylitalo et al., 2013; Murray et al., 2011) and midlife populations may be more amenable to intervention. Few studies have examined the role of midlife physical activity and risk of physical functioning decline in later life. This may be due to the limited number of observational studies with sufficient longitudinal follow-up to characterize the midlife transition. Regardless, evidence from previous observational studies support an inverse association between physical activity and physical functioning decline. In 6398 Whitehall II participants, higher midlife physical activity was significantly related to higher perceived physical function as measured by the SF-36 an average of 8.8 years later (Hillsdon et al., 2005). Similarly, among 1155 In-CHIANTI Study participants, those who engaged in higher physical activity levels during midlife were more likely to perform better on the Short Physical Performance Battery (SPPB) than those less active (Patel et al., 2006). In men, midlife physical activity was also related to completion of

the 400 meter walk test, a test of lower extremity endurance (Patel et al., 2006). In a 2013 study of 4753 men and women (Chang et al., 2013), individuals classified as active in midlife had significantly better lower extremity function (i.e., faster gait speed and Timed Up and Go tests and greater knee extensor strength) in late-life. However, in a paper by Peeters et al., higher baseline physical activity levels was associated with perceived (SF-36) baseline physical functioning, but not with rate of decline in midlife women (Peeters et al., 2013).

Collectively, these previous studies had methodological limitations that may influence the precision of the observed measures of association. Limitations pertinent to the physical activity exposure include the use of crude exposure estimates (inactive versus active)(Chang et al., 2013) or unvalidated questionnaires (Hillsdon et al., 2005), historical recall of physical activity across several decades (Patel et al., 2006), or a single assessment of physical activity at baseline (Chang et al., 2013). Further, several studies included perceived, rather than objectively measured, physical function as the targeted outcome (Hillsdon et al., 2005) (Peeters et al., 2013). The Study of Women's Health Across the Nation (SWAN) overcomes these limitations through use of a large, well-characterized, and racially/ethnically diverse cohort of women with sufficient follow-up data to characterize patterns of physical activity change during midlife. Further, a comprehensive physical function battery was conducted at the Visit 13 follow-up (2011–13) when participants were aged 56–69 (61.9 ± 2.7) years. The objectives of this study were to characterize patterns of physical activity change during midlife and examine the trajectories of physical activity during midlife with physical function in later life.

2. Methods

2.1. Design overview and participants

SWAN included 3302 pre- and early peri-menopausal women who were between the ages of 42 and 52 (46.4 ± 2.7) years at the baseline examination in 1996–97. Details of the sampling and recruitment strategies have been previously described (Sowers et al., 2000). Briefly, women were recruited from defined sampling frames in seven geographic sites across the United States, including: Boston (MA), Chicago (IL), Detroit area (MI), Los Angeles (CA), Newark (NJ), Oakland (CA), and Pittsburgh (PA). Eligibility criteria included: reported menstrual period and no exogenous hormone use in the three months prior to recruitment, not currently pregnant or lactating, and identified primary race/ethnicity as black (Boston, Chicago, Detroit, and Pittsburgh sites), Japanese (Los Angeles site), Hispanic (Newark site), Chinese (Oakland site), or white (all SWAN sites). Participants were seen approximately annually since the baseline exam. Retention at the Visit 13 exam was 77%. Participants provided written informed consent and all protocols were approved by the Institutional Review Boards at each of the participating institutions.

2.2. Data collection

2.2.1. Exposure: physical activity—Physical activity data were collected using the Kaiser Physical Activity Survey, a self-administered reliable and valid questionnaire (Ainsworth et al., 2000). To create the physical activity trajectories, the sports and exercise

items were used. Participants were asked to record up to two sports and exercise activities that she engaged in most frequently over the previous 12 months. Acceptable activity types, including brisk walking, were of at least moderate intensity (≥ 3 METs), performed during discretionary periods of the day. For each activity, additional information including: perceived intensity (through heart rate and respiration changes), frequency (number of months per year), and duration (hours per week) were obtained. Reported sports and exercise activities were coded by intensity and multiplied by the reported frequency and duration. The resulting score was mapped to an ordinal scale from 1 to 5 (Sternfeld et al., 1999). Data were collected at baseline, Visit 3 (1999–2000), Visit 5 (2001–02), Visit 6 (2002–03), Visit 9 (2005–06), Visit 12 (2010–11), and Visit 13 (2011–13) and at least three time-points were required to construct the trajectory.

2.2.2. Outcomes: physical function

2.2.2.1. 40 Foot walk: The course was set-up on a level floor with two tape markers denoting the start and end point, located 40 ft apart. Participants were instructed to complete the walk in a comfortable, but steady *brisk pace* and timing was stopped when both of the participant's feet crossed the end line. If needed, participants were able to use an assistive device for the walk and this information was recorded. The 40 foot walk protocol was conducted twice and the faster of the two measures was used in analysis and expressed as meters per second.

2.2.2.2. 4 Meter walk: The course was set-up on a level floor with tape markers at the start and stop point, located 4 m apart (Guralnik et al., 1994). Participants were instructed to walk at their *usual speed* and timing was stopped when the first foot completely crossed the 4-m mark. Use of assistive devices were allowed and documented. The 4 meter walk was done twice and the faster of the two timed walks was used for analysis and expressed as meters per second.

2.2.2.3. Repeated chair stands: A standard height (18 in. from the ground) chair or bench with a back was placed on a level floor (Guralnik et al., 1994). While sitting, participants were asked to sit and place their arms across her chest. Study staff instructed participants to stand without using their arms. The stopwatch was started when the participant visually responded and ended when the participant was standing in a fully erect position. Time (seconds) taken to complete five consecutive repetitions was used in analysis.

2.2.2.4. Grip strength: To assess grip strength, a dynamometer, adjusted for hand size was used. Participants were seated in a comfortable position with their tested arm bent at a right angle to the body with a 90 degree bend at the elbow. The hands were then placed so that the fingers and thumb pointed forward and parallel to the legs, with the wrist slightly bent backward to hold the dynamometer. Study staff placed the dynamometer in the participants hand and instructed her to squeeze the handle as hard as she could, and then release (American College of Sports Medicine, 2017). Grip strength (in kilograms) was assessed in each hand two times, with the maximum measurement used for analysis.

2.2.3. Covariates—Standardized questionnaires were used to assess participant characteristics including, age, race/ethnicity, and socio-demographic factors (e.g., educational attainment) and other health behaviors (e.g., smoking status). Body mass index (BMI) was calculated in kilograms per meters squared (kg/m^2) based on measured height (stadiometer) and body weight (calibrated scale) and categorized into ethnic-specific under or normal weight ($< 25 \text{ kg}/\text{m}^2$ for white, black, and Hispanic women and $< 24 \text{ kg}/\text{m}^2$ for Chinese or Japanese women), overweight ($25 \text{ or } 24 \text{ kg}/\text{m}^2 \text{ to } < 30 \text{ kg}/\text{m}^2$), or obese ($\geq 30 \text{ kg}/\text{m}^2$). Other measures include: self-rated health status (excellent/very good, good, or fair/poor), bodily pain (from SF-36: none, very mild/mild, moderate, or severe/very severe), physical difficulties (from SF-26: yes or no), menopausal status (baseline: early perimenopausal or pre-menopausal; Visit 13: natural post-menopausal, post-menopausal by bilateral salpingo-oophorectomy, or pre or early/late perimenopausal), ever use of hormone therapy (ever use; reported HT use at any follow-up visit), presence of depressive symptoms (≥ 16 on Center for Epidemiological Studies Depression (CES-D) scale (Radloff, 1977), and self-reported co-morbidities (osteoarthritis, diabetes, heart attack, and/or stroke). Covariates, including SWAN clinical site, were selected based on the literature and biological plausibility for confounding the main relations of interest.

2.3. Statistical analysis

Descriptive statistics included frequency distributions, as well as measures of central tendency (mean or median) and measures of variability (standard deviation (SD) or 25th and 75th percentiles). For continuous variables, the assumption of normality was tested. Differences in baseline socio-demographic factors and physical activity levels were compared between the analytic sample and excluded participants using appropriate bivariate test statistics (i.e., chi-squared tests, Student *t*-tests, or Wilcoxon Rank Sum tests).

Latent class growth modeling (Andruff et al., 2009) (PROC TRAJ in SAS) was used to identify subgroups of participants following similar patterns of change in physical activity across time points. The estimated parameters define the intercept and slopes of the trajectory for each identified subgroup and provide information regarding group membership probabilities. Model selection was based on scientific plausibility and Bayesian Information Criteria (BIC) to evaluate goodness of fit. After the trajectory classes were determined, participants were assigned to the trajectory class that reflected their highest prior probability (Andruff et al., 2009). Since the primary exposure variable of interest was the set of five trajectory groupings, which represent the patterns of physical activity over the entire period of follow-up rather than data from any particular time point, overlap between the exposure and outcome variables at the Visit 13 data point is not a major concern.

Differences by physical activity trajectory class in potential covariates and physical functioning outcomes were examined using analysis of variance for continuous variables and chi square statistics for categorical variables. Linear regression analyses were used to model each continuous physical performance measure as a function of the physical activity trajectory class using the *lowest* physical activity trajectory class as the referent group. Models were run for each physical performance outcome, proceeding, first, from a minimally adjusted model that included age, race, site, education, BMI, and self-rated health

to the fully adjusted model that also included diabetes, cancer, heart attack, stroke, depression, bodily pain, arthritis, menopause status and hormone use. Covariates, assessed at Visit 13, were determined based on the prior literature and associations with the physical performance outcomes at $p < 0.10$. Results were also reported using the *increasing* physical activity trajectory class as the referent group. Dunnett's tests were used to adjust for multiple comparisons (Dunnett, 1955). To further aid interpretation, associations were expressed and reported (text only) as percent differences and computed as the adjusted mean value of physical activity trajectory group of interest (e.g., highest) minus the adjusted mean value of the reference group (numerator) divided by the adjusted mean of the reference group (denominator) multiplied by 100. All statistical analyses were conducted in SAS v.9.3 (SAS Institute Inc., Cary, North Carolina).

A total of 1771 women were included in the analytic sample, exclusions included: missing physical performance data at Visit 13 ($n = 1357$: 1063 did not participate in the visit, 248 were unwilling or unable to come to the office, 12 refused and 34 had other reasons for not doing the performance measures), self-reported substantial physical limitations at baseline ($n = 114$), unknown menopause status at Visit 13 ($n = 45$), and insufficient physical activity follow-up data ($n = 15$). Due to collinearity issues, women requiring assistance (e.g., cane) during the timed walks were also excluded ($n = 29$). More specifically, 84.6% and 81.3% of women requiring assistance during the 40 foot and 4 meter walks, respectively, were in the lowest physical activity trajectory class; excluding them from further analysis did not substantially change the findings. When compared to the analytic sample, excluded women were more likely to be black or Hispanic, unemployed, current smokers, obese and perimenopausal, and to be separated, widowed or divorced, have less income, fair/poor self-rated health, and report physical difficulties, bodily pain, and osteoarthritis (all $p < 0.05$).

3. Results

Five major trajectory classes of structured physical activity (i.e., sports index) emerged with patterns reflecting: (1) *lowest* (26.2%), (2) *increasing* (13.4%), (3) *decreasing* (22.4%), (4) *middle* (23.9%), and (5) *highest* (14.1%) physical activity (Fig. 1). At Visit 13, Hispanic and black women were more likely to be in the *lowest* physical activity trajectory group, with white women least likely. Other characteristics associated with the *lowest* physical activity trajectory include income $< \$35,000$, single/never married, fair/poor overall health status, obesity, current cigarette smoker, severe/very severe bodily pain, reported physical difficulties and osteoarthritis. Similar patterns were observed for the association between baseline characteristics and physical activity trajectories (Tables 1 and 2). Statistically significant differences were noted in physical functioning outcomes by physical activity trajectory group, with the highest trajectory group having the most favorable outcomes (all $p < 0.001$; Table 3).

After adjustment, 40 foot gait speed was statistically significantly faster in the *highest* and *middle* physical activity trajectory groups when compared to the *lowest* group (6.2% and 5.1% faster, respectively; both $p < 0.001$); however, there was no difference in gait speed when comparing the *decreasing* and *increasing* groups with the *lowest* group (Table 4). In the fully-adjusted model, 4 meter gait speed was statistically significantly faster in the

highest and *middle* physical activity trajectory group, compared to the *lowest* group (8.9% and 6.9% quicker, respectively; both $p < 0.0001$). The *highest*, *middle*, and *increasing* physical activity trajectory groups took statistically significantly less time to complete the repeated chair stands compared to the *lowest* group in the fully adjusted model (9.8%, 6.4%, and 6.1% less time, respectively; all $p < 0.01$), with no statistically significant difference between the *decreasing* and *lowest* physical activity trajectory groups. Grip strength was statistically significantly stronger in the *highest*, *middle*, and *decreasing* physical activity trajectory classes when compared to the *lowest* physical activity trajectory group (9.8%, 7.4%, and 5.1% stronger, respectively; all $p < 0.01$) after adjustment for all covariates, with no statistically significant difference in grip strength between the *increasing* and *lowest* groups.

Similar comparisons were observed between the *lowest* and *increasing* physical activity trajectory groups (Table 5). In addition, repeated chair stand completion was statistically significantly slower in the *decreasing* and *lowest* physical activity group compared to the *increasing* group after full adjustment for covariates (7.3% and 6.5% slower, respectively; both $p < 0.01$). Further, gait speed during the 4 meter walk was statistically significantly faster in the *highest* and *middle* physical activity trajectory groups, compared to the *increasing* group, after full adjustment for covariates (6.3% and 4.3% faster, respectively; both $p < 0.05$). No other statistically significant differences were noted.

4. Discussion

Few studies have characterized physical activity change in women during midlife, and the health consequences of these patterns of change. In the current study, five distinct physical activity patterns during midlife, emerged. Also, study findings suggest that these physical activity trajectories were statistically significantly related to objective measures of physical function collected in late midlife. Percent improvement over the *lowest* physical activity group ranged from 5.1% to 9.8% depending on the physical functioning outcome; changes that are clinically meaningful based on previous literature (Curb et al., 2006; Duncan et al., 1990; Sanchez-Zuriaga et al., 2011; Perera et al., 2006). Statistically significant differences were also observed when all other trajectory groups were compared to the *increasing* group.

In the current study, the largest proportion of participants were classified into the *lowest* physical activity trajectory class (26.2%), followed by the *middle* (23.9%), *decreasing* (22.4%), *highest* (14.1%), and *increasing* (13.4%) groups. These findings provide important additional information that extends beyond population-level age-related declines in physical activity (Harris et al., 2013; Troiano et al., 2008). In women, midlife is characterized by a number of key life-course events that could either promote or discourage physical activity (Allender et al., 2006; Allender et al., 2008; Corder et al., 2009). These potential life-course events include changes in employment (e.g., full- or part-time employment to retirement), relationships (e.g., married or living as married to widowed), and family structure (e.g., child dependents to empty nester). Several studies have reported on the potential influence of these key life-course events on physical activity levels. For example, in a 2002 paper by Evenson and colleagues (Evenson et al., 2002), retirement was associated with an increase in sport and exercise participation. This was also demonstrated in a midlife Australian cohort

where retirement, changing conditions at work, major personal achievement, death of a spouse/partner, and loss of income were associated with an increased odds of being classified as *increasing activity* over 3 years (Brown et al., 2009). At Visit 13, the average age was 61.9 ± 2.7 years (i.e., < 65 years) and a majority of women were still employed and most were married or living as married. Taken together, these characteristics may partially explain the high proportion of women assigned to a trajectory group that reflected patterns of physical activity maintenance across midlife. Continued physical activity follow-up in SWAN could significantly advance our understanding of the patterns of physical activity change in midlife, including how those changes impact health; particularly as the cohort transitions into older adulthood.

In the 2008 Physical Activity Guidelines for Americans (U.S. Department of Health and Human Services, 2008b), one of the major conclusions was that “some physical activity is better than none”. Current study findings compliment this primary recommendation. Overall performance on the walking tests, repeated chair stands, and grip strength was statistically significantly better in the *highest* and *middle* physical activity trajectory groups when compared to the lowest. However, findings varied by physical performance outcome when the *increasing* or *decreasing* trajectory groups were compared with the *lowest* trajectory group. Interestingly, in relation to the timed walks, the *increasing* group performed significantly better on the longer walk (40 ft), whereas, the *decreasing* group performed significantly better on the shorter walk (4 m) when compared to the *lowest* trajectory group. An increase in physical activity levels most proximal to the outcome likely improved overall capacity to complete the 40 foot walk, which places additional demand on the cardiorespiratory and musculoskeletal systems than the 4 meter walk, at the requisite brisk pace.

Our findings have important public health and clinical relevance in that they collectively support ongoing public health campaigns and health promotion efforts centered on the importance of taking small steps to becoming more physically active. For example, the Centers for Disease Control and Prevention provides multiple publicly-available resources that are specific to encouraging habitual physical activity among an older adult population (U.S. Department of Health and Human Services, 2017a). In addition, the National Institute on Aging offers the *Go4Life* physical activity and exercise campaign (U.S. Department of Health and Human Services, 2017b), which provides guidance for both health care providers and older adults to incorporate physical activity into daily life to improve cardiorespiratory endurance, muscular strength and endurance, flexibility and balance to optimize healthy aging. However, given that mobility issues are the leading cause of disability among older adults (U.S. Department of Health and Human Services, 2014), additional strategies are needed to bring greater awareness to available resources that encourage physical activity in this vulnerable population.

Strengths of the current study include the use of the large and diverse SWAN cohort with availability of longitudinal physical activity data to characterize the midlife transition. This provided unique opportunities to identify distinct subgroups of women that followed a similar pattern of physical activity change across midlife, rather than utilize an estimate that simply averages physical activity change across the entire analytic sample. Limitations of

the current study include use of reported physical activity data, which may be subject to recall bias (Troiano et al., 2012). Further, the physical activity trajectories were based on reported sports and exercise participation, only. Follow-up data has been collected on the SWAN cohort for nearly two decades and, therefore, they may not entirely be representative of all midlife women or the initial SWAN cohort at baseline. The excluded sample had a higher prevalence of racial/ethnic minority and obese women than the analytic sample, which are factors that are also associated with inadequate physical activity (Harris et al., 2013) and/or functional decline (Jensen and Friedmann, 2002; Manini, 2011). By excluding these women, the observed measures of association were likely attenuated; therefore, we are confident that our findings are robust. Further, very little variability in physical performance was observed among SWAN participants at Visit 13 (Sternfeld et al., 2016). While not surprising that ceiling effects were observed in this relatively younger cohort of women, clinically relevant differences were still found. Finally, while specific mobility disability measures were not collected in SWAN, the performance tests used at Visit 13 have been shown to predict mobility (Pahor et al., 2014; Vasunilashorn et al., 2009; Fielding et al., 2011).

5. Conclusions

Current study findings support the notion that physical activity during midlife is important for physical function in later life. Currently, the U.S. is experiencing a dramatic demographic shift as the baby-boomer generation transitions to older adulthood. Future studies should continue to examine the importance of physical activity for preservation of physical functioning as a primary prevention strategy to attenuate the considerable public health burden associated with disability in older adults (U.S. Department of Health and Human Services, 2013).

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References

- Ainsworth BE, Sternfeld B, Richardson MT, Jackson K. Evaluation of the kaiser physical activity survey in women. *Med Sci Sports Exerc.* 2000; 32(7):1327–1338. [PubMed: 10912901]
- Allender S, Cowburn G, Foster C. Understanding participation in sport and physical activity among children and adults: a review of qualitative studies. *Health Educ Res.* 2006; 21(6):826–835. [PubMed: 16857780]
- Allender S, Hutchinson L, Foster C. Life-change events and participation in physical activity: a systematic review. *Health Promot Int.* 2008; 23(2):160–172. [PubMed: 18364364]
- American College of Sports Medicine. ACSM's Guidelines for Exercise Testing and Prescription. 10. Lippincott Williams & Wilkins; 2017.
- Andruff H, Carraro N, Thompson A, Gaudreau P, Louvet B. Latent class growth modelling: a tutorial. *Tutor Quant Methods Psychol.* 2009; 5(1):11–24.
- Brown WJ, Heesch KC, Miller YD. Life events and changing physical activity patterns in women at different life stages. *Ann Behav Med.* 2009; 37(3):294–305. [PubMed: 19506989]
- Chang M, Saczynski JS, Snaedal J, et al. Midlife physical activity preserves lower extremity function in older adults: age gene/environment susceptibility-Reykjavik study. *J Am Geriatr Soc.* 2013; 61(2):237–242. [PubMed: 23320618]
- Corder K, Ogilvie D, van Sluijs EM. Invited commentary: physical activity over the life course—whose behavior changes, when, and why? *Am J Epidemiol.* 2009; 170(9):1078–1081. (discussion 1082–1073). [PubMed: 19767350]
- Curb JD, Ceria-Ulep CD, Rodriguez BL, et al. Performance-based measures of physical function for high-function populations. *J Am Geriatr Soc.* 2006; 54(5):737–742. [PubMed: 16696737]
- Duncan PW, Weiner DK, Chandler J, Studenski S. Functional reach: a new clinical measure of balance. *J Gerontol.* 1990; 45(6):M192–197. [PubMed: 2229941]
- Dunnnett CW. A multiple comparison procedure for comparing several treatments with a control. *J Am Stat Assoc.* 1955; 50(272):1096–1121.
- Evenson KR, Rosamond WD, Cai J, Diez-Roux AV, Brancati FL. Influence of retirement on leisure-time physical activity: the atherosclerosis risk in communities study. *Am J Epidemiol.* 2002; 155(8):692–699. [PubMed: 11943686]
- Fielding RA, Rejeski WJ, Blair S, et al. The lifestyle interventions and independence for elders study: design and methods. *J Gerontol A Biol Sci Med Sci.* 2011; 66(11):1226–1237. [PubMed: 21825283]
- 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(2):M85–94. [PubMed: 8126356]
- Harris, CD., Watson, KB., Carlson, SA., Fulton, JE., Dorn, JM. Adult Participation in Aerobic and Muscle-Strengthening Physical Activities – United States 2011. 2013.
- Hillsdon MM, Brunner EJ, Guralnik JM, Marmot MG. Prospective study of physical activity and physical function in early old age. *Am J Prev Med.* 2005; 28(3):245–250. [PubMed: 15766611]
- Jensen GL, Friedmann JM. Obesity is associated with functional decline in community-dwelling rural older persons. *J Am Geriatr Soc.* 2002; 50(5):918–923. [PubMed: 12028181]
- Keehan SP, Cuckler GA, Sisko AM, et al. National health expenditure projections: modest annual growth until coverage expands and economic growth accelerates. *Health Aff (Millwood).* 2012; 31(7):1600–1612. [PubMed: 22692089]
- King DE, Matheson E, Chirina S, Shankar A, Broman-Fulks J. The status of baby boomers' health in the United States: the healthiest generation? *JAMA Intern Med.* 2013; 173(5):385–386. [PubMed: 23381505]
- Manini T. Development of physical disability in older adults. *Curr Aging Sci.* 2011; 4(3):184–191. [PubMed: 21529321]

- Murray ET, Hardy R, Strand BH, Cooper R, Guralnik JM, Kuh D. Gender and life course occupational social class differences in trajectories of functional limitations in midlife: findings from the 1946 British birth cohort. *J Gerontol A Biol Sci Med Sci*. 2011; 66(12):1350–1359. [PubMed: 21860018]
- Pahor M, Guralnik JM, Ambrosius WT, et al. Effect of structured physical activity on prevention of major mobility disability in older adults: the LIFE study randomized clinical trial. *JAMA*. 2014; 311(23):2387–2396. [PubMed: 24866862]
- Patel KV, Coppin AK, Manini TM, et al. Midlife physical activity and mobility in older age: the InCHIANTI study. *Am J Prev Med*. 2006; 31(3):217–224. [PubMed: 16905032]
- Peeters G, Dobson AJ, Deeg DJ, Brown WJA. Life-course perspective on physical functioning in women. *Bull World Health Organ*. 2013; 91(9):661–670. [PubMed: 24101782]
- Perera S, Mody SH, Woodman RC, Studenski SA. Meaningful change and responsiveness in common physical performance measures in older adults. *J Am Geriatr Soc*. 2006; 54(5):743–749. [PubMed: 16696738]
- Radloff LS. The CES-D scale: a self-report depression scale for research in the general population. *Appl Psychol Meas*. 1977; 1(3):385–401.
- Sanchez-Zuriaga D, Lopez-Pascual J, Garrido-Jaen D, de Moya MF, Prat-Pastor J. Reliability and validity of a new objective tool for low back pain functional assessment. *Spine (Phila Pa 1976)*. 2011; 36(16):1279–1288. [PubMed: 21240051]
- Sowers, MF., Crawford, SL., Sternfeld, B. A multicenter, multiethnic, community-based cohort study of women and the menopausal transition. In: Lobo, RA.Kelsey, J., Marcus, R., editors. *Menopause: Biology and Pathobiology*. Academic Press; San Diego, CA: 2000.
- Sternfeld B, Ainsworth BE, Quesenberry CP. Physical activity patterns in a diverse population of women. *Prev Med*. 1999; 28(3):313–323. [PubMed: 10072751]
- Sternfeld B, Colvin A, Stewart A, et al. The impact of a healthy lifestyle on future physical functioning in midlife women. *Med Sci Sports Exerc*. 2016
- Troiano RP, Berrigan D, Dodd KW, Masse LC, Tilert T, McDowell M. Physical activity in the United States measured by accelerometer. *Med Sci Sports Exerc*. 2008; 40(1):181–188. [PubMed: 18091006]
- Troiano RP, Pettee Gabriel KK, Welk GJ, Owen N, Sternfeld B. Reported physical activity and sedentary behavior: why do you ask? *J Phys Act Health*. 2012; 9(Suppl 1):S68–75. [PubMed: 22287450]
- U.S. Department of Health and Human Services. [Accessed date: 10 October 2008] Physical Activity Guidelines for Americans. 2008a. www.health.gov/paguidelines
- U.S. Department of Health and Human Services. [Accessed date: 19 March 2011] Physical Activity Guidelines Advisory Committee Report. 2008b. <http://www.health.gov/paguidelines/Report/pdf/CommitteeReport.pdf>
- U.S. Department of Health and Human Services. [Accessed date: 20 December 2016] The State of Aging and Health in America 2013. 2013. https://www.cdc.gov/features/agingandhealth/State_of_aging_and_health_in_america_2013.pdf
- U.S. Department of Health and Human Services. [Accessed date: 5 January 2017] Older Americans With a Disability: 2008–2012: American Community Survey Reports. 2014. <http://www.census.gov/content/dam/Census/library/publications/2014/acs/acs-29.pdf>
- U.S. Department of Health and Human Services. [Accessed date: 5 January 2017] How much physical activity do older adults need?. 2017a. https://www.cdc.gov/physicalactivity/basics/older_adults/index.htm
- U.S. Department of Health and Human Services. [Accessed January 5, 2017] National Institute on Aging. Go4Life. 2017b. <https://go4life.nia.nih.gov/>
- Vasunilashorn S, Coppin AK, Patel KV, et al. Use of the short physical performance battery score to predict loss of ability to walk 400 meters: analysis from the InCHIANTI study. *J Gerontol A Biol Sci Med Sci*. 2009; 64(2):223–229. [PubMed: 19182232]
- Vincent, GK., Velkoff, VA. *The Next four Decades: The Older Population in the United States: 2010 to 2050*. U.S. Census Bureau; Washington, DC: 2010.

Ylitalo KR, Karvonen-Gutierrez CA, Fitzgerald N, et al. Relationship of race-ethnicity, body mass index, and economic strain with longitudinal self-report of physical functioning: the Study of Women's Health Across the Nation. *Ann Epidemiol.* 2013; 23(7):401–408. [PubMed: 23694761]

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Fig. 1. Predicted values and 95% confidence intervals for the five latent trajectory classes of physical activity in SWAN ($n = 1771$) participants, using reported physical activity data (sports and activity index) from the Kaiser Physical Activity Survey, a self-administered reliable and valid self-report recall questionnaire (Ainsworth et al., 2000).

Table 1

Comparison of baseline characteristics across physical activity trajectory classes.

	<i>n</i>	Lowest				Increasing				Decreasing				Middle				Highest			
		450	213	392	456	260	450	213	392	456	260	450	213	392	456	260	450	213	392	456	260
Age	Mean (SD)	46.4 (2.7)	46.2 (2.6)	46.4 (2.6)	46.6 (2.7)	46.5 (2.8)	46.4 (2.7)	46.2 (2.6)	46.4 (2.6)	46.6 (2.7)	46.5 (2.8)	46.4 (2.7)	46.2 (2.6)	46.4 (2.6)	46.6 (2.7)	46.5 (2.8)	46.4 (2.7)	46.2 (2.6)	46.4 (2.6)	46.6 (2.7)	46.5 (2.8)
Race/ethnicity, N (%)	White	173 (38.4)	79 (37.1)	185 (47.2)	246 (53.9)	179 (68.8)	173 (38.4)	79 (37.1)	185 (47.2)	246 (53.9)	179 (68.8)	173 (38.4)	79 (37.1)	185 (47.2)	246 (53.9)	179 (68.8)	173 (38.4)	79 (37.1)	185 (47.2)	246 (53.9)	179 (68.8)
	Black	154 (34.2)	52 (24.4)	122 (31.1)	104 (22.8)	29 (11.2)	154 (34.2)	52 (24.4)	122 (31.1)	104 (22.8)	29 (11.2)	154 (34.2)	52 (24.4)	122 (31.1)	104 (22.8)	29 (11.2)	154 (34.2)	52 (24.4)	122 (31.1)	104 (22.8)	29 (11.2)
	Hispanic	38 (8.4)	23 (10.8)	13 (3.3)	6 (1.3)	0 (0)	38 (8.4)	23 (10.8)	13 (3.3)	6 (1.3)	0 (0)	38 (8.4)	23 (10.8)	13 (3.3)	6 (1.3)	0 (0)	38 (8.4)	23 (10.8)	13 (3.3)	6 (1.3)	0 (0)
	Chinese	45 (10)	35 (16.4)	40 (10.2)	44 (9.6)	19 (7.3)	45 (10)	35 (16.4)	40 (10.2)	44 (9.6)	19 (7.3)	45 (10)	35 (16.4)	40 (10.2)	44 (9.6)	19 (7.3)	45 (10)	35 (16.4)	40 (10.2)	44 (9.6)	19 (7.3)
	Japanese	40 (8.9)	24 (11.3)	32 (8.2)	56 (12.3)	33 (12.7)	40 (8.9)	24 (11.3)	32 (8.2)	56 (12.3)	33 (12.7)	40 (8.9)	24 (11.3)	32 (8.2)	56 (12.3)	33 (12.7)	40 (8.9)	24 (11.3)	32 (8.2)	56 (12.3)	33 (12.7)
Income, N (%)	<\$35,000	157 (36.3)	59 (28.6)	115 (30)	81 (18)	21 (8.2)	157 (36.3)	59 (28.6)	115 (30)	81 (18)	21 (8.2)	157 (36.3)	59 (28.6)	115 (30)	81 (18)	21 (8.2)	157 (36.3)	59 (28.6)	115 (30)	81 (18)	21 (8.2)
	\$35,000–\$74,999	243 (56.1)	121 (58.7)	232 (60.6)	282 (62.7)	146 (56.8)	243 (56.1)	121 (58.7)	232 (60.6)	282 (62.7)	146 (56.8)	243 (56.1)	121 (58.7)	232 (60.6)	282 (62.7)	146 (56.8)	243 (56.1)	121 (58.7)	232 (60.6)	282 (62.7)	146 (56.8)
	>\$75,000	33 (7.6)	26 (12.6)	36 (9.4)	87 (19.3)	90 (35)	33 (7.6)	26 (12.6)	36 (9.4)	87 (19.3)	90 (35)	33 (7.6)	26 (12.6)	36 (9.4)	87 (19.3)	90 (35)	33 (7.6)	26 (12.6)	36 (9.4)	87 (19.3)	90 (35)
Marital status, N (%)	Single/never married	76 (16.9)	25 (11.8)	47 (12)	52 (11.4)	27 (10.4)	76 (16.9)	25 (11.8)	47 (12)	52 (11.4)	27 (10.4)	76 (16.9)	25 (11.8)	47 (12)	52 (11.4)	27 (10.4)	76 (16.9)	25 (11.8)	47 (12)	52 (11.4)	27 (10.4)
	Currently married or living as married	290 (64.6)	152 (71.7)	259 (66.1)	327 (71.7)	204 (78.5)	290 (64.6)	152 (71.7)	259 (66.1)	327 (71.7)	204 (78.5)	290 (64.6)	152 (71.7)	259 (66.1)	327 (71.7)	204 (78.5)	290 (64.6)	152 (71.7)	259 (66.1)	327 (71.7)	204 (78.5)
	Separated/widowed/divorced	83 (18.5)	35 (16.5)	86 (21.9)	77 (16.9)	29 (11.2)	83 (18.5)	35 (16.5)	86 (21.9)	77 (16.9)	29 (11.2)	83 (18.5)	35 (16.5)	86 (21.9)	77 (16.9)	29 (11.2)	83 (18.5)	35 (16.5)	86 (21.9)	77 (16.9)	29 (11.2)
Employed	Yes, N (%)	362 (80.6)	179 (84.4)	326 (83.2)	401 (88.3)	228 (87.7)	362 (80.6)	179 (84.4)	326 (83.2)	401 (88.3)	228 (87.7)	362 (80.6)	179 (84.4)	326 (83.2)	401 (88.3)	228 (87.7)	362 (80.6)	179 (84.4)	326 (83.2)	401 (88.3)	228 (87.7)
Overall health, N (%)	Excellent/very good	82 (18.3)	30 (14.4)	94 (24.1)	99 (21.8)	59 (22.8)	82 (18.3)	30 (14.4)	94 (24.1)	99 (21.8)	59 (22.8)	82 (18.3)	30 (14.4)	94 (24.1)	99 (21.8)	59 (22.8)	82 (18.3)	30 (14.4)	94 (24.1)	99 (21.8)	59 (22.8)
	Good	285 (63.6)	138 (66)	248 (63.6)	307 (67.6)	180 (69.5)	285 (63.6)	138 (66)	248 (63.6)	307 (67.6)	180 (69.5)	285 (63.6)	138 (66)	248 (63.6)	307 (67.6)	180 (69.5)	285 (63.6)	138 (66)	248 (63.6)	307 (67.6)	180 (69.5)
	Fair/poor	81 (18.1)	41 (19.6)	48 (12.3)	48 (10.6)	20 (7.7)	81 (18.1)	41 (19.6)	48 (12.3)	48 (10.6)	20 (7.7)	81 (18.1)	41 (19.6)	48 (12.3)	48 (10.6)	20 (7.7)	81 (18.1)	41 (19.6)	48 (12.3)	48 (10.6)	20 (7.7)
BMI category, N (%)	Underweight or normal	130 (29.1)	89 (41.8)	140 (36.2)	221 (49.2)	172 (66.4)	130 (29.1)	89 (41.8)	140 (36.2)	221 (49.2)	172 (66.4)	130 (29.1)	89 (41.8)	140 (36.2)	221 (49.2)	172 (66.4)	130 (29.1)	89 (41.8)	140 (36.2)	221 (49.2)	172 (66.4)
	Overweight	111 (24.8)	69 (32.4)	100 (25.8)	123 (27.4)	65 (25.1)	111 (24.8)	69 (32.4)	100 (25.8)	123 (27.4)	65 (25.1)	111 (24.8)	69 (32.4)	100 (25.8)	123 (27.4)	65 (25.1)	111 (24.8)	69 (32.4)	100 (25.8)	123 (27.4)	65 (25.1)
	Obese	206 (46.1)	55 (25.8)	147 (38)	105 (23.4)	22 (8.5)	206 (46.1)	55 (25.8)	147 (38)	105 (23.4)	22 (8.5)	206 (46.1)	55 (25.8)	147 (38)	105 (23.4)	22 (8.5)	206 (46.1)	55 (25.8)	147 (38)	105 (23.4)	22 (8.5)
Smoker	Yes, N (%)	84 (19)	30 (14.2)	60 (15.4)	43 (9.5)	12 (4.7)	84 (19)	30 (14.2)	60 (15.4)	43 (9.5)	12 (4.7)	84 (19)	30 (14.2)	60 (15.4)	43 (9.5)	12 (4.7)	84 (19)	30 (14.2)	60 (15.4)	43 (9.5)	12 (4.7)
Bodily pain, N (%)	None	65 (14.4)	36 (16.9)	72 (18.4)	84 (18.4)	58 (22.3)	65 (14.4)	36 (16.9)	72 (18.4)	84 (18.4)	58 (22.3)	65 (14.4)	36 (16.9)	72 (18.4)	84 (18.4)	58 (22.3)	65 (14.4)	36 (16.9)	72 (18.4)	84 (18.4)	58 (22.3)
	Very mild/mild	245 (54.4)	117 (54.9)	218 (55.6)	283 (62.1)	167 (64.2)	245 (54.4)	117 (54.9)	218 (55.6)	283 (62.1)	167 (64.2)	245 (54.4)	117 (54.9)	218 (55.6)	283 (62.1)	167 (64.2)	245 (54.4)	117 (54.9)	218 (55.6)	283 (62.1)	167 (64.2)
	Moderate	107 (23.8)	48 (22.5)	81 (20.7)	75 (16.4)	28 (10.8)	107 (23.8)	48 (22.5)	81 (20.7)	75 (16.4)	28 (10.8)	107 (23.8)	48 (22.5)	81 (20.7)	75 (16.4)	28 (10.8)	107 (23.8)	48 (22.5)	81 (20.7)	75 (16.4)	28 (10.8)
	Severe/very severe	33 (7.3)	12 (5.6)	21 (5.4)	14 (3.1)	7 (2.7)	33 (7.3)	12 (5.6)	21 (5.4)	14 (3.1)	7 (2.7)	33 (7.3)	12 (5.6)	21 (5.4)	14 (3.1)	7 (2.7)	33 (7.3)	12 (5.6)	21 (5.4)	14 (3.1)	7 (2.7)
Physical difficulties	Yes, N (%)	122 (27.1)	60 (28.2)	103 (26.3)	102 (22.4)	49 (18.8)	122 (27.1)	60 (28.2)	103 (26.3)	102 (22.4)	49 (18.8)	122 (27.1)	60 (28.2)	103 (26.3)	102 (22.4)	49 (18.8)	122 (27.1)	60 (28.2)	103 (26.3)	102 (22.4)	49 (18.8)
Osteoarthritis	Yes, N (%)	85 (18.9)	37 (17.5)	76 (19.4)	71 (15.6)	32 (12.3)	85 (18.9)	37 (17.5)	76 (19.4)	71 (15.6)	32 (12.3)	85 (18.9)	37 (17.5)	76 (19.4)	71 (15.6)	32 (12.3)	85 (18.9)	37 (17.5)	76 (19.4)	71 (15.6)	32 (12.3)
Menopause status, N (%)	Early peri	212 (47.4)	90 (43.1)	172 (44)	199 (43.8)	97 (37.3)	212 (47.4)	90 (43.1)	172 (44)	199 (43.8)	97 (37.3)	212 (47.4)	90 (43.1)	172 (44)	199 (43.8)	97 (37.3)	212 (47.4)	90 (43.1)	172 (44)	199 (43.8)	97 (37.3)

	Lowest	Increasing	Decreasing	Middle	Highest
	450	213	392	456	260
	235 (52.6)	119 (56.9)	219 (56)	255 (56.2)	163 (62.7)
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Table 2

Characteristics of SWAN women at follow-up visit 13 by physical activity trajectory class.

VARIABLE	n	Physical Activity Trajectory Class				p-Value
		Lowest	Increasing	Decreasing	Middle	Highest
		450	213	392	456	260
Age	Mean (SD)	61.9 (2.6)	61.8 (2.7)	61.9 (2.6)	62.1 (2.7)	62 (2.8)
Race/ethnicity	White	173 (38.4)	79 (37.1)	185 (47.2)	243 (53.6)	180 (69.5)
	Black	154 (34.2)	52 (24.4)	122 (31.1)	104 (23)	28 (10.8)
	Hispanic	38 (8.4)	23 (10.8)	13 (3.3)	6 (1.3)	0 (0)
	Chinese	45 (10)	35 (16.4)	40 (10.2)	44 (9.7)	18 (6.9)
Income	Japanese	40 (8.9)	24 (11.3)	32 (8.2)	56 (12.4)	33 (12.7)
	< \$35,000	144 (34.9)	40 (19.9)	103 (28.8)	61 (14.5)	16 (6.6)
	\$35,000–\$74,999	200 (48.4)	107 (53.2)	162 (45.3)	230 (54.6)	109 (45)
	> \$75,000	69 (16.7)	54 (26.9)	93 (26)	130 (30.9)	117 (48.3)
Marital status	Single/never married	75 (16.7)	22 (10.3)	39 (9.9)	51 (11.3)	24 (9.3)
	Currently married or living as married	230 (51.1)	133 (62.4)	231 (58.9)	283 (62.5)	193 (74.5)
	Separated/widowed/divorced	145 (32.2)	58 (27.2)	122 (31.1)	119 (26.3)	42 (16.2)
Employed		71 (63.4)	44 (73.3)	85 (70.8)	89 (67.4)	56 (73.7)
Overall health	Excellent/very good	136 (30.4)	105 (50.5)	163 (42)	283 (63.2)	208 (80.6)
	Good	178 (39.7)	78 (37.5)	159 (41)	127 (28.3)	41 (15.9)
BMI category	Fair/poor	134 (29.9)	25 (12)	66 (17)	38 (8.5)	9 (3.5)
	Underweight or normal	102 (23)	52 (24.4)	90 (23)	150 (33.1)	130 (50.2)
	Overweight	99 (22.3)	81 (38)	117 (29.9)	155 (34.2)	84 (32.4)
	Obese	242 (54.6)	80 (37.6)	184 (47.1)	148 (32.7)	45 (17.4)
Smoker		58 (12.9)	18 (8.5)	35 (9)	21 (4.7)	5 (1.9)
Bodily pain	None	65 (14.5)	32 (15.2)	49 (12.6)	84 (18.8)	48 (18.6)
	Very mild/mild	210 (46.9)	122 (57.8)	216 (55.5)	268 (59.8)	171 (66.3)
	Moderate	132 (29.5)	44 (20.9)	91 (23.4)	82 (18.3)	32 (12.4)
Physical difficulties	Severe/very severe	41 (9.2)	13 (6.2)	33 (8.5)	14 (3.1)	7 (2.7)
		151 (33.7)	46 (21.8)	111 (28.6)	83 (18.5)	31 (12)
Osteoarthritis		166 (37)	67 (31.5)	134 (34.4)	123 (27.2)	64 (24.8)
Menopause status	Natural post	419 (93.1)	200 (93.9)	362 (92.3)	425 (93.8)	245 (94.6)

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VARIABLE	Lowest	Increasing	Decreasing	Middle	Highest	p-Value
<i>n</i>	450	213	392	456	260	
Post by BSO	27 (6)	12 (5.6)	25 (6.4)	26 (5.7)	12 (4.6)	
Pre/early/late peri	4 (0.9)	1 (0.5)	5 (1.3)	2 (0.4)	2 (0.8)	
Hormone use (ever)	142 (31.6)	78 (36.6)	166 (42.3)	199 (43.9)	124 (47.9)	< 0.0001

^aUnable to calculate *p*-value using Fisher's exact test.

Table 3
Mean and standard deviation of physical performance measures by physical activity trajectory class.

	Lowest	Increasing	Decreasing	Middle	Highest	p-Value
<i>n</i>	450	213	392	456	260	
40 ft gait speed, m/s	1.34 (0.32)	1.5 (0.3)	1.43 (0.3)	1.54 (0.29)	1.62 (0.24)	< 0.0001
4 m gait speed, m/s	0.93 (0.24)	1 (0.26)	1.02 (0.25)	1.1 (0.24)	1.17 (0.25)	< 0.0001
Repeated chair stand, s	12.4 (3.93)	10.96 (3.64)	11.99 (3.76)	10.41 (3.09)	9.44 (2.58)	< 0.0001
Grip strength, kg	24.31 (5.92)	24.86 (5.5)	25.47 (5.61)	25.96 (5.65)	26.29 (4.82)	< 0.0001

Table 4

Beta coefficients and 95% confidence intervals from multivariable linear regression models of physical activity trajectories and performance outcomes, adjusting for visit 13 age, race, site, education, BMI, self-rated health (minimally-adjusted models), diabetes, cancer, heart attack, stroke, depression, bodily pain, arthritis, menopause status and hormone use (fully-adjusted models) in 1771 Study of Women's Health Across the Nation (SWAN) participants.

	40 foot walk gait speed, m/s	4 meter walk gait speed, m/s	Repeated chair stand, s	Grip strength, kg
	Beta, 95% CI	Beta, 95% CI	Beta, 95% CI	Beta, 95% CI
Minimally-adjusted model				
Highest	0.08 (0.04, 0.13) **	0.08 (0.05, 0.11) ****	-1.24 (-1.75, -0.74) ****	2.29 (1.42, 3.15) ****
Middle	0.07 (0.03, 0.11) ***	0.06 (0.04, 0.09) ****	-0.84 (-1.26, -0.43) ***	1.72 (1, 2.44) ****
Decreasing	0.02 (-0.01, 0.06)	0.03 (0.01, 0.06)	0.13 (-0.29, 0.54)	1.18 (0.47, 1.9) **
Increasing	0.05 (0.004, 0.1)	0.02 (-0.01, 0.05)	-0.79 (-1.29, -0.28) **	1.14 (0.27, 2.01) *
Lowest	REF	REF	REF	REF
Fully-adjusted model				
Highest	0.09 (0.04, 0.13) ***	0.08 (0.05, 0.11) ****	-1.29 (-1.79, -0.79) ****	2.22 (1.35, 3.09) ****
Middle	0.07 (0.03, 0.11) ***	0.06 (0.04, 0.09) ****	-0.85 (-1.27, -0.44) ***	1.69 (0.97, 2.42) ****
Decreasing	0.02 (-0.01, 0.06)	0.03 (0.01, 0.06)	0.1 (-0.32, 0.52)	1.17 (0.45, 1.89) **
Increasing	0.05 (0.01, 0.1)	0.02 (-0.01, 0.05)	-0.81 (-1.31, -0.31) **	1.08 (0.21, 1.95)
Lowest	REF	REF	REF	REF

*
 $p < 0.05$,

**
 $p < 0.01$,

 $p < 0.001$,

 $p < 0.0001$, adjusted using Dunnett's method.

Table 5

Beta coefficients and 95% confidence intervals from multivariable linear regression models of physical activity trajectories and performance outcomes, adjusting for visit 13 age, race, site, education, BMI, self-rated health (minimally-adjusted models), diabetes, cancer, heart attack, stroke, depression, bodily pain, arthritis, menopause status and hormone use (fully-adjusted models) in 1771 Study of Women's Health Across the Nation (SWAN) participants.

	40 foot walk gait speed	4 meter walk gait speed	Repeated chair stand	Grip strength
	Beta, 95% CI	Beta, 95% CI	Beta, 95% CI	Beta, 95% CI
Minimally-adjusted model				
Highest	0.03 (−0.02, 0.09)	0.06 (0.02, 0.1) **	−0.46 (−1.02, 0.1)	1.15 (0.17, 2.12)
Middle	0.02 (−0.03, 0.07)	0.04 (0.01, 0.07) *	−0.06 (−0.56, 0.44)	0.58 (−0.28, 1.44)
Decreasing	−0.03 (−0.07, 0.02)	0.01 (−0.02, 0.04)	0.91 (0.4, 1.42) **	0.04 (−0.84, 0.92)
Lowest	−0.05 (−0.1, −0.004)	−0.02 (−0.05, 0.01)	0.79 (0.28, 1.29) **	−1.14 (−2.01, −0.27) *
Increasing	REF	REF	REF	REF
Fully-adjusted model				
Highest	0.04 (−0.02, 0.09)	0.06 (0.02, 0.09) **	−0.48 (−1.04, 0.08)	1.14 (0.16, 2.12)
Middle	0.02 (−0.03, 0.07)	0.04 (0.01, 0.07) *	−0.04 (−0.53, 0.46)	0.61 (−0.25, 1.48)
Decreasing	−0.03 (−0.07, 0.02)	0.01 (−0.02, 0.04)	0.91 (0.4, 1.42) **	0.09 (−0.8, 0.97)
Lowest	−0.05 (−0.1, −0.01)	−0.02 (−0.05, 0.01)	0.81 (0.31, 1.31) **	−1.08 (−1.95, −0.21) *
Increasing	REF	REF	REF	REF

* $p < 0.05$,

** $p < 0.01$,

*** $p < 0.001$,

**** $p < 0.0001$, adjusted using Dunnett's method.