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Research Article

# Self-reported Fitness and Objectively Measured Physical Activity Profile Among Older Adults: A Twin Study

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## Abstract

**Background:** Maintaining good fitness and good level of physical activity are important factors for maintaining physical independence later in life. The aim was to investigate the relationship between self-reported fitness and objectively measured physical activity and sedentary behavior in the elderly.
**Methods:** Same-sex twin pairs born 1940–1944 in Finland were invited to the study. Altogether 787 individuals (mean age 72.9 years), of whom 404 were female, used a hip-worn triaxial accelerometer for at least 4 days and answered a question on perceived fitness. First, individual differences were studied between four fitness categories. Second, pairwise differences were examined among twin pairs discordant for fitness.
**Results:** Self-reported fitness explained moderately the variation in objectively measured physical activity parameters: $R^2$ for daily steps 26%, for daily mean metabolic equivalent 31%, for daily moderate-to-vigorous activity time 31%, and lower for sedentary behavior time 14% (all $p < .001$). Better self-reported fitness was associated with more steps taken on average (8,558 daily steps [very good fitness] vs 2,797 steps [poor fitness], $p < .001$) and with a higher amount of moderate-to-vigorous activity (61 min vs 12 min $p < .001$, respectively) in the adjusted multivariable model. Among 156 twin pairs discordant for self-reported fitness, co-twins with better fitness took more steps, did more moderate-to-vigorous activity, and had less sedentary behavior (all, $p < .05$) compared to their less fit co-twins; however, difference was smaller among monozygotic than dizygotic pairs.
**Conclusion:** One simple question on self-reported fitness is associated with daily activity profile among community-dwelling older people. However, genetic factors modulate this association to some extent.

**Keywords:** Exercise, Accelerometer, Fitness, Self-report, Elderly.

## Introduction

Among the elderly, high physical activity (PA) and fitness are indicators of good physical health and functioning, both accounting for reduced probability of developing several chronic diseases and all-cause mortality (1–3). Both fitness and PA are important in maintaining activities of daily living, which includes a spectrum activities ranging from self-care and basic mobility to physically demanding household chores (4,5). Physical fitness is also an important factor for maintaining physical independence later in life even irrespective of obesity status (6). Decreased aerobic fitness, assessed as self-reported feeling of fatigue and exhaustion, and low PA are both frailty-related criteria (7,8). Therefore, from the viewpoint of healthy aging, it is important that individuals maintain sufficient level of PA and optimal physical fitness.

As far as we are aware, no study has examined the association between self-reported fitness and objectively measured PA and sedentary behavior (SB) among older adults. However, mixed results have been obtained when objectively measured PA were associated with measured cardiorespiratory fitness (ie, maximal oxygen uptake—$VO_2$). Among middle-aged people, correlation between accelerometer-measured vigorous activity and measured $VO_2$ was moderate ($r$ = .50), whereas no differences in sedentary time were found between fit and unfit persons (9). Among elderly people (mean age 75.5 years), a submaximal $VO_2$ field test exhibited moderately high correlations (.61–.69) with different accelerometer-measured PA parameters, whereas SB exhibited a moderately high negative correlation (−.69) with $VO_2$ (7). Some studies have investigated the relationship between objectively measured PA and physical function or other measures of fitness among older adults, for example, higher moderate-to-vigorous activity (MVPA) is associated with better strength and faster timed chair stand speed (10) and lower MVPA time with poorer functional fitness (11).

Objective fitness tests are time consuming and difficult to conduct in primary health care, and therefore a simpler evaluation of physical fitness among older adults is desirable. Self-reported fitness might suffice to assess fitness in normal daily use. Associations between self-reported fitness and measured fitness among adults have been moderate to very strong correlations when a 22-item survey on self-reported fitness (multidimensional fitness) was used (12) and moderate associations when only one question was used (13,14). However, among older adults fewer studies have been conducted and multidimensional self-reported fitness question batteries have displayed only weak-to-moderate correlations with objectively measured fitness (4,15). van Heuvelen and colleagues (15) suggested that older adults might not be able to evaluate their multidimensional fitness and this tended to reflect their general physical functioning, and therefore a single question about self-reported fitness question among older adults might capture the same information.

However, it is unknown whether perceived fitness, assessed as self-reported fitness, is associated with objectively measured PA or SB. Older adults who perceive themselves unfit might be less active and spend more time in sedentary activities than individuals considering themselves fit, regardless of their actual fitness. Therefore, the study assesses relationship between a single question about self-reported fitness and objectively measured PA and SB. Specifically, this study examines whether PA and SB differ between the self-reported fitness categories and whether the possible differences persist when genetic factors are taken into account within a twin-study design. It is important that the elderly remain fit and perform at least some PA so that they can enjoy independent living and avoid or at least postpone the development of frailty. Therefore, feasible and broadly accessible tools to identify those individuals at imminent risk of developing frailty are needed.

## Methods

### Study Participants

The study is based on the older Finnish Twin cohort and is part of the MOBILETWIN study (16). In this study conducted during 2014–2016, a sub-cohort of twin pairs born between 1940 and 1944 were invited to participate in a telephone interview, use accelerometer, and respond to an activity-related questionnaire. Altogether 787 twin individuals (including 283 complete pairs; 119 monozygotic [MZ] pairs, 148 same-sex dizygotic (DZ) pairs, and 16 same-sex pairs with uncertain zygosity) answered the required questions about self-reported fitness and wore an accelerometer for predetermined time. The final analysis included 383 males and 404 females, whose mean age was 72.9 years (range 71.1–75.0).

### Objectively Measured Physical Activity and Sedentary Behavior

PA was measured with a hip-worn, light triaxial accelerometer (Hookie AM20, Traxmeet Ltd, Espoo, Finland). The device and the instructions on how it should be worn were mailed to the participants who provided a written consent. The participants were instructed to use the accelerometer during waking hours for 7 consecutive days. Thereafter the participants mailed the accelerometer back to UKK Institute in a prepaid envelope for data analysis. The time criterion for adequate accelerometer data collection was at least 4 days with a minimum of 10 hours per day. The daily non-wear time during waking hours was defined as a sum of at least 30 minutes of consecutive zero acceleration.

The raw acceleration data were analyzed by recently developed and validated MAD-APE algorithms (17–19). The acronym MAD stands for the mean amplitude deviation of the raw acceleration signal and the MAD value of the resultant acceleration has shown a strong correlation ($r$ > .9) with directly measured incident $VO_2$ whereas walking or running on a track (19). The acronym APE, in turn, stands for the angle for posture estimation and it together with incident MAD values provides about 90% accuracy in detecting the body posture not only in laboratory conditions but also in free-living conditions (17). These novel algorithms were used to differentiate between lying, sitting, standing and different PA intensities. For the analysis, MAD and APE values were determined for each 6 second epoch and a 1 minute moving average of the MAD values was calculated to estimate incident energy consumption expressed in metabolic equivalents (MET). The MET values were categorized as follows: 1.5–3 MET for light activities, 3–6 MET for moderate activities, and more than 6 MET for vigorous activities. Sedentary activities were defined as MET less than 1.5 while lying, sitting or standing. Exact explanations for all objectively measured variables can be seen in Supplementary Table 1.

In order to acquire a comprehensive understanding on the relationship between self-reported fitness and PA profile, a variety of PA and SB variables were determined from the processed acceleration data. Main PA and SB variables in this study were mean daily times spent in lying, sitting, or standing or in light, moderate, or vigorous activities. Other variables were the number of daily steps, running steps, sit-to-stand transitions, activity bouts comprising at least 10 minutes consecutive activity, the mean daily MET for all recorded days (daily MET), and the most intense 10 minute period (Peak-10 min MET based on 10 minute moving exponential average of MAD data) during the monitoring week. In some analyses, lying and sitting were combined to represent SB and moderate and vigorous physical activities were combined to designate activity at an MVPA level.

### Physical Function Questionnaire and Covariates

Together with the accelerometer, the participants received a questionnaire about their physical function and self-reported health and fitness. In this study, self-reported fitness was assessed by their response to the question: “Is your current physical fitness in your opinion, 1) Very good, 2) Fairly good, 3) Satisfactory 4) Fairly poor, 5) Very poor”. Due to the low number of responses in categories four and five, these two were combined for the analyses and called poor.

Age, sex, body mass index (BMI, kg/m$^2$), and diseases restricting mobility were used as covariates in the study. BMI was calculated from reported height and weight and information on diseases

**Table 1.** Group Characteristics Broken Down by the Self-reported Fitness Categories

| | Very Good (1) | Fairly Good (2) | Satisfactory (3) | Poor (4) | |
|---|---|---|---|---|---|
| | *n* = 127 | *n* = 389 | *n* = 236 | *n* = 35 | *p* |
| Sex | | | | | .033‡ |
| Male, *n* (%) | 75 (59.1) | 181 (46.5) | 106 (44.9) | 21 (60) | |
| Female, *n* (%) | 52 (40.9) | 208 (53.5) | 130 (55.1) | 14 (40) | |
| Age, mean years (*SD*) | 72.9 (0.9) | 72.9 (1.0) | 72.8 (0.9) | 72.6 (1.0) | 0.23† |
| BMI, mean (*SD*) | 24.3 (2.9) | 25.7 (3.3) | 27.6 (4.6) | 27.3 (4.8) | <.001† |
| Disease restricting mobility | | | | | <.001‡ |
| No, *n* (%) | 121 (96) | 325 (85) | 137 (59) | 12 (36) | |
| Yes, *n* (%) | 5 (4) | 58 (15) | 96 (41) | 21 (64) | |
| Accelerometer wear time | 14:08:50 (1:04:58) | 14:01:19 (1:24:47) | 14:00:31 (1:21:54) | 13:50:56 (1:36:18) | .27† |
| Accelerometer wear days | 6.85 (0.46) | 6.72 (0.59) | 6.70 (0.62) | 6.6 (0.74) | .027 |

*Note:* BMI = body mass index; *SD* = standard deviation.
†Linear regression, sex, and age adjusted. ‡Rao–Scott symmetry test.

was self-reported and asked as follows: Do you have a physician diagnosed disease that affect your ability to move or exercise? Participants answered either yes or no. The main diseases restricting mobility were musculoskeletal, cardiovascular, neurological, and pulmonary diseases.

## Statistical Analyses

Data analyses were conducted using StataIC version 14. To determine *R*-squared ($R^2$) for the associations linear regression was used. In the analyses, the twins were treated as individuals but because the observations from twin pairs may be correlated, robust estimators of variance (the cluster option in Stata) were used. All basic analyses calculating $R^2$ were adjusted for age and sex. In order to estimate $R^2$ only for self-reported fitness, it was entered into the model after the basic model with age and sex, and then the change in $R^2$ ($\Delta R^2$) was determined. Subsequently, the Sidak multiple-comparison test was applied to identify differences between the four fitness categories. The same procedure was conducted when the regression analysis was additionally adjusted for BMI and self-reported disease. A multivariable model for $R^2$ including all covariates was also devised. Square root-transformation of lying, moderate activity, MVPA and 10 minutes bouts and logarithm-transformation of running steps, vigorous activity, and Peak-10 min MET were done to make these variables more normally distributed in linear regression analyses. Means and standard deviations (*SD*s) were calculated with bootstrapping option due to these not normally distributed variables.

Pairwise differences were studied among 156 twin pairs (90 DZ, 57 MZ, and 9 uncertain zygosity) discordant for self-reported fitness, one co-twin having better self-reported fitness versus their co-twin (eg, 1 vs 2, 2 vs 3, 1 vs 3). Pairs with uncertain zygosity were included in the pairwise analysis of all discordant pairs, but they were not included when either MZ or DZ pairs were analyzed separately. Wilcoxon signed-rank test was used to study pairwise differences in PA and SB variables. In another set of twin analyses, pairwise differences were also studied among 40 twin pairs (27 DZ, 11 MZ pairs, 2 uncertain zygosity) discordant for daily steps. Discordance was defined as one twin belonging to the lowest step count tertile (in the whole sample) and their co-twin to the highest step count tertile. The exact symmetry test was used to assess differences between self-reported fitness categories.

**Table 2.** Explanatory Value ($R^2$) of Self-reported Fitness Alone and in the Multivariable Model Explaining Various Objectively Measured Physical Activity Variables

| | Model 1, $R^2$ for Self-reported Fitness† (%) | Model 2, Multivariable $R^{2‡}$ (%) |
|---|---|---|
| *Activity variable* | | |
| Steps | 18.5 | 26.1 |
| Running steps | 8.8 | 11.6 |
| Sit-to-stand transitions | 6.1 | 19.0 |
| Daily MET | 20.8 | 30.5 |
| Peak-10 min MET | 19.4 | 31.9 |
| No. > 10 min activity bouts | 12.8 | 20.5 |
| *Time spent in each activity level* | | |
| Lying | 4.2 | 6.4 |
| Sitting | 3.2 | 6.3 |
| Standing | 4.3 | 14.4 |
| Light activity | 4.7 | 8.2 |
| Moderate activity | 19.4 | 29.9 |
| Vigorous activity§ | 13.4 | 33.1 |
| SB | 8.8 | 13.9 |
| MVPA | 20.4 | 31.4 |

*Note:* MET = metabolic equivalent; MVPA = moderate-to-vigorous activity; SB = sedentary behavior.
†Model 1: basic regression analysis, cl (family), additional $R^2$ for self-reported fitness after age and sex adjustment. ‡Model 2: Multivariable model; activity variable + age, sex, body mass index, and disease, $R^2$ includes all the variables. §Based on 218 participants, who had vigorous activity.

## Results

In all of the 787 individuals for whom we had both the fitness and acceleration data, the accelerometers were worn for an average of 14.0 h/day (range = 11.0–20.1 h/day, *SD* = 1.2). An average 6,387 (range = 380–18,362, *SD* = 3,117) daily steps were taken and 31.8 (range = 0–91.4, *SD* = 15.1) sit-to-stand transitions were done per day. Participant characteristics broken down by self-rated fitness categories are shown in Table 1. Individuals who reported being the most fit had the lowest BMI, whereas the highest BMI values were present in those individuals with satisfactory fitness. Individuals with poor fitness reported having proportionally the highest number of diseases restricting their mobility. The recommended 10,000 daily steps for healthy adults to be classified as active (20) was achieved by 110 (14%) participants, the vast majority (97/110) belonged to one of the top two self-reported fitness categories (very good or fairly good).

Self-reported fitness explained moderately variation in different PA and SB variables (Table 2). Highest additional $R^2$ after age and sex adjustment was 20.8% for daily MET and 20.4% for MVPA. Similar moderate explanation values were observed for daily steps and moderate activity alone, whereas lower additional $R^2$ values were seen for SB variables. The multivariable model including self-reported fitness, age, sex, BMI, and disease explained variation most (>30%) for Peak-10 min MET, daily MET, MVPA, and vigorous activity whereas less than 10% of the variance in SB variables was accounted for by the same multivariable model variables (Table 2).

The differences between self-reported fitness categories and objectively measured PA varied according to the activity variable.

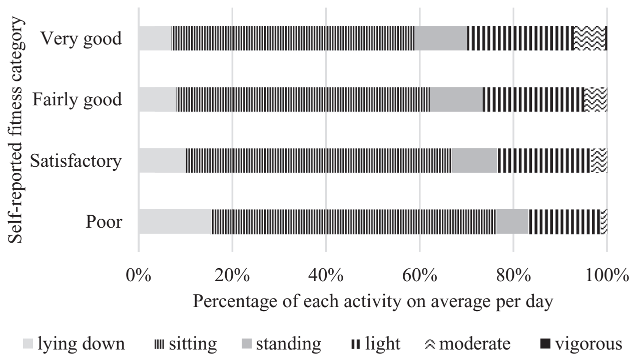


**Figure 1.** Average activity profile per day for each self-rated fitness categories.

Figure 1 shows the overall daily activity patterns broken down by the self-reported fitness categories. Most of the SB variables revealed only small differences between the fitness categories (Table 3). In the fully adjusted model (age, sex, BMI, and disease-restricting mobility), no group level differences were seen in lying down and only one between-group difference in sitting time (Very good vs Satisfactory) and in standing time (Fairly good vs Poor).

Differences were evident between the self-reported fitness categories and variables describing PA, as participants with better self-reported fitness were clearly more active. For example, participants with very good fitness took an average of 8,558 steps per day, whereas participants with fairly good (6,724), satisfactory (5,196), and poor (2,797) fitness took substantially fewer steps with significant differences ($p < .001$ between all categories). Significant differences between all self-reported fitness categories were also seen in moderate activity, MVPA, daily MET, Peak-10 min MET, and number of activity bouts longer than 10 minutes, all of these differences remained statistically significant even after adjustments (Table 3). Participants reporting very good fitness undertook some vigorous activity (3.3 min/day) whereas all other fitness groups did practically none (<1 min/day, $p < .001$). Those with poor fitness had significantly less sit-to-stand transitions and undertook less light activity compared to the other fitness groups even after adjustments. Figure 2 illustrates the differences in PA and SB between self-reported fitness groups separately for men and women.

Pairwise analysis of 156 twin pairs discordant for self-reported fitness showed statistically significant differences between all variables (steps, Peak-10 min MET, SB, light activity, and MVPA, $p < .05$) but standing ($p = .187$), Table 4. Similar significant differences were seen among DZ pairs whereas no significant differences were observed among MZ pairs. Similar results were seen when limited number of pairs (9 MZ pairs, 25 DZ pairs) were analyzed with larger discordance (difference ≥ 2 fitness categories). According to another set of discordant pairwise analyses including 40 pairs

**Table 3.** Associations Between Self-reported Fitness and Accelerometer Measured Physical Activity[†]

| | Very Good (1) | Fairly Good (2) | Satisfactory (3) | Poor (4) | | |
|---|---|---|---|---|---|---|
| | *n* = 127 | *n* = 389 | *n* = 236 | *n* = 35 | Sig. diff. between groups[‡,§] | Sig. diff. between groups[‡,‖] |
| *Activity Variable* | *Mean (SD)* | *Mean (SD)* | *Mean (SD)* | *Mean (SD)* | | |
| Steps | 8,558 (2,913) | 6,724 (2,937) | 5,196 (2,683) | 2,797 (1,742) | a–f | a–f |
| Running steps | 248 (564) | 74 (179) | 44 (87) | 33 (25) | a–e | a–c, e |
| Sit-to-stand transitions | 38.5 (11.7) | 37.6 (12.7) | 33.4 (15.4) | 23.0 (16.2) | b–f | c, e, f |
| Overall MET per day | 1.50 (0.15) | 1.40 (0.13) | 1.34 (0.13) | 1.22 (0.08) | a–f | a–f |
| Peak-10 min MET | 4.3 (1.18) | 3.7 (0.81) | 3.2 (0.75) | 2.7 (0.44) | a–f | a–f |
| No. bouts ≥ 10 min activity | 3.47 (1.6) | 2.78 (1.7) | 2.15 (1.6) | 1.17 (1.1) | a–f | a–f |
| *Time spent doing different activities* | *Mean h:min:sec (SD)* | *Mean h:min:sec (SD)* | *Mean h:min:sec (SD)* | *Mean h:min:sec (SD)* | | |
| Lying | 1:00:01 (0:50:41) | 1:07:57 (0:58:27) | 1:24:32 (1:07:17) | 2:08:10 (2:05:22) | b–e | — |
| Sitting | 7:20:33 (1:19:41) | 7:35:15 (1:30:12) | 7:58:26 (1:28:13) | 8:26:13 (2:04:17) | b–d | b |
| Standing | 1:34:28 (0:42:13) | 1:34:46 (0:44:01) | 1:20:36 (0:43:28) | 0:56:43 (0:45:35) | b–f | e |
| Light activity | 3:12:53 (0:57:07) | 3:01:33 (1:02:33 | 2:47:52 (1:03:42) | 2:08:13 (0:56:06) | b, c, e, f | c, e, f |
| Moderate activity | 0:57:29 (0:29:43) | 0:41:07 (0:24:21) | 0:28:52 (0:21:57) | 0:11:37 (0:08:59) | a–f | a–f |
| Vigorous activity | 0:03:27 (0:07:21) | 0:00:40,4 (0:03:12) | 0:00:13,2 (0:01:29) | 0:00:00,66 (0:00:02) | a–c, e, f | a–c |
| SB | 8:20:16 (1:24:22) | 8:41:38 (1:38:36) | 9:21:45 (1:39:10) | 10:33:29 (2:02:17) | b–f | b–e |
| MVPA | 1:00:55 (0:31:41) | 0:41:48 (0:24:56) | 0:29:06 (0:22:20) | 0:11:37 (0:08:59) | a–f | a–f |

*Note:* MET = metabolic equivalent; MVPA = moderate-to-vigorous activity; SB = sedentary behavior, *SD* = standard deviation.

[†]Mean (*SD*) calculated with bootstrapping based on 1,000 samples. [‡]Linear regression followed with Sidak's multiple comparisons test, significant difference ($p < 0.05$) between groups represented by the following letters; a = 1 vs 2, b = 1 vs 3, c = 1 vs 4, d = 2 vs 3, e = 2 vs 4, f = 3 vs 4. [§]Adjusted for age and sex. [‖]Adjusted for age, sex, body mass index and disease.

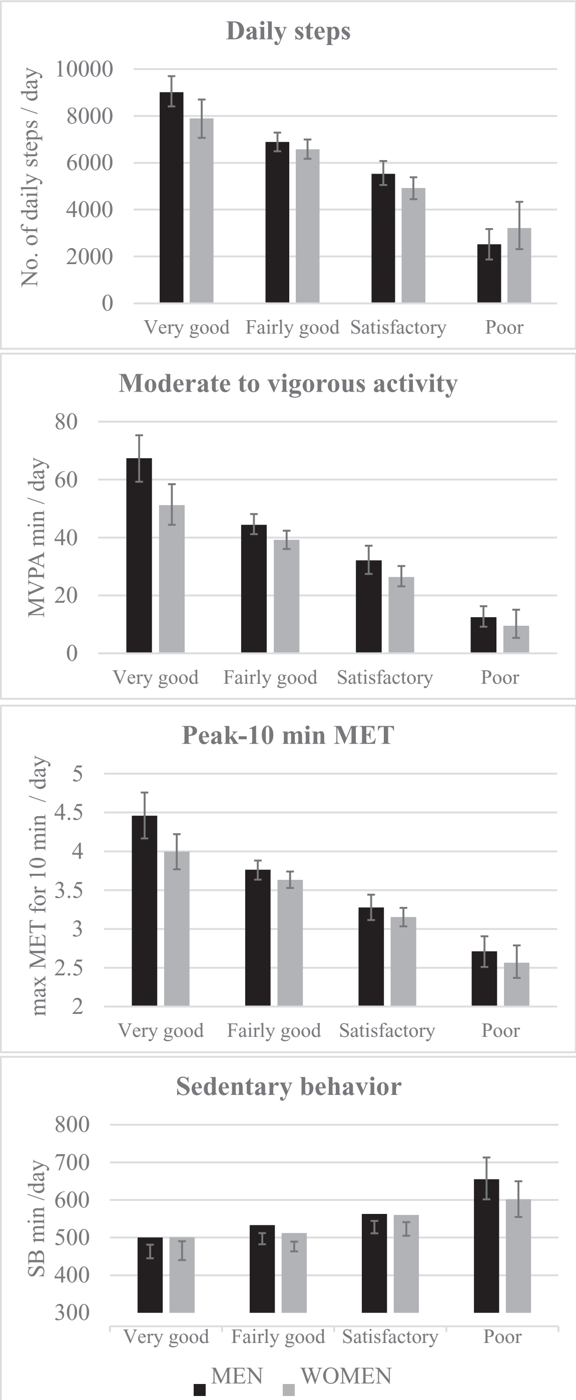


**Figure 2.** Different objectively measured activities according to the self-reported fitness categories separately for males and females. Bars and the error bars represent the unadjusted means and 95% CI of the means.

discordant for daily step, self-reported fitness was significantly better among co-twins who belonged to highest step count tertile ($p <$ .001). No significant differences were seen among 11 discordant MZ pairs ($p$ = .63).

## Discussion

This study showed that self-reported fitness is associated with objectively measured PA in adults in their early 70s. Self-reported fitness explained at its best about 20% of the variation in different objectively measured PA variables. Statistically significant differences between all self-reported fitness categories were seen in PA variables, whereas some SBs (lying and standing) did not differ between the different categories of self-reported fitness. The results suggest that an easily assessed self-reported fitness might be a relatively good indicator of habitual PA level in older adults whereas SB does not vary so much by fitness level. Furthermore the perceived fitness might be an important factor in determining whether older adults decide to participate in physical activities.

Several objectively measured activity variables (Daily MET, Peak-10 min MET, steps, number of 10 min bouts, and moderate activity) displayed the greatest differences according to self-reported fitness, as significant differences were seen between all fitness categories even after adjustments. In addition, participants reporting very good fitness undertook some vigorous activity whereas other groups did hardly any at all. All of these variables describe activities with high intensity and therefore they can be expected to be closely related to fitness. As significant differences were observed between all fitness categories, even between those belonging to very good and fairly good categories, the single question about fitness seems to indicate current actual fitness and PA level among older adults. Egerton and colleagues (21) found that self-reported fatigue was also associated with objectively measured PA. However, in that study cardiorespiratory fitness attenuated the association and fitness was found to be the key predictor for PA among community-living 70- to 77-year-old people.

Co-twins with better self-reported fitness were more active and had less SB compared to their co-twins with lower fitness level; however, this was not seen among MZ pairs even when the discordance was larger. Similar results were seen in the another set of twin analysis, as self-reported fitness was significantly better among co-twins who belonged to the highest step count tertile compared to their co-twin in the lowest tertile, again no difference was seen in this analysis of MZ pairs. This suggests that genetic factors explain some of the association between self-reported fitness and objectively measured PA, though the finding was in the same direction, but sample size was small in this second set of twin analysis. Also, it seems that twins from MZ pairs were less different from each other in these objectively measured PA and SB variables compared to twins in DZ pairs, as mean intrapair difference in most of the variables was significantly smaller among MZ pairs. This is shown by our additional discordance analyses (Supplementary Table 2). It is known that the heritability of PA (22) and cardiorespiratory fitness is at least moderate (23,24). In our recent article (16), we presented some genetic modeling on these objectively measured PA variables, and showed that the broad sense heritability is 0.41 (95% CI = 0.24–0.56) for SB, 0.60 (0.49–0.70) for MVPA, 0.48 (0.35–0.60) for steps, and 0.60 (0.45–0.73) for Peak-10 min MET, indicating that the fitness-related variables had more genetic influence than the sedentary and lower activity variables (16).

In this study, the only differences observed in vigorous activity between the fitness categories were between very good fitness and the other categories. Only about a quarter of the participants ($n$ = 218, 28%) achieved a vigorous activity level, which might be partly explained by the cut point used (6 MET) for vigorous activity. In the current study, these MET cutoff points were based on studies conducted in younger individuals and they might not reflect appropriate MET values for vigorous activity older adults. Evenson and colleagues (25) stated that the use of fixed cut points to determine MVPA seemed to be most problematic for older adults. Some older adults might not be able to undertake such vigorous activities (6

**Table 4.** Objectively Measured PA and SB in Twin Pairs Discordant for Self-reported Fitness

| | Mean time activity/day† (hours:minutes:seconds) median (IQR) (95% CI) | | |
|---|---|---|---|
| | Co-twins with higher self-reported fitness | Co-twins with lower self-reported fitness | Z and *p* value‡ |
| *Sedentary behavior time/day, h:min* | | | |
| All pairs ($n$ = 156) | 8:36 (2:12) (8:23–8:55) | 9:12 (2:17) (8:48–9:29) | Z = −3.17, $p$ = .002 |
| DZ pairs ($n$ = 90) | 8:42 (2:25) (7:59–9:05) | 9:21 (2:33) (8:47–9:48) | Z = −3.185, $p$ = .001 |
| MZ pairs ($n$ = 57) | 8:40 (1:53) 8:27–9:06) | 9:10:22 (1:46:45) (8:43–9:29) | Z = −0.683, $p$ = .494 |
| *Standing time/day, h:min* | | | |
| All pairs | 1:29 (1:02) (1:14–1:36) | 1:23 (1:02) (1:12–1:32) | Z = −1.320, $p$ = .187 |
| DZ pairs | 1:27 (1:08) (1:13–1:38) | 1:12 (1:08) (1:01–1:27) | Z = −2.102, $p$ = .036 |
| MZ pairs | 1:32 (0:57) (1:07–1:42) | 1:31 (0:50) (1:19–1:44) | Z = −0.624, $p$ = .533 |
| *Time of light physical activity/day, h:min* | | | |
| All pairs | 2:52 (1:09) (2:40–3:01) | 2:40 (1:20) (2:27–2:58) | Z = −2.350, $p$ = .019 |
| DZ pairs | 3:01 (1:16) (2:43–3:16) | 2:34 (1:22) (2:25–3:04) | Z = −3.261, $p$ = .001 |
| MZ pairs | 2:34 (0:55) (2:25–2:55) | 2:56 (1:18) (2:24–3:09) | Z = −0.282, $p$ = .778 |
| *Time of moderate-to-vigorous physical activity/day, h:min:sec* | | | |
| All pairs | 0:38:14 (0:35:54) (0:33:22–0:42:57) | 0:28:11 (0:32:12) (0:24:26–0:34:44) | Z = −4.093, $p$ < .001 |
| DZ pairs | 0:40:16 (0:40:57) (0:32:11–0:46:07) | 0:23:24 (0:34:01) (0:17:30–0:29:51) | Z = −4.140, $p$ < .001 |
| MZ pairs | 0:38:37 (0:29:53) (0:28:50–0:45:31) | 0:36:31 (0:28:30) (0:30:13–0:42:27) | Z = −0.973, $p$ = .330 |
| *Daily step count, number of steps* | | | |
| All pairs | 6,513 (3,943) (5,928–7,142) | 4,968 (3,676) (4,475–5,759) | Z = −4.611, $p$ < .001 |
| DZ pairs | 6,678 (4,142) (6,019–7,998) | 4,652 (3,049) (4,128–5,569) | Z = −4.589, $p$ < .001 |
| MZ pairs | 6,506 (3,909) (5,690–7,937) | 6,406 (4,284) (4,805–6,804) | Z = −1.053, $p$ = .292 |
| *Peak-10 min MET, MET* | | | |
| All pairs | 3.69 (1.31) (3.53–3.85) | 3.21 (1.06) (3.14–3.37) | Z = −4.423, $p$ < .001 |
| DZ pairs | 3.65 (1.24) (3.44–3.83) | 3.12 (0.94) (2.91–3.23) | Z = −4.243, $p$ < .001 |
| MZ pairs | 3.72 (1.29) (3.30–4.16) | 3.43 (0.99) (3.26–3.83) | Z = −1.212, $p$ = .226 |

*Note:* DZ = dizygotic; IQR = interquartile range; MET = metabolic equivalent; MZ = monozygotic.
†Descriptive analyses with bootstrapping (1,000 samples). ‡Z-score and $p$ by Wilcoxon matched-pairs signed-rank test.

METS and above) because of their declined maximal cardiorespiratory fitness (25). Furthermore, it might be more difficult for older adults to reach moderate and vigorous activities when activities are categorized as absolute intensities (26) as was seen in a recent study where older participants had lower total activity counts, as well as lower light, moderate, and vigorous activity minutes compared with younger participants when PA was measured as absolute intensity while they had more moderate and vigorous intensity minutes when PA was defined as relative intensity (27). Many older adults with low cardiorespiratory fitness might feel as if they are exercising vigorously, but they might not reach even a moderate activity level when the activity is assessed with accelerometers. On average, for adults aged 65–79 years, moderate-intensity activity perceived as "somewhat hard" corresponds to 3.2–4.7 METS, and vigorous-intensity activity perceived as "hard" corresponds to 4.8–6.7 METS (28). Therefore, the cut point for vigorous activity (6 MET) might have been too high for our population. So far there is currently no consensus on the optimal cutoff points for older adults.

The results showed that those participants who had poor fitness undertook significantly fewer light activities (MET level 1.5–3) and had fewer sit-to-stand transitions compared to those in the other fitness categories. No differences were observed between the other fitness categories. Light activities among older adults could pertain to household chores and self-care tasks, such as dressing (2.5 MET), washing dishes (1.8 MET), and cooking and food preparation (2.5 MET) (29). These results indicate that older adults who consider that they have poor fitness are not able to maintain for a long time the intensity level required for activities of daily living tasks, such as self-care activities or basic mobility related household activities (4,5). Even though the poor category has relatively few participants ($n$ = 35), the observation of significantly lower activity level in the poor fitness group clearly shows that the easily administered self-reported fitness question can be used to identify people with poor fitness and low levels of PA. Therefore, these individuals can be targeted with interventions and detailed examinations. However, self-reported fitness is not the only indicator of PA level among elderly individuals as 80% of the variation is explained by other factors; therefore, to increase PA level of people with low fitness could be achieved by many different ways.

The decreased time spent in PA among participants with poor fitness has been substituted with increased SB, both lying and sitting, although these were not all statistically significant when adjusted with BMI and disease. When one examines the mean times (Table 3), there were substantial differences in these activities between the least fit individuals and those with better fitness. For older adults with poor fitness, it might be important to address the issue of switching the activities from long-term sitting to interruptions of sitting, various light activities, and then further on to moderate activities. This could improve both their perceived fitness and actual fitness gradually so that they start to believe that they are capable of undertaking physically more demanding daily activities. Achieving slightly more activities and feeling more fit might be important in preventing and reducing frailty and improving perceived health among older adults.

### Strengths and Limitations

To the best of our knowledge, this is the first study that has examined the associations between self-reported fitness and objectively measured PA and SB in a twin study setting. Besides the twin-study setting, another major strength is the use of state-of-the-art and valid algorithms to determine a variety of PA and SB variables (17–19). Also, the total sample size was relatively large.

The main limitation is the cross-sectional design, preventing us from drawing conclusions about the direction of causality. Participants could have reduced their PA first due to some reason (eg, disease or injury) and this reduced activity might have caused them to feel unfit or vice versa. Feeling of being unfit due to any reason is likely inactivate people. Another limitation of the study is the known limitations of accelerometers, such as inability to measure exercise intensity correctly during cycling, swimming, and resistance training (30). However, most common type of exercise within this age group is walking; therefore, the results would not be affected very much by this limitation. Also, the lack of objective measurements of physical functioning and fitness are limitations.

## Conclusion

A single-item question on self-reported fitness is associated with daily activity profile among community-dwelling older people. Elderly individuals who perceive their fitness poor would likely benefit from being identified and from appropriate measures to improve factors accounting for their low mobility and inactivity.

## Supplementary Material

Supplementary data are available at *The Journals of Gerontology, Series A: Biological Sciences and Medical Sciences* online.

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## Conflict of Interest

None declared.

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