Physical Activity and Mortality in Frail, Community-Living Elderly Patients

Francesco Landi,1 Matteo Cesari,1,2 Graziano Onder,1,2 Fabrizia Lattanzio,3 Ester Manes Gravina,1 and Roberto Bernabei,1 on Behalf of the SilverNet-HC Study Group

1Department of Gerontology, Geriatrics and Physiatrics, Catholic University of the Sacred Heart, Rome, Italy. 
2Sticht Center on Aging, Wake Forest University–Baptist Medical Center, Winston–Salem, North Carolina. 
3Pfizer Italiana SpA, Rome, Italy.

Background. The authors describe the prevalence of moderate-intensity physical activity in a population of older persons living in the community. In addition, they explore the relationship between physical activity and mortality.

Methods. In this longitudinal observational study, the authors analyzed data from patients admitted to home care programs collected as part of the Italian Silver Network Home Care project. Twelve home health agencies participated in the project, which evaluated the implementation of the Minimum Data Set for Home Care (MDS-HC) instrument. A total of 2757 patients were enrolled in the current study. The primary outcome measures were the prevalence of 2 or more hours per week of physical activity and survival.

Results. Fewer than 20% of patients had regular physical activity. During a median follow-up period of 10 months from the initial MDS-HC assessment, 442 (16%) patients died. After adjusting for sex, physical and cognitive disability, and all potential risk factors for death, active patients were less likely to die compared with those with no or very low-intensity physical activity (relative risk ratio [RR], 0.51; 95% confidence interval [CI], 0.35–0.73). This inverse relationship was also significant in patients aged 80 years and older (RR 0.55; 95% CI, 0.32–0.95).

Conclusions. Physical activity is associated with a significantly lower risk of all-cause mortality. The current findings support the possibility that moderate-intensity physical activity has an independent effect on survival even among frail and old persons.

Exercise capacity and physical activity are associated with lower risks for all-cause mortality and with lower morbidity and mortality rates from cardiovascular diseases (1–5). Benefits of physical activity also include reductions in risks for stroke (6), diabetes mellitus (7), cancer (8), and osteoporosis (9). However, the relative contribution of moderate-intensity physical activity to reductions in the numbers of coronary events and deaths is still unclear. In fact, although some authors have found that only participation in vigorous physical activity or a high-intensity exercise program is associated with reductions in mortality risk (10,11), others have extended these benefits to moderate activities (12,13). Furthermore, some authors have shown that the type and level of physical activity performed as part of everyday activities can also be sufficient to achieve significant positive effects (3,5).

Maintaining or increasing physical activity in late middle age is reported to be associated with reduced mortality rates (4,13). However, few studies have explored the effects of home-based leisure physical activity across a broad spectrum of ages. In fact, most of the physical activity intervention studies have focused on a younger adult population (14). Furthermore, the best physical activity stimulus for obtaining appropriate health benefits among older persons has not been identified.

The aim of the current study was to explore the relationship between moderate-intensity physical activity and the risk for all-cause mortality in a large population of frail and very old persons living in the community.

METHODS

Study Population

Data were collected as part of a national home care program, the Silver Network Home Care project, under the sponsorship of the Italian Gerontology and Geriatrics Society, the Italian General Practitioners Society, and Pfizer Italy (15). The purpose of this project was to reorganize the care of frail older persons living in the community, adopting an integrated social and medical care program along a case management approach and using, as a screening and geriatric assessment tool, the Minimum Data Set for Home Care (MDS-HC) instrument (16).

This population-based, longitudinal, multilinked database consists of (a) data collected from the MDS-HC on more than 3000 patients in more than 12 home health agencies in Italy, (b) data on all the medications used by each patient at the time of the MDS-HC assessment (drugs were coded using the Anatomical Therapeutic and Chemical codes), and (c) data on vital status.

The study population consisted of all patients admitted to home care programs in 12 home health agencies from 1998 to 2000 who participated in the National Silver Network project (n = 3103). For the current analyses, we excluded 103 patients admitted to home care services with explicit diagnoses of terminal illness and 243 patients who were completely dependent in locomotion, assuming that these conditions are incompatible with any kind of physical activity. As a result, the final analysis sample consisted of 2757 patients.
All patients in the sample were assessed by trained staff (medical doctors and nurses) who collected data on the MDS-HC form according to the guidelines published in the MDS-HC manual (16), independent of the study protocol. The steering committee of the Catholic University and local state authorities approved and monitored the project. All patients provided written informed consent at baseline MDS-HC assessment authorizing the use of data for research purposes. In the case of cognitive impairment, the patient’s family gave informed consent. The characteristic of the specific components of the Silver Network Home Care database have been described in detail elsewhere (15) and are briefly summarized here.

**MDS-HC Assessment Data**

The MDS-HC (16) contains more than 350 data elements, including sociodemographic variables, many clinical items regarding both physical and cognitive status, and all clinical diagnoses. The MDS-HC also includes information about an extensive array of signs, symptoms, syndromes, and treatments provided (16). A variety of multiple-item summary scales are embedded in the MDS-HC measurements, such as physical function (activities of daily living and instrumental activities of daily living) (17) and cognitive status (cognitive performance scale) (17). The MDS items have excellent interrater and test–retest reliability when completed by nurses performing their usual assessment duties (average weighted Kappa = 0.8) (17,18). Furthermore, the MDS-HC has already paved the way to a representative database that proved a powerful tool for health researchers (19–21), even through the use of items concerning physical activity pattern (22).

**Physical Activity**

According to the recommendations of the MDS-HC manual (23), we used a single question about the average number of hours spent during a standard week in domestic activities, such as light housework, cleaning house, or gardening, or chosen physical activities, such as recreation, going out to shop or walk, or light exercise. This item of MDS-HC form (H6b) is coded as 0 if physical activities are equal to or greater than 2 hours and 1 if fewer than 2 hours. Assessing these activities in hours per week is in accordance with the recent American College of Sports Medicine guidelines that stated all recommendations in terms of units of time (24). Furthermore, for older persons, it is easy to think in terms of time devoted to physical activity rather than in terms of energy expenditure. The assessors were instructed to ask simple and direct questions about whether the patients participated in such physical activities. Because some patients had limitations in verbal communication, the assessors were also instructed to directly observe such persons and eventually to ask family members about the patient’s lifestyle.

**Survival Status**

General practitioners provided vital status, which was then confirmed by the National Death Registry. Time to death was calculated from the date of the first MDS-HC assessment to the date of death. All participants were followed for at least 12 months.

**Analytic Approach**

All demographic variables, measures of physical and cognitive function, and comorbid conditions were gathered at the initial MDS-HC assessment on admission to the home care program. Patients were divided into two groups based on the amount of physical activity: active (2 or more hours per week, \( n = 534 \)) or sedentary (fewer than 2 hours per week, \( n = 2223 \)).

We analyzed data first to obtain descriptive statistics. Continuous variables are presented as mean values ± standard deviation (SD). We evaluated trends of sociodemographic variables and indicators of disease severity using the Fisher exact test. We assessed differences between continuous variables using analysis of variance comparisons for normally distributed parameters; otherwise, the Kruskal–Wallis test was adopted. Statistical significance was set at \( p < .05 \).

We calculated time to death from the date of the first MDS-HC assessment to the date of death. We evaluated all events that occurred through December 2001, with a mean follow-up period of 10 months (range, 1–12 months). We performed Cox proportional hazard analyses, adjusted for age, sex, baseline comorbidity (cardiovascular diseases, pneumonia, cancer, stroke, diabetes, chronic obstructive pulmonary disease, renal failure, Parkinson’s disease, depression, delirium, arthritis), functional ability (as measured by MDS ADL score), and cognitive impairment (as measured by MDS cognitive performance scale score) to assess the relative risk for death. We derived hazard rate ratios (RRs) and corresponding 95% confidence intervals (CIs) from the final models. We also tested the effect of physical activity on survival and compared this information with the survival curves obtained using the Kaplan–Meier method. We evaluated differences between curves using the log-rank test. We performed all analyses using SPSS software (Chicago, IL).

**Results**

Table 1 shows the main characteristics of the study population. Patients were white and predominately female (59%), with a mean age of 78.2 ± 9.5 years. More than 45% of the participants were aged 80 years or older. Overall, patients had moderate to severe impairments in basic and instrumental activities of daily living; similarly, cognitive function was compromised in many of the patients (more than 35% showed a cognitive performance scale score more than 2, indicating moderate to severe cognitive impairment). Physical activity for 2 or more hours per week was recorded in 25% of patients younger than 70 years, 21% of those aged 70 to 80 years, and 16% of those 80 years and older (p for trend < .001).

During a mean follow-up of 10 months from the initial MDS-HC assessment, 442 (16%) patients died. The distribution of risk was uneven. After adjusting for sex, physical and cognitive disability, and all measured risk factors for death (cardiovascular diseases, pneumonia, cancer, stroke, diabetes, chronic obstructive pulmonary disease, renal failure, Parkinson’s disease, depression, delirium), active patients (physical activity for 2 or more...
Table 1. Descriptive Analysis of Baseline Sociodemographic, Functional, and Clinical Parameters According to Age*

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Total (N = 2757)</th>
<th>&lt;70 (N = 999)</th>
<th>70–80 (N = 1245)</th>
<th>&gt;80 (N = 513)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marital status</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married</td>
<td>1287 (47)</td>
<td>334 (67)</td>
<td>525 (52)</td>
<td>418 (34)</td>
</tr>
<tr>
<td>Widowed</td>
<td>1121 (41)</td>
<td>64 (12)</td>
<td>363 (37)</td>
<td>694 (56)</td>
</tr>
<tr>
<td>Never married</td>
<td>349 (12)</td>
<td>114 (21)</td>
<td>111 (11)</td>
<td>133 (10)</td>
</tr>
<tr>
<td>Living alone</td>
<td>513 (19)</td>
<td>52 (10)</td>
<td>190 (19)</td>
<td>271 (22)</td>
</tr>
<tr>
<td>ADL score (mean ± SD)</td>
<td>4.4 ± 2.7</td>
<td>3.9 ± 2.8</td>
<td>4.2 ± 2.8</td>
<td>4.9 ± 2.6</td>
</tr>
<tr>
<td>IADL score (mean ± SD)</td>
<td>4.8 ± 2.1</td>
<td>4.5 ± 2.1</td>
<td>4.8 ± 2.1</td>
<td>5.0 ± 2.0</td>
</tr>
<tr>
<td>CPS score (mean ± SD)</td>
<td>2.2 ± 2.1</td>
<td>1.5 ± 1.9</td>
<td>1.9 ± 2.0</td>
<td>2.7 ± 2.1</td>
</tr>
<tr>
<td>No. of diseases (mean ± SD)</td>
<td>3.6 ± 2.3</td>
<td>2.8 ± 1.8</td>
<td>3.6 ± 2.2</td>
<td>4.0 ± 2.4</td>
</tr>
<tr>
<td>No. of medications (mean ± SD)</td>
<td>3.8 ± 2.5</td>
<td>3.8 ± 2.6</td>
<td>3.8 ± 2.5</td>
<td>3.7 ± 2.5</td>
</tr>
<tr>
<td>Physical Activity†</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Active</td>
<td>533 (19)</td>
<td>127 (25)</td>
<td>213 (21)</td>
<td>193 (16)</td>
</tr>
<tr>
<td>Sedentary</td>
<td>2224 (81)</td>
<td>386 (75)</td>
<td>786 (79)</td>
<td>1052 (84)</td>
</tr>
</tbody>
</table>

Notes: *Data are given as number (percent) unless otherwise indicated.
†Physical activity: active (2 or more hours per week); sedentary (<2 hours per week).

ADL = activities of daily living (range 0–7, a higher number indicates higher impairment); IADL = instrumental activities of daily living (range 0–7, a higher number indicates higher impairment); CPS = cognitive performance scale (range 0–6, a higher number indicates higher impairment).

hours per week) were less likely to die compared with patients with no or very low levels of physical activity (RR 0.51; 95% CI, 0.35–0.73). This inverse relationship was still significant in the group of very old patients (Table 2). We also performed the analyses after eliminating patients who died in the first 90 days, to exclude those in whom underlying terminal illness was the cause of the inactivity and early mortality. Excluding these participants, the inverse association between physical activity and risk for death was still persistent for all age groups (patients younger than 70 years: RR 0.63; 95% CI, 0.29–1.33; patients aged 70 to 80 years: RR 0.61; 95% CI, 0.35–0.99). Figure 1 shows adjusted survival curves for the different age groups according to different levels of physical activity.

**Discussion**

The current study shows that moderate physical activity has an important prognostic influence for older patients living in the community, independent of age and other clinical and functional variables. Even after adjusting for several confounders, such as comorbidity and physical and cognitive impairment, mortality was reported more frequently in the participants with the lowest level of physical activity (fewer than 2 hours per week). Our data are consistent with previous studies that showed that persons who are more physically active have a reduced mortality risk compared with those who are less active (24–29). To our knowledge, ours is the first study to extend these findings to older men and women. Our results also suggest an inverse association between physical activities and mortality among frail and very old persons (those aged older than 80 years). Participants in the Framingham Study (27), the Lipid Research Clinics Trial (26), the Aerobic Center Longitudinal Studies (25), the Harvard Alumni studies (10), and the British Regional Heart Studies (4) were younger than those in our study.

The benefits of aerobic exercise, strength training, and vigorous physical activity have already been described and are well established (7,30–33). However, this type of heavy training usually is not a reasonable goal for older persons, especially for those who have comorbid conditions. Moderate physical activity, such as leisure-time activities (i.e., walking, gardening, housekeeping), is very beneficial for older persons, even those with functional limitations or health problems. Furthermore, these activities, which confer a substantial benefit in terms of longevity (34), are easily undertaken by the oldest age group and do not present substantial contraindications (35,36). Recent guidelines regarding physical activity from the Centers for Disease Control and Prevention and the American College of Sports Medicine recommend that every adult should participate in at least 30 minutes of moderate-intensity physical activity on most days of the week (24). It is important to emphasize that this recommendation closely corresponds to the categorization of our sample: active persons (more than 2 hours of physical activity per week) and sedentary persons (fewer than 2 hours per week).

Some limitations of our study should be noted. Physical inactivity makes an important contribution to chronic diseases such as coronary artery diseases, cerebrovascular accidents, obesity, diabetes mellitus, and arthritis. Conversely, severe and chronic diseases may be associated with low physical activity. Therefore, we cannot completely exclude that this reverse causation may play an important role in the relationship between low physical activity level and increased mortality risk observed in our sample. Reverse causation is particularly likely with diseases with...
a long natural history preceding death, such as chronic obstructive pulmonary disease, dementia, and arthritis (29). However, because of the use of MDS-HC, a multidimensional assessment instrument, our study was able to comprehensively investigate the different domains of elderly status influencing physical activity level and survival. For this reason and to permit an analysis accounting for the largest number of potential confounders, we incorporated in our model a whole series of variables, including comorbidity and measures of cognitive and functional status.

Another limitation of the current study is the lack of documentation of the duration of physical activity. For this reason, we cannot exclude that selective survivorship explains all or part of the results observed.

In addition, we did not distinguish between different types of physical activity. Although this warrants additional studies, we were interested in characterizing the effect of 2 or more hours of daily activities on mortality risk.

Finally, a more critical consideration is that our sample consisted of only patients considered eligible for home care programs, indicating that a health problem existed. Therefore, we cannot extend our results to all community-dwelling older persons.

Older persons are repeatedly told about the benefits of physical exercise. Encouraging older men and women to maintain or increase their physical activity can help them to lose weight, lower their blood pressure, improve their cholesterol levels, lower their blood sugar levels, and slow the effects of osteoporosis. All these positive effects help to maintain mobility, to prolong independence, and to reduce the risk of all-cause mortality. Unfortunately, despite the benefits of physical activity, practical advice is often lacking. It is noteworthy that in our Italian sample of older persons, fewer than 20% participate in regular moderate-intensity physical activity in their leisure hours.

**Conclusion**

Our results expand the knowledge that moderate physical activity performed as part of everyday activities can substantially benefit even frail and older persons. Vigorous exercises are not always required (37–39), whereas regular leisure activities, such as walking, gardening, or housekeeping, seem to be enough to confer considerable benefits. “Too frail” or “too old” are not really good reasons to limit or avoid moderate physical activity. Therefore, health educational authorities and health care organizations, together with primary care physicians, should encourage all older persons to be more physically active even during the extreme ages of life (40).

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Address correspondence to Francesco Landi, MD, Centro Medicina dell’Invecchiamento, Istituto di Medicina Interna e Geriatria, Università Cattolica del Sacro Cuore, Largo Agostino Gemelli 8, 00168 Rome, Italy. E-mail: francesco_landi@rm.unicatt.it

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