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REVIEW ARTICLE

# Association between physical activity and quality of life in the elderly: a systematic review, 2000-2012

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**Objective:** To review information regarding the association of physical activity (PA) with quality of life (QoL) in the elderly and to identify the study designs and measurement instruments most commonly used in its assessment, in the period 2000-2012.
**Methods:** Relevant articles were identified by a search of four electronic databases and cross-reference lists and by contact with the authors of the included manuscripts. Original studies on the association between PA and QoL in individuals aged 60 years or older were examined. The quality of studies as well as the direction and the consistency of the association between PA and QoL were evaluated.
**Results:** A total of 10,019 articles were identified as potentially relevant, but only 42 (0.42%) met the inclusion criteria and were retrieved and examined. Most studies demonstrated a positive association between PA and QoL in the elderly. PA had a consistent association with the following QoL domains: functional capacity; general QoL; autonomy; past, present and future activities; death and dying; intimacy; mental health; vitality; and psychological.
**Conclusion:** PA was positively and consistently associated with some QoL domains among older individuals, supporting the notion that promoting PA in the elderly may have an impact beyond physical health. However, the associations between PA and other QoL domains were moderate to inconsistent and require further investigation.

**Keywords:** Quality of life; motor activity; elderly; aged; physical activities

## Introduction

As the size of the elderly population continues to increase, health maintenance and physical independence in this population have become widely discussed topics in the literature. An important component in determining the health status of an individual, especially during the aging process, is quality of life (QoL). However, concepts of QoL are very widespread and diverse.

Most definitions of QoL involve domains such as functional ability, socioeconomic status, emotional state, intellectual activity, cultural and ethical values, religiosity, health, living environment, and daily activities.[1-4] From this perspective, QoL in the elderly consists of physical, psychological, social, cultural, mental, and spiritual domains.[5]

QoL can also be divided into general QoL (QoL) or health-related QoL (HRQoL). The former is based on a broad definition that encompasses a sense of well-being and happiness, without reference to health problems or disorders. HRQoL, on the other hand, is part of a multidimensional approach that considers physical, mental, and social-related symptoms, as well as limitations that are caused by illness.[6]

According to the World Health Organization (WHO), participation in physical activity (PA) may play a key role in healthy aging and thus in promoting good QoL.[7] Previous studies have suggested that elderly patients with adequate PA levels live healthier lives and are at lower risk for cardiovascular disease.[8-10] Additionally, PA has positive effects on psychological,[11] physical,[12,13] and emotional[14] well-being. However, there is still a need for studies on the benefits of PA for domains of well-being and QoL.

Several reviews have been conducted to synthesize information regarding the relationship between PA and domains of mental health and QoL.[15-18] Some of these reviews have suggested an association between PA and QoL.[15-17] However, the results appear to be dependent on the instruments used to measure PA and QoL, as well as on the type of study design (i.e., most studies use cross-sectional designs). Additionally, many studies do not restrict their research to the elderly, making it difficult to assess the extent of the relationship between PA and QoL for this specific population. Finally, these reviews do not identify the consistency or direction of the association

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of PA with different domains of QoL in the elderly. Thus, it is important to conduct a review to systematize information regarding the association between PA and QoL domains specifically in the elderly.

Understanding the way in which PA influences general and specific domains of QoL is an important factor for promoting health in the elderly. A review of the association between PA and QoL in the elderly will also identify gaps in the literature and allow for the development of new research on QoL in this population. With these factors in mind, the present study aims to systematically review information regarding the association of PA with specific domains of QoL in the elderly and to identify the study designs and measurement instruments most commonly used for the assessment of PA and QoL in the elderly in the literature published between 2000 and 2012.

## Methods

### *Search strategy*

Relevant articles for this review were identified by searching four electronic databases: MEDLINE/PubMed, SPORTDiscus, SciELO, and LILACS. The search was limited to articles that were published between 2000 and 2012, in Portuguese, English, or Spanish. Keywords that characterized components of PA (physical activity, exercise, motor activity, functional capacity, and functionality) and the population of interest (elder, senior, elderly, older adults, and aged) were used in combination with the keyword for QoL (quality of life). Queries were performed in English and Portuguese. Keywords were combined using the Boolean operators ''AND'' and ''OR.'' We decided not to include theses, dissertations, or monographs, as conducting a systematic search of these would be logistically unfeasible.

The search was initially conducted in 2010 and updated on November 20, 2012. All of the selection processes and article evaluations were conducted in pairs (GCV, VCBF), and if there was disagreement between reviewers on the inclusion and exclusion criteria, the article in question was specifically discussed until a final consensus was reached. An initial analysis was performed on the basis of the titles of the manuscripts, and a second evaluation was carried out on the basis of the abstracts of all articles that met the inclusion criteria or could not be clearly ruled out. After examining the abstracts, all of the selected articles were retrieved and subsequently examined using the established inclusion criteria. A manual search of the reference lists of selected articles was also performed, and the principal authors of the manuscripts were contacted to identify other publications that met the inclusion criteria.

### *Inclusion and exclusion criteria*

The following inclusion criteria were considered: i) original articles published in peer-reviewed journals that aimed to test for an association between PA and domains of QoL; ii) studies published between January 2000 and November 2012; iii) samples with individuals aged 60 years or older or samples with a mean age in this age group. Intervention, cross-sectional, and longitudinal studies were considered in this review. However, we chose to restrict the review to intervention studies that had a sample size equal to or greater than 50 individuals and cross-sectional/longitudinal studies that had a sample size equal to or greater than 100 individuals. This approach has been adopted in previous systematic reviews[19,20] with the aim of obtaining greater statistical power for detecting associations between variables and higher reliability in the interpretation of findings.

Several indicators of PA in elderly patients were included: self-administered scales for PA participation and electronic devices that objectively evaluated PA (e.g., accelerometers, pedometers, and heart rate monitors). Due to the direct relationship between PA and physical fitness, objective measures of physical or functional fitness (e.g., treadmill test) were also considered to be indicators of PA.

For QoL assessment, we decided that the search for studies should not be limited to those that used a generic instrument to assess QoL (e.g., WHOQoL-100 or SF-36), as this could exclude important intervention and cohort studies that examine the association between PA and domains of QoL. Therefore, we included studies that utilized self-reported QoL questionnaires, inventories, and well-being scales which contained QoL or HRQoL domains (well-being, life satisfaction, self-rated health) and the specific domains that comprise QoL or HRQoL (physical, psychological, social, cultural, mental, and spiritual domains).[1-5]

### *Quality assessment*

Two independent reviewers (GCV, VCBF) evaluated the quality of the intervention studies using the Downs & Black checklist.[21] This spreadsheet contains 27 items that assess information quality, internal validity (biases and confounders), study power, and external validity. Due to the difficulties in evaluating the quality of cross-sectional and observational articles, we decided to use the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE)[22] checklist to evaluate the quality of articles with these designs. This checklist consists of 22 items and contains recommendations about what should be included for a more accurate and complete description of observational studies. All of the questions were coded as zero (representing poor quality) or one (representing adequate quality). Study quality scores could range from zero to 27 points in intervention studies and from zero to 22 points in cross-sectional and cohort studies; on both scales, the higher the score, the better the methodological quality of the study. In the event of differences in article evaluations between the two reviewers, the article was reassessed until they reached an agreement. The studies were classified into three groups according to their methodological quality. For this purpose, each study score was compared to the maximum score of the STROBE (22 points) or Downs &

Black (27 points) checklists. This strategy was used to stratify studies as being of high quality ($\geqslant$ 70% total score), moderate quality (50-69% total score), or low quality ($<$ 50% total score).[23] The instruments used to assess PA and QoL in the studies included in the review are described in Box 1.

*Consistency and direction of the association between PA and QoL*

An evaluation was performed to determine the consistency of the association between PA and domains related to QoL in the reviewed studies. Consistency was defined as the proportion of studies that displayed a positive association between PA measures and QoL measures. This strategy derived a classification of the PA-QoL associations into three groups: consistent ($\geqslant$ 60%); moderate (30-59%); and inconsistent ($\leqslant$ 30% of studies with positive associations). This classification has previously been used elsewhere.[23] The percentage of studies indicating a significant association between PA and QoL was calculated for the three types of study designs (intervention, longitudinal, and cross-sectional). For longitudinal and intervention studies, however, only the percentage was analyzed to determine the consistency of the association between PA and QoL. The direction of the association between PA and QoL domains was classified as positive, zero, or negative (Table 1).

Table 1 had the purpose to identify the association between PA and QoL domains, independently of the instrument used to assess QoL. Domains with similar contents were grouped into the same class, as follows: functional capacity: physical limitation,[39] functional fitness[35]; social relationships: social functioning,[34,42,44,47,54,61,64] social engagement,[53] social support,[32] social participation[29,56,60,62]; and, physical: physical functioning,[33,34,37,44,49,54,59,61] physical health,[46] physical role.[54,61]

*Data extraction*

The following data were extracted from each of the included studies: study site, country, type and size of the sample, age of participants, application mode for the PA and QoL measurement instruments, adjustment variables, and main results. The articles were arranged chronologically based on the year of publication and according to the methodological design that was used (intervention, longitudinal, or cross-sectional) (Figure 1). To evaluate the effect size for the QoL outcomes of each PA intervention, Cohen's f was calculated using G* Power statistical software version 3.1.2 (Franz Faul, Universitat Kiel, Germany).

## Results

The detailed characteristics and main results of the studies reviewed are shown in a Supplementary Table online. A total of 10,019 articles were identified as potentially relevant to this review. After analysis of titles, 1,048 studies were selected for the abstract reading process. Ninety-four studies were considered to be relevant after the abstract reading and were thus selected for a full-text reading. Two additional studies[24,42] were included from the references of the selected articles; thus, 96 studies were considered relevant for this review. Of these, 54 studies (56.25%) were excluded because they did not meet the eligibility criteria: 23 (42.55%) did not address the association between PA and QoL variables, five (9.22%) did not present QoL as an outcome, and 26 (48.23%) had a sample of less than 100 individuals (in the case of cross-sectional studies) or less than 50 individuals (in the case of intervention studies). Therefore, the electronic search generated 42 studies (43.75%) deemed relevant for this systematic review.

*Quality of studies*

None of the studies achieved a maximum score (27 points) on the Downs & Black checklist;[21] the scores of intervention studies ranged from 18 points[2,25,29,40,54,58] to 22 points.[32,33,34,53] Using the STROBE checklist,[22] only three of the studies[32-34,53] achieved a maximum score of 22 points, and six studies[2,25,29,40,54,58] obtained the minimum score (18 points). Based on the proposed cutoff points,[23] 95.24% of the studies were classified as high-quality, and only two studies (4.76%) as being of medium quality.[25,29]

*General characteristics of the studies*

Eleven intervention studies and 31 observational studies were included. Twenty-seven of the observational studies were cross-sectional, and four were prospective cohorts.

With the exception of three studies (7.14%),[39,41,45] the included studies had a sample that was composed exclusively of the elderly (60 years or older). Most studies (73.81%) included participants of both sexes, and 11 studies (26.19%)[2,25,27,33,35,36,40,46,54,56,62] only included women. The majority of studies included healthy, elderly individuals who were living independently (92.86%), while others included institutionalized elderly subjects (7.14%)[30,47,57] or elderly subjects with health problems. These health problems included dizziness (2.38%),[51] depression (2.38%),[57] hypertension (2.38%),[45] cancer (9.52%),[28,33,49,59] and osteoarthritis (2.38%).[58]

*Evaluation of PA and QoL*

In 29 studies (69.04%), the estimate of PA participation was obtained through self-reporting methods. In these studies, the International Physical Activity Questionnaire (IPAQ)[2,54,56,58,60,62,63] and Physical Activity Scale for the Elderly (PASE)[35,36,38,46,55] were the most frequently used instruments (24.13 and 17.24%, respectively) for estimating PA participation. Three studies (10.34%)[35,36,50] used a test battery of functional fitness, and two studies (6.89%)[43,48] used functional capacity self-assessment

**Box 1** Instruments used to assess physical activity and quality of life in the studies included in the review (instruments listed by acronym; see full names in a footnote to the Supplementary Table online)

*Physical activity*

- Accelerometer: measures minutes and counts per day in moderate and vigorous physical activity.
- Andersen's behavioral model: in this model, contextual and individual characteristics are conceptualized as factors that impede or enhance the individual's health behaviors, most notably health care utilization and subsequent other outcomes related to health and satisfaction.
- Barthel Index: evaluates the functional potential of the individual, assessing the degree of assistance required in 10 independent activities, such as feeding, personal hygiene, dressing, bladder and bowel control, walking, climbing stairs, and transferring from wheelchair to bed.
- CHAMPS: assesses weekly frequency and duration of various physical activities typically undertaken by older people.
- ECOG scale: a scale that ranges from 0 (able to perform physical activity without restriction) to 4 (completely unable to perform physical activity, confined to bed or wheelchair).
- FES-I: composed of 10 items rated on a Likert scale (1 = no concern, 4 = very concerned) to estimate the level of concern about falling during physical activity and social events within and outside the home in the elderly.
- GLTEQ: an instrument of habitual physical activity during the last 7 days. It includes three items measuring the frequency of light, moderate, and vigorous physical activity.
- HAP: Brazilian version consisting of 94 items addressing participation in physical activity, which can be categorized according to the International Classification of Functioning, Disability and Health.
- IPAQ: composed of items related to frequency and duration of physical activity at different intensities (light, moderate, vigorous), in periods of at least 10 minutes in habitual week days.
- Johnson Space Center physical activity scale: composed of a Likert scale on participation in physical activity in the last month, ranging from 0 (avoid physical activity) to 7 (participates in vigorous physical activity regularly, for 3 or more hours/week). Considered active when reporting scores 3 or higher on the Likert scale.
- LL-FDI: composed of items scored on a Likert scale (1 = not, 5 = no limitations) to assess functional limitations in older adults.
- PASE: 10 items designed to assess frequency and duration of physical activity in the elderly, in areas such as leisure, family, and professional activity.
- Pedometer: analyzes the number of steps per day.
- PSW: composed of five items scored on a Likert scale (1 = strongly disagree, 7 = strongly agree) to assess the overall judgment of the individual's life satisfaction.
- Exercise Self-Efficacy Scale: measures an individual's belief in his or her ability to perform physical activity three times per week, at moderate intensity, for 40 min or more. For each item, participants indicate their confidence in completing the physical activity, ranging from 0% (no confidence) to 100% (highly reliable).
- Questionnaire developed to assess physical activity for the BRFSS: six questions on participation in moderate/vigorous physical activity in a typical week.
- Self-Efficacy for Walking Scale: investigates the individual's belief in his or her physical ability to successfully complete a given distance in 4 minutes. For each item, participants indicate their confidence in performing the behavior on a percentage scale ranging from 0% (no confidence) to 100% (highly confident).
- The Activity-Specific Balance Confidence Scale: assesses the individual's confidence in performing various daily activities without compromising their balance.
- The Older American Resources and Services Scale: composed of 14 daily activities and work. The subjects were grouped into four categories: independent (maximum score on the physical activity scale), lightly dependent (to perform one to three activities), moderately dependent (to perform four to six activities), and severely dependent (to perform seven or more physical activity).
- YPAS: list of work and recreational physical activity performed during a habitual week.

*Quality of life*

- EORTC-QLQ-C30: measures physical, role, emotional, social and cognitive functioning, as well as global quality of life and three symptom types: fatigue, pain, and nausea/vomiting.
- GDS: used to identify symptoms of depression in the elderly. Respondents may be classified as ''normal'' (0-9 points), ''mildly depressed'' (10-19 points), or ''severely depressed'' (20-30 points).
- HRQL: questionnaire consisting of 12 domains that cover a range of psychological and physical functions: functional status, vitality, social function, physical pain, emotions, general health, and mental health.
- IADL: composed of eight items to assess independent living skills and aspects of quality of life related to physical

function. Scores range from 0 (low function, dependent) to 8 (high function, independent) for women, and 0 to 5 for men. This instrument is intended to be used among non-institutionalized elderly.
- LGC questionnaire: a subscale of a previously validated questionnaire consisting of nine items that seek to evaluate factors related to quality of life in the elderly, especially well-being and social engagement.
- MOS: composed of 116 items that assess structural social support (social network), functional support, and physical, mental, and general health. It consists of seven components of health-related quality of life (physical functioning, pain, emotional well-being, energy/fatigue, sleep problems, sense of mastery, and self-esteem).
- MUNSH: comprises 24 items designed to evaluate "happiness" in the elderly. This instrument consists of four subscales: positive affect (PA), negative affect (NA), positive experiences (EP), and negative experiences (EN). The total score is obtained by the formula (PA - NA) + (EP - EN), and ranges from 0 to 48 points.
- NPI: composed of 12 neuropsychiatric symptoms (for example, delusions, hallucinations, agitation/depression, and aggression), with scores ranging from 0 to 144 points. Higher scores indicate greater behavioral problems and poorer quality of life.
- PGC morale scale: designed to measure the dimensions of emotional adjustments in people aged 70 to 90, providing an assessment of psychological well-being of older people.
- Physical Self-Perception Profile: developed for self-perceptions related to a "physique" based on a hierarchical model. In this model, global self-esteem is at the peak of the physical hierarchy, self-esteem and competence as a field of sports, physical strength and condition as subdomains.
- Questionnaire developed for the BRFSS to assess quality of life: composed of four questions related to number of days during the 30 days preceding the study, in which the individual did not have a good health status (general, physical, and mental).
- SF-12: a version of the SF-36 with a small number of items (only 12) that can be grouped into two components (physical and mental health).
- SF-36: a shortened version of the MOS questionnaire comprising 36 items covering eight components (domains): functional capacity, physical aspects, pain, general health, vitality, social, emotional aspects, mental health.
- SWLS: composed of five items that seek to estimate overall life satisfaction.
- TMIG-IC: this scale, comprising 13 items, enables estimation of the competence of elderly individuals to perform everyday physical activity, with scores ranging from 0 to 13 points.
- World Health Organization Quality of Life instruments (WHOQoL-100, WHOQoL-Bref, and WHOQoL-Old): developed by the WHO. The WHOQoL-100 consists of 100 questions that assess six domains: physical, psychological, level of independence, social relationships, environment and spirituality/personal beliefs, and global quality of life. The WHOQoL-Bref is an abbreviated version, comprising 26 questions, that evaluates only the physical, psychological, social relationships and environment, and overall quality of life domains. The WHOQoL-Old consists of 24 items assigned to six domains and overall quality of life, specifically for the elderly: operation of consciousness; autonomy; past, present, and future activities; social participation; death and dying; and intimacy.

scales. Four studies (9.52%)[26,31,37,47] used a direct measure of PA (accelerometer and/or pedometer).

The most widely used questionnaire to assess QoL was the Short Form-36 (SF-36) (33.33%),[27,28,33,37,40,42,44,47,49,54,57,58,61,64] followed by the World Health Organization Quality of Life Assessment – Abbreviated Version (WHOQoL-Bref) (19.04%),[2,26,43,48,50,52,63,64] the Short Form-12 (SF-12) (7.14%),[36,46,51] the World Health Organization Quality of Life Assessment – Module for Older Adults (WHOQoL-Old) (9.52%),[29,56,60,62] the Satisfaction with Life Scale (SWLS) (7.14%),[36,46,55] a questionnaire developed for the Behavioral Risk Factor Surveillance System (BRFSS) (7.14%),[39,41,45] and the World Health Organization Quality of Life 100 (WHOQoL-100)(4.76%).[25,32] The following instruments were used in one (2.38%) study each: Medical Outcomes Study (MOS),[24] Neuropsychiatric Inventory (NPI),[30] Instrumental Activities of Daily Living Scale (IADL),[31] Lund Gerontology Centre Life Quality Questionnaire (LGC),[53] European Organization for Research and Treatment of Cancer Quality of Life questionnaire, version C30 (EORTC-QLQ-C30),[59] and Health-Related Quality of Life Questionnaire (HRQL).[34] Due to the variability of PA and QoL assessment tools, a meta-analysis could not be performed.

*Characteristics of the intervention studies*

Of the intervention studies, three (27.27%)[25,29,32] were conducted in Brazil, and the rest in the following countries: United States (9.1%),[24] England (9.1%),[26] the Netherlands (9.1%),[27] Australia (9.1%),[28] France (9.1%),[30] Japan (9.1%),[31] Canada (9.1%),[33] and Iceland (9.1%).[34]

The duration of the 11 intervention studies ranged from 3[29] to 12[24,26,31,33] months, but only six of these studies were randomized. The duration of each PA session ranged from 30[30] to 90 minutes,[31] and the weekly frequency (number of sessions) ranged from one[31] to five[33] sessions per week.

Twelve different exercise programs were employed in the analyzed intervention studies. Five studies (45.45%)[24,26,29,31,32] used programs focused on muscle strength, three (27.27%)[27,29,34] used programs focused on muscle endurance exercises, and four (36.36%)[24,26,31,33] focused on aerobic endurance exercises. Four studies

**Table 1** Summary of the association of PA and different aspects of QoL

| QoL domains | Total no. of articles (C/L/I) | No. of studies (L/I) | Direction of association with PA (numbers are the study reference number) | | | | | | | Consistency of the association with PA | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | + | | | 0 | | | - | | | |
| | | | C | L | I | C | L | I | C | % total | % studies L/I | Classification* |
| Physical | 28 | 2/7 | 25,[†] 44, 45, 46, 47, 48, 2, 49, 51, 52, 53, 55, 50, 36, 56, 58, 59, 61 | 34, 38 | 28, 27, 35, 33 | 25 | - | 42, 26, 28 | | 85.71 | 55.6 | Moderate |
| Mental health | 14 | 2/1 | 40, 43, 25*, 46, 47, 48, 52, 55, 56, 30 | 38, 37 | - | 45 | - | 28 | | 86.6 | 75.0 | Consistent |
| Social relations | 22 | 1/4 | 25*, 45, 49, 30, 54, 55, 57, 44, 63, 64, 59, 60, 61, 62 | - | 32, 34 | 2, 51, 53 | 38 | 26, 28 | | 72.7 | 40.0 | Moderate |
| Functional capacity | 12 | 1/4 | 25, 45, 48, 55, 57, 36, 58 | 36 | 28, 29, 30, 35 | - | - | - | | 100 | 100 | Consistent |
| Psychological | 11 | 0/5 | 2, 49, 44, 63 | - | 27, 31, 32 | 51, 53 | - | 42, 26 | | 63.6 | 60.0 | Consistent |
| Emotional | 12 | 2/2 | 54, 55, 64, 61 | 39 | 42 | 25,[‡] 45, 54, 36 | 38 | 28 | | 50.0 | 50.0 | Moderate |
| General QoL | 14 | 2/4 | 41, 49, 57, 47, 60, 59 | 38, 39 | 27, 30, 32, 34 | 44, 2 | - | - | | 85.7 | 100 | Consistent |
| Environment | 7 | 0/2 | 49, 44 | - | 27 | 2, 51, 53 | - | 26 | | 42.8 | 50.0 | Moderate |
| Vitality | 10 | 1/3 | 25, 48, 55, 36, 45, 61 | 38 | 33, 34 | - | - | 28 | | 90.0 | 75.0 | Consistent |
| Overall health | 7 | 0/2 | 25, 55, 36, 61 | - | 33 | 45 | - | 28 | | 71.4 | 50.0 | Moderate |
| Pain | 6 | 0/2 | 45, 55, 61 | - | 33 | - | - | 28 | 48[§] | 66.6 | 50.0 | Moderate |
| Autonomy | 3 | 0/1 | 57, 60 | - | 30 | - | - | - | | 100 | 100 | Consistent |
| Past, present, and future activities | 3 | 0/1 | 57, 62 | - | 30 | - | - | - | | 100 | 100 | Consistent |
| Death and dying | 2 | 0/1 | - | - | 30 | 57 | - | - | | 50.0 | 100 | Consistent |
| Intimacy | 3 | 0/1 | 57, 60 | - | 30 | - | - | - | | 100 | 100 | Consistent |
| Sensory ability | 3 | 0/1 | 57, 60 | - | - | - | - | 30 | | 66.7 | 0.0 | Inconsistent |

C = cross-sectional studies; I = intervention studies; L = longitudinal studies; PA = physical activity; QoL = quality of life.
* Classification previously adopted, considering only the percentage of longitudinal and intervention studies (Strong et al.[24])
[†] Guallar-Castillón et al.,[42] only in men.
[‡] Guallar-Castillón et al.,[42] in light PA.
[§] Lobo et al.[47]: higher pain scores reflect lower QoL; therefore, this was also considered in estimating the consistency of association between PA and QoL.
Studies that sought to identify a common specific QoL domain, independently of the instrument used to assess QoL, were grouped into the same class of the evidence summary, as follows: functional capacity: physical limitation,[39] functional fitness[35]; social relationships: social functioning,[34,42,44,47,54,61,64] social engagement,[53] social support,[32] social participation[29,56,60,62]; and physical: physical functioning,[33,34,37,44,49,54,59,61] physical health,[46] physical role.[54,61]

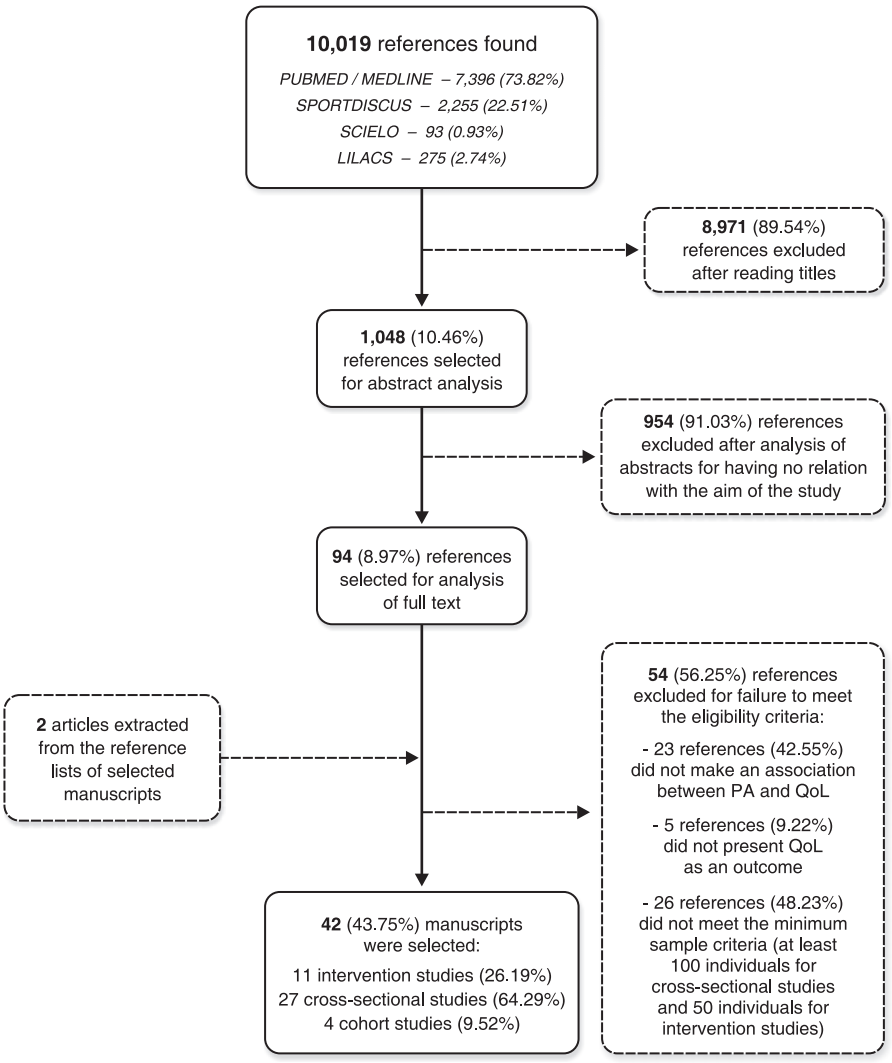


**Figure 1** Flowchart of study search and selection. PA = physical activity; QoL = quality of life.

(36.36%)[24-26,31] focused on exercises for developing flexibility, and two (18.18%)[30,31] used a program focused on the development of body awareness.

The majority of the intervention studies (81.81%)[22,26-31,33,34] employed programs based on moderate-to-vigorous PA. Only one study (9.09%)[25] developed an intervention program consisting of low-intensity PA.

Four intervention studies (36.36%)[28,30,33,34] used statistical approaches that allowed for the inclusion of possible confounding variables. The most commonly used variables were age, gender, and number of comorbidities/diseases.

Regarding the effect size, the intervention studies showed values between 0.14[25] and 0.70[27] in the physical domain, 0.02[25] and 0.27[25] in the psychological domain, 0.20[33] and 1.06[27] in the bodily pain domain, 0.09[34] and 0.63[29] in the social domain, 0.18[25] and 0.20[25] in the environmental domain, 0.18[34] and 0.22[33] in vitality, 0.41[29] and 0.60[29] in autonomy, 0.11[25] and 0.25[25] in spiritual, 0.36[29] and 0.45[29] in intimacy, 0.36[29] and 0.77[29] in past, present, and future activities, and, finally, 0.56[29] and 1.13[29] in the general QoL domain.

### *Characteristics of the longitudinal (cohort) studies*

Of the four longitudinal studies, three (75%)[35,36,38] were conducted in the U.S. and one (25%)[37] in Japan. Of these studies, one (25%)[37] had subjects who were followed for 1 year, two (50%)[35,36] for 2 years, and one (25%)[38] for 5 years. Only one study (25%)[37] used a direct measure of PA (pedometers), while the rest used the PASE.[35,36,38] Three studies (75%)[35,36,38] used self-efficacy as a mediating variable between PA and QoL.

All longitudinal studies[35-38] used the covariance model for data analysis, but one study (25%)[37] also used linear regression. Three studies (75%)[35-37] included confounding variables into the model. The most commonly used variables were age, race, education level, and chronic health conditions.

*Characteristics of cross-sectional studies*

Of the 27 cross-sectional studies, 11 (40.74%)[2,48,50,52,54,56,58,60-63] were conducted in Brazil, eight (29.63%)[39,41,44-46,49,55,64] in the U.S., two (7.40%)[51,53] in Sweden, two (7.40%)[42,57] in Spain, and one (3.70%) each in China,[43] Portugal,[47] England,[59] and Australia.[40]

Of these 27 studies, only one (3.70%)[47] used a direct measure of PA (accelerometer). Five (18.52%)[40,42,51,53,61] used a questionnaire developed for the study itself, seven (25.92%)[2,54,56,58,60,62,63] used the IPAQ, three (11.11%)[39,41,45] used the questionnaire developed for the BRFSS, and 11 (40.74%) used other instruments. To evaluate QoL, the majority of the studies (37.04%)[40,42,44,47,49,54,57,58,61,64] used the SF-36. Five studies (25.92%)[2,43,48,50,52,63,64] used the WHOQoL-Bref, three (11.11%)[39,41,45] used the BRFSS scale, three others (11.11%)[56,60,62] used the WHOQoL-Old, two (7.40%)[46,51] used the SF-12, and three (11.11%)[53,55,59] used other instruments.

The majority of the studies (59.26%)[2,37,39,40,42,43,45,51,53,56,58,59,61-64] used regression analysis. Six studies (22.22%)[47,48,50,52,54,57] used analysis of variance, and five (18.55%),[44,46,49,55,60] analysis of covariance. Sixteen studies (59.26%)[39,41,42,44,45,49,51-53,55,59-64] used statistical approaches that allowed for the inclusion of possible confounding variables. The most commonly used variables were age, race/ethnicity, gender, educational level, and health problems.

*Summary of evidence for the association between PA and QoL*

Table 1 summarizes the main results regarding the association between PA and QoL domains. Different instruments were used to obtain QoL scores, which resulted in a wide variety of QoL domains being evaluated in the studies included in this review. The most commonly evaluated domains were physical health, mental health, functional capacity, psychological, emotional, social relationships, environment, pain, overall health, general QoL, and vitality.

The consistency of the associations was assessed in longitudinal and intervention studies. The results of this review showed a consistent and positive association between PA and the functional capacity (100%), general QoL (100%), autonomy (100%), past, present, and future activities (100%), death and dying (100%), intimacy (100%), mental health (75%), vitality (75%) and psychological (60%) domains. There was a moderate association between PA and the following domains: physical (55.6%), social relations (40%), emotional (50%), overall health (50%), pain (50%), and environment (50%). The results showed an inconsistent association between PA and the sensory ability domain.

## Discussion

*Characteristics of the study*

There was a strong concentration of studies in some countries, especially the U.S. and Brazil, which together accounted for 61.90% of the included studies. This characteristic makes it difficult to generalize the results to populations with socio-cultural characteristics that are different from those of the countries in which the studies were conducted. Most studies were performed in developed countries, although Brazil is a developing nation and had a fairly large number of studies on this topic. The development of Brazilian and international literature on the importance of PA for the promotion of QoL in the elderly is also supported by the significant increase in the number of publications since 2005 (see Supplementary Table online). This progression should be accompanied by the conduction of research of a higher level of methodological quality to confirm the causal relationship between PA and QoL[15] and to understand the mechanisms of this relationship.[38]

Regarding participant age, the WHO defines the elderly as individuals aged 65 years or older in developed countries and 60 years or older in developing countries.[65] However, some studies did not follow this guideline for inclusion in their samples. Additionally, some studies had samples consisting exclusively of elderly women. Many scientific studies involving this age group typically have a greater number of female participants,[18] possibly because i) women have a longer life expectancy (6 years longer on average), ii) women have a higher level of social support, are more likely to seek new sources of support, have a greater ability to form bonds, enjoy affectionate relations, and assemble in a group, and iii) women have lower biological vulnerability, as the rate of lethal diseases is higher among men.[66]

This review shows some variability among the studies regarding how PA is measured. Only three studies[31,37,47] used direct measures to assess PA. The remainder used subjective measures of PA, and in some cases, these measures were created by the authors themselves without assessing the validity and reliability of PA estimates based on these instruments. The use of questionnaires offers low cost and ease of application; however, information reported by individuals has limited accuracy, as they tend to overestimate participation in PA.[67] A good test of reliability and validity of self-reported measures of PA may be to compare data from the same population, thus facilitating the identification of temporal changes in participation in PA and its possible influences on health factors.[16]

QoL assessment in the elderly was also performed using different methods. Among the studies included in this review, the most widely used instrument for measuring QoL was the SF-36. This questionnaire was developed to assess HRQoL based on the MOS, which is a questionnaire that was published in 1990. The SF-36 contains 36 items that are divided into eight scales and can also be grouped into physical and mental components. The SF-36 has been translated into several languages and validated for several cultures. Research has been conducted using the SF-36 in over 40 countries.[68] The instrument allows for the measurement of health dimensions and can assess the impact of disease and the benefits of treatment. It is also a good

predictor of mortality.[69] In Brazil, the instrument was translated and validated by Ciconelli et al.[70] The popularity of the SF-36 may be due to the year of its development, in the early 1990s. Additionally, the SF-36 allows for the assessment of HRQoL and its specific domains, which represents an outcome of interest in the research models included in this review (e.g., studies of institutionalized elderly or those with health problems).

Another instrument used in the studies was the QoL assessment questionnaire developed by the WHO, which is widely used in research and clinical practice.[5] This questionnaire was used in nine of the studies included in this review in the WHOQoL-100, WHOQoL-Bref and WHOQoL-Old versions. This prevalence demonstrates the importance of these instruments for evaluating QoL in cases in which general QoL and its specific domains is an outcome of interest.

It bears stressing that different instruments and QoL domains have specific properties (e.g., some instruments assess general QoL while other assess HRQoL, but both evaluate QoL in different ways, implying different concepts of QoL). Therefore, the lack of data limits the generalization and comparison of the results of different studies, since QoL domains are also affected by a number of factors related to culture, physical, and social environment of communities and societies.[71,72] Standardization of QoL assessment instruments in studies with elderly participants is essential for future research that seeks to identify the causal relationship between PA and QoL.

*Association between PA and QoL*

In general, the studies included in this review showed a positive association between PA and QoL in the elderly. However, the consistency of the association varied across different samples, as did the type of intervention/observation and the instruments used to measure the dependent variable. Only a few of the studies in which associations between PA and QoL domains were observed were methodologically robust (with sample randomization or adequate control for confounders). Furthermore, the effect sizes for the associations derived from experimental studies were generally small or medium and usually highly variable between studies. Therefore, the consistency of findings, by itself, does not define the possible causal association between PA and QoL domains as clinically robust.

The summary of the study evidence (see Table 1) indicates that PA is consistently associated with the following QoL domains: functional capacity; general QoL; autonomy; past, present, and future activities; death and dying; intimacy; mental health; vitality; and psychological. These associations suggest that PA may promote physical independence as well as essential mental aspects of QoL. However, this review showed that the associations between PA and the physical, emotional, overall health, social relations, pain, and environment domains of QoL are moderate. These associations may be related to the fact that PA promotes physical independence by improving functional capacity and physical health, which are essential for individual autonomy. These positive changes in life may induce increases in the states of mental health and general QoL.

Finally, only one domain presented an inconsistent association with PA: the sensory ability domain (see Table 1). Conflicting results regarding the association of PA and different domains are present in a number of studies.[2,25,26,29,31,44,50,52,53,55] This inconsistency may be due to the nature of PA and to the use of different methodologies and instruments for assessment of PA and QoL. The nature of PA programs for the elderly (aerobic, anaerobic, strength training, stretching exercises, social leisure activities, and others) may relate to QoL domains in a unique way, resulting in different associations. Standardization of methodologies for intervention and longitudinal studies is required, as is standardization of the instruments of QoL and type of PA used in these studies.

Other systematic reviews that were conducted with the general population have shown a positive association between PA and QoL,[71] but further studies are needed to evaluate the consistency of this association. It is important to note that not all of the studies included in the present review used statistical approaches that could control for potential confounding variables in the association between PA and QoL.

The present review provides evidence for a causal relationship between PA and some domains of QoL in the elderly. We cannot sustain that a causal relationship exists for all domains of QoL, because most studies that showed significant associations used cross-sectional designs, thus precluding any inferences about causality.

The studies included in this review proposed to elucidate and provoke further discussion about the association between PA and QoL in the elderly. First, some studies sought to identify possible explanatory variables for the association between PA and QoL, primarily testing the importance of self-efficacy for PA as a mediating variable in this association.[35,46] Second, other studies examined the dose-response relationship between PA and QoL (i.e., analysis of PA frequency and intensity and the impact of these factors on QoL). These studies will be discussed in greater detail in the following sections. Third, the lack of agreement among studies investigating the association between PA and specific QoL domains demonstrates the need for standardization of methodologies and instruments in future studies. These studies may guide the development of actions for the promotion of PA, QoL, and other health factors in the elderly.

*Association between PA and QoL: the mediating role of self-efficacy for PA*

In this area of study, mediating variables are mechanisms that can show the connection between PA and QoL in the elderly and may influence the consistency and direction of this relationship.[15] Although the results of recent literature reviews suggest a positive and consistent influence on the association between PA and QoL in the elderly, the mechanisms underlying these effects are unclear.[38] The relationship between PA and QoL is more complex than

typically described in the literature, and appears to involve a number of variables. Self-efficacy for PA appears to be an initial step in the study of variables that mediate the association between PA and QoL.[15]

Previous studies have suggested that self-efficacy for PA has a mediating impact on the association between PA and QoL. For example, the cross-sectional study by McAuley et al.[46] presented evidence to support such a position, arguing that self-efficacy, the central component of social cognitive theory, has been consistently shown to be a determining factor in PA participation. The authors concluded that elderly women who were more active had greater self-efficacy, which was associated with more positive states of both physical health and mental health.

An intervention study[38] showed that self-efficacy and affect are important mediators of the effectiveness of a PA program to promote QoL. This study indicated that changes in PA practice 5 years after intervention are associated with increased affect, which, in turn, is associated with increased QoL. Participation in PA may influence individual assessments of cognitive abilities, i.e., self-efficacy and affect, during exercise. This is the main theoretical basis for the mediating role of these variables in the association between PA and QoL.[73] In their examination of the literature, Rejeski et al.[15] used similar arguments to explain the relationship between PA and QoL, proposing, for example, that self-efficacy is an important mediator in this relationship.

The evidence of these and other studies[15,35,36,38] represents the first attempts to test potential mediators of the relationship between PA and QoL. These analyses are based on theoretical models and have important implications for how PA promotion programs can be structured for improvement of QoL in the elderly. This research highlights the need for the study of other variables that might explain the relationship between PA and QoL (e.g., enjoyment of PA), as well as the mediating role of these variables in the relationship between PA and other domains of QoL (e.g., the psychological domain). Nonetheless, current evidence suggests that PA interventions and programs should orient their activities toward providing experiences, comments, and information that serve to increase awareness of the perception of cognitive abilities of the elderly in relation to their participation in PA.

### *Intensity and frequency of PA*

The dose-response relationship between PA and QoL domains was also examined in some studies (i.e., different frequencies and intensities of PA and the impact of these factors on QoL).[28,33,34,37,41,42,45,50,51,53,56,59,63] One study included in this review highlighted that light PA was associated with the following SF-36 scales: general health, vitality, social function, and mental health.[42] In another study, light PA was associated with 40% lower odds of having low scores in the physical and mental domains of HRQoL.[51]

In a study by Varejão et al.,[25] in which an intervention program consisting of low-intensity PA was implemented, no significant improvements were found in QoL domains. A previous longitudinal study demonstrated that the practice of moderate PA was predictive of an improvement in the functional capacity domain of QoL.[74] Active individuals maintain or improve their physical abilities and are better prepared to perform any kind of work in their daily lives, which, in turn, can promote this domain of QoL.[36,75]

Other cross-sectional studies showed that moderate and/or vigorous intensity PA was also associated with the following QoL domains: functional capacity,[42,47,57,59,76] global QoL,[59] pain,[47,76] physical,[59] vitality,[42,44,47,57,76] mental health,[76] and general health.[42,57] Vigorous PA was associated with 50-70% lower odds of having low scores in the physical and mental domains[51] and a 15% increase in the odds of experiencing social engagement and emotional support.[53] Non-participation in moderate or vigorous PA increased the odds of experiencing 14 or more unhealthy days (physical or mental HRQoL domains) when compared to performing moderate or vigorous PA.[39,41]

Thus, studies suggest that different PA intensities contribute to different domains of QoL. It should be noted, however, that most of these studies are cross-sectional, making it difficult to draw conclusions about the association between different PA intensities and qualities and specific QoL domains.

Other studies have sought to test the impact of the frequency of PA on QoL domains. For example, Alexander et al.[50] used the Human Activity Profile (HAP) and WHOQoL-Bref to assess QoL and found that a greater weekly frequency of PA was associated with higher values in the physical domain of QoL. Likewise, Grimmett[59] found that practicing at least five PA sessions per week was associated with higher scores in several QoL domains, such as global QoL and the physical, functional capacity, and social domains.

In another study, elderly patients who performed moderate PA with low weekly frequency (1 or 2 days) had a 30% greater chance of experiencing 14+ unhealthy days when compared to those who performed moderate PA 5 or 6 days a week.[41] Analysis of the relationship between PA frequency and QoL domains is even rarer.

On the basis of the studies included in this review, it is clear that the evidence is contradictory regarding the dose-response relationship between PA and QoL, and that this relationship may be dependent on the QoL domain assessed (e.g., the impact of PA frequency on the physical domain of QoL may be different from its impact on the psychological domain). More intervention studies are required to investigate the impact of the intensity and frequency of PA on QoL. It is also important that future studies seek approaches that permit the inclusion of confounding variables in the statistical models. Such approaches will help establish the cause and effect relationship between PA and QoL by controlling for possible intervening variables.

### *Limitations of the study*

This review had some limitations that should be highlighted. The first limitation concerns the possibility that

some relevant studies were not included. The electronic search was limited to studies published between 2000 and 2012 and indexed in the PubMed/MEDLINE, SPORTDiscus, SciELO, and LILACS databases. It is possible that relevant studies published prior to that period or indexed in other databases are missing. The search for studies was also limited to the peer-reviewed literature; therefore, unpublished data, theses, dissertations, and institutional position papers were not included. It is important to emphasize that the study of the association between PA and QoL is a topic of relatively recent interest, as the main instruments for assessing QoL were only developed in the 1990s. Additionally, major original studies are published in the peer-reviewed literature. Therefore, it is believed that the most important studies examining the association between PA and QoL and published in this period are summarized in this review.

A second limitation is the small number of studies that evaluated the different domains of QoL. For example, the domains past, present, and future activities, death and dying, intimacy, and sensory ability were only evaluated in three studies,[29,60,62] and the pain domain of QoL was only evaluated in seven studies.[27,33,37,44,47,57,61] Other QoL domains were assessed in several studies (e.g., physical domain). However, the vast majority of studies were cross-sectional. This type of design has important limitations in seeking to establish the causal relationship between PA and QoL. Longitudinal and intervention studies are needed to assess different domains of QoL and the impact of PA on these outcomes.

## Conclusions

The literature on the association between PA and QoL in the elderly is mainly composed of cross-sectional studies. Different questionnaires are used to assess PA, and the long and short versions of SF-36 and WHOQoL-Bref are the most used questionnaires to assess QoL. There was a consistent positive association between PA and the following QoL domains: functional capacity; general QoL; autonomy; past, present, and future activities; death and dying; intimacy; psychological; vitality; and mental health. This evidence supports the notion that promoting PA in the elderly may have an impact beyond functional capacity and mental health, as it was associated with a positive perception of general QoL. PA had a positive association, albeit moderate or inconsistent, with other domains of QoL in the elderly. The results also showed that PA may not be associated with some QoL domains (e.g., sensory ability), but further investigations are needed.

Evidence on the impact of the frequency and intensity of PA on QoL domains is still limited. Longitudinal and intervention studies are needed to better understand the dose-response relationship between PA and QoL. The association between PA and QoL is clearly more complex than is generally stated in the literature, and seems to involve some mediating variables, such as self-efficacy for PA and affect. Further studies are needed to support this hypothesis.

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## Disclosure

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