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# BMJ Open

## Relationship of different domains of physical activity practice with health-related quality of life among community-dwelling older people: a cross-sectional study.

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3 **Relationship of different domains of physical activity practice with health-related**  
4 **quality of life among community-dwelling older people: a cross-sectional study.**  
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## ABSTRACT

**Objectives:** to analyze the association between the different domains of physical activity (PA) and health related domains of health-related quality of life (HRQoL) in the elderly, independent of confounding variables. **Design:** Cross-sectional study. **Participants:** In total, 400 randomly selected elderly individuals participated in the study. **Primary and secondary outcome measures:** The Baecke questionnaire was used to evaluate the level of PA and the 36-item Short Form Health Survey (SF-36) was used to evaluate the HRQoL. The association between the variables was analyzed using the Chi-square test and the magnitude of the associations using Binary Logistic Regression. **Results:** Sufficiently active elderly (32.2%) presented higher HRQoL scores for functional capacity ( $p = 0.045$ ), less body pain ( $p = 0.045$ ), and better social aspects ( $p = 0.010$ ). They also had 82% more chances of presenting better functional capacity in the work/domestic occupation domain ( $p = 0.024$ ) and 81% more chances of having better general health perception in the sports/gym domain ( $p = 0.034$ ). In relation to PA in total, associations were observed for better functional capacity (OR = 1.94; 95% CI= 1.13-3.30); less body pain (OR = 1.77; 95% CI = 1.11-2.82); and better parameters related to social aspects (OR = 2.06; 95% CI = 1.29-3.29). **Conclusion:** Physically active elderly people in the different domains of PA presented better HRQoL parameters, reinforcing the importance of studies analyzing PA in different contexts and in countries with low and medium socioeconomic conditions.

**Keywords:** Physical activity, elderly, epidemiology, quality of life.

## ARTICLE SUMMARY

### Strengths and limitations of this study

#### Limitations:

- This study has a cross-sectional design that does not allow cause and effect inference.
- The use of a questionnaire to assess the level of physical activity did not allow a more robust assessment.

#### Strengths:

- We highlight the sample randomization process, as well as the sample number of elderly participants, and the control of the variables by confounding factors in the analyses between physical activity and health related quality of life.
- The evaluation of physical activity addressing different domains in the elderly population, and considering the different domains of health related quality of life.
- It is worth noting the collection and storage of data through electronic devices, which can minimize errors during data export and tabulation which are high complexity tasks in a population study.

## INTRODUCTION

Insufficient physical activity is among the top 10 health risk factors [1] and is the fourth cause of mortality in the world [2]. In 2015, non-communicable chronic diseases accounted for 70% of deaths globally, with 78% of these deaths occurring in countries with low and medium socioeconomic status [3].

The benefits that regular physical activity (PA) can provide are well established, and yet the global pandemic of insufficient physical activity remains [4]. Benefits promoted by PA can be explored through different domains: work/domestic occupations, leisure/displacement time, and sports practices/gym. In this sense, there are some factors that can influence the prevalence of physically active people in each of the domains, such as cultural and demographic issues, as well as sex and chronological age [5].

Both physical health and mental health influence quality of life, which is understood as a subjective and multifactorial parameter [6]. Health-related quality of life (HRQoL) includes different domains in relation to how the individual feels about their experiences, involving perceptions of physical and psychological health, functional and social aspects, and general condition of life, making it an important part of any clinical examination [7,8]. Some studies affirm that physically active individuals are more likely to present better HRQoL parameters [9–12]. However, little is known about this relationship when these two variables (PA and HRQoL) are analyzed separated by domains.

Currently the elderly population is the fastest growing segment in the world [13]. In Brazil, the estimate is that the elderly population, composed of 14 million people in 2010, will represent around 70.5 million people by 2060 [14] and it is known that the more chronological age increases, the less physically active people become [15]. Thus, the physiological and cognitive declines that occur naturally during the aging process can

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3 be aggravated when individuals adopt lifestyle habits with insufficient physical activity  
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5 [16], reflecting on general health and HRQoL.  
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8 Evaluation and continuous monitoring of PA by domains can help in the execution  
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10 of interventions to promote PA more effectively. It is unclear in the literature whether the  
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12 PA level of the elderly population, separated into each of the PA domains, is associated  
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14 differently with HRQoL, as well as if this relationship is independent of confounding  
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16 variables such as gender, age, and socioeconomic status, since these variables may be  
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18 related to quality of life [17,18] and PA [19].  
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22 Thus, the objective of the present study was to analyze the different domains of  
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24 PA practice and possible associations with HRQoL in the elderly.  
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## 28 **MATERIALS E METHOD**

### 29 **Sample calculation and participant selection process**

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32 This is a cross-sectional study with an analytical and descriptive character.  
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34 Individuals aged 60 and over, of both sexes, living in the city of Presidente Prudente –  
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36 SP, Brazil were interviewed. The city is located in the western state of São Paulo - Brazil,  
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38 has an HDI of 0.806 and approximately 207,610 people [20]. Considering a maximum  
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40 expected prevalence of 50% [21] and a tolerable error of 5% the minimum number of  
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42 elderly required for the present study was 379.  
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48 With the support of a city map and the list of streets available on the city council  
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50 website, the city of Presidente Prudente was divided into five regions (north, south, east,  
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52 west, and central), and in each of these regions streets were randomly selected. In the  
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54 selected streets, the researchers were distributed in pairs and all the residences of the  
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56 selected streets were approached once. After explaining the research, all individuals from  
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3 each household who met the inclusion criteria were considered eligible and invited to  
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5 participate in the study.  
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8 Participants were instructed to make a chair available and the research was  
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10 conducted in front of the home of the elderly, or inside the house. The following inclusion  
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12 criteria were considered: (a) age equal to or greater than 60 years; (b) resident in the city  
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14 for at least two years. Exclusion criteria: (a) being in a wheelchair; or (b) presenting any  
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16 kind of cognitive deficiency that would prevent understanding of the questions. All  
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18 participants signed the Informed Consent Term. The group of interviewers was composed  
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20 of postgraduate students and students of scientific initiation, all of whom received  
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22 previous training. The interviews lasted approximately 40 minutes, and the survey was  
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24 conducted between March 2016 and February 2017. This study was approved by the  
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26 Research Ethics Committee Involving Human Beings (Protocol: 45486415.4.0000.5402).  
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### 33 **Anthropometry**

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36 Anthropometric measurements were performed to measure body mass and height,  
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38 using a digital scale, Wiso brand (model: w912, Lot: 13A01, China), and a portable  
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40 stadiometer with a maximum length of two meters, respectively. All measurements were  
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42 performed according to the description of Freitas Jr et al [22]. Thus, body mass index  
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44 (BMI) was calculated using the equation: body mass in kg divided by height in meters  
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46 squared.  
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### 54 **Physical activity practice**

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57 Physical activity practice was measured using the Baecke questionnaire [23],  
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59 previously validated for the Brazilian elderly population [24]. This questionnaire  
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3 evaluates the total PA in three domains: PA in the work environment or in domestic  
4 occupations, PA in sports practices or in activities performed at a gym; PA during leisure  
5 time or during displacement. The questionnaire contains a Likert scale with the response  
6 options: never, rarely, sometimes, often, and always. At the end, the instrument provides  
7 a score in relation to the practice of physical activity in each of the three domains, as well  
8 as a total score from the sum of these three domains. The elderly in the highest quartile  
9 (Q4) were classified as sufficiently active and the elderly in the lower quartiles were  
10 classified as insufficiently active (Q1, Q2, and Q3).  
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### 26 **Health related quality of life**

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28 The HRQL was evaluated using the 36-item Short Form Health Survey (SF-36).  
29 The SF-36 questionnaire consists of 36 items covering eight domains: functional capacity,  
30 physical limitations, body pain, general health perception, vitality, social aspects,  
31 emotional limitations, and mental health. The questionnaire presents a final score of 0 to  
32 100, where 0 represents the worst score and 100 represents the best score in relation to  
33 the general state of health and quality of life [25]. The elderly were divided into quartiles,  
34 with those located in the highest quartile (Q4) classified to have high HRQoL and those  
35 in the lower quartiles classified to have low HRQoL (Q1, Q2, and Q3).  
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### 51 **Socioeconomic condition**

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53 In order to determine the economic condition of the families, the "Brazilian  
54 Economic Classification Criteria" was used, established in 2014 by the Brazilian  
55 Association of Research Companies (ABEP), according to a survey database carried out  
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3 in 2009 by the Brazilian Institute of Public Opinion and Statistics [26]. The questionnaire  
4 takes into account the degree of education and presence and quantity of certain rooms and  
5 belongings in the analyzed home (bathrooms, domestic servants, automobiles,  
6 microcomputer/computers, dishwasher, refrigerator, freezer, DVD player, washing  
7 machine, and dryer machine). It establishes the following classifications for economic  
8 condition: A1, B1, B2, C1, C2, and D - E. After the classification of the participants by  
9 means of the instrument, the sample was distributed into: high economic class composed  
10 of categories A1 and B1, average economic class composed of classes B2 and C1, and  
11 low economic class composed of categories C2 and D - E.  
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### 28 **Data Collection and Storage (ODK)**

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30 All data were collected electronically using tablets (Tablet Galaxy TAB 3 WFI  
31 7PBCO2, Tablet Galaxy TAB 3 T2100, Tablet DL TP258PIN) or cellular phones with an  
32 android system (Motorola XT1032; Samsung Galaxy SM-G530H) through the Open Data  
33 Kit program (ODK). This tool stores all the information without needing an Internet  
34 connection. Subsequently, the data is sent to a storage platform using an Internet  
35 connection, and exported to an excel spreadsheet for data analysis.  
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### 50 **Statistical analysis**

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52 The sample characteristics are presented as mean and standard deviation.  
53 Information on the practice of PA and HLQoL in the population of the present study is  
54 presented in frequencies. The associations of PA practice in the different domains and in  
55 its totality with HLQoL were analyzed through the Chi-square test. The magnitude of  
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3 these associations was verified through Binary Logistic Regression in its unadjusted and  
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5 adjusted form (age, sex, and socioeconomic condition). The statistical program used was  
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7 SPSS version 20.0 (IBM Corporation). The level of significance was 5%.  
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### 13 **Patient and Public Involvement**

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16 Patients and or public were not involved in the research.  
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## 23 **RESULTS**

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26 In total 400 elderly, aged 60 years and over, participated in the study, of which  
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28 232 were female (58%). In relation to the PA level, 64.2% of the women were classified  
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30 as insufficiently active (n = 149), and 72.6% of the men were classified as insufficiently  
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32 active (n = 122). Out of the total, 129 elderly (32.3%) were classified as sufficiently  
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34 active. Table 1 shows the characteristics of the sample according to levels of PA. No  
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36 significant differences ( $p < 0.05$ ) were observed between groups for anthropometric  
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38 measures. Among the eight domains of HRQoL analyzed, a significant statistical  
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40 difference was observed for three. Sufficiently active elderly reported better HRQoL as  
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42 they presented higher scores in the following SF-36 domains: better functional capacity  
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44 ( $p = 0.025$ ), less body pain ( $p = 0.037$ ), and better perception in relation to social aspects  
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46 ( $p = 0.023$ ) when compared to the insufficiently active elderly group.  
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**Table 1. Characterization of the sample presented as mean and standard deviation (n = 400, Presidente Prudente - SP, Brazil, 2017).**

|                                       | <b>Sufficiently Active (n=129)</b> | <b>Insufficiently Active (n=271)</b> | <b>p-value</b> |
|---------------------------------------|------------------------------------|--------------------------------------|----------------|
| Age (years)                           | 71.04±7.81                         | 71.85±8.86                           | 0.353          |
| Height (m)                            | 1.58 ±0.07                         | 1.60±0.09                            | 0.106          |
| Weight (kg)                           | 68.66±13.54                        | 71.45±15.07                          | 0.066          |
| BMI (kg/m <sup>2</sup> )              | 27.09±4.93                         | 27.70±4.94                           | 0.252          |
| QL Functional capacity (scores)       | 71.20±24.98                        | 64.76±29.94                          | 0.025          |
| QL Physical limitations (scores)      | 73.84±42.02                        | 66.97±44.33                          | 0.135          |
| QL Body pain (scores)                 | 68.98±26.11                        | 62.97±28.31                          | 0.037          |
| QL General health perception (scores) | 69.67±21.01                        | 67.60±18.76                          | 0.343          |
| QL Vitality (scores)                  | 72.95±19.31                        | 70.35±20.52                          | 0.220          |
| QL Social aspects (scores)            | 87.40±21.95                        | 81.82±24.57                          | 0.023          |
| QL Emotional limitations (scores)     | 82.42±37.05                        | 80.32±37.81                          | 0.598          |
| QL Mental health (scores)             | 74.91±18.25                        | 74.95±18.97                          | 0.985          |

BMI= Body Mass Index; QL= Health related quality of life

Table 2 presents the associations related to physical activities performed at work or in domestic occupations, sports practice and/or practices of activities performed at a gym, activities performed during leisure time and/or during displacement, and the total sum of these activities, with the eight domains of HLQoL. The practice of PA in work/occupation was associated with a higher HLQoL considering the domain of functional capacity (p = 0.031). The elderly who participated in sports practices or activities in the gym presented a better general perception of health (p = 0.041). There

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3 was no significant association ( $p < 0.05$ ) between being sufficiently active in the leisure  
4 domain or during displacement and the domains of HLQoL. With regard to the total score  
5 of PA domains, sufficiently active elderly presented higher HLQoL in relation to  
6 functional capacity ( $p = 0.045$ ), perception of less body pain ( $p = 0.045$ ), and social  
7 aspects ( $p = 0.010$ ).  
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**Table 2. Association between sufficiently active elderly and the HRQoL domains.**

| Variable   | n total<br>(n=400) | Occupation/work | Chi-square test | Sport/Gym | Chi-square test | Leisure   | Chi-square test | Total      | Chi-square test |
|------------|--------------------|-----------------|-----------------|-----------|-----------------|-----------|-----------------|------------|-----------------|
|            | n                  | n (%)           | p-value         | n (%)     | p-value         | n (%)     | p-value         | n (%)      | p-value         |
| <b>FC</b>  |                    |                 |                 |           |                 |           |                 |            |                 |
| Low QL     | 111                | 23 (20.7)       | 0.031           | 26 (23.4) | 0.197           | 31 (27.9) | 0.745           | 27 (24.3)  | 0.045           |
| High QL    | 288                | 93 (32.3)       |                 | 88 (30.6) |                 | 87 (30.2) |                 | 102 (35.4) |                 |
| <b>PL</b>  |                    |                 |                 |           |                 |           |                 |            |                 |
| Low QL     | 122                | 33 (27.0)       | 0.653           | 31 (25.4) | 0.431           | 37 (30.3) | 0.903           | 35 (28.7)  | 0.372           |
| High QL    | 278                | 83 (29.9)       |                 | 83 (29.9) |                 | 81 (29.1) |                 | 94 (33.8)  |                 |
| <b>BP</b>  |                    |                 |                 |           |                 |           |                 |            |                 |
| Low QL     | 141                | 42 (29.8)       | 0.888           | 37 (26.2) | 0.534           | 36 (25.5) | 0.242           | 36 (25.5)  | 0.045           |
| High QL    | 259                | 74 (28.6)       |                 | 77 (29.7) |                 | 82 (31.7) |                 | 93 (35.9)  |                 |
| <b>GHP</b> |                    |                 |                 |           |                 |           |                 |            |                 |
| Low QL     | 100                | 26 (26.0)       | 0.525           | 20 (20.0) | 0.041           | 29 (29.0) | 1.00            | 30 (30.0)  | 0.666           |
| High QL    | 300                | 90 (30.0)       |                 | 94 (31.3) |                 | 89 (29.7) |                 | 99 (33.0)  |                 |
| <b>VI</b>  |                    |                 |                 |           |                 |           |                 |            |                 |
| Low QL     | 111                | 26 (23.4)       | 0.161           | 31 (27.9) | 0.973           | 31 (27.9) | 0.76            | 28 (25.2)  | 0.081           |
| High QL    | 289                | 90 (31.1)       |                 | 83 (28.7) |                 | 87 (30.1) |                 | 101 (34.9) |                 |
| <b>AS</b>  |                    |                 |                 |           |                 |           |                 |            |                 |
| Low QL     | 146                | 37 (25.3)       | 0.268           | 36 (24.7) | 0.240           | 36 (24.7) | 0.135           | 35 (24.0)  | 0.010           |
| High QL    | 254                | 79 (31.1)       |                 | 78 (30.7) |                 | 82 (32.2) |                 | 94 (37.0)  |                 |
| <b>EL</b>  |                    |                 |                 |           |                 |           |                 |            |                 |
| Low QL     | 87                 | 24 (27.6)       | 0.845           | 20 (23.0) | 0.249           | 26 (29.9) | 1.00            | 25 (28.7)  | 0.507           |
| High QL    | 313                | 92 (29.4)       |                 | 94 (30.0) |                 | 92 (29.4) |                 | 104 (33.2) |                 |
| <b>MH</b>  |                    |                 |                 |           |                 |           |                 |            |                 |
| Low QL     | 116                | 27 (23.3)       | 0.136           | 31 (26.7) | 0.703           | 36 (31.0) | 0.757           | 36 (31.0)  | 0.830           |
| High QL    | 284                | 89 (31.3)       |                 | 83 (29.2) |                 | 82 (28.9) |                 | 93 (32.7)  |                 |

QL = health related quality of life; FC = functional capacity; PL = physical limitations; BP = body pain; GHP = general health perception; VI = vitality; SA = social aspects; EL = emotional limitations; MH = mental health

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3 Tables 3 and 4 present information on the magnitude of associations between the  
4 different domains of PA and the domains of HLQoL. Sufficiently active elderly were  
5 approximately twice as likely to demonstrate better functional capacity in the unadjusted  
6 model. PA through gymnastic practice and/or sports practice was associated with higher  
7 HLQoL for the general health perception of the elderly, both in the unadjusted ( $p = 0.031$ )  
8 and adjusted models ( $p = 0.034$ ). When analyzing the three domains of PA together,  
9 sufficiently active elderly presented higher chances of high HLQoL for functional  
10 capacity, less body pain, and better social aspects.  
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**Table 3. Association between sufficiently active elderly and HRQoL domains in unadjusted and adjusted models.**

|            | occupation/work sufficiently active |           |         |           |           |         | sports/gym sufficiently active |           |         |           |           |         |
|------------|-------------------------------------|-----------|---------|-----------|-----------|---------|--------------------------------|-----------|---------|-----------|-----------|---------|
|            | Unadjusted                          |           |         | Adjusted* |           |         | Unadjusted                     |           |         | Adjusted* |           |         |
|            | OR                                  | CI        | p-value | OR        | CI        | p-value | OR                             | CI        | p-value | OR        | CI        | p-value |
| <b>FC</b>  |                                     |           |         |           |           |         |                                |           |         |           |           |         |
| Low QL     | 1.00                                | 1.00      |         | 1.00      | 1.00      |         | 1.00                           | 1.00      |         | 1.00      | 1.00      |         |
| High QL    | 1.82                                | 1.08-3.07 | 0.024   | 1.62      | 0.92-2.87 | 0.092   | 1.43                           | 0.86-2.38 | 0.159   | 1.63      | 0.94-2.82 | 0.077   |
| <b>PL</b>  |                                     |           |         |           |           |         |                                |           |         |           |           |         |
| Low QL     | 1.00                                | 1.00      |         | 1.00      | 1.00      |         | 1.00                           | 1.00      |         | 1.00      | 1.00      |         |
| High QL    | 1.14                                | 0.71-1.84 | 0.569   | 1.32      | 0.80-2.18 | 0.276   | 1.24                           | 0.77-2.02 | 0.365   | 1.22      | 0.75-2.00 | 0.412   |
| <b>BP</b>  |                                     |           |         |           |           |         |                                |           |         |           |           |         |
| Low QL     | 1.00                                | 1.00      |         | 1.00      | 1.00      |         | 1.00                           | 1.00      |         | 1.00      | 1.00      |         |
| High QL    | 0.94                                | 0.60-1.47 | 0.798   | 1.05      | 0.65-1.68 | 0.84    | 1.18                           | 0.75-1.88 | 0.461   | 1.2       | 0.75-1.93 | 0.425   |
| <b>GHP</b> |                                     |           |         |           |           |         |                                |           |         |           |           |         |
| Low QL     | 1.00                                | 1.00      |         | 1.00      | 1.00      |         | 1.00                           | 1.00      |         | 1.00      | 1.00      |         |
| High QL    | 1.22                                | 0.73-2.03 | 0.446   | 1.33      | 0.78-2.28 | 0.287   | 1.82                           | 1.05-3.15 | 0.031   | 1.81      | 1.04-3.15 | 0.034   |
| <b>VI</b>  |                                     |           |         |           |           |         |                                |           |         |           |           |         |
| Low QL     | 1.00                                | 1.00      |         | 1.00      | 1.00      |         | 1.00                           | 1.00      |         | 1.00      | 1.00      |         |
| High QL    | 1.47                                | 0.89-2.45 | 0.129   | 1.38      | 0.80-2.37 | 0.235   | 1.04                           | 0.63-1.69 | 0.875   | 1.08      | 0.65-1.78 | 0.764   |
| <b>AS</b>  |                                     |           |         |           |           |         |                                |           |         |           |           |         |
| Low QL     | 1.00                                | 1.00      |         | 1.00      | 1.00      |         | 1.00                           | 1.00      |         | 1.00      | 1.00      |         |
| High QL    | 1.33                                | 0.84-2.10 | 0.222   | 1.55      | 0.95-2.53 | 0.075   | 1.35                           | 0.85-2.14 | 0.198   | 1.33      | 0.83-2.12 | 0.224   |
| <b>EL</b>  |                                     |           |         |           |           |         |                                |           |         |           |           |         |
| Low QL     | 1.00                                | 1.00      |         | 1.00      | 1.00      |         | 1.00                           | 1.00      |         | 1.00      | 1.00      |         |
| High QL    | 1.09                                | 0.64-1.85 | 0.743   | 1.37      | 0.78-2.41 | 0.269   | 1.43                           | 0.82-2.50 | 0.199   | 1.4       | 0.80-2.46 | 0.237   |
| <b>MH</b>  |                                     |           |         |           |           |         |                                |           |         |           |           |         |
| Low QL     | 1.00                                | 1.00      |         | 1.00      | 1.00      |         | 1.00                           | 1.00      |         | 1.00      | 1.00      |         |
| High QL    | 1.5                                 | 0.91-2.47 | 0.108   | 1.74      | 1.02-2.97 | 0.042   | 1.13                           | 0.69-1.83 | 0.615   | 1.14      | 0.68-1.82 | 0.668   |

QL = health related quality of life; FC = functional capacity; PL = physical limitations; BP = body pain; GHP = general health perception; VI = vitality; SA = social aspects; EL = emotional limitations; MH = mental health; \*Adjusted by sex, age and socioeconomic condition; OR= Odds Ratio; CI=confidence interval



**Table 4. Association between sufficiently active elderly and HRQoL domains in unadjusted and adjusted models.**

|            | Leisure sufficiently active |           |           |      |           |       | Total score sufficiently active |           |           |      |           |       |
|------------|-----------------------------|-----------|-----------|------|-----------|-------|---------------------------------|-----------|-----------|------|-----------|-------|
|            | Unadjusted                  |           | Adjusted* |      |           |       | Unadjusted                      |           | Adjusted* |      |           |       |
|            | OR                          | CI        | OR        | CI   | OR        | CI    | OR                              | CI        | OR        | CI   | OR        | CI    |
| <b>FC</b>  |                             |           |           |      |           |       |                                 |           |           |      |           |       |
| Low QL     | 1.00                        | 1.00      | 1.00      | 1.00 | 1.00      | 1.00  | 1.00                            | 1.00      | 1.00      | 1.00 | 1.00      | 1.00  |
| High QL    | 1.11                        | 0.68-1.81 | 0.655     | 1.39 | 0.82-2.53 | 0.219 | 1.7                             | 1.03-2.80 | 0.035     | 1.94 | 1.13-3.30 | 0.015 |
| <b>PL</b>  |                             |           |           |      |           |       |                                 |           |           |      |           |       |
| Low QL     | 1.00                        | 1.00      | 1.00      | 1.00 | 1.00      | 1.00  | 1.00                            | 1.00      | 1.00      | 1.00 | 1.00      | 1.00  |
| High QL    | 0.94                        | 0.59-1.50 | 0.81      | 1.01 | 0.63-1.63 | 0.942 | 1.27                            | 0.79-2.02 | 0.313     | 1.39 | 0.87-2.24 | 0.167 |
| <b>BP</b>  |                             |           |           |      |           |       |                                 |           |           |      |           |       |
| Low QL     | 1.00                        | 1.00      | 1.00      | 1.00 | 1.00      | 1.00  | 1.00                            | 1.00      | 1.00      | 1.00 | 1.00      | 1.00  |
| High QL    | 1.35                        | 0.85-2.14 | 0.2       | 1.43 | 0.89-2.95 | 0.132 | 1.63                            | 1.03-2.57 | 0.035     | 1.77 | 1.11-2.82 | 0.016 |
| <b>GHP</b> |                             |           |           |      |           |       |                                 |           |           |      |           |       |
| Low QL     | 1.00                        | 1.00      | 1.00      | 1.00 | 1.00      | 1.00  | 1.00                            | 1.00      | 1.00      | 1.00 | 1.00      | 1.00  |
| High QL    | 1.03                        | 0.62-1.69 | 0.899     | 1.08 | 0.65-1.80 | 0.745 | 1.14                            | 0.70-1.87 | 0.578     | 1.21 | 0.74-2.00 | 0.436 |
| <b>VI</b>  |                             |           |           |      |           |       |                                 |           |           |      |           |       |
| Low QL     | 1.00                        | 1.00      | 1.00      | 1.00 | 1.00      | 1.00  | 1.00                            | 1.00      | 1.00      | 1.00 | 1.00      | 1.00  |
| High QL    | 1.11                        | 0.68-1.80 | 0.669     | 1.25 | 0.76-2.06 | 0.377 | 1.59                            | 0.97-2.60 | 0.064     | 1.69 | 1.02-2.82 | 0.041 |
| <b>AS</b>  |                             |           |           |      |           |       |                                 |           |           |      |           |       |
| Low QL     | 1.00                        | 1.00      | 1.00      | 1.00 | 1.00      | 1.00  | 1.00                            | 1.00      | 1.00      | 1.00 | 1.00      | 1.00  |
| High QL    | 1.45                        | 0.92-2.30 | 0.108     | 1.58 | 0.99-2.53 | 0.054 | 1.86                            | 1.17-2.94 | 0.008     | 2.06 | 1.29-3.29 | 0.002 |
| <b>EL</b>  |                             |           |           |      |           |       |                                 |           |           |      |           |       |
| Low QL     | 1.00                        | 1.00      | 1.00      | 1.00 | 1.00      | 1.00  | 1.00                            | 1.00      | 1.00      | 1.00 | 1.00      | 1.00  |
| High QL    | 0.97                        | 0.58-1.64 | 0.929     | 1.07 | 0.63-1.82 | 0.798 | 1.23                            | 0.73-2.07 | 0.428     | 1.4  | 0.82-2.40 | 0.209 |
| <b>MH</b>  |                             |           |           |      |           |       |                                 |           |           |      |           |       |
| Low QL     | 1.00                        | 1.00      | 1.00      | 1.00 | 1.00      | 1.00  | 1.00                            | 1.00      | 1.00      | 1.00 | 1.00      | 1.00  |
| High QL    | 0.9                         | 0.56-1.44 | 0.667     | 1.01 | 0.62-1.64 | 0.952 | 1.08                            | 0.68-1.72 | 0.74      | 1.2  | 0.74-1.94 | 0.448 |

QL = health related quality of life; FC = functional capacity; PL = physical limitations; BP = body pain; GHP = general health perception; VI = vitality; SA = social aspects; EL = emotional limitations; MH = mental health; \*Adjusted by sex, age and socioeconomic condition; OR= Odds Ratio; CI=confidence interval

## DISCUSSION

In the present study the prevalence of sufficiently active elderly was 32.3% and these individuals presented higher HLQoL scores for better functional capacity, less body pain, and better social aspects, regarding social activities related to a group of friends or family, when considering the total PA. Being sufficiently active in the work/home occupation was associated with better HRQoL for the functional capacity domain. Elderly people who reported attending sports activities or activities in the gym presented higher HRQoL for general health perception. Regarding PA in leisure/displacement, when analyzed separately there was no significant statistical difference.

The majority of studies present the beneficial effects of total PA for physical and mental health in general. However, when the different contexts in which PA can be explored are analyzed separately, just as the different perceptions of HRQoL are reported separately by domains, the results should be observed more carefully. For example, the elderly classified as sufficiently active at work or in domestic occupations demonstrated better functional capacity. In contrast to these results, Jurakic et al [27] found an inverse relationship between this domain and quality of life, showing that sufficiently active people in domestic activities reported having more pain in the body, probably due to repetitive movement efforts that may be part of the PA of that domain. However, elderly who are physically able to continue working, whether in the work environment or household work, are likely to preserve the ability to perform activities of daily living. On the other hand, those who opt for a lifestyle with insufficient practice of PA tend to accentuate the physiological processes of aging.

In relation to PA related to sports practices or exercises performed at a gym, the results of the present study presented better HRQoL for the domain of general health perception. This is one of the domains that encompasses both physical components and

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3 mental components related to health, emphasizing the benefits that PA provides for  
4 physical health and also suggesting improvement in the HRQoL related to the mental  
5 component. These results are in agreement with Takata et al [28], who verified that  
6 training directed to physical abilities can improve not only functional capacity, but also  
7 quality of life in general. In this way, PA can provide benefits not only for physical health  
8 but also for mental health, noting that neuropsychiatric diseases are increasingly affecting  
9 older people [29].

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12 In the case of PA in the field of leisure and/or displacement, several studies have  
13 presented associations between this domain and quality of life [27,30–32]. In the present  
14 study, the findings are not in agreement with the literature. Possibly, the lack of options  
15 for leisure activities for the elderly in the region studied influenced the results, presenting  
16 a gap that should be further investigated. Moreover, the infrastructure of sidewalks and  
17 streets, as well as the insecurity of the elderly, can demotivate the population in question  
18 to opt for active displacement, and consequently minimize the prevalence of active  
19 individuals in this group.

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22 When total PA was analyzed, using the sum of all domains, the results presented  
23 better HRQL for functional capacity, less pain in the body, and better perception  
24 regarding social activities (social aspects). These results corroborate the findings in the  
25 literature that suggest that people who present higher levels of PA, may present better  
26 parameters of HRQoL [33,34].

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29 Despite evidence of the benefits that an active lifestyle provides for the elderly  
30 population [10], the use of different tools in other studies to analyze the HRQoL and each  
31 domain of PA separately, as well as total PA make it difficult to compare the results. The  
32 majority of studies use either total PA or the leisure time domain as an outcome, making  
33 it difficult to compare our findings with other domains, such as activities in the work  
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3 environment or in domestic occupations, and activities practiced at a gym and their  
4 relation with HRQoL. In addition, there is a lack of knowledge about this relationship in  
5 countries with low and medium socioeconomic conditions as is the case of Brazil [28,35–  
6 37]. The present study has some limitations. Its cross-sectional design does not allow  
7 cause and effect inference. The use of a questionnaire to assess the level of PA did not  
8 allow a more robust assessment, although the instrument used has been validated for the  
9 elderly population [24] and is widely used in the scientific community, in addition to  
10 being validated against gold standard instruments for PA measurement such as doubly  
11 marked water [38]. The levels of PA in each domain can be influenced by cultural  
12 differences, climatic factors, and developmental factors of each region and/or country,  
13 what suggests that the results should be interpreted with caution, since the present study  
14 was developed in only one Brazilian city and cannot be generalized to other region of  
15 Brazil or other countries. Furthermore, the analyzed age group does not allow  
16 extrapolation to other ages. However, it is worth emphasizing the importance of studies  
17 with the elderly population, which comprises the fastest growing age group in the world,  
18 and which has consequently changed demographic and epidemiological patterns. As  
19 positive aspects, we highlight the sample randomization process, as well as the sample  
20 number of elderly, and the control of the variables by confounding factors in the analyses  
21 between PA and HRQoL. We also emphasize the evaluation of PA addressing different  
22 domains in the elderly population, and considering the different domains of HRQoL. In  
23 addition, it is worth noting the collection and storage of data through electronic devices,  
24 optimizing the time in the collection process in the residences of the participants, as well  
25 as minimization of errors during data export and tabulation which are high complexity  
26 tasks in a population study.  
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3 The results of the present study suggest that the different domains of PA in  
4 work/occupation, sports/gym, and leisure/displacement activities are related in different  
5 and specific ways to the different domains of HRQoL. In addition, the practice of PA was  
6 related to higher HRQL in the elderly in the different domains and in their entirety. Our  
7 findings reinforce the importance of studies encompassing different domains of PA for  
8 the elderly population, especially in middle-income countries. Taking advantage of public  
9 spaces to encourage and promote group activities for this population, especially in  
10 relation to the leisure time domain, could be a positive strategy.  
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## 23 **CONCLUSION**

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26 Given the results of the study, it is suggested that participants involved in some  
27 kind of sport or in gym activities, usually practiced in groups, presented a better general  
28 perception of health, a domain that encompasses both physical and emotional aspects of  
29 health. Thus, exploring PA separately by domains may be an important tool for  
30 monitoring and promoting more active and healthy lifestyles, and consequently  
31 preserving HRQoL during aging.  
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## DECLARATIONS

### **Ethics approval and consent to participate**

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Informed consent was obtained from all individual participants included in this study. The Research Ethics Committee Involving Human Beings approved this study (Protocol: 45486415.4.0000.5402).

### **Consent for publication**

Not applicable

### **Availability of data and materials**

All data generated or analysed during this study are included in this published article [and its supplementary information files].

### **Competing interests**

The authors declare that they have no competing interests

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**Authors' contributions**

CCS was responsible to the conception, design, analysis, interpretation, data collection and was a major contributor in writing the manuscript. ESC, PMN and LAG reviewed the manuscript critically for important intellectual content. WRT and DSC were responsible to the interpretation and data collection. DGDC reviewed the manuscript critically for important intellectual content and was responsible to the final approval of the version to be published.

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# BMJ Open

## Relationship of different domains of physical activity practice with health-related quality of life among community-dwelling older people: a cross-sectional study.

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3 **Relationship of different domains of physical activity practice with health-related**  
4 **quality of life among community-dwelling older people: a cross-sectional study.**  
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## ABSTRACT

**Objectives:** to analyze the association between different domains of physical activity (PA) and health related domains of health-related quality of life (HRQoL) in older adults, independent of confounding variables. **Design:** Cross-sectional study.

**Participants:** In total, 400 individuals with 60 years or above were randomly selected to participate in the study. **Primary and secondary outcome measures:** The PA was assessed by questionnaire in three different domains (work/occupational, sports/gym, and leisure time) and in total PA. The 36-item Short Form Health Survey (SF-36) was used to evaluate HRQoL. Variables of socioeconomic condition, marital status, and presence of health-professional diagnosed comorbidities were self-reported. **Results:** The mean age of the sample was 71,5 ( $\pm$  8,4) years, of which 58% (n=232) were female. Male older adults showed higher scores of PA in sports, leisure time and in total than females. Older adults who were more physically active in work/occupational domain were associated with high better scores of functional capacity (OR=1.73, 95% CI=1.02; 2.93) and general health perception (OR=1.61, 95% CI=1.02; 2.56). Those who presented a higher score in actives in sports/gym domain were associated with better scores of functional capacity, even after adjustment for comorbidities (OR=1.72, 95% CI=1.01; 2.96). Higher actives in leisure time were more likely to have better scores of functional capacity (OR=1.75, 95% CI=1.03; 2.98), body pain (OR=1.74, 95% CI=1.09; 2.78), and mental health (OR=1.67, 95% CI=1.03; 2.69). Older adults who were higher active in total PA score were 77% more likely to have better scores of functional capacity (OR=1.77, 1.04; 3.02). **Conclusion:** Physically active older adults in the different domains of PA presented better HRQoL parameters, reinforcing the importance of studies analyzing PA in different contexts and in countries with low and medium socioeconomic conditions.

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3 **Keywords:** Physical activity, elderly, epidemiology, quality of life.  
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5 **ARTICLE SUMMARY**  
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8 **Strengths and limitations of this study**  
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11 **Limitations:**  
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15 ➤ This study has a cross-sectional design that does not allow cause and effect  
16 inference.  
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18 ➤ The use of a questionnaire to assess the level of physical activity did not allow a  
19 more robust assessment.  
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25 **Strengths:**  
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- 27  
28 ➤ We highlight the random sample, as well as the sample size of older adults, and  
29 the control of the variables by confounding factors in the analyses between  
30 physical activity and health related quality of life.  
31  
32 ➤ The evaluation of physical activity addressing different domains in older adults,  
33 and considering the different domains of health related quality of life.  
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35 ➤ It is worth noting the collection and storage of data through electronic devices,  
36 which can minimize errors during data export and tabulation, which are complex  
37 tasks in a population study.  
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## INTRODUCTION

Insufficient physical activity is among top 10 health risk factors[1] and is the fourth cause of mortality in the world[2]. In 2015, non-communicable chronic diseases accounted for 70% of deaths globally, with 78% of these deaths occurring in countries with low and medium socioeconomic status[3].

The benefits regular physical activity (PA) can provide are well established, and yet the global pandemic of insufficient physical activity remains[4]. Benefits promoted by PA can be explored through different domains: i) work/occupation, that comprises physical activities performed in work environment or in domestic activities or gardening, ii) leisure time, that corresponds to activities in the off work time and in regard to active commuting by cycling or walking, and iii) sports practices/gym, that comprises the physical activities performed in sports modalities or physical training. In this sense, there are some factors that can influence the prevalence of physically active people in each of the domains, such as cultural and demographic issues, as well as sex and chronological age[5,6].

Both physical health and mental health influence quality of life, which is understood as a subjective and multifactorial parameter[7]. Health-related quality of life (HRQoL) includes different domains in relation to how the individual feels about their experiences, involving perceptions of physical and psychological health, functional and social aspects, and general condition of life, making it an important part of any clinical examination[8,9]. Some studies affirm that physically active individuals are more likely to present better quality of life[10,11] and/or better HRQoL parameters[12–15]. However, little is known about this relation when these two variables (PA and HRQoL) are analyzed separated by different domains. The studies carried out in Brazil with older adults considering this issue used the total PA measure[10,11].

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3 Currently, older adults population is the fastest growing segment in the world[16].  
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5 In Brazil, the estimation is that the older adults population composed of 14 million people  
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7 in 2010, will be around 70.5 million people by 2060[17] and it is known that the more  
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9 chronological age increases, the less physically active people become[18]. Thus, the  
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11 physiological and cognitive declines that occur naturally during the aging process can be  
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13 aggravated when individuals adopt lifestyle habits with insufficient physical activity[19],  
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15 affecting general health and HRQoL.  
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19 Evaluation and continuous monitoring of PA by domains can help the  
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21 interventions execution to promote PA more effectively. It is unclear in the literature  
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23 whether the PA level of older adults, separated into each of the PA domains, is associated  
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25 differently with HRQoL, as well as if this relationship is independent of confounding  
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27 variables such as gender, age, and socioeconomic status, since these variables may be  
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29 related to quality of life[20,21] and PA[22].  
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33 Thus, the objective of the present study was to analyze the different domains of  
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35 PA practice and possible associations with HRQoL in older adults.  
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## 38 39 40 **METHODS**

### 41 42 **Sample calculation**

43  
44 This is a cross-sectional study, composed by older adults of the city of Presidente  
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46 Prudente, Brazil. Presidente Prudente is located in the western region of the state of São  
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48 Paulo - Brazil, with an Human Development Index (indicator of human development  
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50 level, that range from 0 [poor] to 1 [better]) of 0.806 and approximately 207,610  
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52 people[23]. Considering the prevalence of HRQoL in different domains is not consensual  
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54 in the literature and that was not carried out on a previous pilot-study, a prevalence of  
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56 50% was used, that maximizes the sample size and has been adopted in epidemiological  
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3 studies[24], with a tolerable error of 5% and the power of study of 80%, the minimum  
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5 sample size required for the present study was 379. At the end of the study, a total of 419  
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7 older adults were evaluated, with exclusion of 19 participants for incomplete data of PA  
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9 or HRQoL, resulting in 400 older adults for data analysis.  
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### 15 **Participant selection process**

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18 The city of Presidente Prudente does not have a clearly geographical or  
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20 demographical division. In this sense, with the support of the city map, postal codes and  
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22 the list of streets available on the city council website, the city of Presidente Prudente was  
23  
24 divided into five geographical regions (north, south, east, west, and central). In each of  
25  
26 these regions was performed a list of all districts and its streets, which were randomly  
27  
28 selected for being visited. In this way, all streets in each region had the opportunity to be  
29  
30 selected. The researchers were distributed in pairs to do the recruitment of the  
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32 participants, door to door, and all the residences of the selected streets were approached  
33  
34 once. After explaining the research, all individuals from each household who met the  
35  
36 inclusion criteria were considered eligible and invited to participate in the study.  
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38 Participants were instructed to make a chair available and the research was conducted in  
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40 front of the home or inside the house. In case of the participant decline to participate, the  
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42 next household was visited, until the required sample size has been reached.  
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48 The following inclusion criteria were considered: (a) age equal to or greater than  
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50 60 years; (b) resident in the city of Presidente Prudente for at least two years. Exclusion  
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52 criteria: (a) being in a wheelchair or other disabilities that does not allow the subject to  
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54 stand and walk, not to have underestimation of habitual practice of PA measured by the  
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56 adopted questionnaire; and (b) presenting any kind of cognitive deficiency that would  
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58 prevent understanding the questions. All participants signed the Patient Consent Form.  
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3 The group of interviewers was composed of postgraduate students and students of  
4 scientific initiation, all of who received previous training. The interviews lasted  
5 approximately 40 minutes, and the survey was conducted between March 2016 and  
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10 February 2017. The Research Ethics Committee Involving Human Beings of UNESP -  
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12 São Paulo State University approved this study (Protocol: 45486415.4.0000.5402).  
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### 14 15 16 17 **Comorbidities**

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19 The participants were asked if they had the following chronic diseases diagnosed  
20 by a health-professional: Hypertension, Diabetes, Elevated LDL Cholesterol, and  
21 Elevated Triglycerides. They had to answer “Yes” or “No” for each one the comorbidities.  
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26 This information were used to adjustment of the analysis.  
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### 31 32 **Anthropometry**

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34 Anthropometric measurements were performed to measure body mass and height,  
35 using a digital scale, Wiso brand (model: w912, Lot: 13A01, China), and a portable  
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stadiometer with a maximum length of two meters, respectively. All measurements were  
performed according to the description of Freitas Jr et al[25]. Thus, body mass index  
(BMI) was calculated by using the equation: body mass in kg divided by height in meters  
squared.

### 51 52 53 54 55 56 57 58 59 60 **Physical activity practice**

Physical activity practice was measured using the Baecke questionnaire[26],  
previously validated for Brazilian older adults[27]. This questionnaire evaluates the total  
PA in three domains: PA in the work environment or in domestic occupations (8 items),

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3 PA in sports practices or in activities performed at a gym (10 items), PA during leisure  
4 time or during transportation (4 items). The questionnaire contains a Likert scale with the  
5 answer options: never, rarely, sometimes, often, and always. At the end, the instrument  
6 provides a dimensionless score in relation to the practice of PA in each of the three  
7 domains, as well as a total score from the sum of these three domains. The older adults in  
8 the highest quartile (Q4) were classified as “high active” and those in the lower quartiles  
9 were classified as “less active” (Q1, Q2, and Q3).

### 21 **Health related quality of life**

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24 The HRQoL was evaluated by using the 36-item Short Form Health Survey (SF-  
25 36). The SF-36 questionnaire consists of 36 items covering eight domains: functional  
26 capacity, physical limitations, body pain, general health perception, vitality, social  
27 aspects, emotional limitations, and mental health. The SF-36 questionnaire presents a  
28 final score of 0 to 100, where 0 represents the worst score and 100 represents the best  
29 score in relation to the general state of health and quality of life[28]. The sample was  
30 divided into quartiles, with those located in the highest quartile (Q4) classified to have  
31 high HRQoL and those in the lower quartiles classified to have low HRQoL (Q1, Q2, and  
32 Q3).

### 49 **Sociodemographic variables**

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51 The "Brazilian Economic Classification Criteria" was used to determine the  
52 economic condition of the families, established in 2014 by the Brazilian Association of  
53 Research Companies (ABEP), according to a survey database carried out in 2009 by the  
54 Brazilian Institute of Public Opinion and Statistics[29]. The questionnaire takes into  
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3 account the degree of education and presence and quantity of certain rooms and  
4 belongings in the analyzed home (bathrooms, domestic servants, automobiles,  
5 microcomputer/computers, dishwasher, refrigerator, freezer, DVD player, washing  
6 machine, and dryer machine). It establishes the following classifications for economic  
7 condition: A1, B1, B2, C1, C2, and D - E. After the classification of the participants by  
8 questionnaire, the sample was distributed into: high economic class composed of  
9 categories A1 and B1, average economic class composed of classes B2 and C1, and low  
10 economic class composed of categories C2 and D - E. The marital status was self-reported  
11 using the following options: i) single; ii) married; iii) widower; iv) divorced.  
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### 26 **Data Collection and Storage**

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29 All data were collected electronically using tablets (Tablet Galaxy TAB 3 WFI  
30 7PBCO2, Tablet Galaxy TAB 3 T2100, Tablet DL TP258PIN) or cellular phones with an  
31 android system (Motorola XT1032; Samsung Galaxy SM-G530H) through the Open Data  
32 Kit program (ODK). This tool stores all the information without needing internet  
33 connection. Subsequently, the data is sent to a storage platform using internet connection,  
34 and exported to an excel spreadsheet for data analysis.  
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### 45 **Statistical analysis**

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48 The sample characteristics are presented as median and interquartile range,  
49 compared between sex by Mann Whitney U test for nonparametric data. The information  
50 about the practice of PA and HRQoL in the population of the present study was presented  
51 in frequencies. And the associations of PA practice in the different domains and in its  
52 totality with HRQoL were analyzed through the Chi-square test. The magnitude of these  
53 associations was verified through Binary Logistic Regression in two models. The Model  
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3 1 was adjusted by age, sex, marital status, and socioeconomic condition, and the Model  
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5 2 was adjusted by variables of model 1 plus presence of the reported comorbidities  
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7 (Hypertension, Diabetes, Elevated LDL Cholesterol, and Elevated Triglycerides)  
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9 simultaneously. The goodness of model fit was analyzed by Hosmer & Lemeshow test,  
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11 where p-values less than 0.05 were considered as poor fit. The statistical program used  
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13 was SPSS version 20.0 (IBM Corporation). It was adopted the 95% confidence interval  
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15 and the level of significance adopted was the p-value less than 0.05.  
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### 21 **Patient and Public Involvement**

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24 Patients and or public were not involved in the research.  
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### 29 **RESULTS**

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32 In total, 400 older adults, with mean age of 71,5 ( $\pm$  8,4) years, participated in the  
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34 study, of which 232 were female (58%). For the marital status, the majority of sample  
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36 was married (55.8%), followed by widower (23.4%), divorced (10.3%), single (9.3%)  
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38 and 1.2% did not respond. The reported comorbidities were observed in 63.9% for  
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40 Hypertension, 24.1% for Diabetes, 24.9% for Elevated LDL Cholesterol, and 11.1% for  
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42 Elevated Triglycerides. In relation to the PA level, the proportion of high physically  
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44 actives was higher among men than women in total score (39.3% [95% CI = 34.5-44.0]  
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46 vs. 17.8% [95% CI = 14.0-21.5]), at leisure time (47.5% [95% CI = 42.6-52.4] vs. 17.8%  
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48 [95% CI = 14.0-21.5]), and in sports domain (38.0% [95% CI = 33.2-42.8] vs. 22.5%  
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50 [95% CI = 18.4-26.6]), being lower among men than women only in work/occupational  
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52 domain (23.5% [95% CI = 19.3-27.7] vs. 36.8% [95% CI = 32.0-41.5]). Table 1 shows  
53  
54 the characteristics of the sample and comparisons according to sex.  
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**Table 1. Characterization of the sample (n = 400, Presidente Prudente - SP, Brazil, 2017).**

|                               | <b>Overall Sample</b>       | <b>Males</b>         | <b>Females</b>       |                 |
|-------------------------------|-----------------------------|----------------------|----------------------|-----------------|
|                               | <b>Median (Min. - Max.)</b> | <b>Median (IR)</b>   | <b>Median (IR)</b>   | <b>p-value*</b> |
| Age (years)                   | 70.0 (60.0 - 97.0)          | 71.0 (65.0 - 77.0)   | 70.0 (65.0 - 77.0)   | 0.370           |
| Height (meters)               | 1.60 (1.37 - 1.88)          | 1.68 (1.64 - 1.73)   | 1.54 (1.50 - 1.59)   | 0.001           |
| Weight (kilograms)            | 70.5 (36.6 - 127.5)         | 74.9 (65.1 - 83.9)   | 67.0 (57.6 - 76.2)   | 0.001           |
| BMI (kg/m <sup>2</sup> )      | 27.2 (17.4 - 42.6)          | 26.3 (23.5 - 29.2)   | 27.7 (24.0 - 31.5)   | 0.061           |
| PA Work/occupation score      | 2.88 (1.00 - 4.50)          | 2.75 (2.13 - 3.13)   | 3.00 (2.50 - 3.38)   | 0.001           |
| PA Sports/Gym score           | 1.75 (1.00 - 4.25)          | 2.00 (1.50 - 2.25)   | 1.75 (1.50 - 2.00)   | 0.001           |
| PA Leisure score              | 6.50 (3.25 - 14.25)         | 7.50 (5.75 - 8.75)   | 5.75 (4.50 - 7.25)   | 0.001           |
| PA Total score                | 11.00 (5.80 - 19.00)        | 12.13 (9.88 - 14.00) | 10.50 (8.94 - 12.25) | 0.001           |
| <b>HRQoL domains (scores)</b> |                             |                      |                      |                 |
| Functional capacity           | 75.0 (0.0 - 100.0)          | 80.0 (60.0 - 95.0)   | 65.0 (40.0 - 85.0)   | 0.001           |
| Physical limitations          | 100.0 (0.0 - 100.0)         | 100.0 (25.0 - 100.0) | 100.0 (90.0 - 100.0) | 0.080           |
| Body pain                     | 62.00 (0.0 - 100.0)         | 72.0 (51.0 - 100.0)  | 61.0 (41.0 - 84.0)   | 0.006           |
| General health perception     | 72.00 (0.0 - 100.0)         | 72.0 (62.0 - 82.0)   | 70.0 (56.0 - 82.0)   | 0.259           |
| Vitality                      | 75.00 (0.0 - 100.0)         | 80.0 (70.0 - 90.0)   | 70.0 (55.0 - 80.0)   | 0.001           |
| Social aspects                | 100.0 (0.0 - 100.0)         | 100.0 (75.0 - 100.0) | 87.5 (75.0 - 100.0)  | 0.001           |
| Emotional limitations         | 100.0 (0.0 - 100.0)         | 100.0 (90.0 - 100.0) | 100.0 (90.0 - 100.0) | 0.112           |
| Mental health                 | 80.0 (0.0 - 100.0)          | 80.0 (72.0 - 92.0)   | 76.0 (64.0 - 86.0)   | 0.011           |

\*p-value for Mann Whitney U test. Min.= minimum value; Max.= maximum value; IR= Interquartile range; BMI= Body Mass Index; PA=Physical activity; HRQoL= Health related quality of life; Kg/m<sup>2</sup>= kilograms by meter squared.



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3 Table 2 presents the associations related to physical activities performed at work  
4 or in domestic occupations, sports practice and/or practices of activities performed at a  
5 gym, activities performed during leisure time and/or during transportation, and the total  
6 sum of these activities, with the eight domains of HRQoL. The practice of PA in  
7 work/occupation was associated with a higher HRQoL considering the domain of  
8 functional capacity. Older adults who participated in sports practices or activities in a  
9 gym presented a better general health perception. There was no significant association  
10 between being high active in the leisure domain or during transportation and the domains  
11 of HRQoL. Regarding the total score of PA domains, high active older adults presented  
12 higher HRQoL in relation to functional capacity, perception of less body pain, and social  
13 aspects than the less actives.  
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**Table 2. Association between high active older adults and the HRQoL domains.**

| Variable   | n total<br>(n=400) | Occupation/work          | Sport/Gym                | Leisure                 | Total Score               |
|------------|--------------------|--------------------------|--------------------------|-------------------------|---------------------------|
|            | n                  | n (% [95% CI])           | n (% [95% CI])           | n (% [95% CI])          | n (%[95% CI])             |
| <b>FC</b>  |                    |                          |                          |                         |                           |
| Low QL     | 111                | 23 (20.7 [13.2 – 28.3])* | 26 (23.4 [15.5 – 31.3])  | 31 (27.9 [19.6 – 36.3]) | 27 (24.3 [16.3 – 32.3])*  |
| High QL    | 288                | 93 (32.3 [26.9 – 37.7])* | 88 (30.6 [25.2 – 35.9])  | 87 (30.2 [24.9 – 35.5]) | 102 (35.4 [29.9 – 40.9])* |
| <b>PL</b>  |                    |                          |                          |                         |                           |
| Low QL     | 122                | 33 (27.0 [19.2 – 34.9])  | 31 (25.4 [17.7 – 33.1])  | 37 (30.3 [22.2 – 38.5]) | 35 (28.7 [20.7 – 36.7])   |
| High QL    | 278                | 83 (29.9 [24.5 – 35.2])  | 83 (29.9 [24.5 – 35.2])  | 81 (29.1 [23.8 – 34.5]) | 94 (33.8 [28.3 – 39.4])   |
| <b>BP</b>  |                    |                          |                          |                         |                           |
| Low QL     | 141                | 42 (29.8 [22.2 – 37.3])  | 37 (26.2 [19.0 – 33.5])  | 36 (25.5 [18.3 – 32.7]) | 36 (25.5 [18.3 – 32.7])*  |
| High QL    | 259                | 74 (28.6 [23.1 – 34.1])  | 77 (29.7 [24.2 – 35.3])  | 82 (31.7 [26.0 – 37.3]) | 93 (35.9 [30.1 – 41.8])*  |
| <b>GHP</b> |                    |                          |                          |                         |                           |
| Low QL     | 100                | 26 (26.0 [17.4 – 34.6])  | 20 (20.0 [12.2 – 27.8])* | 29 (29.0 [20.1 – 37.9]) | 30 (30.0 [21.0 – 39.0])   |
| High QL    | 300                | 90 (30.0 [24.8 – 35.2])  | 94 (31.3 [26.1 – 36.6])* | 89 (29.7 [24.5 – 34.8]) | 99 (33.0 [27.7 – 38.3])   |
| <b>VI</b>  |                    |                          |                          |                         |                           |
| Low QL     | 111                | 26 (23.4 [15.5 – 31.3])  | 31 (27.9 [19.6 – 32.3])  | 31 (27.9 [19.6 – 32.3]) | 28 (25.2 [17.2 – 33.3])   |
| High QL    | 289                | 90 (31.1 [25.8 – 31.1])  | 83 (28.7 [23.5 – 28.7])  | 87 (30.1 [24.8 – 35.4]) | 101 (34.9 [29.5 – 40.5])  |
| <b>AS</b>  |                    |                          |                          |                         |                           |
| Low QL     | 146                | 37 (25.3 [18.3 – 32.4])  | 36 (24.7 [17.7 – 31.7])  | 36 (24.7 [17.7 – 31.7]) | 35 (24.0 [17.1 – 30.9])*  |
| High QL    | 254                | 79 (31.1 [25.4 – 36.8])  | 78 (30.7 [25.0 – 36.4])  | 82 (32.2 [26.5 – 38.0]) | 94 (37.0 [31.1 – 42.9])*  |
| <b>EL</b>  |                    |                          |                          |                         |                           |
| Low QL     | 87                 | 24 (27.6 [18.2 – 37.0])  | 20 (23.0 [14.2 – 31.8])  | 26 (29.9 [20.3 – 39.5]) | 25 (28.7 [19.2 – 38.2])   |
| High QL    | 313                | 92 (29.4 [24.4 – 34.4])  | 94 (30.0 [24.9 – 35.1])  | 92 (29.4 [24.4 – 34.4]) | 104 (33.2 [28.0 – 38.5])  |
| <b>MH</b>  |                    |                          |                          |                         |                           |
| Low QL     | 116                | 27 (23.3 [15.6 – 31.0])  | 31 (26.7 [18.7 – 34.8])  | 36 (31.0 [22.6 – 39.5]) | 36 (31.0 [22.6 – 39.5])   |
| High QL    | 284                | 89 (31.3 [25.9 – 36.7])  | 83 (29.2 [23.9 – 34.5])  | 82 (28.9 [23.6 – 34.1]) | 93 (32.7 [27.3 – 38.2])   |

\*Statistical difference by Chi-square test for distribution. QL = health related quality of life; FC = functional capacity; PL = physical limitations; BP = body pain; GHP = general health perception; VI = vitality; SA = social aspects; EL = emotional limitations; MH = mental health

Tables 3 and 4 present information on the magnitude of associations between the different domains of PA and the domains of HRQoL. In the work/occupation domain, the high active older adults were 73% more likely to demonstrate better functional capacity and 61% more likely to have better global health perception than the less active ones. High PA through gym practice and/or sports practice was associated with more than 70% for higher functional capacity, even after adjustment for comorbidities. In regard to the PA at leisure time, high active older adults were 75% more likely to have better functional capacity, 74% more likely to have less body pain, and 67% more likely to have better mental health than the less actives participants, while body pain and mental health remained significant even after adjustment for comorbidities. When analyzing the three

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3 domains of PA together in total score, high active older adults were 77% more likely to  
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5 have high HRQoL for functional capacity than the less active older adults.  
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**Table 3. Association of sufficiently active older adults at occupational/work and at sports/gym with HRQoL domains.**

|            | High active at occupation/work |                   |                        |        |            |                        | High active at sports/gym |                   |                        |                   |       |                        |
|------------|--------------------------------|-------------------|------------------------|--------|------------|------------------------|---------------------------|-------------------|------------------------|-------------------|-------|------------------------|
|            | Model1                         |                   | p-value for model fit* | Model2 |            | p-value for model fit* | Model1                    |                   | p-value for model fit* | Model2            |       | p-value for model fit* |
|            | OR                             | CI                |                        | OR     | CI         |                        | OR                        | CI                |                        | OR                | CI    |                        |
| <b>FC</b>  |                                |                   | 0.951                  |        |            | 0.688                  |                           |                   | 0.984                  |                   | 0.219 |                        |
| Low QL     | 1.00                           | -                 |                        | 1.00   | -          |                        | 1.00                      | -                 | 1.00                   | -                 |       |                        |
| High QL    | <b>1.73</b>                    | <b>1.02; 2.93</b> |                        | 1.52   | 0.89; 2.61 |                        | <b>1.78</b>               | <b>1.05; 3.02</b> | <b>1.72</b>            | <b>1.01; 2.96</b> |       |                        |
| <b>PL</b>  |                                |                   | 0.065                  |        |            | 0.365                  |                           |                   | 0.435                  |                   | 0.360 |                        |
| Low QL     | 1.00                           | -                 |                        | 1.00   | -          |                        | 1.00                      | -                 | 1.00                   | -                 |       |                        |
| High QL    | 1.35                           | 0.85; 2.13        |                        | 1.20   | 0.75; 1.92 |                        | 1.03                      | 0.65; 1.65        | 1.04                   | 0.64; 1.68        |       |                        |
| <b>BP</b>  |                                |                   | 0.788                  |        |            | 0.997                  |                           |                   | 0.238                  |                   | 0.272 |                        |
| Low QL     | 1.00                           | -                 |                        | 1.00   | -          |                        | 1.00                      | -                 | 1.00                   | -                 |       |                        |
| High QL    | 0.89                           | 0.56; 1.42        |                        | 0.82   | 0.51; 1.32 |                        | 1.12                      | 0.70; 1.79        | 1.10                   | 0.68; 1.78        |       |                        |
| <b>GHP</b> |                                |                   | 0.645                  |        |            | 0.745                  |                           |                   | 0.739                  |                   | 0.439 |                        |
| Low QL     | 1.00                           | -                 |                        | 1.00   | -          |                        | 1.00                      | -                 | 1.00                   | -                 |       |                        |
| High QL    | <b>1.61</b>                    | <b>1.02; 2.56</b> |                        | 1.48   | 0.92; 2.38 |                        | 1.49                      | 0.92; 2.40        | 1.47                   | 0.91; 2.39        |       |                        |
| <b>VI</b>  |                                |                   | 0.702                  |        |            | 0.878                  |                           |                   | 0.277                  |                   | 0.184 |                        |
| Low QL     | 1.00                           | -                 |                        | 1.00   | -          |                        | 1.00                      | -                 | 1.00                   | -                 |       |                        |
| High QL    | 1.03                           | 0.64; 1.65        |                        | 0.95   | 0.59; 1.54 |                        | 1.09                      | 0.67; 1.76        | 1.08                   | 0.67; 1.76        |       |                        |
| <b>SA</b>  |                                |                   | 0.677                  |        |            | 0.841                  |                           |                   | 0.449                  |                   | 0.132 |                        |
| Low QL     | 1.00                           | -                 |                        | 1.00   | -          |                        | 1.00                      | -                 | 1.00                   | -                 |       |                        |
| High QL    | 1.24                           | 0.80; 1.92        |                        | 1.12   | 0.72; 1.76 |                        | 0.87                      | 0.55; 1.36        | 0.87                   | 0.55; 1.38        |       |                        |
| <b>EL</b>  |                                |                   | 0.033                  |        |            | 0.816                  |                           |                   | 0.178                  |                   | 0.451 |                        |
| Low QL     | 1.00                           | -                 |                        | 1.00   | -          |                        | 1.00                      | -                 | 1.00                   | -                 |       |                        |
| High QL    | 1.33                           | 0.77; 2.31        |                        | 1.20   | 0.68; 2.10 |                        | 0.71                      | 0.40; 1.24        | 0.70                   | 0.40; 1.25        |       |                        |
| <b>MH</b>  |                                |                   | 0.119                  |        |            | 0.933                  |                           |                   | 0.226                  |                   | 0.044 |                        |
| Low QL     | 1.00                           | -                 |                        | 1.00   | -          |                        | 1.00                      | -                 | 1.00                   | -                 |       |                        |
| High QL    | 1.19                           | 0.74; 1.91        |                        | 1.11   | 0.69; 1.80 |                        | 0.67                      | 0.40; 1.12        | 0.70                   | 0.42; 1.17        |       |                        |

\*p-value for Hosmer&Lemeshow goodness of fit test. Model 1=Adjusted for sociodemographic variables: sex, age, socioeconomic status, marital status; Model 2=Adjusted by Model 1 + self reported comorbidities: hypertension, diabetes, elevated triglycerides, elevated LDL cholesterol. QL = health related quality of life; FC = functional capacity; PL = physical limitations; BP = body pain; GHP = general health perception; VI = vitality; SA = social aspects; EL = emotional limitations; MH = mental health; \*Adjusted by sex, age and socioeconomic condition; OR= Odds Ratio; CI=confidence interval. Bold values were statistically significant.

**Table 4. Association of sufficiently active older adults at leisure and in total with HRQoL domains.**

|            | High active at Leisure |                   |                        |             |                   | High active in Total score |             |                   |        |            |                        |
|------------|------------------------|-------------------|------------------------|-------------|-------------------|----------------------------|-------------|-------------------|--------|------------|------------------------|
|            | Model1                 |                   | p-value for model fit* | Model2      |                   | p-value for model fit*     | Model1      |                   | Model2 |            | p-value for model fit* |
|            | OR                     | CI                |                        | OR          | CI                |                            | OR          | CI                | OR     | CI         |                        |
| <b>FC</b>  |                        |                   | 0.183                  |             |                   |                            |             | 0.040             |        |            | 0.347                  |
| Low QL     | 1.00                   | -                 |                        | 1.00        | -                 |                            | 1.00        | -                 | 1.00   | -          |                        |
| High QL    | <b>1.75</b>            | <b>1.03; 2.98</b> |                        | 1.71        | 0.99; 2.95        |                            | <b>1.77</b> | <b>1.04; 3.02</b> | 1.63   | 0.94; 2.82 |                        |
| <b>PL</b>  |                        |                   | 0.181                  |             |                   |                            |             | 0.206             |        |            | 0.348                  |
| Low QL     | 1.00                   | -                 |                        | 1.00        | -                 |                            | 1.00        | -                 | 1.00   | -          |                        |
| High QL    | 1.04                   | 0.65; 1.68        |                        | 0.98        | 0.61; 1.60        |                            | 1.41        | 0.86; 2.32        | 1.33   | 0.84; 2.21 |                        |
| <b>BP</b>  |                        |                   | 0.034                  |             |                   |                            |             | 0.810             |        |            | 0.009                  |
| Low QL     | 1.00                   | -                 |                        | 1.00        | -                 |                            | 1.00        | -                 | 1.00   | -          |                        |
| High QL    | <b>1.74</b>            | <b>1.09; 2.78</b> |                        | <b>1.63</b> | <b>1.02; 2.62</b> |                            | 1.52        | 0.95; 2.45        | 1.42   | 0.88; 2.31 |                        |
| <b>GHP</b> |                        |                   | 0.334                  |             |                   |                            |             | 0.034             |        |            | 0.124                  |
| Low QL     | 1.00                   | -                 |                        | 1.00        | -                 |                            | 1.00        | -                 | 1.00   | -          |                        |
| High QL    | 1.52                   | 0.94; 2.47        |                        | 1.47        | 0.90; 2.41        |                            | 1.41        | 0.87; 2.31        | 1.31   | 0.80; 2.16 |                        |
| <b>VI</b>  |                        |                   | 0.784                  |             |                   |                            |             | 0.005             |        |            | 0.007                  |
| Low QL     | 1.00                   | -                 |                        | 1.00        | -                 |                            | 1.00        | -                 | 1.00   | -          |                        |
| High QL    | 1.18                   | 0.73; 1.90        |                        | 1.18        | 0.73; 1.92        |                            | 1.03        | 0.63; 1.68        | 1.01   | 0.62; 1.66 |                        |
| <b>SA</b>  |                        |                   | 0.436                  |             |                   |                            |             | 0.017             |        |            | 0.009                  |
| Low QL     | 1.00                   | -                 |                        | 1.00        | -                 |                            | 1.00        | -                 | 1.00   | -          |                        |
| High QL    | 0.97                   | 0.62; 1.54        |                        | 0.93        | 0.58; 1.48        |                            | 1.03        | 0.65; 1.64        | 0.97   | 0.60; 1.55 |                        |
| <b>EL</b>  |                        |                   | 0.068                  |             |                   |                            |             | 0.127             |        |            | 0.005                  |
| Low QL     | 1.00                   | -                 |                        | 1.00        | -                 |                            | 1.00        | -                 | 1.00   | -          |                        |
| High QL    | 1.17                   | 0.65; 2.12        |                        | 1.11        | 0.61; 2.03        |                            | 1.34        | 0.72; 2.47        | 1.25   | 0.67; 2.34 |                        |
| <b>MH</b>  |                        |                   | 0.255                  |             |                   |                            |             | 0.447             |        |            | 0.142                  |
| Low QL     | 1.00                   | -                 |                        | 1.00        | -                 |                            | 1.00        | -                 | 1.00   | -          |                        |
| High QL    | <b>1.67</b>            | <b>1.03; 2.69</b> |                        | <b>1.64</b> | <b>1.01; 2.66</b> |                            | 1.23        | 0.75; 2.01        | 0.83   | 0.51; 1.38 |                        |

\*p-value for Hosmer&Lemeshow goodness of fit test. Model 1=Adjusted for sociodemographic variables: sex, age, socioeconomic status, marital status; Model 2=Adjusted by Model 1 + self reported comorbidities: hypertension, diabetes, elevated triglycerides, elevated LDL cholesterol. QL = health related quality of life; FC = functional capacity; PL = physical limitations; BP = body pain; GHP = general health perception; VI = vitality; SA = social aspects; EL = emotional limitations; MH = mental health; \*Adjusted by sex, age and socioeconomic condition; OR= Odds Ratio; CI=confidence interval. Bold values were statistically significant.

## DISCUSSION

In the present study, the high active older adults presented different associations with HRQoL domains, according to PA domains. High actives older adults in the work/occupational PA domain presented higher scores for better functional capacity and general health perception. Being high active in sports and in total score was associated with better scores of functional capacity. Those older adults who were high active in the leisure time domain were more likely to have better scores of functional capacity, body pain, and mental health.

The majority of studies present the total PA beneficial effects on physical and mental health in general[30]. However, when different contexts in which PA can be explored are analyzed separately, just as the different perceptions of HRQoL are reported separately by domains, the results should be observed more carefully. For example, the older adults classified as high active at work or in domestic occupations demonstrated better functional capacity. In contrast to these results, Jurakic et al[31] found an inverse relationship between this domain and quality of life, showing that sufficiently active people in domestic activities reported having more pain in the body, probably due to repetitive movement efforts that may be part of the PA of that domain. However, older adults who are physically able to continue working, whether in the work environment or household work, are likely to preserve the ability to perform activities of daily living. On the other hand, those who opt for a lifestyle with insufficient practice of PA tend to accentuate the physiological processes of aging.

In relation to PA related to sports practices or exercises performed at a gym, the results of the present study presented better HRQoL for functional capacity domain, regardless of the presence of comorbidities. These results are in agreement with Takata

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2  
3 et al[32], who verified that training directed to physical abilities can improve the  
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5 functional capacity and the quality of life in general.  
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8 In the case of PA in the field of leisure and/or transportation, several studies have  
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10 presented associations between this domain and quality of life[31,33–35]. The present  
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12 study observed significant association of being high active in leisure time with better  
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14 scores of functional capacity, body pain and mental health. In this way, PA at leisure time  
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16 can provide benefits not only for physical health, but also for mental health, noting that  
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18 neuropsychiatric diseases are increasingly affecting older people[36]. Otherwise, the  
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20 infrastructure of sidewalks and streets, as well as the insecurity of older adults, can  
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22 demotivate this population in question to opt for active transportation, and consequently  
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24 limit the increase of the benefits of this domain of PA in quality of life.  
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28 When total PA was analyzed, using the sum of all domains, the results presented  
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30 better HRQL for functional capacity. These results corroborate the findings in the  
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32 literature suggesting that people who present higher levels of PA, may present better  
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34 parameters of HRQoL[37–39]. In this sense, the accumulation of physical activities of  
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36 different domains and intensities may be able to positively affect HRQoL, due to its  
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38 increase in global levels of PA.  
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42 Despite evidence of the benefits that an active lifestyle provides for the older  
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44 adults[10], the use of different tools in other studies to analyze the HRQoL and each  
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46 domain of PA separately, as well as total PA, makes it difficult to compare results. The  
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48 majority of studies use either total PA or the leisure time domain as an outcome, making  
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50 it difficult to compare our findings with other domains, such as activities in the work  
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52 environment or in domestic occupations, and activities practiced at a gym and their  
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54 relation with HRQoL. In addition, there is a lack of knowledge about this relationship in  
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3 countries with low and medium socioeconomic conditions as is the case of Brazil[32,40–  
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8 One of the novelties of the present study is the analysis of different domains of  
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10 PA. Most of the studies that aimed to verify the relationship between the practice of PA  
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12 and HRQoL in the older adults considered only an isolated domain or PA as a whole  
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14 (considering all domains of PA in a single block). Each PA domain has its specific  
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16 characteristics and must be considered in this relationship. Another factor is the  
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18 adjustment of this relationship for comorbidities, since they are important health risk  
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20 factors that may interfere in this relationship. In addition, the PA assessment by domains  
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22 can help to prevent the health costs generated by insufficient PA practice[43].  
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26 The present study has some limitations. The cross-sectional design of this study  
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28 does not allow cause and effect inference. The use of a questionnaire to assess the level  
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30 of PA did not allow a more robust assessment, although the instrument used has been  
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32 validated for older adults[27] and is widely used in the scientific community, in addition  
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34 to being validated against gold standard instruments for PA measurement such as doubly  
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36 marked water[44]. Weekly energy consumption related to PA, sarcopenia or frailty and  
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38 previous functionality (for example Barthel index score) were not measured which is  
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40 another limitation of the present study, because all of these are confusing variables in the  
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42 relationship between PA and HRQoL. The levels of PA in each domain can be influenced  
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44 by cultural differences, climatic factors, and developmental factors of each region and/or  
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46 country, what suggests that the results should be interpreted with caution, since the  
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48 present study was developed in only one Brazilian city and cannot be generalized to other  
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50 region of Brazil or other countries. Furthermore, the analyzed age group does not allow  
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52 extrapolation to other ages. However, it is worth emphasizing the importance of studies  
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54 with older adults, which comprises the fastest growing age group in the world, and which  
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3 has consequently changed demographic and epidemiological patterns. Besides that, this  
4 population has the largest prevalence of comorbidities[45], which seriously compromises  
5 the quality of life in the physical domain and tends to also affect the psychological  
6 health[46,47], and the practice of PA may promote improvement in HRQoL regardless  
7 of these health problems, mainly in relation to the domain of sports.  
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15 As positive aspects, we highlight the random sample, as well as the sample size,  
16 and the control of the variables by confounding factors in the analyses between PA and  
17 HRQoL. We also emphasize the evaluation of PA addressing different domains in older  
18 adults and considering the different domains of HRQoL. In addition, it is worth noting  
19 the collection and storage of data through electronic devices, optimizing the time in the  
20 collection process in the residences of the participants, as well as minimization of errors  
21 during data export and tabulation, which are complex tasks in a population study.  
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31 The results of the present study suggest the different domains of PA in  
32 work/occupation, sports/gym, and leisure/transportation activities are related in different  
33 and specific ways to the different domains of HRQoL. In addition, the practice of PA was  
34 related to higher HRQL in older adults in the different domains and in their entirety. Our  
35 findings reinforce the importance of studies encompassing different domains of PA for  
36 older adults, especially in middle-income countries. Taking advantage of public spaces to  
37 encourage and promote group activities for this population, especially in relation to the  
38 leisure time domain, could be a positive strategy.  
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## 51 **CONCLUSION**

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54 Given the results and despite presenting limitations in relation to the confounding  
55 factors that may influence the variables analyzed in the present study, it is suggested that  
56 participants involved in some kind of sport or in gym activities, usually practiced in  
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3 groups, presented a better functional capacity, regardless the presence of comorbidities in  
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5 older adults. Thus, exploring PA separately by domains may be an important tool for  
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7 monitoring and promoting more active and healthy lifestyles, and consequently  
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9 preserving HRQoL during aging.  
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## 17 **DECLARATIONS**

### 18 **Ethics approval and consent to participate**

19  
20 All procedures performed in studies involving human participants were in accordance  
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22 with the ethical standards of the institutional and/or national research committee and with  
23  
24 the 1964 Helsinki declaration and its later amendments or comparable ethical standards.  
25  
26 Informed consent was obtained from all individual participants included in this study.  
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28 The Research Ethics Committee Involving Human Beings of UNESP - São Paulo State  
29  
30 University approved this study (Protocol: 45486415.4.0000.5402).  
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### 38 **Consent for publication**

39  
40 Not applicable  
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### 45 **Availability of data and materials**

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47 All data generated or analysed during this study are included in this published article [and  
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49 its supplementary information files].  
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### 54 **Competing interests**

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56 The authors declare that they have no competing interests  
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## **Authors' contributions**

We declare that all authors named in this paper: Catarina Covolo Scarabottolo; Edilson Serpeloni Cyrino; Priscila Missaki Nakamura; William Rodrigues Tebar; Daniel da Silva Canhin; Luis Alberto Gobbo and Diego Giulliano Destro Christofaro participated in the present study based on the following 4 criteria about authorship recommendations:

- Substantial contributions to the conception or design of the work; or the acquisition, analysis, or interpretation of data for the work;
- Drafting the work or revising it critically for important intellectual content;
- Final approval of the version to be published;
- Agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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**STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies***

| Section/Topic                | Item # | Recommendation   | Reported on page # |
|------------------------------|--------|--|--------------------|
| <b>Title and abstract</b>    | 1      | (a) Indicate the study's design with a commonly used term in the title or the abstract   | 2                  |
|                              |        | (b) Provide in the abstract an informative and balanced summary of what was done and what was found  | 2                  |
| <b>Introduction</b>          |        |  |                    |
| Background/rationale         | 2      | Explain the scientific background and rationale for the investigation being reported   | 4, 5               |
| Objectives                   | 3      | State specific objectives, including any prespecified hypotheses   | 5                  |
| <b>Methods</b>               |        |  |                    |
| Study design                 | 4      | Present key elements of study design early in the paper  | 5, 6               |
| Setting                      | 5      | Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection  | 6, 7               |
| Participants                 | 6      | (a) Give the eligibility criteria, and the sources and methods of selection of participants  | 6, 7               |
| Variables                    | 7      | Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable   | 7 - 10             |
| Data sources/<br>measurement | 8*     | For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group | 7 - 10             |
| Bias                         | 9      | Describe any efforts to address potential sources of bias  | 5, 6               |
| Study size                   | 10     | Explain how the study size was arrived at  | 5, 6               |
| Quantitative variables       | 11     | Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why   | 9, 10              |
| Statistical methods          | 12     | (a) Describe all statistical methods, including those used to control for confounding  | 9, 10              |
|                              |        | (b) Describe any methods used to examine subgroups and interactions  | 9, 10              |
|                              |        | (c) Explain how missing data were addressed  | 6                  |
|                              |        | (d) If applicable, describe analytical methods taking account of sampling strategy   | -                  |
|                              |        | (e) Describe any sensitivity analyses  | -                  |
| <b>Results</b>               |        |  |                    |

|                          |     |  |         |
|--------------------------|-----|--|---------|
| Participants             | 13* | (a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed            | 10      |
|                          |     | (b) Give reasons for non-participation at each stage   | -       |
|                          |     | (c) Consider use of a flow diagram   | -       |
| Descriptive data         | 14* | (a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders   | 10 - 12 |
|                          |     | (b) Indicate number of participants with missing data for each variable of interest  | 13 - 17 |
| Outcome data             | 15* | Report numbers of outcome events or summary measures   | 13 - 17 |
| Main results             | 16  | (a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included | -       |
|                          |     | (b) Report category boundaries when continuous variables were categorized  | -       |
|                          |     | (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period   | -       |
| Other analyses           | 17  | Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses   | --      |
| <b>Discussion</b>        |     |  |         |
| Key results              | 18  | Summarise key results with reference to study objectives   | 18      |
| Limitations              | 19  | Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias   | 20, 21  |
| Interpretation           | 20  | Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence                                   | 21, 22  |
| Generalisability         | 21  | Discuss the generalisability (external validity) of the study results  | 21, 22  |
| <b>Other information</b> |     |  |         |
| Funding                  | 22  | Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based  | 23      |

\*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at [www.strobe-statement.org](http://www.strobe-statement.org).

# BMJ Open

## Relationship of different domains of physical activity practice with health-related quality of life among community-dwelling older people: a cross-sectional study.

|                                 |  |
|---------------------------------|--|
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| <b>Primary Subject Heading</b>: | Epidemiology   |
| Secondary Subject Heading:      | Epidemiology   |
| Keywords:                       | physical activity, elderly, quality of life, EPIDEMIOLOGY, PUBLIC HEALTH   |
|                                 |  |

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3 **Relationship of different domains of physical activity practice with health-related**  
4 **quality of life among community-dwelling older people: a cross-sectional study.**  
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## ABSTRACT

**Objectives:** to analyze the association between different domains of physical activity (PA) and health related domains of health-related quality of life (HRQoL) in older adults, independent of confounding variables. **Design:** Cross-sectional study.

**Participants:** In total, 400 individuals of 60 years or above were randomly selected to participate in the study. **Primary and secondary outcome measures:** The PA was assessed by a questionnaire in three different domains (work/occupational, sports/gym, and leisure time) and total PA. The 36-item Short Form Health Survey (SF-36) was used to evaluate HRQoL. Variables of socioeconomic condition, marital status, and presence of health-professional diagnosed comorbidities were self-reported. **Results:** The mean age of the sample was 71.5 ( $\pm 8.4$ ) years, of which 58% (n=232) were female. Male older adults showed higher scores of PA in sports, leisure time, and in total than females. Older adults who were more physically active in the work/occupational domain were associated with better scores of functional capacity (OR=1.73, 95% CI=1.02; 2.93) and general health perception (OR=1.61, 95% CI=1.02; 2.56). Those who presented a higher score in actives in the sports/gym domain were associated with better scores of functional capacity, even after adjustment for comorbidities (OR=1.72, 95% CI=1.01; 2.96). Individuals with higher activity in leisure time were more likely to have better scores of functional capacity (OR=1.75, 95% CI=1.03; 2.98), body pain (OR=1.74, 95% CI=1.09; 2.78), and mental health (OR=1.67, 95% CI=1.03; 2.69). Older adults who were more active in total PA score were 77% more likely to have better scores of functional capacity (OR=1.77, 1.04; 3.02). **Conclusion:** Physically active older adults in the different domains of PA presented better HRQoL parameters, reinforcing the importance of studies analyzing PA in different contexts and in countries with low and medium socioeconomic conditions.

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3 **Keywords:** Physical activity, elderly, epidemiology, quality of life.  
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5 **ARTICLE SUMMARY**  
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8 **Strengths and limitations of this study**  
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11 **Limitations:**  
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15 ➤ This study has a cross-sectional design that does not allow cause and effect  
16 inference.  
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18 ➤ The use of a questionnaire to assess the level of physical activity did not allow a  
19 more robust assessment.  
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25 **Strengths:**  
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28 ➤ We highlight the random sample, as well as the sample size of older adults, and  
29 the control of the variables by confounding factors in the analyses between  
30 physical activity and health related quality of life.  
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32 ➤ The evaluation of physical activity addressing different domains in older adults,  
33 and considering the different domains of health related quality of life.  
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35 ➤ It is worth noting the collection and storage of data through electronic devices to  
36 minimize errors during data export and tabulation, which are complex tasks in a  
37 population study.  
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## INTRODUCTION

Insufficient physical activity is among the top 10 health risk factors[1] and is the fourth cause of mortality in the world[2]. In 2015, non-communicable chronic diseases accounted for 70% of deaths globally, with 78% of these deaths occurring in countries with low and medium socioeconomic status[3].

The benefits that regular physical activity (PA) can provide are well established, and yet the global pandemic of insufficient physical activity remains[4]. Benefits promoted by PA can be explored through different domains: i) work/occupation, comprising physical activities performed in the work environment or in domestic activities or gardening, ii) leisure time, corresponding to activities in the off work time and in regard to active commuting by cycling or walking, and iii) sports practices/gym, comprising physical activities performed in sports modalities or physical training. In this sense, there are some factors that can influence the prevalence of physically active people in each of the domains, such as cultural and demographic issues, as well as sex and chronological age[5,6].

Both physical health and mental health influence quality of life, which is understood as a subjective and multifactorial parameter[7]. Health-related quality of life (HRQoL) includes different domains in relation to how the individual feels about their experiences, involving perceptions of physical and psychological health, functional and social aspects, and general condition of life, making it an important part of any clinical examination[8,9]. Some studies affirm that physically active individuals are more likely to present better quality of life[10,11] and/or better HRQoL parameters[12–15]. However, little is known about this relation when these two variables (PA and HRQoL) are analyzed separated by different domains. Studies carried out in Brazil with older adults considering this issue used the total PA measure[10,11].

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3 Currently, the older adult population is the fastest growing segment in the  
4 world[16]. In Brazil, the estimation is that the older adult population, composed of 14  
5 million people in 2010, will be around 70.5 million people by 2060[17] and it is known  
6 that the more chronological age increases, the less physically active people become[18].  
7 Thus, the physiological and cognitive declines that occur naturally during the aging  
8 process can be aggravated when individuals adopt lifestyle habits with insufficient  
9 physical activity[19], affecting general health and HRQoL.  
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19 Evaluation and continuous monitoring of PA by domains can help in the  
20 execution of interventions to promote PA more effectively. It is unclear in the literature  
21 whether the PA level of older adults, separated into each of the PA domains, is  
22 associated differently with HRQoL, or if this relationship is independent of confounding  
23 variables such as gender, age, and socioeconomic status, since these variables may be  
24 related to quality of life[20,21] and PA[22].  
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33 Thus, the objective of the present study was to analyze the different domains of  
34 PA practice and possible associations with HRQoL in older adults.  
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## 40 **METHODS**

### 41 **Sample calculation**

42 This is a cross-sectional study, composed of older adults of the city of Presidente  
43 Prudente, Brazil. Presidente Prudente is located in the western region of the state of São  
44 Paulo - Brazil, with a Human Development Index (indicator of human development  
45 level, ranging from 0 [poor] to 1 [better]) of 0.806 and approximately 207,610  
46 people[23]. Considering that the prevalence of HRQoL in different domains is not  
47 consensual in the literature and a previous pilot-study was not carried out, a prevalence  
48 of 50% for unknown binary outcome was used, which is considered as a conservative  
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3 solution and maximizes the sample size for a common outcome in epidemiological  
4 descriptive studies[24]. Thus, a tolerable error of 5% and a study power of 80% were  
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6 also considered, resulting in a minimum sample size of 379. At the end of the study, a  
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8 total of 419 older adults were evaluated, with exclusion of 19 participants for  
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10 incomplete PA or HRQoL data, resulting in 400 older adults for the data analysis.  
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### 18 **Participant selection process**

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20 The city of Presidente Prudente does not have a clear geographical or  
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22 demographical division. In this sense, with the support of the city map, postal codes,  
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24 and the list of streets available on the city council website, the city of Presidente  
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26 Prudente was divided into five geographical regions (north, south, east, west, and  
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28 central). In each of these regions a list of all districts and streets was compiled, which  
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30 were randomly selected for being visited. In this way, all streets in each region had the  
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32 opportunity to be selected. The researchers were distributed in pairs to perform  
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34 recruitment of the participants, door to door, and all the residences of the selected streets  
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36 were approached once. After explaining the research, all individuals from each  
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38 household who met the inclusion criteria were considered eligible and invited to  
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40 participate in the study. Participants were instructed to make a chair available and the  
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42 research was conducted in front of the home or inside the house. In cases where the  
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44 participant declined to participate, the next household was visited, until the required  
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46 sample size had been reached.  
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52 The following inclusion criteria were considered: (a) age equal to or greater than  
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54 60 years; (b) resident in the city of Presidente Prudente for at least two years. Exclusion  
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56 criteria: (a) being in a wheelchair or other disabilities that do not allow the individual to  
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58 stand and walk and consequently present an underestimation of habitual practice of PA  
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3 measured by the adopted questionnaire; and (b) presenting any kind of cognitive  
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5 deficiency that would prevent understanding of the questions. All participants signed  
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7 the Patient Consent Form. The group of interviewers was composed of graduate and  
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9 postgraduate students, all of whom received previous training. The interviews lasted  
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11 approximately 40 minutes, and the survey was conducted between March 2016 and  
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13 February 2017. The Research Ethics Committee Involving Human Beings of UNESP -  
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15 São Paulo State University approved this study (Protocol: 45486415.4.0000.5402).  
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### 21 **Comorbidities**

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24 The participants were asked if they had the following chronic diseases diagnosed  
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26 by a health-professional: Hypertension, Diabetes, Elevated LDL Cholesterol, and  
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28 Elevated Triglycerides. They were required to answer “Yes” or “No” for each  
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30 comorbidity. This information was used to adjustment of the analysis.  
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### 36 **Anthropometry**

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39 Anthropometric measurements were performed to measure body mass and  
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41 height, using a digital scale, Wiso brand (model: w912, Lot: 13A01, China), and a  
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43 portable stadiometer with a maximum length of two meters, respectively. All  
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45 measurements were performed according to the description of Freitas Jr et al[25]. Thus,  
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47 body mass index (BMI) was calculated using the equation: body mass in kg divided by  
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49 height in meters squared.  
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### 55 **Physical activity practice**

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3 Physical activity practice was measured using the Baecke questionnaire[26],  
4 previously validated for Brazilian older adults[27]. This questionnaire evaluates the  
5 total PA in three domains: PA in the work environment or in domestic occupations (8  
6 items), PA in sports practices or in activities performed at a gym (10 items), and PA  
7 during leisure time or during transportation (4 items). The questionnaire contains a  
8 Likert scale with the answer options: never, rarely, sometimes, often, and always. At the  
9 end, the instrument provides a dimensionless score in relation to the practice of PA in  
10 each of the three domains, as well as a total score from the sum of these three domains.  
11 The older adults in the highest quartile (Q4) were classified as “highly active” and those  
12 in the lower quartiles were classified as “less active” (Q1, Q2, and Q3).  
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### 28 **Health related quality of life**

31 HRQoL was evaluated using the 36-item Short Form Health Survey (SF-36).  
32 The SF-36 questionnaire consists of 36 items covering eight domains: functional  
33 capacity, physical limitations, body pain, general health perception, vitality, social  
34 aspects, emotional limitations, and mental health. The SF-36 questionnaire presents a  
35 final score of 0 to 100, where 0 represents the worst score and 100 represents the best  
36 score in relation to the general state of health and quality of life[28]. The sample was  
37 divided into quartiles, with those located in the highest quartile (Q4) classified as  
38 having high HRQoL and those in the lower quartiles classified as having low HRQoL  
39 (Q1, Q2, and Q3).  
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### 56 **Sociodemographic variables**

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3 The "Brazilian Economic Classification Criteria" was used to determine the  
4 economic condition of the families, established in 2014 by the Brazilian Association of  
5 Research Companies (ABEP), according to a survey database carried out in 2009 by the  
6 Brazilian Institute of Public Opinion and Statistics[29]. The questionnaire takes into  
7 account the degree of education and the presence and quantity of certain rooms and  
8 belongings in the analyzed home (bathrooms, domestic servants, automobiles,  
9 microcomputer/computers, dishwasher, refrigerator, freezer, DVD player, washing  
10 machine, and dryer machine). It establishes the following classifications for economic  
11 condition: A1, B1, B2, C1, C2, and D - E. After classification of the participants using  
12 the questionnaire, the sample was distributed into: high economic class composed of  
13 categories A1 and B1, average economic class composed of classes B2 and C1, and low  
14 economic class composed of categories C2 and D - E. The marital status was self-  
15 reported using the following options: i) single; ii) married; iii) widower; iv) divorced.

### 35 **Data Collection and Storage**

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38 All data were collected electronically using tablets (Tablet Galaxy TAB 3 WFI  
39 7PBCO2, Tablet Galaxy TAB 3 T2100, Tablet DL TP258PIN) or cellular phones with  
40 an android system (Motorola XT1032; Samsung Galaxy SM-G530H) through the Open  
41 Data Kit program (ODK). This tool stores all the information without needing an  
42 internet connection. Subsequently, the data is sent to a storage platform using an  
43 internet connection, and exported to an excel spreadsheet for data analysis.

### 54 **Statistical analysis**

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57 The sample characteristics are presented as median and interquartile range,  
58 compared between sexes by the Mann Whitney U test for nonparametric data.  
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Information about the practice of PA and HRQoL in the population of the present study was presented in frequencies. The associations of PA practice in the different domains and in its totality with HRQoL were analyzed through the Chi-square test. The magnitude of these associations was verified through Binary Logistic Regression in two models. Model 1 was adjusted by sex, age, marital status, and socioeconomic condition, and Model 2 by the variables of model 1 plus the presence of the reported comorbidities (Hypertension, Diabetes, Elevated LDL Cholesterol, and Elevated Triglycerides) simultaneously. The statistical program used was SPSS version 20.0 (IBM Corporation), with a confidence interval of 95% and level of significance set as  $p < 0.05$ . Aiming to reduce the probability of type I errors due to the multiple comparison tests performed in the regression models, an extra analysis with a confidence interval of 99% was adopted to provide more robust adjustment of evidence.

### **Patient and Public Involvement**

Patients and or the public were not involved in the research.

### **RESULTS**

In total, 400 older adults, with a mean age of 71.5 ( $\pm 8.4$ ) years, participated in the study, of which 232 were female (58%). For the marital status, the majority of the sample was married (55.8%), followed by widower (23.4%), divorced (10.3%), single (9.3%), and 1.2% did not respond. The reported comorbidities were observed in 63.9% for Hypertension, 24.1% for Diabetes, 24.9% for Elevated LDL Cholesterol, and 11.1% for Elevated Triglycerides. In relation to the PA level, the proportion of highly physically active individuals was higher among men than women in total score (39.3% [95% CI= 34.5-44.0] vs. 17.8% [95% CI= 14.0-21.5]), in leisure time (47.5% [95% CI=

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3 42.6-52.4] vs. 17.8% [95% CI= 14.0-21.5]), and in the sports domain (38.0% [95% CI=  
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5 33.2-42.8] vs. 22.5% [95% CI= 18.4-26.6]), being lower among men than women only  
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7 in the work/occupational domain (23.5% [95% CI= 19.3-27.7] vs. 36.8% [95% CI=  
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9 32.0-41.5]). Table 1 shows the characteristics of the sample and comparisons according  
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11 to sex.  
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**Table 1. Characterization of the sample (n = 400, Presidente Prudente - SP, Brazil, 2017).**

|                               | <b>Overall Sample<br/>Median (Min. - Max.)</b> | <b>Males<br/>Median (IR)</b> | <b>Females<br/>Median (IR)</b> | <b>p-value*</b> |
|-------------------------------|--|------------------------------|--------------------------------|-----------------|
| Age (years)                   | 70.0 (60.0 - 97.0)                             | 71.0 (65.0-77.0)             | 70.0 (65.0-77.0)               | 0.370           |
| Height (meters)               | 1.60 (1.37 - 1.88)                             | 1.68 (1.64-1.73)             | 1.54 (1.50-1.59)               | 0.001           |
| Weight (kilograms)            | 70.5 (36.6 – 127.5)                            | 74.9 (65.1-83.9)             | 67.0 (57.6-76.2)               | 0.001           |
| BMI (kg/m <sup>2</sup> )      | 27.2 (17.4 - 42.6)                             | 26.3 (23.5-29.2)             | 27.7 (24.0-31.5)               | 0.061           |
| PA Work/occupation score      | 2.88 (1.00 – 4.50)                             | 2.75 (2.13 – 3.13)           | 3.00 (2.50 – 3.38)             | 0.001           |
| PA Sports/Gym score           | 1.75 (1.00 – 4.25)                             | 2.00 (1.50 – 2.25)           | 1.75 (1.50 – 2.00)             | 0.001           |
| PA Leisure score              | 6.50 (3.25 – 14.25)                            | 7.50 (5.75 – 8.75)           | 5.75 (4.50 – 7.25)             | 0.001           |
| PA Total score                | 11.00 (5.80 – 19.00)                           | 12.13 (9.88 – 14.00)         | 10.50 (8.94 – 12.25)           | 0.001           |
| <b>HRQoL domains (scores)</b> |  |                              |                                |                 |
| Functional capacity           | 75.0 (0.0 - 100.0)                             | 80.0 (60.0-95.0)             | 65.0 (40.0-85.0)               | 0.001           |
| Physical limitations          | 100.0 (0.0 - 100.0)                            | 100.0 (25.0-100.0)           | 100.0 (90.0-100.0)             | 0.080           |
| Body pain                     | 62.00 (0.0 - 100.0)                            | 72.0 (51.0-100.0)            | 61.0 (41.0-84.0)               | 0.006           |
| General health perception     | 72.00 (0.0 - 100.0)                            | 72.0 (62.0-82.0)             | 70.0 (56.0-82.0)               | 0.259           |
| Vitality                      | 75.00 (0.0 - 100.0)                            | 80.0 (70.0-90.0)             | 70.0 (55.0-80.0)               | 0.001           |
| Social aspects                | 100.0 (0.0 - 100.0)                            | 100.0 (75.0-100.0)           | 87.5 (75.0-100.0)              | 0.001           |
| Emotional limitations         | 100.0 (0.0 - 100.0)                            | 100.0 (90.0-100.0)           | 100.0 (90.0-100.0)             | 0.112           |
| Mental health                 | 80.0 (0.0 - 100.0)                             | 80.0 (72.0-92.0)             | 76.0 (64.0-86.0)               | 0.011           |

\*p-value for the Mann Whitney U test. Min.= minimum value; Max.= maximum value; IR= Interquartile range; BMI= Body Mass Index; PA=Physical activity; HRQoL= Health related quality of life; Kg/m<sup>2</sup>= kilograms by meter squared.

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3 Table 2 presents the associations related to physical activities performed at work  
4 or in domestic occupations, sports practice and/or practices of activities performed at a  
5 gym, activities performed during leisure time and/or during transportation, and the total  
6 sum of these activities, with the eight domains of HRQoL. The practice of PA in  
7 work/occupation was associated with a higher HRQoL considering the domain of  
8 functional capacity. Older adults who participated in sports practices or activities in a  
9 gym presented a better general health perception. There was no significant association  
10 between being highly active in the leisure domain or during transportation and the  
11 domains of HRQoL. Regarding the total score of PA domains, highly active older adults  
12 presented a higher HRQoL in relation to functional capacity, perception of less body  
13 pain, and social aspects than less active older adults.  
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**Table 2. Prevalence of highly active older adults according to the HRQoL domains.**

| Variable   | n total<br>(n=400) | Occupation/work          | Sport/Gym                | Leisure                 | Total Score              |
|------------|--------------------|--------------------------|--------------------------|-------------------------|--------------------------|
|            | n                  | n (% [95% CI])           | n (% [95% CI])           | n (% [95% CI])          | n (%[95% CI])            |
| <b>FC</b>  |                    |                          |                          |                         |                          |
| Low QL     | 111                | 23 (20.7 [13.2 – 28.3])* | 26 (23.4 [15.5 – 31.3])  | 31 (27.9 [19.6 – 36.3]) | 27 (24.3 [16.3 – 32.3])* |
| High QL    | 288                | 93 (32.3 [26.9 – 37.7])* | 88 (30.6 [25.2 – 35.9])  | 87 (30.2 [24.9 – 35.5]) | 102 (35.4[29.9 – 40.9])* |
| <b>PL</b>  |                    |                          |                          |                         |                          |
| Low QL     | 122                | 33 (27.0 [19.2 – 34.9])  | 31 (25.4 [17.7 – 33.1])  | 37 (30.3 [22.2 – 38.5]) | 35 (28.7 [20.7 – 36.7])  |
| High QL    | 278                | 83 (29.9 [24.5 – 35.2])  | 83 (29.9 [24.5 – 35.2])  | 81 (29.1 [23.8 – 34.5]) | 94 (33.8 [28.3 – 39.4])  |
| <b>BP</b>  |                    |                          |                          |                         |                          |
| Low QL     | 141                | 42 (29.8 [22.2 – 37.3])  | 37 (26.2 [19.0 – 33.5])  | 36 (25.5 [18.3 – 32.7]) | 36 (25.5 [18.3 – 32.7])* |
| High QL    | 259                | 74 (28.6 [23.1 – 34.1])  | 77 (29.7 [24.2 – 35.3])  | 82 (31.7 [26.0 – 37.3]) | 93 (35.9 [30.1 – 41.8])* |
| <b>GHP</b> |                    |                          |                          |                         |                          |
| Low QL     | 100                | 26 (26.0 [17.4 – 34.6])  | 20 (20.0 [12.2 – 27.8])* | 29 (29.0 [20.1 – 37.9]) | 30 (30.0 [21.0 – 39.0])  |
| High QL    | 300                | 90 (30.0 [24.8 – 35.2])  | 94 (31.3 [26.1 – 36.6])* | 89 (29.7 [24.5 – 34.8]) | 99 (33.0 [27.7 – 38.3])  |
| <b>VI</b>  |                    |                          |                          |                         |                          |
| Low QL     | 111                | 26 (23.4 [15.5 – 31.3])  | 31 (27.9 [19.6 – 32.3])  | 31 (27.9 [19.6 – 32.3]) | 28 (25.2 [17.2 – 33.3])  |
| High QL    | 289                | 90 (31.1 [25.8 – 31.1])  | 83 (28.7 [23.5 – 28.7])  | 87 (30.1 [24.8 – 35.4]) | 101 (34.9 [29.5 – 40.5]) |
| <b>AS</b>  |                    |                          |                          |                         |                          |
| Low QL     | 146                | 37 (25.3 [18.3 – 32.4])  | 36 (24.7 [17.7 – 31.7])  | 36 (24.7 [17.7 – 31.7]) | 35 (24.0 [17.1 – 30.9])* |
| High QL    | 254                | 79 (31.1 [25.4 – 36.8])  | 78 (30.7 [25.0 – 36.4])  | 82 (32.2 [26.5 – 38.0]) | 94 (37.0 [31.1 – 42.9])* |
| <b>EL</b>  |                    |                          |                          |                         |                          |
| Low QL     | 87                 | 24 (27.6 [18.2 – 37.0])  | 20 (23.0 [14.2 – 31.8])  | 26 (29.9 [20.3 – 39.5]) | 25 (28.7 [19.2 – 38.2])  |
| High QL    | 313                | 92 (29.4 [24.4 – 34.4])  | 94 (30.0 [24.9 – 35.1])  | 92 (29.4 [24.4 – 34.4]) | 104 (33.2 [28.0 – 38.5]) |
| <b>MH</b>  |                    |                          |                          |                         |                          |
| Low QL     | 116                | 27 (23.3 [15.6 – 31.0])  | 31 (26.7 [18.7 – 34.8])  | 36 (31.0 [22.6 – 39.5]) | 36 (31.0 [22.6 – 39.5])  |
| High QL    | 284                | 89 (31.3 [25.9 – 36.7])  | 83 (29.2 [23.9 – 34.5])  | 82 (28.9 [23.6 – 34.1]) | 93 (32.7 [27.3 – 38.2])  |

\*Statistical difference by Chi-square test for distribution. QL = health related quality of life; FC = functional capacity; PL = physical limitations; BP = body pain; GHP = general health perception; VI = vitality; SA = social aspects; EL = emotional limitations; MH = mental health

Tables 3 and 4 present information on the magnitude of associations between the different domains of PA and the domains of HRQoL. In the work/occupation domain, the highly active older adults were 73% more likely to demonstrate better functional capacity and 61% more likely to have a better global health perception than the less active older adults. High PA through gym practice and/or sports practice was associated with more than 70% higher functional capacity, even after adjustment for comorbidities. In regard to the PA in leisure time, highly active older adults were 75% more likely to have better functional capacity, 74% more likely to have less body pain, and 67% more likely to have better mental health than the less active participants, while body pain and mental health remained significant even after adjustment for comorbidities. When

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3 analyzing the three domains of PA together in total score, highly active older adults  
4 were 77% more likely to have high HRQoL for functional capacity than the less active  
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8 older adults. However, none of the observed associations remained significant at the  
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10 99% confidence interval level.  
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**Table 3. Association of highly active older adults at occupational/work and at sports/gym with HRQoL domains.**

|            | Highly active at occupation/work |                   |            |        |            |            | Highly active at sports/gym |                   |            |             |                   |            |
|------------|----------------------------------|-------------------|------------|--------|------------|------------|-----------------------------|-------------------|------------|-------------|-------------------|------------|
|            | Model1                           |                   |            | Model2 |            |            | Model1                      |                   |            | Model2      |                   |            |
|            | OR                               | 95%CI             | 99% CI     | OR     | 95%CI      | 99% CI     | OR                          | 95%CI             | 99% CI     | OR          | 95%CI             | 99% CI     |
| <b>FC</b>  |                                  |                   |            |        |            |            |                             |                   |            |             |                   |            |
| Low QL     | 1.00                             | -                 | -          | 1.00   | -          | -          | 1.00                        | -                 | -          | 1.00        | -                 | -          |
| High QL    | <b>1.73</b>                      | <b>1.02; 2.93</b> | 0.87; 3.45 | 1.52   | 0.89; 2.61 | 0.75; 3.09 | <b>1.78</b>                 | <b>1.05; 3.02</b> | 0.89; 3.56 | <b>1.72</b> | <b>1.01; 2.96</b> | 0.85; 3.50 |
| <b>PL</b>  |                                  |                   |            |        |            |            |                             |                   |            |             |                   |            |
| Low QL     | 1.00                             | -                 | -          | 1.00   | -          | -          | 1.00                        | -                 | -          | 1.00        | -                 | -          |
| High QL    | 1.35                             | 0.85; 2.13        | 0.74; 2.45 | 1.20   | 0.75; 1.92 | 0.65; 2.22 | 1.03                        | 0.65; 1.65        | 0.56; 1.92 | 1.04        | 0.64; 1.68        | 0.55; 1.95 |
| <b>BP</b>  |                                  |                   |            |        |            |            |                             |                   |            |             |                   |            |
| Low QL     | 1.00                             | -                 | -          | 1.00   | -          | -          | 1.00                        | -                 | -          | 1.00        | -                 | -          |
| High QL    | 0.89                             | 0.56; 1.42        | 0.48; 1.65 | 0.82   | 0.51; 1.32 | 0.44; 1.54 | 1.12                        | 0.70; 1.79        | 0.60; 2.09 | 1.10        | 0.68; 1.78        | 0.59; 2.07 |
| <b>GHP</b> |                                  |                   |            |        |            |            |                             |                   |            |             |                   |            |
| Low QL     | 1.00                             | -                 | -          | 1.00   | -          | -          | 1.00                        | -                 | -          | 1.00        | -                 | -          |
| High QL    | <b>1.61</b>                      | <b>1.02; 2.56</b> | 0.88; 2.96 | 1.48   | 0.92; 2.38 | 0.79; 2.76 | 1.49                        | 0.92; 2.40        | 0.80; 2.79 | 1.47        | 0.91; 2.39        | 0.78; 2.78 |
| <b>VI</b>  |                                  |                   |            |        |            |            |                             |                   |            |             |                   |            |
| Low QL     | 1.00                             | -                 | -          | 1.00   | -          | -          | 1.00                        | -                 | -          | 1.00        | -                 | -          |
| High QL    | 1.03                             | 0.64; 1.65        | 0.55; 1.91 | 0.95   | 0.59; 1.54 | 0.51; 1.79 | 1.09                        | 0.67; 1.76        | 0.58; 2.05 | 1.08        | 0.67; 1.76        | 0.57; 2.04 |
| <b>SA</b>  |                                  |                   |            |        |            |            |                             |                   |            |             |                   |            |
| Low QL     | 1.00                             | -                 | -          | 1.00   | -          | -          | 1.00                        | -                 | -          | 1.00        | -                 | -          |
| High QL    | 1.24                             | 0.80; 1.92        | 0.70; 2.21 | 1.12   | 0.72; 1.76 | 0.63; 2.02 | 0.87                        | 0.55; 1.36        | 0.48; 1.57 | 0.87        | 0.55; 1.38        | 0.48; 1.59 |
| <b>EL</b>  |                                  |                   |            |        |            |            |                             |                   |            |             |                   |            |
| Low QL     | 1.00                             | -                 | -          | 1.00   | -          | -          | 1.00                        | -                 | -          | 1.00        | -                 | -          |
| High QL    | 1.33                             | 0.77; 2.31        | 0.65; 2.75 | 1.20   | 0.68; 2.10 | 0.57; 2.50 | 0.71                        | 0.40; 1.24        | 0.34; 1.48 | 0.70        | 0.40; 1.25        | 0.33; 1.49 |
| <b>MH</b>  |                                  |                   |            |        |            |            |                             |                   |            |             |                   |            |
| Low QL     | 1.00                             | -                 | -          | 1.00   | -          | -          | 1.00                        | -                 | -          | 1.00        | -                 | -          |
| High QL    | 1.19                             | 0.74; 1.91        | 0.64; 2.21 | 1.11   | 0.69; 1.80 | 0.59; 2.10 | 0.67                        | 0.40; 1.12        | 0.34; 1.32 | 0.70        | 0.42; 1.17        | 0.36; 1.38 |

Model 1=Adjusted for sociodemographic variables: sex, age, socioeconomic status, marital status; Model 2=Adjusted by Model 1 + self reported comorbidities: hypertension, diabetes, elevated triglycerides, elevated LDL cholesterol. QL = health related quality of life; FC = functional capacity; PL = physical limitations; BP = body pain; GHP = general health perception; VI = vitality; SA = social aspects; EL = emotional limitations; MH = mental health; \*Adjusted by sex, age, and socioeconomic condition; OR= Odds Ratio; CI=confidence interval. Bold values were statistically significant.

Table 4. Association of highly active older adults at leisure and in total with HRQoL domains.

|            | Highly active at Leisure |                   |            |             |                   |            | Highly active in Total score |                   |            |        |            |            |
|------------|--------------------------|-------------------|------------|-------------|-------------------|------------|------------------------------|-------------------|------------|--------|------------|------------|
|            | Model1                   |                   |            | Model2      |                   |            | Model1                       |                   |            | Model2 |            |            |
|            | OR                       | 95%CI             | 99% CI     | OR          | 95%CI             | 99% CI     | OR                           | 95%CI             | 99% CI     | OR     | 95%CI      | 99% CI     |
| <b>FC</b>  |                          |                   |            |             |                   |            |                              |                   |            |        |            |            |
| Low QL     | 1.00                     | -                 | -          | 1.00        | -                 | -          | 1.00                         | -                 | -          | 1.00   | -          | -          |
| High QL    | <b>1.75</b>              | <b>1.03; 2.98</b> | 0.87; 3.52 | 1.71        | 0.99; 2.95        | 0.84; 3.50 | <b>1.77</b>                  | <b>1.04; 3.02</b> | 0.88; 3.57 | 1.63   | 0.94; 2.82 | 0.79; 3.34 |
| <b>PL</b>  |                          |                   |            |             |                   |            |                              |                   |            |        |            |            |
| Low QL     | 1.00                     | -                 | -          | 1.00        | -                 | -          | 1.00                         | -                 | -          | 1.00   | -          | -          |
| High QL    | 1.04                     | 0.65; 1.68        | 0.56; 1.95 | 0.98        | 0.61; 1.60        | 0.52; 1.86 | 1.41                         | 0.86; 2.32        | 0.74; 2.71 | 1.33   | 0.84; 2.21 | 0.69; 2.59 |
| <b>BP</b>  |                          |                   |            |             |                   |            |                              |                   |            |        |            |            |
| Low QL     | 1.00                     | -                 | -          | 1.00        | -                 | -          | 1.00                         | -                 | -          | 1.00   | -          | -          |
| High QL    | <b>1.74</b>              | <b>1.09; 2.78</b> | 0.94; 3.22 | <b>1.63</b> | <b>1.02; 2.62</b> | 0.88; 3.04 | 1.52                         | 0.95; 2.45        | 0.81; 2.85 | 1.42   | 0.88; 2.31 | 0.75; 2.69 |
| <b>GHP</b> |                          |                   |            |             |                   |            |                              |                   |            |        |            |            |
| Low QL     | 1.00                     | -                 | -          | 1.00        | -                 | -          | 1.00                         | -                 | -          | 1.00   | -          | -          |
| High QL    | 1.52                     | 0.94; 2.47        | 0.81; 2.87 | 1.47        | 0.90; 2.41        | 0.77; 2.82 | 1.41                         | 0.87; 2.31        | 0.74; 2.69 | 1.31   | 0.80; 2.16 | 0.68; 2.53 |
| <b>VI</b>  |                          |                   |            |             |                   |            |                              |                   |            |        |            |            |
| Low QL     | 1.00                     | -                 | -          | 1.00        | -                 | -          | 1.00                         | -                 | -          | 1.00   | -          | -          |
| High QL    | 1.18                     | 0.73; 1.90        | 0.63; 2.20 | 1.18        | 0.73; 1.92        | 0.63; 2.23 | 1.03                         | 0.63; 1.68        | 0.54; 1.96 | 1.01   | 0.62; 1.66 | 0.53; 1.94 |
| <b>SA</b>  |                          |                   |            |             |                   |            |                              |                   |            |        |            |            |
| Low QL     | 1.00                     | -                 | -          | 1.00        | -                 | -          | 1.00                         | -                 | -          | 1.00   | -          | -          |
| High QL    | 0.97                     | 0.62; 1.54        | 0.53; 1.78 | 0.93        | 0.58; 1.48        | 0.50; 1.71 | 1.03                         | 0.65; 1.64        | 0.56; 1.90 | 0.97   | 0.60; 1.55 | 0.52; 1.80 |
| <b>EL</b>  |                          |                   |            |             |                   |            |                              |                   |            |        |            |            |
| Low QL     | 1.00                     | -                 | -          | 1.00        | -                 | -          | 1.00                         | -                 | -          | 1.00   | -          | -          |
| High QL    | 1.17                     | 0.65; 2.12        | 0.54; 2.56 | 1.11        | 0.61; 2.03        | 0.50; 2.45 | 1.34                         | 0.72; 2.47        | 0.59; 3.00 | 1.25   | 0.67; 2.34 | 0.55; 2.85 |
| <b>MH</b>  |                          |                   |            |             |                   |            |                              |                   |            |        |            |            |
| Low QL     | 1.00                     | -                 | -          | 1.00        | -                 | -          | 1.00                         | -                 | -          | 1.00   | -          | -          |
| High QL    | <b>1.67</b>              | <b>1.03; 2.69</b> | 0.89; 3.13 | <b>1.64</b> | <b>1.01; 2.66</b> | 0.87; 3.10 | 1.23                         | 0.75; 2.01        | 0.64; 2.35 | 0.83   | 0.51; 1.38 | 0.62; 2.32 |

\*p-value for Hosmer&Lemeshow goodness of fit test. Model 1=Adjusted for sociodemographic variables: sex, age, socioeconomic status, marital status; Model 2=Adjusted by Model 1 + self reported comorbidities: hypertension, diabetes, elevated triglycerides, elevated LDL cholesterol. QL = health related quality of life; FC = functional capacity; PL = physical limitations; BP = body pain; GHP = general health perception; VI = vitality; SA = social aspects; EL = emotional limitations; MH = mental health; \*Adjusted by sex, age and socioeconomic condition; OR= Odds Ratio; CI=confidence interval. Bold values were statistically significant.

## DISCUSSION

In the present study, the highly active older adults presented different associations with HRQoL domains, according to PA domains. Highly active older adults in the work/occupational PA domain presented higher scores for better functional capacity and general health perception. Being highly active in sports and in total score was associated with better scores of functional capacity. Those older adults who were highly active in the leisure time domain were more likely to have better scores of functional capacity, body pain, and mental health.

The majority of studies present the beneficial effects of total PA on physical and mental health in general[30]. However, when different contexts in which PA can be explored are analyzed separately, just as the different perceptions of HRQoL are reported separately by domains, the results should be observed more carefully. For example, the older adults classified as highly active at work or in domestic occupations demonstrated better functional capacity. In contrast to these results, Jurakic et al[31] found an inverse relationship between this domain and quality of life, showing that sufficiently active people in domestic activities reported having more pain in the body, probably due to repetitive movement efforts that may be part of the PA of that domain. However, older adults who are physically able to continue working, whether in the work environment or household work, are likely to preserve the ability to perform activities of daily living. On the other hand, those who opt for a lifestyle with insufficient practice of PA tend to accentuate the physiological processes of aging.

In relation to PA related to sports practices or exercises performed at a gym, the results of the present study presented better HRQoL for the functional capacity domain, regardless of the presence of comorbidities. These results are in agreement with Takata

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2  
3 et al[32], who verified that training directed to physical abilities can improve functional  
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5 capacity and quality of life in general.  
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8 In the case of PA in the field of leisure and/or transportation, several studies  
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10 have presented associations between this domain and quality of life[31,33–35]. The  
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12 present study observed a significant association between being highly active in leisure  
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14 time with better scores of functional capacity, body pain, and mental health. In this way,  
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16 PA in leisure time can provide benefits not only for physical health, but also for mental  
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18 health, noting that neuropsychiatric diseases are increasingly affecting older people[36].  
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20 In addition, the infrastructure of sidewalks and streets, as well as the insecurity of older  
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22 adults, can demotivate this population from opting for active transportation, and  
23  
24 consequently limit the increase in the benefits of this domain of PA on quality of life.  
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28 When total PA was analyzed, using the sum of all domains, the results presented  
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30 better HRQL for functional capacity. These results corroborate the findings in the  
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32 literature suggesting that people who present higher levels of PA, may present better  
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34 parameters of HRQoL[37–39]. In this sense, the accumulation of physical activities of  
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36 different domains and intensities may be able to positively affect HRQoL, due to the  
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38 increase in global levels of PA.  
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42 Despite evidence of the benefits that an active lifestyle provides for older  
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44 adults[10], the use of different tools in other studies to analyze the HRQoL and each  
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46 domain of PA separately, as well as total PA, makes it difficult to compare results. The  
47  
48 majority of studies use either total PA or the leisure time domain as an outcome, making  
49  
50 it difficult to compare our findings with other domains, such as activities in the work  
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52 environment or in domestic occupations, and activities practiced at a gym and their  
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54 relation with HRQoL. In addition, there is a lack of knowledge about this relationship in  
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3 countries with low and medium socioeconomic conditions as is the case of  
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5 Brazil[32,40–42].  
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8 One of the novelties of the present study is the analysis of different domains of  
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10 PA. The majority of studies that aimed to verify the relationship between the practice of  
11  
12 PA and HRQoL in older adults considered only an isolated domain or PA as a whole  
13  
14 (considering all domains of PA in a single block). Each PA domain has specific  
15  
16 characteristics and must be considered in this relationship. Another factor is the  
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18 adjustment of this relationship for comorbidities, since they are important health risk  
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20 factors that may interfere in this relationship. In addition, PA assessment by domains  
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22 can help to prevent the health costs generated by insufficient PA practice[43].  
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27 The present study has some limitations. The cross-sectional design of this study  
28  
29 does not allow cause and effect inference. The use of a questionnaire to assess the level  
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31 of PA did not allow a more robust assessment, although the instrument used has been  
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33 validated for older adults[27] and is widely used in the scientific community, in addition  
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35 to being validated against gold standard instruments for PA measurement such as  
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37 doubly marked water[44]. The Baecke's questionnaire does not provide information  
38  
39 about duration and intensity of physical activity, which does not allow classification of  
40  
41 the individuals into physically active according to the global recommendations. Due to  
42  
43 this lack of classification, the sample was categorized into quartiles and the 4<sup>th</sup> quartile  
44  
45 was considered as the most active, which necessarily divides the sample at 75% of its  
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47 distribution, independently of how active they were compared to other populations or  
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49 global recommendations. The present study was also limited through the assessment of  
50  
51 comorbidities, where the types were restricted. For instance, osteoarthritis could have an  
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53 impact on physical activity and health related quality of life and was not included and,  
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55 therefore, this is considered as one of the limitations of the study. Weekly energy  
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3 consumption related to PA, sarcopenia or frailty and previous functionality (for example  
4 Barthel index score) were not measured which is another limitation of the present study,  
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6 as all of these are confounding variables in the relationship between PA and HRQoL.  
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8 The levels of PA in each domain can be influenced by cultural differences, climatic  
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10 factors, and developmental factors of each region and/or country, suggesting that the  
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12 results should be interpreted with caution, since the present study was developed in only  
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14 one Brazilian city and cannot be generalized to other regions of Brazil or other  
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16 countries. A final limitation is that there are no data available on how many potential  
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18 participants declined to participate when invited since whenever the participant declined  
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20 to participate in the study the next household was visited until the required sample size  
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22 was reached. Furthermore, the observations did not remain significant at the 99%  
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24 confidence interval level, and may therefore have been susceptible to a false positive  
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26 bias. A possible hypothesis is due to the limitation of sample size, which was calculated  
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28 at a confidence level of 95% and compromised the power of evidence in the adjustment  
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30 for multiple comparisons.  
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38 However, it is worth emphasizing the importance of studies with older adults,  
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40 who comprise the fastest growing age group in the world, and have consequently  
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42 changed demographic and epidemiological patterns. In addition, this population has the  
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44 largest prevalence of comorbidities[45], which seriously compromises quality of life in  
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46 the physical domain and tends to also affect psychological health[46,47], and the  
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48 practice of PA may promote improvement in HRQoL regardless of these health  
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50 problems, mainly in relation to the sports domain.  
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55 As positive aspects, we highlight the random sample and the control of the  
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57 variables by confounding factors in the analyses between PA and HRQoL. We also  
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59 emphasize the evaluation of PA addressing different domains in older adults and  
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3 considering the different domains of HRQoL. In addition, it is worth noting the  
4 collection and storage of data through electronic devices, optimizing the time in the  
5 collection process in the residences of the participants, as well as minimization of errors  
6 during data export and tabulation, which are complex tasks in a population study.  
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12 The results of the present study suggest the different domains of PA in  
13 work/occupation, sports/gym, and leisure/transportation activities are related in different  
14 and specific ways to the different domains of HRQoL. In addition, the practice of PA  
15 was related to higher HRQL in older adults in the different domains and in their  
16 entirety. Our findings reinforce the importance of studies encompassing different  
17 domains of PA for older adults, especially in middle-income countries. Taking  
18 advantage of public spaces to encourage and promote group activities for this  
19 population, especially in relation to the leisure time domain, could be a positive  
20 strategy.  
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## 35 **CONCLUSION**

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38 Given the results and despite presenting limitations in relation to the  
39 confounding factors that may influence the variables analyzed in the present study, it is  
40 suggested that older adults involved in some kind of sport or in gym activities, usually  
41 practiced in groups, presented better functional capacity, regardless of the presence of  
42 comorbidities. Thus, exploring PA separately by domains may be an important tool for  
43 monitoring and promoting more active and healthy lifestyles, and consequently  
44 preserving HRQoL during aging.  
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## DECLARATIONS

### **Ethics approval and consent to participate**

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Informed consent was obtained from all individual participants included in this study. The Research Ethics Committee Involving Human Beings of UNESP - São Paulo State University approved this study (Protocol: 45486415.4.0000.5402).

### **Consent for publication**

Not applicable

### **Availability of data and materials**

All data generated or analysed during this study are included in this published article [and its supplementary information files].

### **Competing interests**

The authors declare that they have no competing interests

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### **Authors' contributions**

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2  
3 We declare that all authors named in this paper: Catarina Covolo Scarabottolo; Edilson  
4 Serpeloni Cyrino; Priscila Missaki Nakamura; William Rodrigues Tebar; Daniel da Silva  
5 Canhin; Luis Alberto Gobbo and Diego Giulliano Destro Christofaro participated in the  
6 present study based on the following 4 criteria about authorship recommendations:  
7  
8  
9

- 10 - Substantial contributions to the conception or design of the work; or the acquisition,  
11 analysis, or interpretation of data for the work;  
12
- 13 - Drafting the work or revising it critically for important intellectual content;  
14
- 15 - Final approval of the version to be published;  
16
- 17 - Agreement to be accountable for all aspects of the work in ensuring that questions  
18 related to the accuracy or integrity of any part of the work are appropriately  
19 investigated and resolved.  
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32 Not applicable.  
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**STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies***

| Section/Topic                | Item # | Recommendation   | Reported on page # |
|------------------------------|--------|--|--------------------|
| <b>Title and abstract</b>    | 1      | (a) Indicate the study's design with a commonly used term in the title or the abstract   | 2                  |
|                              |        | (b) Provide in the abstract an informative and balanced summary of what was done and what was found  | 2                  |
| <b>Introduction</b>          |        |  |                    |
| Background/rationale         | 2      | Explain the scientific background and rationale for the investigation being reported   | 4, 5               |
| Objectives                   | 3      | State specific objectives, including any prespecified hypotheses   | 5                  |
| <b>Methods</b>               |        |  |                    |
| Study design                 | 4      | Present key elements of study design early in the paper  | 5, 6               |
| Setting                      | 5      | Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection  | 6, 7               |
| Participants                 | 6      | (a) Give the eligibility criteria, and the sources and methods of selection of participants  | 6, 7               |
| Variables                    | 7      | Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable   | 7 - 10             |
| Data sources/<br>measurement | 8*     | For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group | 7 - 10             |
| Bias                         | 9      | Describe any efforts to address potential sources of bias  | 5, 6               |
| Study size                   | 10     | Explain how the study size was arrived at  | 5, 6               |
| Quantitative variables       | 11     | Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why   | 9, 10              |
| Statistical methods          | 12     | (a) Describe all statistical methods, including those used to control for confounding  | 9, 10              |
|                              |        | (b) Describe any methods used to examine subgroups and interactions  | 9, 10              |
|                              |        | (c) Explain how missing data were addressed  | 6                  |
|                              |        | (d) If applicable, describe analytical methods taking account of sampling strategy   | -                  |
|                              |        | (e) Describe any sensitivity analyses  | -                  |
| <b>Results</b>               |        |  |                    |

|                          |     |  |         |
|--------------------------|-----|--|---------|
| Participants             | 13* | (a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed            | 10      |
|                          |     | (b) Give reasons for non-participation at each stage   | -       |
|                          |     | (c) Consider use of a flow diagram   | -       |
| Descriptive data         | 14* | (a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders   | 10 - 12 |
|                          |     | (b) Indicate number of participants with missing data for each variable of interest  | 13 - 17 |
| Outcome data             | 15* | Report numbers of outcome events or summary measures   | 13 - 17 |
| Main results             | 16  | (a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included | -       |
|                          |     | (b) Report category boundaries when continuous variables were categorized  | -       |
|                          |     | (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period   | -       |
| Other analyses           | 17  | Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses   | --      |
| <b>Discussion</b>        |     |  |         |
| Key results              | 18  | Summarise key results with reference to study objectives   | 18      |
| Limitations              | 19  | Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias   | 20, 21  |
| Interpretation           | 20  | Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence                                   | 21, 22  |
| Generalisability         | 21  | Discuss the generalisability (external validity) of the study results  | 21, 22  |
| <b>Other information</b> |     |  |         |
| Funding                  | 22  | Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based  | 23      |

\*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at [www.strobe-statement.org](http://www.strobe-statement.org).