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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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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

be aggravated when individuals adopt lifestyle habits with insufficient physical activity [16], reflecting on general health and HRQoL.

Evaluation and continuous monitoring of PA by domains can help in the execution of interventions to promote PA more effectively. It is unclear in the literature whether the PA level of the elderly population, separated into each of the PA domains, is associated differently with HRQoL, as well as if this relationship is independent of confounding variables such as gender, age, and socioeconomic status, since these variables may be related to quality of life [17,18] and PA [19].

Thus, the objective of the present study was to analyze the different domains of PA practice and possible associations with HRQoL in the elderly.

MATERIALS E METHOD

Sample calculation and participant selection process

This is a cross-sectional study with an analytical and descriptive character. Individuals aged 60 and over, of both sexes, living in the city of Presidente Prudente – SP, Brazil were interviewed. The city is located in the western state of São Paulo - Brazil, has an HDI of 0.806 and approximately 207,610 people [20]. Considering a maximum expected prevalence of 50% [21] and a tolerable error of 5% the minimum number of elderly required for the present study was 379.

With the support of a city map and the list of streets available on the city council website, the city of Presidente Prudente was divided into five regions (north, south, east, west, and central), and in each of these regions streets were randomly selected. In the selected streets, the researchers were distributed in pairs and all the residences of the selected streets were approached once. After explaining the research, all individuals from

each household who met the inclusion criteria were considered eligible and invited to participate in the study.

Participants were instructed to make a chair available and the research was conducted in front of the home of the elderly, or inside the house. The following inclusion criteria were considered: (a) age equal to or greater than 60 years; (b) resident in the city for at least two years. Exclusion criteria: (a) being in a wheelchair; or (b) presenting any kind of cognitive deficiency that would prevent understanding of the questions. All participants signed the Informed Consent Term. The group of interviewers was composed of postgraduate students and students of scientific initiation, all of whom received previous training. The interviews lasted approximately 40 minutes, and the survey was conducted between March 2016 and February 2017. This study was approved by the Research Ethics Committee Involving Human Beings (Protocol: 45486415.4.0000.5402).

Anthropometry

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

Physical activity practice

Physical activity practice was measured using the Baecke questionnaire [23], previously validated for the Brazilian elderly population [24]. This questionnaire

evaluates the total PA in three domains: PA in the work environment or in domestic occupations, PA in sports practices or in activities performed at a gym; PA during leisure time or during displacement. The questionnaire contains a Likert scale with the response options: never, rarely, sometimes, often, and always. At the end, the instrument provides a score in relation to the practice of physical activity in each of the three domains, as well as a total score from the sum of these three domains. The elderly in the highest quartile (Q4) were classified as sufficiently active and the elderly in the lower quartiles were classified as insufficiently active (Q1, Q2, and Q3).

Health related quality of life

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

Socioeconomic condition

In order to determine the economic condition of the families, the "Brazilian Economic Classification Criteria" was used, established in 2014 by the Brazilian Association of Research Companies (ABEP), according to a survey database carried out

in 2009 by the Brazilian Institute of Public Opinion and Statistics [26]. The questionnaire takes into account the degree of education and presence and quantity of certain rooms and belongings in the analyzed home (bathrooms, domestic servants, automobiles, microcomputer/computers, dishwasher, refrigerator, freezer, DVD player, washing machine, and dryer machine). It establishes the following classifications for economic condition: A1, B1, B2, C1, C2, and D - E. After the classification of the participants by means of the instrument, the sample was distributed into: high economic class composed of categories A1 and B1, average economic class composed of classes B2 and C1, and low economic class composed of categories C2 and D - E.

Data Collection and Storage (ODK)

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

Statistical analysis

The sample characteristics are presented as mean and standard deviation. Information on the practice of PA and HLQoL in the population of the present study is presented in frequencies. The associations of PA practice in the different domains and in its totality with HLQoL were analyzed through the Chi-square test. The magnitude of

these associations was verified through Binary Logistic Regression in its unadjusted and adjusted form (age, sex, and socioeconomic condition). The statistical program used was SPSS version 20.0 (IBM Corporation). The level of significance was 5%.

Patient and Public Involvement

Patients and or public were not involved in the research.

RESULTS

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

Table 1. Characterization of the sample presented as mean and standard deviation (n = 400, Presidente Prudente - SP, Brazil, 2017).

	Sufficiently Active (n=129)	Insufficiently Active (n=271)	p-value
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^2)	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

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

Table 2. Association between sufficiently active elderly and the HRQoL domains.

	n total (n=400)	Occupation/work	Chi-square test	Sport/Gym	Chi-square test	Leisure	Chi-square test	Total	Chi-square test
Variable	n	n (%)	p-value	n (%)	p-value	n (%)	p-value	n (%)	p-value
FC									
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)	
PL									
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)	
BP									
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)	
GHP									
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)	
VI									
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)	
AS									
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)	
EL									
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)	
MH									
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

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

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
FC												
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
PL												
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
BP												
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
GHP												
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
VI												
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
AS												
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
EL												
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
MH												
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	
FC												
Low QL	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
PL												
Low QL	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
BP												
Low QL	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
GHP												
Low QL	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
VI												
Low QL	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
AS												
Low QL	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
EL												
Low QL	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
MH												
Low QL	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

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

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

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

Despite evidence of the benefits that an active lifestyle provides for the elderly population [10], the use of different tools in other studies to analyze the HRQoL and each domain of PA separately, as well as total PA make it difficult to compare the results. The majority of studies use either total PA or the leisure time domain as an outcome, making it difficult to compare our findings with other domains, such as activities in the work

environment or in domestic occupations, and activities practiced at a gym and their relation with HRQoL. In addition, there is a lack of knowledge about this relationship in countries with low and medium socioeconomic conditions as is the case of Brazil [28,35–37]. The present study has some limitations. Its cross-sectional design does not allow cause and effect inference. The use of a questionnaire to assess the level of PA did not allow a more robust assessment, although the instrument used has been validated for the elderly population [24] and is widely used in the scientific community, in addition to being validated against gold standard instruments for PA measurement such as doubly marked water [38]. The levels of PA in each domain can be influenced by cultural differences, climatic factors, and developmental factors of each region and/or country, what suggests that the results should be interpreted with caution, since the present study was developed in only one Brazilian city and cannot be generalized to other region of Brazil or other countries. Furthermore, the analyzed age group does not allow extrapolation to other ages. However, it is worth emphasizing the importance of studies with the elderly population, which comprises the fastest growing age group in the world, and which has consequently changed demographic and epidemiological patterns. As positive aspects, we highlight the sample randomization process, as well as the sample number of elderly, and the control of the variables by confounding factors in the analyses between PA and HRQoL. We also emphasize the evaluation of PA addressing different domains in the elderly population, and considering the different domains of HRQoL. In addition, it is worth noting the collection and storage of data through electronic devices, optimizing the time in the collection process in the residences of the participants, as well as minimization of errors during data export and tabulation which are high complexity tasks in a population study.

The results of the present study suggest that the different domains of PA in work/occupation, sports/gym, and leisure/displacement activities are related in different and specific ways to the different domains of HRQoL. In addition, the practice of PA was related to higher HRQL in the elderly in the different domains and in their entirety. Our findings reinforce the importance of studies encompassing different domains of PA for the elderly population, especially in middle-income countries. Taking advantage of public spaces to encourage and promote group activities for this population, especially in relation to the leisure time domain, could be a positive strategy.

CONCLUSION

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

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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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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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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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 (± 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.

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 random sample, as well as the sample size of older adults, 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 older adults, 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 complex tasks in a population study.

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].

Currently, older adults population is the fastest growing segment in the world[16]. In Brazil, the estimation is that the older adults population composed of 14 million people in 2010, will be around 70.5 million people by 2060[17] and it is known that the more chronological age increases, the less physically active people become[18]. Thus, the physiological and cognitive declines that occur naturally during the aging process can be aggravated when individuals adopt lifestyle habits with insufficient physical activity[19], affecting general health and HRQoL.

Evaluation and continuous monitoring of PA by domains can help the interventions execution to promote PA more effectively. It is unclear in the literature whether the PA level of older adults, separated into each of the PA domains, is associated differently with HRQoL, as well as if this relationship is independent of confounding variables such as gender, age, and socioeconomic status, since these variables may be related to quality of life[20,21] and PA[22].

Thus, the objective of the present study was to analyze the different domains of PA practice and possible associations with HRQoL in older adults.

METHODS

Sample calculation

This is a cross-sectional study, composed by older adults of the city of Presidente Prudente, Brazil. Presidente Prudente is located in the western region of the state of São Paulo - Brazil, with an Human Development Index (indicator of human development level, that range from 0 [poor] to 1 [better]) of 0.806 and approximately 207,610 people[23]. Considering the prevalence of HRQoL in different domains is not consensual in the literature and that was not carried out on a previous pilot-study, a prevalence of 50% was used, that maximizes the sample size and has been adopted in epidemiological

studies[24], with a tolerable error of 5% and the power of study of 80%, the minimum sample size required for the present study was 379. At the end of the study, a total of 419 older adults were evaluated, with exclusion of 19 participants for incomplete data of PA or HRQoL, resulting in 400 older adults for data analysis.

Participant selection process

The city of Presidente Prudente does not have a clearly geographical or demographical division. In this sense, with the support of the city map, postal codes and the list of streets available on the city council website, the city of Presidente Prudente was divided into five geographical regions (north, south, east, west, and central). In each of these regions was performed a list of all districts and its streets, which were randomly selected for being visited. In this way, all streets in each region had the opportunity to be selected. The researchers were distributed in pairs to do the recruitment of the participants, door to door, and all the residences of the selected streets were approached once. After explaining the research, all individuals from each household who met the inclusion criteria were considered eligible and invited to participate in the study. Participants were instructed to make a chair available and the research was conducted in front of the home or inside the house. In case of the participant decline to participate, the next household was visited, until the required sample size has been reached.

The following inclusion criteria were considered: (a) age equal to or greater than 60 years; (b) resident in the city of Presidente Prudente for at least two years. Exclusion criteria: (a) being in a wheelchair or other disabilities that does not allow the subject to stand and walk, not to have underestimation of habitual practice of PA measured by the adopted questionnaire; and (b) presenting any kind of cognitive deficiency that would prevent understanding the questions. All participants signed the Patient Consent Form.

The group of interviewers was composed of postgraduate students and students of scientific initiation, all of who received previous training. The interviews lasted approximately 40 minutes, and the survey was conducted between March 2016 and February 2017. The Research Ethics Committee Involving Human Beings of UNESP - São Paulo State University approved this study (Protocol: 45486415.4.0000.5402).

Comorbidities

The participants were asked if they had the following chronic diseases diagnosed by a health-professional: Hypertension, Diabetes, Elevated LDL Cholesterol, and Elevated Triglycerides. They had to answer "Yes" or "No" for each one the comorbidities. This information were used to adjustment of the analysis.

Anthropometry

Anthropometric measurements were performed to measure body mass and height, using a digital scale, Wiso brand (model: w912, Lot: 13A01, China), and a portable 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.

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),

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

Health related quality of life

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

Sociodemographic variables

The "Brazilian Economic Classification Criteria" was used to determine the economic condition of the families, established in 2014 by the Brazilian Association of Research Companies (ABEP), according to a survey database carried out in 2009 by the Brazilian Institute of Public Opinion and Statistics[29]. The questionnaire takes into

account the degree of education and presence and quantity of certain rooms and belongings in the analyzed home (bathrooms, domestic servants, automobiles, microcomputer/computers, dishwasher, refrigerator, freezer, DVD player, washing machine, and dryer machine). It establishes the following classifications for economic condition: A1, B1, B2, C1, C2, and D - E. After the classification of the participants by questionnaire, the sample was distributed into: high economic class composed of categories A1 and B1, average economic class composed of classes B2 and C1, and low economic class composed of categories C2 and D - E. The marital status was self-reported using the following options: i) single; ii) married; iii) widower; iv) divorced.

Data Collection and Storage

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

Statistical analysis

The sample characteristics are presented as median and interquartile range, compared between sex by Mann Whitney U test for nonparametric data. The information about the practice of PA and HRQoL in the population of the present study was presented in frequencies. And 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. The Model

1 was adjusted by age, sex, marital status, and socioeconomic condition, and the Model 2 was adjusted by variables of model 1 plus presence of the reported comorbidities (Hypertension, Diabetes, Elevated LDL Cholesterol, and Elevated Triglycerides) simultaneously. The goodness of model fit was analyzed by Hosmer & Lemeshow test, where p-values less than 0.05 were considered as poor fit. The statistical program used was SPSS version 20.0 (IBM Corporation). It was adopted the 95% confidence interval and the level of significance adopted was the p-value less than 0.05.

Patient and Public Involvement

Patients and or public were not involved in the research.

RESULTS

In total, 400 older adults, with mean age of 71,5 (± 8,4) years, participated in the study, of which 232 were female (58%). For the marital status, the majority of 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 high physically actives 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]), at leisure time (47.5% [95% CI = 42.6-52.4] vs. 17.8% [95% CI = 14.0-21.5]), and in sports domain (38.0% [95% CI = 33.2-42.8] vs. 22.5% [95% CI = 18.4-26.6]), being lower among men than women only in work/occupational domain (23.5% [95% CI = 19.3-27.7] vs. 36.8% [95% CI = 32.0-41.5]). Table 1 shows the characteristics of the sample and comparisons according to sex.

Table 1. Characterization of the sample (n = 400, Presidente Prudente - SP, Brazil, 2017).

	Overall Sample Median (Min. - Max.)	Males Median (IR)	Females Median (IR)	p-value*
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/m²)	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
HRQoL domains (scores)				
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/m²= kilograms by meter squared.

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 transportation, and the total sum of these activities, with the eight domains of HRQoL. The practice of PA in work/occupation was associated with a higher HRQoL considering the domain of functional capacity. Older adults who participated in sports practices or activities in a gym presented a better general health perception. There was no significant association between being high active in the leisure domain or during transportation and the domains of HRQoL. Regarding the total score of PA domains, high active older adults presented higher HRQoL in relation to functional capacity, perception of less body pain, and social aspects than the less actives.

Table 2. Association between high active older adults and the HRQoL domains.

Variable	n total (n=400) n	Occupation/work n (% [95% CI])	Sport/Gym n (% [95% CI])	Leisure n (% [95% CI])	Total Score n (%[95% CI])
FC					
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])*
PL					
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])
BP					
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])*
GHP					
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])
VI					
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])
AS					
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])*
EL					
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])
MH					
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

domains of PA together in total score, high active older adults were 77% more likely to have high HRQoL for functional capacity than the less active older adults.

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			Model2			Model1			Model2		
	OR	CI	p-value for model fit*	OR	CI	p-value for model fit*	OR	CI	p-value for model fit*	OR	CI	p-value for model fit*
FC			0.951			0.688			0.984			0.219
Low QL	1.00	-		1.00	-		1.00	-		1.00	-	
High QL	**1.73**	**1.02; 2.93**		1.52	0.89; 2.61		**1.78**	**1.05; 3.02**		**1.72**	**1.01; 2.96**	
PL			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	
BP			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	
GHP			0.645			0.745			0.739			0.439
Low QL	1.00	-		1.00	-		1.00	-		1.00	-	
High QL	**1.61**	**1.02; 2.56**		1.48	0.92; 2.38		1.49	0.92; 2.40		1.47	0.91; 2.39	
VI			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	
SA			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	
EL			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	
MH			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 colesterol. 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			Model2			Model1			Model2		
	OR	CI	p-value for model fit*	OR	CI	p-value for model fit*	OR	CI	p-value for model fit*	OR	CI	p-value for model fit*
FC			0.183			0.614			0.040			0.347
Low QL	1.00	-		1.00	-		1.00	-		1.00	-	
High QL	**1.75**	**1.03; 2.98**		1.71	0.99; 2.95		**1.77**	**1.04; 3.02**		1.63	0.94; 2.82	
PL			0.181			0.644			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	
BP			0.034			0.067			0.810			0.009
Low QL	1.00	-		1.00	-		1.00	-		1.00	-	
High QL	**1.74**	**1.09; 2.78**		**1.63**	**1.02; 2.62**		1.52	0.95; 2.45		1.42	0.88; 2.31	
GHP			0.334			0.856			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	
VI			0.784			0.359			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	
SA			0.436			0.952			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	
EL			0.068			0.321			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	
MH			0.255			0.789			0.447			0.142
Low QL	1.00	-		1.00	-		1.00	-		1.00	-	
High QL	**1.67**	**1.03; 2.69**		**1.64**	**1.01; 2.66**		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 colesterol. 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

et al[32], who verified that training directed to physical abilities can improve the functional capacity and the quality of life in general.

In the case of PA in the field of leisure and/or transportation, several studies have presented associations between this domain and quality of life[31,33–35]. The present study observed significant association of being high active in leisure time with better scores of functional capacity, body pain and mental health. In this way, PA at leisure time can provide benefits not only for physical health, but also for mental health, noting that neuropsychiatric diseases are increasingly affecting older people[36]. Otherwise, the infrastructure of sidewalks and streets, as well as the insecurity of older adults, can demotivate this population in question to opt for active transportation, and consequently limit the increase of the benefits of this domain of PA in quality of life.

When total PA was analyzed, using the sum of all domains, the results presented better HRQL for functional capacity. These results corroborate the findings in the literature suggesting that people who present higher levels of PA, may present better parameters of HRQoL[37–39]. In this sense, the accumulation of physical activities of different domains and intensities may be able to positively affect HRQoL, due to its increase in global levels of PA.

Despite evidence of the benefits that an active lifestyle provides for the older adults[10], the use of different tools in other studies to analyze the HRQoL and each domain of PA separately, as well as total PA, makes it difficult to compare results. The majority of studies use either total PA or the leisure time domain as an outcome, making it difficult to compare our findings with other domains, such as activities in the work environment or in domestic occupations, and activities practiced at a gym and their relation with HRQoL. In addition, there is a lack of knowledge about this relationship in

countries with low and medium socioeconomic conditions as is the case of Brazil[32,40–42].

One of the novelties of the present study is the analysis of different domains of PA. Most of the studies that aimed to verify the relationship between the practice of PA and HRQoL in the older adults considered only an isolated domain or PA as a whole (considering all domains of PA in a single block). Each PA domain has its specific characteristics and must be considered in this relationship. Another factor is the adjustment of this relationship for comorbidities, since they are important health risk factors that may interfere in this relationship. In addition, the PA assessment by domains can help to prevent the health costs generated by insufficient PA practice[43].

The present study has some limitations. The cross-sectional design of this study does not allow cause and effect inference. The use of a questionnaire to assess the level of PA did not allow a more robust assessment, although the instrument used has been validated for older adults[27] and is widely used in the scientific community, in addition to being validated against gold standard instruments for PA measurement such as doubly marked water[44]. Weekly energy consumption related to PA, sarcopenia or frailty and previous functionality (for example Barthel index score) were not measured which is another limitation of the present study, because all of these are confusing variables in the relationship between PA and HRQoL. The levels of PA in each domain can be influenced by cultural differences, climatic factors, and developmental factors of each region and/or country, what suggests that the results should be interpreted with caution, since the present study was developed in only one Brazilian city and cannot be generalized to other region of Brazil or other countries. Furthermore, the analyzed age group does not allow extrapolation to other ages. However, it is worth emphasizing the importance of studies with older adults, which comprises the fastest growing age group in the world, and which

has consequently changed demographic and epidemiological patterns. Besides that, this population has the largest prevalence of comorbidities[45], which seriously compromises the quality of life in the physical domain and tends to also affect the psychological health[46,47], and the practice of PA may promote improvement in HRQoL regardless of these health problems, mainly in relation to the domain of sports.

As positive aspects, we highlight the random sample, as well as the sample size, and the control of the variables by confounding factors in the analyses between PA and HRQoL. We also emphasize the evaluation of PA addressing different domains in older adults and considering the different domains of HRQoL. In addition, it is worth noting the collection and storage of data through electronic devices, optimizing the time in the collection process in the residences of the participants, as well as minimization of errors during data export and tabulation, which are complex tasks in a population study.

The results of the present study suggest the different domains of PA in work/occupation, sports/gym, and leisure/transportation activities are related in different and specific ways to the different domains of HRQoL. In addition, the practice of PA was related to higher HRQL in older adults in the different domains and in their entirety. Our findings reinforce the importance of studies encompassing different domains of PA for older adults, especially in middle-income countries. Taking advantage of public spaces to encourage and promote group activities for this population, especially in relation to the leisure time domain, could be a positive strategy.

CONCLUSION

Given the results and despite presenting limitations in relation to the confounding factors that may influence the variables analyzed in the present study, it is suggested that participants involved in some kind of sport or in gym activities, usually practiced in

groups, presented a better functional capacity, regardless the presence of comorbidities in older adults. Thus, exploring PA separately by domains may be an important tool for monitoring and promoting more active and healthy lifestyles, and consequently preserving HRQoL during aging.

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

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 #
Title and abstract	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
Introduction			
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
Methods			
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/ 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	-
Results			

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	--
Discussion			
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
Other information			
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.

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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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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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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 (±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.

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 random sample, as well as the sample size of older adults, 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 older adults, and considering the different domains of health related quality of life.
- It is worth noting the collection and storage of data through electronic devices to minimize errors during data export and tabulation, which are complex 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: 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].

Currently, the older adult population is the fastest growing segment in the world[16]. In Brazil, the estimation is that the older adult population, composed of 14 million people in 2010, will be around 70.5 million people by 2060[17] and it is known that the more chronological age increases, the less physically active people become[18]. Thus, the physiological and cognitive declines that occur naturally during the aging process can be aggravated when individuals adopt lifestyle habits with insufficient physical activity[19], affecting general health and HRQoL.

Evaluation and continuous monitoring of PA by domains can help in the execution of interventions to promote PA more effectively. It is unclear in the literature whether the PA level of older adults, separated into each of the PA domains, is associated differently with HRQoL, or if this relationship is independent of confounding variables such as gender, age, and socioeconomic status, since these variables may be related to quality of life[20,21] and PA[22].

Thus, the objective of the present study was to analyze the different domains of PA practice and possible associations with HRQoL in older adults.

METHODS

Sample calculation

This is a cross-sectional study, composed of older adults of the city of Presidente Prudente, Brazil. Presidente Prudente is located in the western region of the state of São Paulo - Brazil, with a Human Development Index (indicator of human development level, ranging from 0 [poor] to 1 [better]) of 0.806 and approximately 207,610 people[23]. Considering that the prevalence of HRQoL in different domains is not consensual in the literature and a previous pilot-study was not carried out, a prevalence of 50% for unknown binary outcome was used, which is considered as a conservative

solution and maximizes the sample size for a common outcome in epidemiological descriptive studies[24]. Thus, a tolerable error of 5% and a study power of 80% were also considered, resulting in a minimum sample size of 379. At the end of the study, a total of 419 older adults were evaluated, with exclusion of 19 participants for incomplete PA or HRQoL data, resulting in 400 older adults for the data analysis.

Participant selection process

The city of Presidente Prudente does not have a clear geographical or demographical division. In this sense, with the support of the city map, postal codes, and the list of streets available on the city council website, the city of Presidente Prudente was divided into five geographical regions (north, south, east, west, and central). In each of these regions a list of all districts and streets was compiled, which were randomly selected for being visited. In this way, all streets in each region had the opportunity to be selected. The researchers were distributed in pairs to perform recruitment of the participants, door to door, and all the residences of the selected streets were approached once. After explaining the research, all individuals from each household who met the inclusion criteria were considered eligible and invited to participate in the study. Participants were instructed to make a chair available and the research was conducted in front of the home or inside the house. In cases where the participant declined to participate, the next household was visited, until the required sample size had been reached.

The following inclusion criteria were considered: (a) age equal to or greater than 60 years; (b) resident in the city of Presidente Prudente for at least two years. Exclusion criteria: (a) being in a wheelchair or other disabilities that do not allow the individual to stand and walk and consequently present an underestimation of habitual practice of PA

measured by the adopted questionnaire; and (b) presenting any kind of cognitive deficiency that would prevent understanding of the questions. All participants signed the Patient Consent Form. The group of interviewers was composed of graduate and postgraduate students, all of whom received previous training. The interviews lasted approximately 40 minutes, and the survey was conducted between March 2016 and February 2017. The Research Ethics Committee Involving Human Beings of UNESP - São Paulo State University approved this study (Protocol: 45486415.4.0000.5402).

Comorbidities

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

Anthropometry

Anthropometric measurements were performed to measure body mass and height, using a digital scale, Wiso brand (model: w912, Lot: 13A01, China), and a portable 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 using the equation: body mass in kg divided by height in meters squared.

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

Health related quality of life

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

Sociodemographic variables

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

Data Collection and Storage

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

Statistical analysis

The sample characteristics are presented as median and interquartile range, compared between sexes by the Mann Whitney U test for nonparametric data.

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 (±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=

42.6-52.4] vs. 17.8% [95% CI= 14.0-21.5]), and in the sports domain (38.0% [95% CI= 33.2-42.8] vs. 22.5% [95% CI= 18.4-26.6]), being lower among men than women only in the work/occupational domain (23.5% [95% CI= 19.3-27.7] vs. 36.8% [95% CI= 32.0-41.5]). Table 1 shows the characteristics of the sample and comparisons according to sex.

Table 1.Characterization of the sample (n = 400, Presidente Prudente - SP, Brazil, 2017).

	Overall Sample Median (Min. - Max.)	Males Median (IR)	Females Median (IR)	p-value*
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^2)	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
HRQoL domains (scores)				
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/m²= kilograms by meter squared.

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 transportation, and the total sum of these activities, with the eight domains of HRQoL. The practice of PA in work/occupation was associated with a higher HRQoL considering the domain of functional capacity. Older adults who participated in sports practices or activities in a gym presented a better general health perception. There was no significant association between being highly active in the leisure domain or during transportation and the domains of HRQoL. Regarding the total score of PA domains, highly active older adults presented a higher HRQoL in relation to functional capacity, perception of less body pain, and social aspects than less active older adults.

Table 2. Prevalence of highly active older adults according to the HRQoL domains.

	n total (n=400)	Occupation/work	Sport/Gym	Leisure	Total Score
Variable	n	n (% [95% CI])	n (% [95% CI])	n (% [95% CI])	n (%[95% CI])
FC					
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])*
PL					
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])
BP					
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])*
GHP					
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])
VI					
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])
AS					
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])*
EL					
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])
MH					
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

analyzing the three domains of PA together in total score, highly active older adults were 77% more likely to have high HRQoL for functional capacity than the less active older adults. However, none of the observed associations remained significant at the 99% confidence interval level.

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
FC												
Low QL	1.00	-	-	1.00	-	-	1.00	-	-	1.00	-	-
High QL	**1.73**	**1.02; 2.93**	0.87; 3.45	1.52	0.89; 2.61	0.75; 3.09	**1.78**	**1.05; 3.02**	0.89; 3.56	**1.72**	**1.01; 2.96**	0.85; 3.50
PL												
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
BP												
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
GHP												
Low QL	1.00	-	-	1.00	-	-	1.00	-	-	1.00	-	-
High QL	**1.61**	**1.02; 2.56**	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
VI												
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
SA												
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
EL												
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
MH												
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
FC												
Low QL	1.00	-	-	1.00	-	-	1.00	-	-	1.00	-	-
High QL	**1.75**	**1.03; 2.98**	0.87; 3.52	1.71	0.99; 2.95	0.84; 3.50	**1.77**	**1.04; 3.02**	0.88; 3.57	1.63	0.94; 2.82	0.79; 3.34
PL												
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
BP												
Low QL	1.00	-	-	1.00	-	-	1.00	-	-	1.00	-	-
High QL	**1.74**	**1.09; 2.78**	0.94; 3.22	**1.63**	**1.02; 2.62**	0.88; 3.04	1.52	0.95; 2.45	0.81; 2.85	1.42	0.88; 2.31	0.75; 2.69
GHP												
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
VI												
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
SA												
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
EL												
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
MH												
Low QL	1.00	-	-	1.00	-	-	1.00	-	-	1.00	-	-
High QL	**1.67**	**1.03; 2.69**	0.89; 3.13	**1.64**	**1.01; 2.66**	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

et al[32], who verified that training directed to physical abilities can improve functional capacity and quality of life in general.

In the case of PA in the field of leisure and/or transportation, several studies have presented associations between this domain and quality of life[31,33–35]. The present study observed a significant association between being highly active in leisure time with better scores of functional capacity, body pain, and mental health. In this way, PA in leisure time can provide benefits not only for physical health, but also for mental health, noting that neuropsychiatric diseases are increasingly affecting older people[36]. In addition, the infrastructure of sidewalks and streets, as well as the insecurity of older adults, can demotivate this population from opting for active transportation, and consequently limit the increase in the benefits of this domain of PA on quality of life.

When total PA was analyzed, using the sum of all domains, the results presented better HRQL for functional capacity. These results corroborate the findings in the literature suggesting that people who present higher levels of PA, may present better parameters of HRQoL[37–39]. In this sense, the accumulation of physical activities of different domains and intensities may be able to positively affect HRQoL, due to the increase in global levels of PA.

Despite evidence of the benefits that an active lifestyle provides for older adults[10], the use of different tools in other studies to analyze the HRQoL and each domain of PA separately, as well as total PA, makes it difficult to compare results. The majority of studies use either total PA or the leisure time domain as an outcome, making it difficult to compare our findings with other domains, such as activities in the work environment or in domestic occupations, and activities practiced at a gym and their relation with HRQoL. In addition, there is a lack of knowledge about this relationship in

countries with low and medium socioeconomic conditions as is the case of Brazil[32,40–42].

One of the novelties of the present study is the analysis of different domains of PA. The majority of studies that aimed to verify the relationship between the practice of PA and HRQoL in older adults considered only an isolated domain or PA as a whole (considering all domains of PA in a single block). Each PA domain has specific characteristics and must be considered in this relationship. Another factor is the adjustment of this relationship for comorbidities, since they are important health risk factors that may interfere in this relationship. In addition, PA assessment by domains can help to prevent the health costs generated by insufficient PA practice[43].

The present study has some limitations. The cross-sectional design of this study does not allow cause and effect inference. The use of a questionnaire to assess the level of PA did not allow a more robust assessment, although the instrument used has been validated for older adults[27] and is widely used in the scientific community, in addition to being validated against gold standard instruments for PA measurement such as doubly marked water[44]. The Baecke's questionnaire does not provide information about duration and intensity of physical activity, which does not allow classification of the individuals into physically active according to the global recommendations. Due to this lack of classification, the sample was categorized into quartiles and the 4th quartile was considered as the most active, which necessarily divides the sample at 75% of its distribution, independently of how active they were compared to other populations or global recommendations. The present study was also limited through the assessment of comorbidities, where the types were restricted. For instance, osteoarthritis could have an impact on physical activity and health related quality of life and was not included and, therefore, this is considered as one of the limitations of the study. Weekly energy

consumption related to PA, sarcopenia or frailty and previous functionality (for example Barthel index score) were not measured which is another limitation of the present study, as all of these are confounding variables in the relationship between PA and HRQoL. The levels of PA in each domain can be influenced by cultural differences, climatic factors, and developmental factors of each region and/or country, suggesting that the results should be interpreted with caution, since the present study was developed in only one Brazilian city and cannot be generalized to other regions of Brazil or other countries. A final limitation is that there are no data available on how many potential participants declined to participate when invited since whenever the participant declined to participate in the study the next household was visited until the required sample size was reached. Furthermore, the observations did not remain significant at the 99% confidence interval level, and may therefore have been susceptible to a false positive bias. A possible hypothesis is due to the limitation of sample size, which was calculated at a confidence level of 95% and compromised the power of evidence in the adjustment for multiple comparisons.

However, it is worth emphasizing the importance of studies with older adults, who comprise the fastest growing age group in the world, and have consequently changed demographic and epidemiological patterns. In addition, this population has the largest prevalence of comorbidities[45], which seriously compromises quality of life in the physical domain and tends to also affect psychological health[46,47], and the practice of PA may promote improvement in HRQoL regardless of these health problems, mainly in relation to the sports domain.

As positive aspects, we highlight the random sample and the control of the variables by confounding factors in the analyses between PA and HRQoL. We also emphasize the evaluation of PA addressing different domains in older adults and

considering the different domains of HRQoL. In addition, it is worth noting the collection and storage of data through electronic devices, optimizing the time in the collection process in the residences of the participants, as well as minimization of errors during data export and tabulation, which are complex tasks in a population study.

The results of the present study suggest the different domains of PA in work/occupation, sports/gym, and leisure/transportation activities are related in different and specific ways to the different domains of HRQoL. In addition, the practice of PA was related to higher HRQL in older adults in the different domains and in their entirety. Our findings reinforce the importance of studies encompassing different domains of PA for older adults, especially in middle-income countries. Taking advantage of public spaces to encourage and promote group activities for this population, especially in relation to the leisure time domain, could be a positive strategy.

CONCLUSION

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

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

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 #
Title and abstract	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
Introduction			
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
Methods			
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/ 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	-
Results			

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	--
Discussion			
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
Other information			
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.