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Quality of life and physical activity among adults: population-based study in Brazilian adults

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Abstract
Objective To analyze the association between leisure-time physical activity (PA) (walking, moderate- and vigorous-intensity activities) and transport (active commuting) with quality of life (QoL) domains (physical, social relations, environmental and psychological).
Methods Participants were 1,461 adults (18–65 years) living in the city of Curitiba, Brazil. QoL was assessed using the abbreviated WHOQoL questionnaire and PA through the IPAQ long version. Multiple linear regression models were used to analyze the relationship between PA types (walking, moderate and vigorous) and domains (leisure and transport) with QoL domains.
Results Walking for leisure was positively associated with social relations ($\beta = 1.5$; $P = 0.011$) and environment ($\beta = 3.3$; $P = 0.015$) domains among men and with physical ($\beta = 3.2$; $P = 0.04$), environment ($\beta = 4.1$; $P = 0.011$) and psychological ($\beta = 3.2$; $P = 0.009$) domains among women. Moderate intensity PA was associated with all but the physical QoL domain among women. Among men, this association was observed only between insufficient levels of PA and the physical domain of QoL ($\beta = 3.0$; $P = 0.016$). Vigorous PA was associated with social relations ($\beta = 3.4$; $P = 0.034$) and psychological ($\beta = 4.2$; $P = 0.009$) QoL domains. Transport PA was only associated with the physical QoL domain in men ($\beta = 3.1$; $P = 0.042$).
Conclusion There is a positive relationship between PA and QoL, though this association varies according to the type and intensity of PA and differs across QoL domains. Unlike transport PA, leisure-time PA shows consistent association with QoL.

Keywords Leisure physical activity · Transportation physical activity · Quality of life

Introduction

Regular practice of physical activity (PA) is an important factor in the prevention of non-communicable diseases (NCDs) [1] and provides physical and psychological benefits to individuals in various age groups [2–5]. These benefits are also observed when specific domains of PA such as leisure and transport are considered [6, 7]. For example, walking and moderate and vigorous activities (MVPA) during leisure contribute to better levels of physical fitness and body weight control [8]. PA during transport is associated with reduction in the risk of stroke and NCDs mortality [7, 9].

Regular PA is also associated with several aspects of quality of life (QoL) [10–12], and this relationship has been consistently reported in the literature [13–15]. However, evidence about the relationship between domains (e.g., leisure and transport) and PA intensity (e.g., walking and MVPA) with specific dimensions of QoL (e.g., physical and psychological) is still limited. In part, this gap can be

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explained by the fact that the studies investigating this association are based on global measures of PA and QoL [16, 17].

The limited evidence from clinical trials about the effect of different PA intensity on QoL dimensions is not conclusive, and the majority is originated from high-income countries [18–20]. Fox et al. [18] reported positive effects of a 12-month program of moderate PA on physical, psychological and environmental domains among senior women; yet, there was no similar effect in the social relations domain. Holton et al. [20] did not observe effects on QoL domains on men and women, after 10 weeks of a moderate PA program, when compared to the control group. Evidence from clinical trials is lesser among adults. However, cross-sectional studies show that the relationship between PA and QoL domains does not seem to be linear. For example, among Japanese adults reaching PA recommendations, the QoL scores are higher for the physical, vitality and general health domains, when compared to the inactive ones. Nonetheless, low levels of PA were also associated with higher QoL scores, although only for the physical domain [21].

At the present time, considering specific domains, evidence about the complex relationship between PA and QoL is not available in low- and middle-income countries. In high-income countries, most PA is conducted in leisure time; on the other hand, in low- and middle-income settings, transportation and occupational PA represent a large amount of total PA. Because the intensity, duration and frequency of PA practiced in these domains are different, it is possible that the associations observed in high-income countries will differ from the ones observed in low- and middle-income settings. In addition, the region in which this study took place (Brazil) is experiencing rapid urbanization, demographic, nutritional and epidemiological transitions [22], all of which can impact on both PA and QoL. Therefore, the objective of the present study was to verify the relationship between the regular practice of different types of PA in the leisure domain (walking, moderate- and vigorous-intensity activities) and transport (active commuting) with QoL domain scores (physical, social relations, environment and psychological), among adults of Curitiba, Paraná, Brazil.

Methods

Data analyzed in the current study comes from the "Level of PA among adults: associations with perceived environment and social support" project. The project was coordinated by the *Research in PA and QOL Group* (GPAQ in Portuguese) from the *Federal University of Parana* and by the *Studies in Epidemiology and PA Group* (GEEAF in Portuguese) from the *Federal University of Pelotas*, having been approved by the Ethics in Research Committee from the School of Physical Education, Federal University of Pelotas-RS (no 005/2008). The study had a cross-sectional design in the form of a household survey and aimed to analyze lifestyle, health aspects, leisure practice and QOL of individuals living around selected parks and squares in the city of Curitiba, Paraná, Brazil. This city is a state capital located in the southern region of Brazil, with a population of 1,746,896 inhabitants (52% women), and is the 8th largest city in the country. The city is recognized for its health promotion policies and the special attention to green spaces as means for sustainable development. To date, there are 19 parks (18,707,232 m^2), preservation areas (19,378,285 m^2) and 447 plazas (2,750,740 m^2) dispersed in the 75 neighborhoods [23]. Due to large territory of Brazil, the study sample is not representative of the whole country; however, the sampling frame and size were drawn to provide adequate statistics power.

The selection of parks and squares was carried out according to the socioeconomic status and environment's quality for the practice of PA in neighborhoods, where parks and squares were present. Initially, neighborhoods were classified as high-, medium- and low-environment potential according to information about quantity of parks, squares and sports and leisure centers, length of bike paths, number of traffic accidents, and crime rate from each neighborhood in the city. The same procedure was adopted with the average income, which was used to classify the economic condition (low, medium and high economic level) of each neighborhood. The results from both indicators, quality of the environment score and economic condition, were cross-tabulated. The neighborhoods were then grouped into nine categories. Only neighborhoods that were on the extremes of each category were selected for the study, which warranted that regions with different socioeconomic and environmental conditions were represented in the study. Since not all parks and squares from the city are intended for the practice of PA, their selection was intentional. The selection process considered places with services provided by the Health Secretariat and/or by the Sports and Leisure Secretary (SMEL in Portuguese). In case of tie or uncertainty, safer parks and squares were considered for the data collection.

A radius of 500 meters around selected parks and squares was adopted, and all street segments contained within this area with at least one household were eligible [24] ($n = 1{,}538$), with a population estimating in 27,732 adults. In each segment, one household was randomly selected from where, based on the number of people living in the house, study participants were randomly selected following the methods proposed by Kish [25]. Male and female adults aged between 18 and 65 years old, living in

that household for at least 1 year considering the data collection date, were considered eligible. Individuals who did not live in the selected household (e.g., maid and visitors), those with any severe physical limitation impeding the PA practice and also those with cognitive limitations which impede the understanding of the questionnaire were excluded from the study.

The data collection occurred between April and July 2009 for which 25 interviewers aged 18–60 years and with at least the equivalent of high school completed were hired. A theoretical and practical training with 30 h of duration was carried out to show the questionnaire and standardize its implementation, besides other field procedures. Overall, 1,461 people were interviewed (95% of the eligible segments), with a refusal rate of 7.9% ($n = 121$). Interview quality control was done in 12.5% of the sample, and data were double-entered and validated using the software *Epidata.* Differences encountered were checked and corrected.

QOL was assessed using the abbreviated version of WHOQoL [26]. The questionnaire contains 26 questions and includes four QoL domains: physical, psychological, environment and social relations. The Brazilian abbreviated version of the WHOQoL has adequate psychometric characteristics ($\alpha = 0.69$ and 0.84) and has the advantage of requiring less time for the completion as compared to the full version [27]. The WHOQoL allows to establish specific scores for each QoL domain which, after being standardized, vary from 0 (lowest QoL) to 100 points (highest QoL) [26].

PA was assessed using the IPAQ long version [28]. In the present study, only questions related to leisure and transport PA were analyzed, allowing the establishment of weekly frequency and duration of walking for at least 10 min for leisure or transport, as well as PA of moderate and vigorous intensity during leisure. The main objective of this study was to explore the association between specific contexts and intensities of PA and QOL. Thus, despite the literature, consider the combination of different contexts and intensities of PA to classify individuals into "active" was chosen in this study by independent analysis of the intensities of PA and contexts. Also, walking is the most frequent PA in Brazil and has fewer barriers for adoption as compared with other forms of activity it has been analyzed separately from MVPA. This strategy has been adopted in other studies investigating these PA domains [29–31]. Participants were classified as inactive (0 min/week), insufficiently active (1–149 min/week) or active ($\geq$150 min/week) based on the recent recommendations for PA practice [32]. Level of PA was classified taking into consideration the PA intensity (walking and moderate and vigorous activity) and domain (leisure and transport) separately [33].

The analyses were adjusted for sex, age, socioeconomic (SES) level and body mass index (BMI). Age was categorized into five age group levels varying from 18 to 29, 9 years (lowest) and 60–65 years (highest). Social strata were determined according to the Brazilian economic classification (ABEP) into high (classes A1 + A2), medium (B1 + B2) and low (C + D + E) [34]. This classification is widely used in Brazilian research and is based on some assets such as TV, radio, jobs, motorcycle, car and number of toilets within the household. Marital status was dichotomized in single/divorced/widower or married/living with partner. Nutritional status was verified through self-reported weight and height and the BMI calculation. Individuals were classified as low weight, normal weight, overweight and obese [35].

Data were managed and analyzed using Stata version 9.0 and SPSS version 11.0. χ^2 test for heterogeneity was used to compare the variables age group, social strata, nutritional status and leisure and transport PA among men and women. Independent t test was used to compare the QoL domains' average values.

Multiple linear regressions were used to estimate the association between PA and QoL. In the models, the PA domains (leisure and transport) and intensity (walking, moderate and vigorous activity) were considered predictor variables, while the QoL domains (physical, psychological, environmental and social relations) were included as outcome variables. Analyses were adjusted for age group and social strata and stratified by sex, and P values below 5% were considered significant.

Levels of PA were included in the model as dummy variables with the group "inactives" being the reference group. The commands *svy* from STATA were used to take into consideration the study design in the computed estimators, having the sites (parks and squares) as primary sampling units and the households as secondary units.

Results

The sample contained 1,461 subjects (63.7% women) between 40 and 59 years of age (46.4%), who were married (57.3%) and from intermediate social strata (49.4%). Excess of weight (overweight + obesity) was observed among almost half of the sample: 33.3% of the subjects were overweight and 15.0% obese. Men presented higher levels of high schooling (30.2% vs. 22.3%; $P = 0.009$), overweight (37.9% vs. 30.7%; $P = 0.001$) and moderate (13.8% vs. 8.9%; $P = 0.046$) and vigorous PA (11.1% vs. 4.4%; $P = 0.001$) when compared to women. Relative to QoL men had higher values than women in all QoL domains with the exception of the physical domain, for which values were similar between sexes (56.2 vs. 56.8; $P = 0.257$) (Table 1).

Table 1 Sociodemographic characteristics, PA level and QOL according to participants sex, Curitiba, Brazil, 2009 ($n = 1,461$)

Variables	Categories	Men		Women		*P*	Total	
		N	%	*n*	%		*n*	%
Age (years)	18–29.9	133	25.1	186	20.1	0.118	319	22.0
	30–39.9	122	23.1	209	22.6		331	22.8
	40–49.9	114	21.6	223	24.1		337	23.2
	50–59.9	114	21.6	223	24.1		337	23.2
	≥60	57	10.8	127	13.7		184	12.7
Marital status	Single, divorced or widower	222	41.9	402	43.2	0.611	624	42.7
	Married or living with a partner	308	58.1	529	56.8		837	57.3
Social strata	High	82	15.6	101	10.9	0.004	183	12.6
	Medium	271	51.4	447	48.4		718	49.4
	Low	174	33.0	377	40.7		551	37.9
Schooling	≤9 years	58	11.2	136	14.6	0.009	195	13.4
	9 years or more	90	17.0	174	18.7		264	18.1
	High school completed	220	41.6	413	44.3		633	43.4
	College completed	160	30.2	208	22.3		368	25.2
Nutritional state	Low weight	8	1.5	30	3.3	0.001	38	2.6
	Normal weight	247	46.6	465	50.5		715	48.9
	Overweight	201	37.9	282	30.7		483	33.3
	Obese	74	14	143	15.5		217	15
Walking for leisure	Inactive (0 min/sem)	316	59.6	586	62.9	0.266	902	61.7
	Insufficiently active (1–149 min/week)	119	22.5	174	18.7		293	20.1
	Active (≥150 min/week)	95	17.9	171	18.4		266	18.2
Leisure moderate PA	Inactive (0 min/week)	373	70.4	740	79.5	0.046	1,113	76.2
	Insufficiently active (1–149 min/week)	83	15.7	108	11.6		191	13.1
	Active (≥150 min/week)	73	13.8	83	8.9		156	10.7
Leisure vigorous PA	Inactive (0 min/week)	403	76.0	862	92.6		1,265	86.6
	Insufficiently active (1–149 min/week)	68	12.8	27	2.9	0.001	95	6.5
	Active (≥150 min/week)	59	11.1	41	4.4		100	6.8
QOL (D.P.)	General	65.4	8.5	62.8	9.3	0.001	63.7	9.1
	Physical	56.2	9.5	56.8	9.8	0.257	56.6	9.7
	Social relations	74.5	14.2	70.2	15.9	0.001	71.8	15.5
	Psychological	65.4	9.4	62.0	11.2	0.001	63.3	10.7
	Environment	65.5	10.9	62.2	12.1	0.030	63.4	11.8

Among men, there was an association between higher levels of walking (active) with the social relations ($\beta = 1.5$; $P = 0.011$) and environment ($\beta = 3.3$; $P = 0.015$) domains. Only intermediate levels of moderate PA were associated with physical ($\beta = 3.0$; $P = 0.016$) and psychological ($\beta = 2.9$; $P = 0.003$) domains. Vigorous PA and walking for transport were only associated with the physical QoL domain, which had a linear relationship with transport PA ($\beta = 1.8$; $P = 0.028$ e $\beta = 3.1$; $P = 0.042$).

Consistent association between PA levels and the psychological domain was observed among women, with walking scores ($\beta = 2.4$; $P = 0.003$ e $\beta = 3.2$; $P = 0.009$) slightly lower for moderate PA ($\beta = 2.6$; $P = 0.001$ e $\beta = 5.3$; $P = 0.005$). High level of PA was associated with specific QoL domains. Among active women, walking had higher QoL scores in the physical ($\beta = 3.2$; $P = 0.045$) and environment ($\beta = 4.1$; $P = 0.011$) domains, while for moderate PA the association was with social relations ($\beta = 4.6$; $P = 0.037$) and environment domains ($\beta = 6.1$; $P = 0.01$). Vigorous PA was only associated with social relations ($\beta = 3.4$; $P = 0.034$) and psychological QoL domains ($\beta = 4.2$; $P = 0.009$) (Table 2).

Table 2 Multiple regression between PA level (leisure and transport) partial scores and general scores and domains of QOL adjusted for age, schooling and nutritional state

PA level	QOL domain							
	Physical		Social relations		Environment		Psychological	
	β (SD)	*P*	β (SD)	*P*	β (SD)	*P*	β (SD)	*P*
Men								
Walking (leisure)								
Insufficiently active	2.0 (0.94)	0.073	1.2 (1.59)	0.479	1.7 (0.93)	0.119	1.4 (0.61)	0.056
Active	2.0 (0.91)	0.064	1.5 (0.42)	0.011	3.3 (1.00)	0.015	1.7 (0.71)	0.054
Moderate (leisure)								
Insufficiently active	3.0 (0.90)	0.016	−0.5 (0.96)	0.577	1.6 (1.69)	0.364	2.9 (0.60)	0.003
Active	2.1 (1.45)	0.194	−1.4 (1.27)	0.324	2.9 (1.44)	0.088	0.5 (1.30)	0.688
Vigorous (leisure)								
Insufficiently active	3.1 (0.91)	0.013	1.3 (1.67)	0.451	3.1 (1.32)	0.058	2.3 (1.53)	0.193
Active	3.8 (1.61)	0.058	2.6 (2.20)	0.276	3.8 (1.56)	0.052	3.3 (1.90)	0.122
Walking (transportation)								
Insufficiently active	1.8 (0.64)	0.028	1.9 (1.41)	0.228	2.0 (1.15)	0.126	2.0 (1.15)	0.126
Active	3.1 (1.20)	0.042	1.4 (1.02)	0.236	1.0 (1.65)	0.538	1.0 (1.65)	0.538
Women								
Walking (leisure)								
Insufficiently active	0.7 (1.26)	0.571	2.0 (1.17)	0.136	3.2 (1.46)	0.071	2.4 (0.51)	0.003
Active	3.2 (1.24)	0.045	2.2 (1.74)	0.242	4.1 (1.15)	0.011	3.2 (0.83)	0.009
Moderate (leisure)								
Insufficiently active	2.3 (0.86)	0.035	2.5 (1.30)	0.159	4.3 (0.72)	0.001	2.6 (0.44)	0.001
Active	3.0 (1.37)	0.068	4.6 (1.73)	0.037	6.1 (0.69)	0.001	5.3 (1.25)	0.005
Vigorous (leisure)								
Insufficiently active	2.5 (1.19)	0.077	−0.39 (2.82)	0.893	2.8 (1.18)	0.057	1.7 (1.80)	0.372
Active	0.4 (2.06)	0.831	3.4 (1.25)	0.034	4.9 (2.24)	0.069	4.2 (1.11)	0.009
Walking (transportation)								
Insufficiently active	0.2 (1.43)	0.859	4.5 (1.99)	0.066	1.5 (2.10)	0.508	1.5 (2.10)	0.508
Active	0.8 (1.01)	0.432	2.9 (2.84)	0.339	0.8 (2.36)	0.744	0.8 (2.36)	0.744

Discussion

Results from this study confirm the premise about the positive association between PA and QoL. However, the findings showed that the type of PA is associated in different ways for women and men and also for the different QoL domains. In general, leisure PA was associated with a larger number of QoL domains than transport PA. Nonetheless, this was the type of PA that was most practiced by participants. Low levels of leisure PA in the sample contributed in a moderate but consistent way to the samples QoL, having been observed a dose–response effect particularly for higher levels of PA, which is supported by other findings [36]. Several of our findings are clinically relevant. For example, the present results indicate that individuals performing 150+ min/week of moderate PA present a score of QOL 5.3 points higher than their counterparts. In this context, a follow-up study of 7 years found that an increase of 10 score points in the overall QOL may increase by 9% survival rate [37]. Another important contribution is the setting. The study was conducted in a middle-income country filling the gap of the evidence in such context. The lack of such data limits the generalization and comparison of the results, since QoL and PA levels are also affected by factors related to culture, physical and social environment of communities and societies [38, 39]. For this reason, studies should be conducted in populations of low- and middle-income in order to establish clearly the role of PA in QoL within contexts where social inequalities represent an important to the population's health [40, 41].

Few studies investigated the relationship between PA and QoL considering various PA contexts. Jurakic et al. [17], assessing QoL with the SF-36 questionnaire, observed that leisure PA was associated with vitality and mental health domains among women, and with vitality and bodily

pain among men. However, transport PA was inversely associated with QoL (physical domain in women and physical domain, bodily pain, social and physical component in men). The authors believe that the negative results of transport PA reflect the low importance given to walking for transportation as a way to provide health benefits.

On the other hand, positive associations between leisure PA and general QoL [18, 42], physical [10, 18, 42], psychological [10] and environment [10, 18] domains have been reported, which confirm the findings from this study. Still, among the cited studies, none found significant association between PA and the social relations domain. Silva et al. [10], in a study with apparently healthy adults, also reported that the social relations' domain was the one that explained QoL the least. Similar pattern was found in our study since this domain was the one with the smallest association with PA (leisure and transport).

An important finding from the present study relates to the physical and psychological domains. In general, the PA effects on physical and mental health often come out in studies independently of the study design, the examined population, age, gender or type of intervention [13, 43]. Nevertheless, the present study results did not confirm these findings when different contexts and intensity of PA were analyzed. For example, women who walked for transportation did not show significantly higher scores in the physical and psychological domains when compared to those who did not walk. The same happened for men in the psychological domain.

With regard to leisure PA, the low PA intensities were not associated with the physical QoL domain in men, and only vigorous activities were significant. In contrast, an opposite pattern was observed among women with lower PA intensity (walking and moderate PA) positively associated with this domain. Partly, this behavior may be explained by the low levels of PA among women in the sample; therefore, small variations in PA may be sufficient to cause an effect in QoL, especially in the physical domain, as this is associated with independence and mobility [26].

Among all types of PA analyzed, walking during leisure was the one that presented the highest relation with QoL. In this study, walking had a marked protective effect for men and women who achieved the PA recommendations. This is an important finding if considered that walking is a low-intensity activity and accessible and can be easily built into people's days [44, 45]. Furthermore, walking provides some of the same benefits of higher intensity activities with the advantage of presenting less risks of injury and sudden death [46]. Thereby, walking should be strongly supported for health promotion and QoL since it is easier to encourage inactive people to start and adhere to low-intensity activities.

Some limitations of this study should be taken into consideration. The fact that the study has a cross-sectional design does not allow the determination of a cause and effect relationship. It is possible that people that practice PA have better QoL, but it is also possible that QoL influences the practice of PA. Furthermore, others factors may influence this relationship, such as self-efficacy [13, 47], which can influence the one's perception on fitness and vitality. In addition, since the PA measure was self-reported, it is possible that the collected information does not duplicate the real PA levels of individuals. However, it is important to highlight that the questionnaire used to assess PA was used in various large-scale epidemiological studies [16, 21, 48] and has good psychometrical measures [49].

Finally, the results point to a positive relation between PA practice and QoL. This relationship, though, varies according to gender, PA type and intensity. Additionally, the different QoL domains are distinctively influenced by PA. Leisure PA contributes more to the enhanced QoL than to transport activities. Despite the results having not pointed to a significant variation between leisure PA of all intensities with QoL domains, the biggest averages were found among those who practice the activity at the recommended levels.

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