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Impact of Physical Activity on Survival in Hypertensive and Diabetic Patients in the Interior of São Paulo

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Abstract

Non-communicable chronic diseases (NCDs) are a group of complications characterized by a long latency period, prolonged evolution time and irreversible lesions that lead to a variety of disabilities and death. Thus, this study aims to prospectively evaluate the association between physical activity level and mortality in hypertensive and diabetic patients from a city in the state of São Paulo, Brazil. A standardized longitudinal study was conducted with 200 patients evaluated in 2012 and reassessed in 2018. These hypertensive and diabetic patients answered specific questions about the level of physical activity and quality of life. Univariate analyzes for the significance test of associations were performed using the analysis of variance and the chi- square test for continuous and discrete variables, respectively. All significance tests were considered at $p<0.05$ and survival analysis was conducted using the COX regression model. The major findings have shown that the chance of active patients with 80% survival could be compared to sedentary. Physical activity was related to survival, although irregularly with 65% of chances of survival by the patients who do not maintain this practice. We concluded that active people have lower odds of mortality compared to sedentary. Irregularly active people have a higher chance of death when compared to the active as the level of physical activity is directly related to mortality in hypertensive and diabetic patients.

Keywords: Hypertension • Diabetes mellitus • Physical activity • Mortality • São Paulo

Introduction

Non communicable chronic diseases (NCDs) are a group of complications characterized by a long latency period, prolonged evolution time and irreversible lesions that lead to a variety of disabilities and death. Among the diseases, high blood pressure (HBP) and diabetes mellitus (DM) have common characteristics and are easily diagnosed and responsible for more than two million deaths per year worldwide [1-5].

Therefore, the Brazilian Ministry of Health, through the Unified Health System launched the Hiperdia program that aims to prevent complications arising from the non-adherence to antihypertensive treatment prescribed by the doctor for hypertensive treatment and diabetes.

A previous cross-sectional study conducted by our group "Characterization of people with hypertension and diabetes treated at the basic health units of the city of Agudos and evaluation of the association among physical activity level and cardiovascular risk factors, quality of life and comorbidities" [6] concluded that sedentary people had higher rates of stroke, infarction, heart failure hospitalization, kidney disease, dialysis and higher frequency of family history of hypertension. On the one hand, the higher level of physical activity was associated with better quality of life, even after excluding patients with stroke, dialysis or heart failure.

Literature suggests that maintaining an adequate level of physical activity is an important health promotion factor in the elderly population. Thus, lifestyle plays a key role in the prevention and control of chronic non communicable diseases, especially those that constitute the main cause of mortality [7].

On the other hand, many randomized experimental studies have shown that exercise programs improve not only physical fitness but also blood lipid levels, blood pressure, bone density, body composition, insulin sensitivity and glucose tolerance. Hence, it seems reasonable to suppose that the improvement of these clinical variables may lead to a reduction in mortality rates and to an increase in people's healthy lifespan [7,8].

We have found in Brazil peer-reviewed studies on healthy aging [8], historical profile of morbidity and on elderly's mortality [9] and on the epidemiological aspect of aging [10]. Nevertheless, there is a lack of longitudinal studies in the literature to verify the association between physical activity and mortality.

The results of these studies may suggest that intervention strategies in the adoption and maintenance of physical activity should emphasize the proposals for adherence to physical activity practice considering the specific characteristics of our population.

We should also consider that the main studies in this scope were conducted abroad. Thus, it is necessary to conduct research with the Brazilian population to assess whether the results obtained in other countries can be confirmed in our country. The present study is justified as it contributes to the knowledge of the impact of physical activity on mortality in hypertensive and diabetic patients in a city in the interior of the state of São Paulo.

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Therefore, the present study aims to prospectively evaluate the association between physical activity level and mortality in hypertensive and diabetic patients.

Material and Methods

Outline

A longitudinal study was conducted with 200 patients aged over 18 years, both sexes, who enrolled in the Hiperdia Program of the city of Agudos. They had already participated in a previous study in 2009, where the number of patients was determined using the Hiperdia population average sample formula reaching 200 patients.

From May to August 2018 the same patients were evaluated and data were collected in a standardized assessment by questionnaires, anthropometric, biometric parameters and blood pressure measured according to the recommendations of the VI Hypertension Guidelines [11].

Laboratory tests were obtained from a specific patient's database registered in Hiperdia that has been considered the last examination requested by the physician.

Regarding the patients who died, an investigative research was conducted to verify the cause of death through the death certificate. The inclusion criteria comprised participants aged over 18 years, aware and able to answer the questionnaires and the exclusion criteria encompassed intellectual disabilities and patients aged less than 18 years.

All the involved have read and gave written informed consent and all the procedures were in accordance with the Botucatu Protocol 1.642.169. The instruments used for evaluation were the Kidney Disease and Quality of Life Short-Form (KDQOL-SFTM) [12] and the International Physical Activity Questionnaire (IPAQ) [13], both in their translated version, adapted and validated for the Brazilian culture.

Statistical analysis

Data has been written in discrete or continuous quantitative variables and the independent variable was the level of physical activity. Data were transcribed in a spreadsheet that was specifically designed for data collection in the software Statistic SPSS 25.

Univariate analyzes for the significance test of associations were performed using the analysis of variance and the chi-square test for continuous and discrete variables, respectively. All significance tests were considered at $p<0.05$. Data were presented as mean and standard deviation or median (first, fourth quartile) when appropriate.

Survival analysis was performed using the COX regression model to data analysis from life time studies, in which the response was the beginning of the evaluation in 2012, until the occurrence of a covariate adjusted to a death event.

Results

The cohort comprised 200 patients, 152 were female (76%), with a mean age of 65 ± 12.8 years. White patients predominated with 91 (45%) and a mean of 3.3 ± 2.3 years of schooling, average monthly income of 1.13 minimum wages.

There were 22 deaths, 13 women (7%) and 9 men (5%). The causes were: 01 patient died from ischemic stroke and respiratory failure, 03 acute pulmonary edema, 02 congestive heart failure (CHF), 01 neck cancer, 01 septic shock and pneumonia, 01 chronic obstructive arterial disease, 02 acute respiratory failure, 02 breast cancer, 01 lung cancer, respiratory failure, 01 rectal cancer, peritonal carcinomatosis, 02 cardiopulmonary failure, 01 cardiac failure, and finally 04 home deaths without medical assistance.

Patients were categorized according to physical activity level classification: sedentary, insufficiently active and active. Thus, the frequency of sedentary lifestyle was 11% (22), insufficiently active 68.5% (137), and active 20.5% (41).

Table 1 shows clinical and anthropometric data divided according to death occurrence. We obtained a 30 ± 5.3 kg/m^2 mean body mass index (BMI). No statistical difference was found among groups as we did not find it on blood pressure, heart rate and neck circumference indicators.

Table 1. Sample physical examinations and deaths of the population of Hiperdia in the municipality of Agudos.

Dependent Variables	Deaths (n=22)	Sample (n=178)	p
SBP (mm Hg)	138 ± 19.1	132 ± 21.8	0.235
DBP (mm Hg)	87 ± 10.8	84 ± 16.2	0482
HR (bpm)	69 ± 11.2	70 ± 10.1	0.606
BMI	30 ± 5.6	30 ± 6.7	0.992
Circ. neck (cm)	40 ± 11.2	38 ± 7.5	0.182

Data are expressed as mean ± standard deviation, or median (first; fourth quartile).

Abbreviations: SBP, systolic blood pressure; DBP, diastolic blood pressure; HR, heart rate; BMI, body mass index; Circ. Neck, neck circumference.

Data of laboratory tests divided according to death occurrence are shown in Table 2. Laboratory tests have shown differences between the sample and the different levels of physical activity outcomes, as fasting glycemia (p=0.038) and LDL (p=0.02).

Table 2. Sample laboratory tests and deaths of the population of Hiperdia and outcome in the municipality of Agudos.

Dependent Variables	Deaths (n=22)	Sample (n=178)	p
Fasting Blood Glucose (mg/dL)	128 ± 75.4	112 ± 75.4	0.038
Total cholesterol (mg/dL)	201 ± 50.3	204 ± 38.6	0.756
HDL (mg/dL)	49 ± 21.5	44 ± 10.6	0.060
LDL (mg/dL)	114 ± 42.2	131 ± 37.5	0.002

Data are expressed as mean ± standard deviation, or median (first; fourth quartile).

Abbreviations: HDL: High Density Lipoprotein; LDL: Low Density Lipoprotein.

This study presented on the variable of congestive heart failure (CHF) a difference among the distinct levels of physical activity, indicating p=0.007, as well as in nonsmoker patients at any time of life, p=0.014. Patients who never drank alcohol or who stopped drinking have showed difference among the distinct levels of physical activity, p=0.038.

A statistically significant difference was found among the outcomes of different levels of physical activity and mortality, p=0.003.

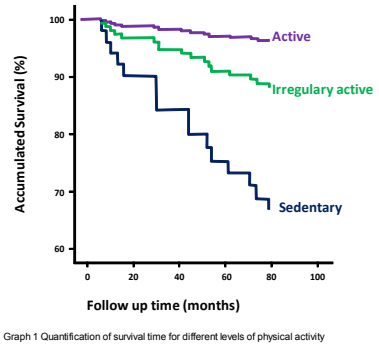
The level of physical activity was associated with mortality, even after adjusting for the confounding variables, age and CHF hospitalization, as shown in Table 3. Taking the sedentary patients as a reference, the hazard ratio was 0.345 (95% CI: 0.130-0.914) for irregularly active patients and 0.193 (95% CI: 0.038-0.980) for active (Figure 1).

Table 3. Association of different levels of physical activity and mortality in hypertensive and/or diabetic patients.

		p	Hazard Ratio	95% IC Hazard Ratio	
				Botton	Higher
Step 1	Age (years)	0.136	1.023	0.993	1.054
	Male	0.454	1.479	0.531	4.123
	Limitation by physical aspects	0.964	1.000	0.987	1.013
	Emotional aspects	0.211	0.993	0.981	1.004
	DM	0.133	1.983	0.811	4.846
	Previous hospitalization for CHF	0.066	20.764	0.935	80.176
	Past ou current smoking	0.335	10.551	0.635	30.785
	IPAQ (active)	0.264	Reference		
	IPAQ (irregulary active)	0.265	0.520	0.165	10.640
	IPAQ (sedentary)	0.114	0.246	0.043	10.403
Step 2	Age (years)	0.136	10.023	0.993	10.054
	Male	0.445	10.484	0.539	40.089
	Emotional aspects	0.152	0.993	0.983	10.003
	DM	0.133	10.979	0.812	40.820
	Previous hospitalization for CHF	0.064	20.755	0.941	80.065
	Past ou current smoking	0.335	10.551	0.635	30.785
	IPAQ (active)	0.233	Reference		
	IPAQ (irregularly active)	0.258	0.523	0.170	10.609
	IPAQ (sedentary)	0.099	0.249	0.048	10.300
Step 3	Age (years)	0.108	10.024	0.995	10.054
	Emotional aspects	0.127	0.993	0.983	10.002
	DM	0.123	20.007	0.827	40.866
	Previous hospitalization for CHF	0.054	20.855	0.984	80.287
	Past ou current smoking	0.239	10.676	0.709	30.964
	IPAQ (active)	0.142	Reference		
	IPAQ (irregularly active)	0.113	0.441	0.160	10.214
	IPAQ (sedentary)	0.080	0.232	0.045	10.190

Step 4	Age (years)	0.082	10.026	0.997	10.055
	Emotional aspects	0.142	0.993	0.983	10.002
	DM	0.165	10.855	0.775	40.437
	Previous hospitalization for CHF	0.055	20.746	0.977	70.714
	IPAQ (active)	0.123	Reference		
	IPAQ (irregularly active)	0.079	0.414	0.155	10.106
	IPAQ (sedentary)	0.087	0.241	0.047	10.230
Step 5	Age (years)	0.101	10.024	0.995	10.053
	Emotional aspects	0.134	0.993	0.983	10.002
	Previous hospitalization for CHF	0.098	20.329	0.856	60.338
	IPAQ (active)	0.062	Reference		
	IPAQ (irregularly active)	0.043	0.368	0.140	0.969
	IPAQ (sedentary)	0.051	0.201	0.040	10.009
Step 6	Age (years)	0.087	10.026	0.996	10.058
	Previous hospitalization for CHF	0.042	20.788	10.036	70.498
	IPAQ (active)	0.050	Reference		
	IPAQ (irregularly active)	0.032	0.345	0.130	0.914
	IPAQ (sedentary)	0.047	0.193	0.038	0.980

HR: Hazard Ratio, Physical aspects: limitation by physical aspects according to SF-36; Emotional aspects Physical limitation according to SF-36; DM: presence of diabetes; CHF: Congestive Heart Failure



Graph 1 Quantification of survival time for different levels of physical activity

Figure 1. Quantification of survival time for different levels of physical activity.

Discussion

The main finding of this study was the 80% chance of survival in active patients compared to sedentary. Data were maintained throughout the analysis process. Physical activity was related to survival, although irregularly, with 65% of chances of survival of the patient who does not maintain this practice.

In the literature, a hispanic investigation with 3.298 participants conducted over 11 years has found that free time physical activity protects against all mortality causes, except obesity [14].

A Greek longitudinal study with 1.918 patients found the relation of education level with the level of physical activity, noting that the high level of education was related to higher levels of physical activity [15]. In correlation with mortality, the lower level of education had a higher risk of death for all causes, as well as a recurrence on coronary artery disease.

A study in North Manhattan with 3.298 elderly, multiethnic, city-dwelling participants and mean age 69 years has associated the lower risk of all-cause mortality with the lower risk. However, these findings were only seen among those with a BMI<30 and not in those with a BMI ≥ 30. In the study, no association was found between mortality and leisure time physical activity. The authors sustained that the physical activity protective effect could be mitigated by high BMI in a group with high risk of mortality [16].

We have found in the literature a study on the level of physical activity and mortality comprising 13. 485 men, mean age 57.5 years, where the low level of physical activity was not related to a reduction in mortality rate. Whereas moderate physical activity seemed beneficial, only vigorous activities were clearly associated with physical activity and reduced mortality rates. In the current study, involving hypertensive and diabetic patients, those with irregular levels of physical activity have already statistically correlated with the significance for reducing the mortality rate [17].

A study conducted for 7 years, 12.138 middle-aged men showed that moderate leisure time physical activity was associated with only 63% of CVD deaths and that low levels of leisure time physical activity accounted for 70% of deaths from all causes compared to their detected mortality rates [18].

In another study involving 1.405 Swedish women aged 38 to 60 years, it was reported that in the most active group, the risk of death was only slightly reduced compared to that found in the moderately active and among it, compared to the less active without statistical significance [19].

Another study demonstrated that the beneficial effect of physical activity remained unchanged after adjusting other mortality predictors of moderately active leisure time and highly active individuals relative to the odds detected in sedentary counterparts [20].

Pekkanen et al. found in an investigation encompassing 636 healthy Finnish men, aged 45-64 yrs, that the highly active individuals lived 2.1 years longer than the less active [21].

We found data on 1.404 women in Framingham, aged 50 to 74 years, monitored for 16 years based on their physical activity and it was reported that two more active groups had an overall 30% lower mortality rate compared to the two most sedentary groups [22]. Adjustment for cardiac risk factors or exclusion of all subjects who died throughout these six years did not result in any change, and there was no association between activity levels and cardiovascular morbidity or mortality.

The current study has shown no statistical differences between the different outcome groups regarding blood pressure, heart rate, and BMI, waist and neck circumference. We found data in the study that systolic and diastolic blood pressure was associated with increased physical activity. Several studies have indicated that low levels of physical activity associated with various other risk factors are independent on morbidity and mortality [23,24]. Forest et al. reported that, in men, physical activity inversely correlated with high blood pressure risk [25].We have not found significant statistical difference on fasting glucose, total cholesterol, HDL and glucose, but triglycerides have shown no difference among the living groups and those who died. Ashton, Forest et al. maintained the inverse relationship of physical activity to insulin, total cholesterol and LDL cholesterol, and have directly correlated with HDL cholesterol, but have not related them to death [24,25].

We have also found that the most important factor in reducing mortality risk was the level of physical activity rather than the subject´s background of exercise, which does not corroborate with our research [23].

Large cohorts of patients were evaluated by telephone and self-reported the possibility of over-report physical activity, which in the current study overlaps the results considering the on- site assessment [25].

It is well documented that both physical fitness and physical activity are associated with the reduced all-cause mortality and the reduced mortality of mixed and healthy groups. However, we have found no substantial data on the group of hypertensive and diabetic patients systematically and presencially assessed, which can add literature a contribution.

Conclusion

We found that active people have lower chances of mortality compared to sedentary, and irregularly active people have a higher chance of death when compared to the active. Therefore, the level of physical activity is directly related to mortality in hypertensive and diabetic patients.

Hypertensive and diabetic patients who were hospitalized due to congestive heart failure have higher mortality chances as there was a direct relationship with age between groups.

Ethical Approval and Consent to Participate

All the involved have given and signed the Informed Consent Form, which was approved by the Botucatu Protocol 1.642.169.

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Authors' Contribution

All authors contributed substantially to the conception, planning or analysis and interpretation of data, to the drafting or critical review of the contents and participated in the approval of the final version of the manuscript.

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