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# ASSOCIATION BETWEEN LEISURE TIME PHYSICAL ACTIVITY AND MORTALITY BY COVID-19 IN THE BRAZILIAN CAPITALS: AN ECOLOGICAL ANALYSIS

Francisco José Gondim Pitanga, Carmem Cristina Beck, Cristiano Penas Seara Pitanga, Cristiano Silva Pinho, Antonio Carlos Leal Cortez, Dartagnan Pinto Guedes, Victor Keihan Rodrigues Matsudo

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ORIGINAL ARTICLE

ASSOCIATION BETWEEN LEISURE TIME PHYSICAL ACTIVITY AND MORTALITY  
BY COVID-19 IN THE BRAZILIAN CAPITALS: AN ECOLOGICAL ANALYSIS

PHYSICAL ACTIVITY AND MORTALITY BY COVID-19

AUTORES

Francisco José Gondim Pitanga<sup>1</sup>

ORCID iD: <https://orcid.org/0000-0002-1033-8684>

Carmem Cristina Beck<sup>2</sup>

ORCID iD: <https://orcid.org/0000-0002-9429-9140>

Cristiano Penas Seara Pitanga<sup>3</sup>

ORCID iD: <https://orcid.org/0000-0001-8276-3738>

Cristiano Silva Pinho<sup>4</sup>

ORCID iD: <https://orcid.org/0000-0002-9183-5892>

Antônio Carlos Leal Cortez<sup>5</sup>

ORCID iD: <https://orcid.org/0000-0002-8387-5026>

Dartagnan Pinto Guedes<sup>6</sup>

ORCID iD: <https://orcid.org/0000-0002-7367-2276>

Victor Keihan Rodrigues Matsudo<sup>7</sup>

ORCID iD: <https://orcid.org/0000-0003-3552-486X>

1. Department of Physical Education. Federal University of Bahia, Salvador, BA, Brazil.
2. Federal Institute of Santa Catarina, Palhoça, SC, Brazil.
3. Catholic University of Salvador, Salvador, BA, Brazil.
4. PhD student in Medicine and Health / PhD Student at Medicine and Health - PPGMS / UFBA - Professor Edgard Santos University Hospital (HUPES)
5. Santo Agostinho University Center - UNIFSA, Teresina, PI, Brazil. Stricto Sensu Graduate Program in Nursing and Biosciences at the Federal University of the State of Rio de Janeiro - UNIRIO - Rio de Janeiro, RJ, Brazil.
6. Center for Research in Health Sciences, University of Northern Paraná, Brazil.
7. Center for the Study of the Physical Fitness Laboratory of São Caetano do Sul - CELAFISCS - São Caetano do Sul, SP, Brazil

## **Author contributions**

Conception and design of the research: Pitanga FJG; Data analysis: Pitanga FJG; Writing of the manuscript and Critical revision of the manuscript for intellectual content: Pitanga FJG, Beck CC, Pitanga CPS, Pinho CS, Cortez ACL, Matsudo VKR, Guedes DP.

## **ABSTRACT**

**Background:** recent points of view catch us attention to the importance of continuing to practice physical activity during the Covid-19 pandemic, however few studies have analyzed the association between physical activity and worsening of the clinical outcome, hospitalizations or mortality from the new coronavirus

**Objective:** to analyze the association between physical activity and deaths by Covid-19 in the Brazilian capitals.

**Methods:** observational cross-sectional ecological study, when data on prevalence of leisure time physical activity and deaths by Covid-19 were analyzed in 26 Brazilian capitals and the Federal District as well. Data on the prevalence of leisure time physical activity, obesity and hypertension has been collected through the Risk Factors Surveillance System for chronic non-communicable diseases of the Brazilian Ministry of Health were used. Information on accumulated deaths, lethality of the disease and mortality rate were extracted from SUS(Brazil's Unified National Health System) Analytical: data on COVID-19 in Brazil, available on the website of the Brazilian Ministry of Health. For data analysis, simple Pearson correlation and multiple regression were used with a 5% significance level.

**Results:** demonstrate the existence of an inverse correlation between leisure time physical activity and accumulated deaths ( $r = -0.44$ ,  $p = 0.03$ ), mortality rate/100,000 inhabitants ( $r = -0.43$ ,  $p = 0.02$ ) as well as with the lethality of the disease ( $r = -0.51$ ,  $p = 0.01$ ). They also demonstrate an inverse association between leisure time physical activity and accumulated deaths ( $\beta = -485.1$ ,  $p = 0.04$ ), as well as with the lethality of the disease ( $\beta = -0.21$ ,  $p = 0.02$ ), even after adjusting for confounding variables.

**Conclusions:** the practice of leisure time physical activity can be an important ally in coping with Covid-19. The inverse association observed among physical activity, accumulated deaths and disease lethality can bring important reflections on the actions that have been implemented by government agencies, both state and municipal regarding the practice of physical activity by the population.

**Keyword:** Physical Activity, Deaths, Disease Lethality, Mortality Rate, Covid-19

## INTRODUCTION

The important benefits of physical activity for cardiometabolic<sup>1</sup>, immunological<sup>2</sup> and mental health<sup>3</sup> are already widely known by the scientific community. Regular physical activity can be very effective in preventing obesity, high blood pressure and other cardiometabolic disorders which are risk factors for the severity of hospital admissions due to Covid-19<sup>1</sup>. Specifically with regard to the immune system, during the infectious process caused by the new coronavirus, individuals whom are more physically active may have more adequate defense mechanisms to reduce the inflammatory process caused by the conflict between the virus and the immune cells of our body. Thus, the reduction of the inflammatory process in the lungs can decrease the severity of the patient's clinical condition, avoiding the use of more drastic interventions, such as, for example, mechanical ventilation<sup>4</sup>.

In this context, a recent publication demonstrated that physical inactivity can be an important risk factor for hospital admissions for COVID-19, and suggests that the adoption of a simple lifestyle can decrease the risk of severe Covid-19 infection<sup>5</sup>. There are still points of view, that catch us attention to the importance of continuing physical activity and reducing sedentary behavior during the Covid-19 pandemic<sup>6</sup>, in addition to suggesting to government officials that when publishing decrees on population movement restrictions, consider physical activity essential during the current pandemic<sup>7</sup>. They also suggest that we live in a moment where, in addition to COVID-19, other pandemics are plaguing humanity, such as physical inactivity and obesity wich come with serious consequences for the health of the world population<sup>8</sup>.

In addition, publications on influenza/H1N1, transported to the current pandemic, suggest that the more physically active the population is, the lower the mortality rates and severity of the infection caused by COVID-19 will be<sup>9,10</sup>. In this context, a recent publication when public domain data were analyzed in 45 African countries showed an association between the prevalence of insufficient physical activity and mortality due to COVID-19<sup>11</sup>.

On the other hand, publications draw attention to the importance of regular physical activity as a means of protection against the severity of infection caused by the new coronavirus<sup>12,13</sup>. They even suggest that doses of physical activity be “inoculated” in the population as a means of protection for future pandemics<sup>14</sup>. Furthermore, studies show that the effect of the influenza vaccine has more significant protective effects on physically active elderly people, a fact that may also be present in the current pandemic<sup>15,16</sup>.

Considering there are very few original studies that relate physical activity to the worsening of the clinical outcome, hospitalizations and mortality due to COVID-19, as well

many points of view that draw attention to the importance of physical activity in the context of the new coronavirus, and also, several studies on physical activity and influenza with data transported to the current pandemic, the present work may expand the initial knowledge about the association between physical activity and Covid-19 contributing to a better understanding on the subject.

Thus, the objective of the study was to analyze the association between physical activity and mortality by Covid-19 in Brazilian capitals.

## **METHODS**

### **Study type**

This is an observational cross-sectional ecological study, when data on prevalence of leisure time physical activity (LTPA), accumulated deaths, disease lethality and mortality rate by Covid-19 in 26 Brazilian capitals and the Federal District were analyzed.

### **Data collect**

Data on the prevalence of LTPA, obesity and arterial hypertension collected in 2019 through the Risk Factor Surveillance System for chronic non-communicable diseases (VIGITEL 2019) were used, available in a document published by the Ministry of Health of Brazil<sup>17</sup>. The information on deaths was related to January 22, 2021, extracted from the Analytical SUS: data on COVID-19 in Brazil, available on the website of the Ministry of Health of Brazil<sup>18</sup>. Information on accumulated deaths by Covid-19, lethality of the disease and mortality rate by Covid-19 per one hundred thousand inhabitants was used, by Brazilian capitals and the Federal District.

### **Data analysis**

Initially, Pearson's simple correlation analysis was performed between LTPA and accumulated deaths by Covid-19, lethality of the disease and mortality by Covid-19 per 100 thousand inhabitants. Subsequently, multiple regression analysis between LTPA and accumulated deaths by Covid-19, lethality of the disease and mortality by Covid-19 per hundred thousand inhabitants was used, adjusted for obesity and arterial hypertension. The adequacy of the final model was tested by analyzing the residuals, the adjusted determination coefficient, sum of the squares of the regression residues, normality test of the regression residues and analysis of the presence of aberrant points. The level of significance used was  $<0,05$ ). The statistical program STATA 12.0 was used.

## RESULTS

Information on the prevalence of the variables analyzed in the study, as well as accumulated deaths by Covid-19, lethality of the disease and mortality rate by Covid-19 per 100 thousand inhabitants in each of the Brazilian capitals are available in Table 1.

INSERT TABLE 1

The simple correlations between LTPA, accumulated deaths, lethality of the disease and mortality by Covid-19 per 100 thousand inhabitants are shown in Figures 1, 2 and 3. There is an inverse and statistically significant correlation between LTPA, accumulated deaths, mortality rate/100,000 inhabitants and lethality of the disease.

INSERT FIGURE 1

INSERT FIGURE 2

INSERT FIGURE 3

The multiple regression analyzes between the variables involved in the study are shown in Tables 2, 3 and 4. One can observe statistically significant regression coefficients in the association between LTPA, accumulated deaths and lethality of the disease even after adjustments for the confounding variables. With regard to the multiple regression analysis between LTPA and Covid-19 mortality rate for every 100 thousand inhabitants, the association losted statistical significance.

INSERT TABLE 2

INSERT TABLE 3

INSERT TABLE 4

## DISCUSSION

The study analyzed in an ecological way the association between physical activity, accumulated deaths, lethality of the disease and mortality rate by Covid-19 for every 100 thousand inhabitants. The results demonstrate the existence of an inverse association, even after adjusting for confounding variables between LTPA, accumulated deaths and lethality of the disease. Despite the limitations inherent to studies with ecological characteristics, the information obtained based on these analyzes can serve as a basis for further studies.

In this context, considering that the Covid-19 pandemic is very recent, we found in the literature consulted few studies on the association between physical activity and worsening of clinical outcome, hospital admissions and mortality by Covid-19. One of these studies, carried out in England, the authors demonstrated that physical inactivity was a risk factor for hospital admissions by Covid-19, despite the fact that information on physical activity was obtained between 2006 and 2010, approximately 10 years ago<sup>5</sup>.

Another more recent study, including characteristics similar to ours, carried out in 45 African countries demonstrated an association between physical inactivity and mortality due to Covid-19. It is noteworthy that the association was observed only in accumulated deaths, not remaining statistically significant when deaths were adjusted per million inhabitants<sup>11</sup>. In our study, we were able to demonstrate an inverse association between physical activity and accumulated deaths, deaths per 100 thousand inhabitants and Covid-19 lethality. In another recent publication, it was observed that athletes are less likely to be admitted to hospital, go to the intensive care unit or die from Covid-19 than non-athletes<sup>19</sup>.

Despite this gap in the literature, recent point of views have been published on the topic of physical activity and Covid-19: the first one reported the importance of continuing physical activity during the Covid-19 pandemic and was based in the city of Wuhan in China<sup>20</sup>, the initial epicenter of the disease, where people were recommended to continue the practice of physical exercises even at home. Soon after, researchers from Spain and the USA<sup>21</sup>, with a specific focus on the elderly, emphasized the importance of physical exercise done outdoors or at home as therapy to combat the physical and mental consequences of quarantine due to the Covid-19 pandemic. Following, the position of the American College of Sports Medicine<sup>22</sup> was published when it was suggested to continue the practice of physical activity outdoors or indoors during the pandemic.

It is important to note that the "Manifesto for the Promotion of Physical Activity in Post Covid" was recently published in Brazil, which calls attention to sensitize and mobilize the most distinct population groups, governmental agencies, non-governmental agencies and

private initiatives to promote a more active lifestyle, considering its preventive effects on mitigating pandemics such as Covid-19<sup>23</sup>.

In addition, a publication by Italian researchers presents lessons learned from studies on influenza and physical activity in obese patients and suggests that the findings may be considered for Covid-19. In this work, the authors emphasize the importance of physical activity in order to enhance the positive immunomodulation provided by the practice of light to moderate intensity physical exercise, especially in obese individuals<sup>12</sup>.

Also is noteworthy a strong relation between physical exercise and extracellular superoxide dismutase (EcSOD) enzymes, in recent study, it has been demonstrated that moderate intensity exercise increased EcSOD enzymes and reduced the cytotoxic activity of ROS cells<sup>24,25</sup> EcSOD, a molecular transducer of health benefits of exercise has been associated with lower endothelial tissues damages<sup>26,27</sup>.

And in addition, another important study catch us much attention about the role of Irisin hormone on the immune system. This original study has been conducted by researchers at São Paulo State University (UNESP) and suggests that irisin, a hormone found to be secreted from muscles in response to exercise, in fact, could have an important therapeutic effect on COVID-19 patients. The researchers analyzed adipose cell gene expression and found that irisin modulated genes associated with replication of the novel coronavirus SARS-CoV-2 in human cells. They found in uninfected adipocytes, the irisin has been altered the expression of genes that regulate ACE-2, and this one is found to encode a protein to which the virus binds in order to invade human cells<sup>28</sup>.

In this sense, it is emphasized that although so far, only one study has been found on the association between physical activity and mortality on Covid-19<sup>11</sup>, the literature presents some publications on physical activity and influenza. Among them, we can mention a study carried out by researchers from Hong Kong<sup>10</sup> where less was observed mortality rate associated with influenza in individuals who exercised at low/moderate intensity. In another publication, it was shown that higher levels of physical activity may be associated with reduced risk and severity of influenza infection in individuals under 65 years of age<sup>9</sup>.

Our results demonstrate that physical activity has an inverse association with accumulated deaths by Covid-19, as well as with the lethality of the disease. We also observed, as can be seen in Tables 3 and 4, that for each 1% increase in the prevalence of physical activity, there would be a reduction of approximately 485 deaths by Covid-19, as well as a 0.21% decrease in the lethality of disease. In this regard, it is important to emphasize that the World Health Organization (WHO) published in 2018 the Global Action Plan for



physical activity 2018-2030, when actions to reduce physical inactivity by 10% were recommended to all countries in the world by 2025 and 15% by 2030<sup>28</sup>.

The strength of the study lies in the fact that it was one of the first to analyze associations between physical activity and deaths resulting from the current Covid-19 pandemic. On the other hand, the present results should be interpreted with caution since the ecological or aggregate study analyzes groups, instead of individuals, a fact that can lead to a lack of information about data in relation to the variables involved in the analysis. In addition, the average age was not found in VIGITEL, as well as socioeconomic information from Brazilian capitals, a fact that made the use of these variables as possible confounders unfeasible. It should also be noted that the information used is from VIGITEL 2019, since the data for the year 2020 will be published later in 2021. Regarding the information on deaths, it is important to clarify that the results presented here may undergo changes over time, since the number of deaths is being changed according to the continuity of the pandemic.

## **CONCLUSIONS**

The results of the present study lead us to believe that the practice of leisure time physical activity can be an important ally in coping with Covid-19. The inverse association observed between physical activity, accumulated deaths and lethality from the disease can bring important reflections on the actions that have been implemented by government agencies, both state and municipal. The information, although preliminary, that each 1% increase in the prevalence of physical activity can mean a reduction of approximately 485 deaths by Covid-19, as well as a decrease of approximately 0.21% in the lethality of the disease, need urgently to be assimilated by our governments, so that they seek concrete and safe measures to increase the levels of physical activity in the population, so that we are better prepared for the current and possible future pandemics with characteristics similar to what we are experiencing at the moment. It should be noted that when designing the results of this study to meet the WHO goal of increasing the prevalence of physical activity in the world population by 10%, in theory, we would observe a 2.1% reduction in the lethality of the disease, which could zero the mortality in some Brazilian capitals. New prospective and retrospective observational studies are suggested, as well as clinical trials that can confirm the results found in this ecological study.

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Table 1 - Characteristics of the variables analyzed by Brazilian capitals.

<b>CAPITALS</b>	<b>LTPA (%)</b>	<b>Death (n)</b>	<b>Lethality (%)</b>	<b>Obesity (%)</b>	<b>Arterial Hypertension (%)</b>	<b>Rate Mortality</b>
Aracajú	41,9	975	1,5	20,6	25,1	148
Belém	43,2	2529	3,9	19,6	19,3	169
BH	39,7	2136	2,6	19,9	25,8	85
Boa vista	39,7	594	1,1	21,2	20,4	149
Cpo. Grande	39,5	1242	1,8	22,5	24,9	139
Cuiabá	38,3	1287	2,8	22,5	22,8	210
Curitiba	41	2117	2,8	19,4	21,1	110
Florianópolis	45,2	387	0,8	17,8	21,6	77
Fortaleza	40,3	4282	4,6	19,9	21,2	160
Goiânia	41	2207	2,5	19,5	24,3	146
João Pessoa	40,1	1244	2,7	20,4	25,6	154
Macapá	44,3	758	2,4	22,9	23,2	151
Maceió	39,9	1189	2,9	20	26,8	117
Manaus	37,1	4617	4,3	23,4	18,4	212
Natal	45,4	1281	3,4	22,5	24,5	145
Palmas	49,9	232	0,9	15,4	17,6	78
Porto Alegre	37,7	2059	2,6	21,6	28,2	139
Porto Velho	37,1	1020	2,2	19,9	19,6	193
Recife	35,6	2860	5,1	21,7	28,4	174

Rio Branco	44,6	533	2,5	23,3	18,5	131
Rio Janeiro	37,8	16608	9,1	21,7	28	247
Salvador	41,3	3305	2,7	18,1	25,2	115
São Luís	37,9	1326	4,8	17,2	16,9	120
São Paulo	34,6	16915	3,8	19,9	24,4	138
Teresina	44,3	1265	2,3	17,6	22,4	146
Vitória	44,2	628	1,9	17,6	24,3	173
Distrito Federal	47,1	4460	1,6	19,6	28,5	148

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LTPA, leisure time physical activity; mortality rate per 100 thousand inhabitants; mortality data for the day January 22 2021; information on leisure time physical activity, obesity and high blood pressure obtained from VIGITEL 2019

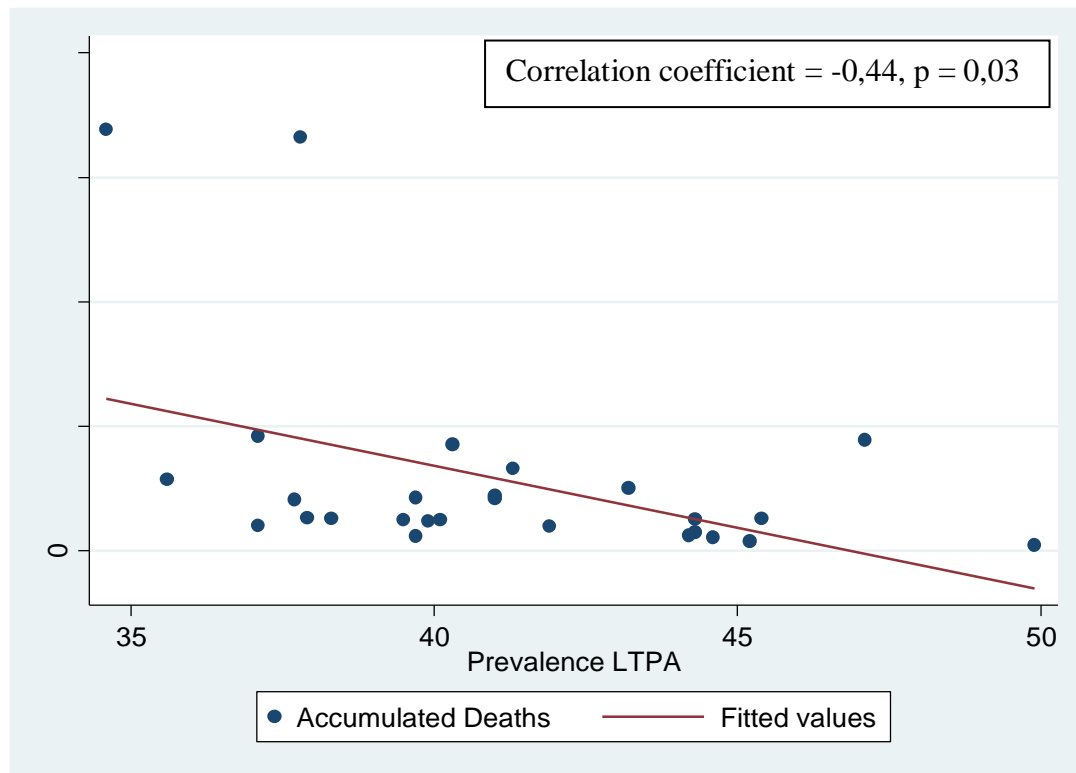


Figure 1 - Association between LTPA (%) and accumulated deaths in Brazilian capitals

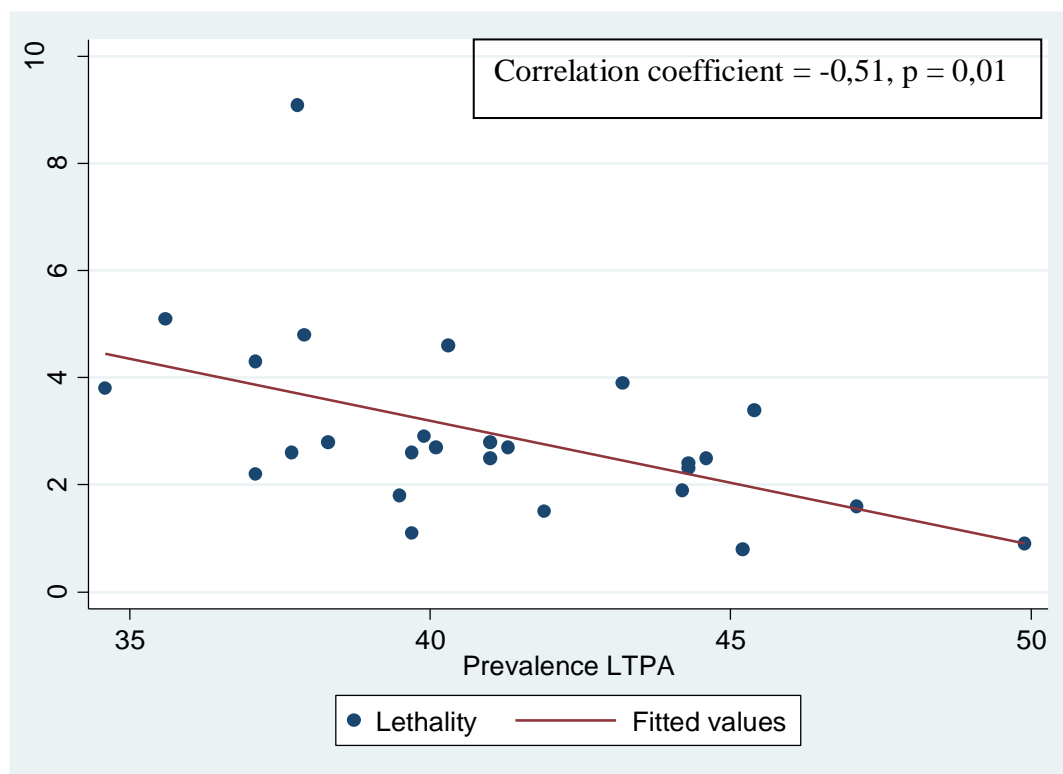


Figure 2 - Association between LTPA (%) and lethality of the disease in Brazilian capitals

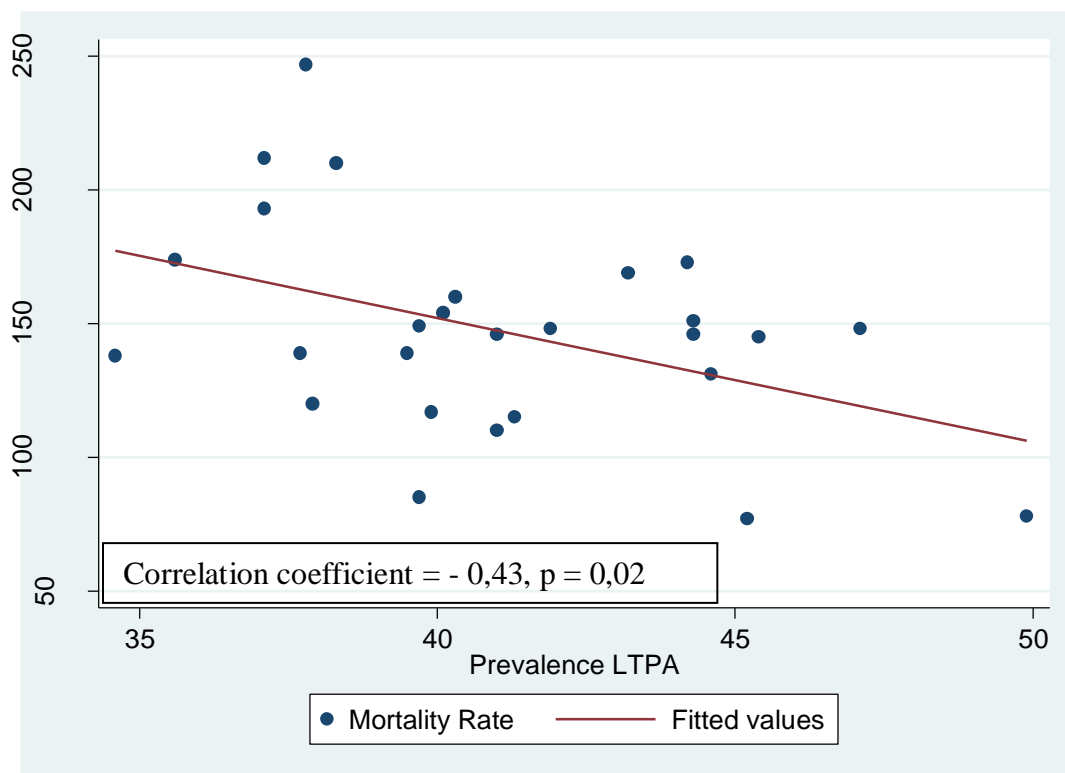


Figure 3 - Association between LTPA (%) and mortality rate/100,000 inhabitants in Brazilian capitals

Table 2 - Multiple Regression Analysis between LTPA and accumulated deaths by Covid-19

<b>Deaths</b>	<b>Coefficient</b>	<b>Standard Error</b>	<b>p value</b>	<b>Confidence Interval (95%)</b>	
LTPA	-485.1158	223.7967	0.041	-948.0746	-22.15704
Obesity	-185.4248	405.1669	0.651	-1023.576	652.7269
Hypertension	285.3133	227.1759	0.222	-184.6359	755.2625
Constant	19933.29	15117.76	0.200	-11340.19	51206.76

Analysis adjusted for confounding variables; LTPA = Leisure Time Physical Activity.



Table 3 - Multiple Regression Analysis between LTPA and Lethality by Covid-19.

<b>Deaths</b>	<b>Coefficient</b>	<b>Standard Error</b>	<b>p value</b>	<b>Confidence Interval (95%)</b>	
LTPA	-.2131576	.0882119	0.024	-.3956378	-.0306774
Obesity	.0629409	.1597009	0.697	-.2674256	.3933074
Hypertension	.0314237	.0895438	0.729	-.1538118	.2166592
Constant	9.699197	5.958829	0.117	-2.627581	22.02597

Analysis adjusted for confounding variables; LTPA = Leisure Time Physical Activity.

Table 4 - Multiple Regression Analysis between AFTL and the mortality rate due to COVID-19 per 100 thousand inhabitants

<b>Deaths</b>	<b>Coefficient</b>	<b>Standard Error</b>	<b>p value</b>	<b>Confidence Interval (95%)</b>	
LTPA	-3.010927	1.982317	0.142	-7.111662	1.089807
Obesity	8.00069	3.588834	0.036	.5766218	15.42476
Hypertension	-.134712	2.012249	0.947	-4.297366	4.027942
Constant	112.2483	133.9081	0.411	-164.7618	389.2583

Analysis adjusted for confounding variables; LTPA = Leisure Time Physical Activity.

## DECLARAÇÃO DE ISENÇÃO DE CONFLITO DE INTERESSE

*Ao Comitê Editorial do SciELO Preprints*

Nós, Francisco José Gondim Pitanga, Carmem Cristina Beck, Cristiano Penas Seara Pitanga, Cristiano Silva Pinho, Dartagnan Pinto Guedes, Victor Keihan Rodrigues Matsudo e Antônio Carlos Leal Cortez (autor correspondente), investigadores e responsáveis pelo estudo: **ASSOCIATION BETWEEN LEISURE TIME PHYSICAL ACTIVITY AND MORTALITY BY COVID-19 IN THE BRAZILIAN CAPITALS: AN ECOLOGICAL ANALYSIS** declaramos que não há nenhum conflito de interesse que possa influenciar o resultado da pesquisa.

Teresina, 26 de Fevereiro de 2021



Antônio Carlos Leal Cortez  
(Autor Correspondente)