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The burden of physical inactivity for the public health care system in Brazil

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ABSTRACT

OBJECTIVE: To update the estimated cost of physical inactivity for the Brazilian Unified Health System (SUS).

METHODS: The hospitalization costs were accessed via a database of the Ministry of Health – Informatics Department of the Brazilian SUS. Physical inactivity for the year 2017 was accessed via the *Sistema de Vigilância de Fatores de Risco e Proteção para Doenças Crônicas por Inquérito Telefônico* (Vigitel – Surveillance System for Risk and Protective Factors for Chronic Diseases by Telephone Survey). Seven chronic non-communicable diseases (NCD) were selected via the international classification of disease (ICD-10). The population fraction attributable to physical inactivity was calculated based on relative risk reported in previous studies and the prevalence of physical inactivity.

RESULTS: In 2017, the seven NCD considered in the analysis were responsible for 154,017 hospital admissions in adults older than 40 years old, residing in the state capitals and the Federal District, which corresponded to 6.5% of hospitalizations and 10.6% of SUS costs at an estimated US$ 112,524,914.47. Considering the group of individuals with insufficient physical activity in their leisure time, the percentage cost attributed to physical inactivity reached 17.4% of the estimated costs with NCD. At a national level, NCD were responsible for approximately 740 thousand hospitalizations, costing US$ 482 million, from which 17.4%, US$ 83 million were attributed to physical inactivity.

CONCLUSION: This study provides evidence to conclude that physical inactivity exerts an economic impact on the SUS due to NCD hospitalization. Physical inactivity is a modifiable lifestyle and compelling evidence, including that of this article, supports the promotion of a more active community as one of the major targets of public health care policies.

DESCRIPTORS: Physical Inactivity. Non-Communicable Disease. Healthcare.

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INTRODUCTION

Physical inactivity has been considered a global burden to the health care system[1,2]. It is related to the increased risk for cardiovascular and metabolic diseases (i.e.; diabetes and hypertension)[3], increasing the risk of premature cardiovascular mortality[4], and other chronic diseases such as cancer and depression[4]. Furthermore, physical inactivity is responsible for 6% of deaths and is the fourth risk factor for mortality globally; behind hypertension (13%), tobacco use (9%), and high blood glucose (6%)[5]. In an opposite direction, regular physical activity is related to decreased risk of morbidity and mortality and better quality of life[6]. Furthermore, eliminating the population's physical inactivity leads to an estimated life expectance gain from 0.49 to 1.25 years for all ages over 40 years old[7].

About 23% of the world's adult population and 81% of the world's adolescent population do not reach the recommended levels of regular physical activity for maintaining health[8–10]. In Latin America and the Caribbean, 39.1% of the population is physically inactive. Among those, Brazil has the highest prevalence of physical inactivity, with 47% of the population not reaching recommended levels of physical activity[8].

Additionally to the social costs[11], physical inactivity economically burdens the health care system. Conservative estimates revealed that physical inactivity represented a US$ 53.8 billion cost for health care systems worldwide[12]. Of this cost, US$ 2 billion was paid by the public sector, US$ 12.9 billion was paid by the private sector, and US$ 9.7 billion was paid by the families. Likewise, the deaths related to physical inactivity contributed to US$ 13.7 billion in productivity losses[12].

In 2013, 15% of the hospital admissions were estimated to be due to physical inactivity with a projected cost of US$ 732,586,706 to the public healthcare system in Brazil[13]. Considering that Brazil maintained a high prevalence of physical inactivity in the population, we sought to update the estimated economic impact of physical inactivity on the Brazilian Unified Health System (SUS), which provides 80% of hospital care in Brazil. Furthermore, the knowledge about the financial burden of physical inactivity will strengthen the importance to educate the population about having a more active lifestyle. Those results will show that public policy actions must be taken by the policymakers and stakeholders to promote a lifestyle change at the populational levels. Furthermore, acknowledging the estimated financial costs of physical inactivity can support the financial management of the SUS.

Therefore, the estimated economic impact of physical inactivity was found by analyzing the cost of hospitalization due to non-communicable diseases (NCD) attributable to three levels of physical inactivity in the SUS.

METHODS

This is a descriptive study based on secondary data. Seven chronic NCD were selected (Table 1) according to the international classification of disease (ICD-10), which have a decreased risk with increased physical activity[4,6,7]. The hospitalization costs were accessed via a database of the Ministry of Health – *Departamento de Informática do Sistema Único de Saúde do Brasil* (Datasus – Informatics Department of the Brazilian Unified Health System). The Datasus is a body of the Executive Secretariat of the Ministry of Health, whose mission is to use information technology modernization to support the Brazilian SUS. The prevalence of physical inactivity in the year 2017 was accessed via the *Sistema de Vigilância de Fatores de Risco e Proteção para Doenças Crônicas por Inquérito Telefônico* (Vigitel – Surveillance System for Risk and Protective Factors for Chronic Diseases by Telephone Survey), which is maintained by the Ministry of Health. The Vigitel is a

Table 1. ICD-10 for the selected non-communicable diseases and the respective relative risks.

Non-communicable disease	ICD-10	Number of hospitalizations (%)		RR	
		Male	Female	Male	Female
Breast neoplasm					
Malignant breast neoplasm	C50	-	17,772 (22)	-	1.33
Colon neoplasm					
Malignant colon neoplasm	C18	4,004 (5.5)	4,423 (5.4)	1.32	1.27
Cerebrovascular disease					
Intracerebral hemorrhage	I61				
Cerebral infarction	I63	18,601 (26)	17,945 (22)	1.37	1.12
Unspecified stroke	I64				
Other cerebrovascular diseases	I67				
Ischemic heart disease					
Acute myocardial infarction	I21				
Other ischemic heart diseases	I24	37,375 (51)	28,515 (35)	1.18	1.28
Atherosclerosis	I70				
Cardiac insufficiency	I50				
Essential hypertension					
Essential hypertension	I10	2,880 (4)	4,239 (5)	1.12	1.12
Diabetes					
Diabetes mellitus	E10, E11, E12, E14	9,711 (13)	8,441 (10)	1.3	1.72
Osteoporosis					
Osteoporosis	M80, M81, M82	21 (0.02)	90 (0.1)	1.82	1.61
Total		72,592	**81,425**		

International classification of diseases 10 (ICD-10) and relative risk (RR). Data presented as number of cases (%). All non-communicable diseases presented in the table have a decreased risk with increased physical activity[4,6,7].

telephone survey sampled from the telephone lines register. Individuals from different sociodemographic levels have different probabilities of being interviewed. Thus, Vigitel assigns a weight to each observation, which was used in our study to make statistical inferences for the population of each Brazilian State capital.

The prevalence of physical inactivity among Brazilians was calculated via Vigitel microdata for the year 2017 and was based on data on physical inactivity in the 26 state capitals and the Federal District (Table 2). The Ministry of Health adopted three indicators of physical inactivity for the Vigitel: a) Inactive or sedentary adults were the subjects who did not practice any physical activity during their leisure time for the last three months, do not engage in intense physical efforts at work, do not use active commute (e.g., walking or cycling) for work or school for a minimum of 20 minutes and do not participate in heavy house cleaning; b) Individuals with an insufficient practice of physical activity are those whose time spent in physical activities, including commuting to work and active jobs, does not reach 150 minutes of moderate-intensity physical activities per week, or 75 minutes of vigorous-intensity activities per week; c) Adults with an insufficient practice of physical activity during their leisure time are those whose practice of moderated intensity physical activity during leisure time does not reach 150 minutes per week, or at least 75 minutes of vigorous physical activity a week.

We used the relative risk (RR) of physical inactivity reported in Lee et al.[7] and Bielemann et al.[13] to calculate the fraction of the costs for Brazilian SUS that is attributable to physical inactivity (population attributable fraction – PAF)[7,13]

Table 2. Prevalence of physical inactivity.

Capital city	Total		Men		Women	
	%	95%CI	%	95%CI	%	95%CI
Inactive or sedentary						
Distrito Federal	10.7	8.6–12.9	8.9	5.7–12.0	12.4	9.4–15.3
Palmas	11.7	9.9–13.5	11.6	8.7–14.4	11.8	9.5–14.1
Macapá	11.9	9.7–14.1	9.3	6.2–12.3	14.4	11.3–17.5
Manaus	12.3	10.0–14.5	12.0	8.6–15.5	12.5	9.5–15.4
São Paulo	12.4	10.7–14.2	14.3	11.5–17.2	10.8	8.7–12.9
Porto Alegre	12.7	10.5–14.8	12.0	8.2–15.8	13.2	10.8–15.6
Campo Grande	12.7	10.6–14.9	9.7	6.8–12.7	15.5	12.4–18.5
Porto Velho	13.0	10.3–15.7	12.7	8.3–17.1	13.2	10.3–16.2
Goiânia	13.4	11.4–15.4	12.9	9.7–16.1	13.8	11.3–16.3
Belo Horizonte	13.5	11.8–15.2	14.1	11.4–16.9	13.0	10.8–15.1
São Luís	13.6	11.6–15.7	10.8	8.0–13.7	15.9	13.0–18.8
Florianópolis	13.9	11.8–16.0	14.0	10.6–17.3	13.8	11.2–16.5
Curitiba	14.0	11.6–16.4	16.4	12.1–20.8	12.0	9.6–4.3
Salvador	14.1	12.1–16.0	15.1	11.9–18.4	13.2	10.9–15.4
Boa Vista	14.2	11.6–16.8	14.0	9.9–18.1	14.4	11.1–17.6
Rio Branco	14.4	11.9–17.0	14.8	10.4–19.1	14.1	11.3–16.9
Rio de Janeiro	14.5	12.5–16.4	13.4	10.5–16.3	15.4	12.8–18.0
Belém	14.5	12.5–16.5	10.9	8.3–13.5	17.5	14.6–20.4
Vitória	14.9	12.8–6.9	12.9	9.8–16.1	16.5	13.7–19.3
Cuiabá	15.9	12.6–19.3	16.5	10.4–22.6	15.4	12.3–18.5
Fortaleza	16.2	14.1–18.4	15.6	12.1–19.1	16.8	14.2–19.4
Teresina	17.4	15.1–19.6	17.0	13.3–20.8	17.6	14.9–20.3
João Pessoa	17.5	15.3–19.7	15.7	12.3–19.2	19.0	16.1–21.8
Recife	17.7	15.5–19.8	17.2	13.6–20.7	18.0	15.5–20.6
Natal	17.7	15.4–20.0	16.2	12.5–19.8	19.0	16.2–21.8
Aracaju	18.0	15.6–20.5	19.9	15.6–24.3	16.4	13.8–19.1
Maceió	18.4	16.0–20.8	18.2	14.1–22.2	18.7	15.8–21.5
Brazil	**14.5**	**12.3–16.7**	**13.9**	**10.4–7.5**	**15.0**	**12.3–17.7**
Insufficient physical activity						
Distrito Federal	37.0	33.0–41.1	29.4	23.2–35.6	43.7	38.6–48.8
Florianópolis	40.8	37.6–44.0	33.2	28.5–37.9	47.6	43.5–51.8
Macapá	41.6	37.7–45.5	28.0	22.6–33.3	54.3	49.3–59.3
Palmas	43.0	40.0–45.9	34.9	30.5–39.2	50.4	46.5–54.2
Curitiba	43.0	39.6–46.5	35.9	30.5–41.3	49.2	44.9–53.6
Vitória	43.8	40.8–46.7	34.7	30.2–39.1	51.5	47.7–55.2
Campo Grande	43.8	40.3–47.4	32.1	26.9–37.2	54.4	49.9–59.0
Boa Vista	43.9	40.3–47.4	35.0	29.6–40.4	52.2	47.9–56.5
São Luís	43.9	40.7–47.1	30.1	25.5–34.7	55.2	51.3–59.1
Porto Velho	44.3	40.4–48.2	34.9	28.9–41.0	54.4	49.7–59.1
Rio de Janeiro	45.2	42.2–48.1	37.8	33.3–42.2	51.3	47.4–55.3
Belo Horizonte	45.3	42.6–47.9	36.9	33.0–40.8	52.3	48.8–55.8
Goiânia	46.1	43.0–49.2	39.0	34.2–43.9	52.4	48.5–56.2

Continue

Table 2. Prevalence of physical inactivity. Continuation

Belém	46.6	43.4–49.8	34.7	29.8–39.6	56.7	52.8–60.6
Aracaju	46.7	43.7–49.6	40.1	35.1–45.0	52.1	48.5–55.6
Cuiabá	47.0	43.3–50.8	37.3	30.9–43.7	56.1	51.7–60.4
Salvador	47.0	44.2–49.9	38.0	33.6–42.3	54.5	51.0–58.0
Rio Branco	47.3	43.6–51.0	37.2	31.3–43.0	56.5	52.2–60.8
Manaus	47.8	44.0–51.7	39.1	33.0–45.2	55.9	51.4–60.4
Maceió	48.1	44.9–51.3	38.3	33.2–43.5	56.0	52.1–59.9
Porto Alegre	48.4	44.8–51.9	39.6	33.8–45.3	55.6	51.3–59.8
Natal	48.7	45.7–51.7	38.7	34.1–43.3	57.2	53.5–61.0
Teresina	49.0	46.0–52.1	42.1	37.2–47.1	54.7	51.0–58.4
São Paulo	49.1	46.4–51.8	42.8	38.6–47.0	54.5	51.1–57.9
Fortaleza	50.8	47.8–53.7	41.3	36.4–46.2	58.7	55.2–62.2
João Pessoa	50.9	47.8–54.0	41.7	36.7–46.6	58.6	54.8–62.4
Recife	51.3	48.4–54.2	41.6	36.8–46.4	59.1	55.6–62.6
Brazil	**45.9**	**42.7–49.2**	**36.8**	**31.8–41.9**	**53.9**	**49.9–57.9**
Free time insufficient physical activity						
Macapá	71.8	68.1–75.4	65.2	59.2–71.2	77.8	73.7–81.9
Distrito Federal	72.6	68.8–76.4	67.5	60.8–74.1	77.1	73.0–81.2
Vitória	74.4	71.7–77.0	67.8	63.3–72.3	80.0	76.9–83.0
Cuiabá	74.9	71.8–78.0	68.7	63.2–74.1	80.7	77.4–84.0
Boa Vista	75.4	72.5–78.3	72.5	67.6–77.3	78.2	74.8–81.6
Palmas	75.5	72.9–78.1	73.3	69.2–77.5	77.4	74.2–80.6
Rio Branco	76.1	72.7–79.4	70.9	65.0–76.7	80.8	77.5–84.1
Manaus	76.5	73.1–79.8	72.8	67.3–78.3	79.8	76.0–83.7
Florianópolis	77.0	74.0–79.9	72.7	67.8–77.6	80.8	77.5–84.2
Goiânia	77.2	74.5–79.8	75.2	70.9–79.4	78.9	75.7–82.2
Aracaju	77.2	74.8–79.6	74.7	70.7–78.7	79.2	76.2–82.2
Porto Velho	77.2	73.9–80.6	72.8	67.2–78.4	82.0	78.6–85.3
Natal	77.3	74.7–79.9	70.8	66.3–75.2	82.9	80.1–5.7
Belém	77.5	74.8–80.2	71.5	66.8–76.3	82.5	79.6–85.4
São Luís	77.7	75.0–80.4	70.4	65.5–75.3	83.8	81.1–86.4
Campo Grande	78.3	75.2–81.4	75.2	70.0–80.3	81.1	77.4–84.7
Salvador	78.9	76.5–81.3	75.6	71.6–79.7	81.6	78.8–84.4
Curitiba	78.9	76.0–81.9	75.4	70.5–80.4	82.0	78.7–85.3
Fortaleza	79.1	76.6–81.5	76.1	71.9–80.3	81.6	78.7–84.4
Maceió	79.2	76.5–81.8	72.7	67.9–77.5	84.5	81.8–87.1
Rio de Janeiro	79.2	76.6–81.8	73.6	69.4–77.7	83.9	80.7–87.1
Recife	80.4	78.1–82.8	74.6	70.3–78.9	85.1	82.7–87.5
Teresina	80.6	78.2–83.0	78.0	73.8–82.2	82.8	80.1–85.5
João Pessoa	81.0	78.7–83.3	78.3	74.4–82.1	83.3	80.5–86.1
Belo Horizonte	81.5	79.4–83.6	77.9	74.3–81.4	84.6	82.1–87.1
Porto Alegre	82.7	79.9–85.4	74.4	69.2–79.6	89.4	87.0–91.8
São Paulo	84.7	82.7–86.6	81.1	77.8–84.5	87.7	85.5–89.9
Brazil	**77.9**	**75.1–80.6**	**73.3**	**68.6–78.0**	**81.8**	**78.8–84.9**

Data presented as percentage (95% confidence interval).

$$PAF = \frac{p * (RR - 1)}{p * (RR - 1) + 1}$$

Where p is the prevalence of physical inactivity and RR is the relative risk associated with physical inactivity.

The RR and PAF were attributed to the population over 40 years old (Table 3). The analysis was stratified by gender and grouped by geographic region[7,13] considering the three indicators of physical inactivity separately. To estimate the impact of physical inactivity on hospitalization costs, the PAF was multiplied by the total cost of hospitalizations caused by each of the seven NCD.

Since the data on physical inactivity used are representative of residents of state capitals and the Federal District, data related to hospitalizations was filtered to include only those corresponding to patients residing in the city capitals. The hospitalization cost was pooled from the Datasus database, corresponding to patients residing in the 26 state capitals and the Federal District. The cost of each disease and the total cost of hospitalizations and the total cost per hospitalization financed by the SUS were then calculated, according to the ICD 10 code of the main cause of the hospitalization diagnosis. We performed the same calculation by differentiating the city's location region.

Finally, based on the percentages of incidence of hospitalization costs from NCD attributable to physical inactivity on the total hospitalization costs of the SUS in the state capitals and the Federal District, the incidence of those costs was extrapolated for the national level. Therefore, the simulation assumed that the physical inactivity level data observed in the state capitals would be representative of the whole State. The currency conversion value to convert Brazilian "reais" to United States dollars was 3.192 "reais" to 1 dollar.

All estimates were made using the statistical software R (packages used: survey, dplyr and lubridate).

Table 3. Population attributable fraction to physical inactivity for the selected non-communicable disease.

Disease	Inactive or sedentary		Insufficient physical activity		Free time insufficient physical activity	
	Male	Female	Male	Female	Male	Female
Breast neoplasm	-	0.049 (0.047–0.052)	-	0.161 (0.158–0.165)	-	0.216 (0.215–0.218)
Colon neoplasm	0.056 (0.052–0.060)	0.041 (0.038–0.043)	0.134 (0.130–0.138)	0.136 (0.133–0.139)	0.195 (0.192–0.197)	0.184 (0.183–0.186)
Cerebrovascular disease	0.065 (0.060–0.069)	0.018 (0.017–0.019)	0.152 (0.147–0.156)	0.065 (0.064–0.067)	0.218 (0.215–0.221)	0.091 (0.090–0.092)
Ischemic heart disease	0.033 (0.030–0.035)	0.042 (0.040–0.044)	0.080 (0.077–0.083)	0.140 (0.138–0.143)	0.120 (0.118–0.121)	0.190 (0.188–0.191)
Essential hypertension	0.022 (0.020–0.024)	0.018 (0.017–0.019)	0.055 (0.053–0.057)	0.065 (0.064–0.067)	0.083 (0.082–0.084)	0.091 (0.090–0.092)
Diabetes	0.053 (0.049–0.057)	0.101 (0.096–0.106)	0.127 (0.122–0.131)	0.248 (0.276–0.291)	0.185 (0.182–0.187)	0.376 (0.373–0.378)
Osteoporosis	0.133 (0.124–0.141)	0.087 (0.083–0.091)	0.284 (0.276–0.291)	0.263 (0.258–0.267)	0.382 (0.378–0.386)	0.338 (0.336–0.340)

Data represented as mean (95% confidence interval [CI]).

Table 4. Estimated cost of hospitalizations due to non-communicable disease related to physical activity in 2017.

Variable	Hospitalizations	Total cost (R$)	Inactive or sedentary (R$)	Insufficient physical activity (R$)	Free time insufficient physical activity (R$)
Midwest	56,72	106,170,446	4,379,773	12,501,371	18,451,244
Northeast	132,206	325,181,902	13,414,495	38,289,560	56,513,001
North	290,448	662,672,658	27,336,759	78,028,465	115,165,145
Southeast	198,198	361,359,173	14,906,890	42,549,366	62,800,209
South	62,354	85,854,620	3,541,699	10,109,221	14,920,579
Brazil	**739,927**	**1,541,238,799**	**63,579,617 (4.1%)**	**181,477,984 (11.8%)**	**267,850,179 (17.4%)**

Table 5. Estimated cost of hospitalizations due to non-communicable disease related to physical activity in 2019.

Variable	Hospitalizations	Total cost (R$)	Inactive or sedentary (R$)	Insufficient physical activity (R$)	Free time insufficient physical activity (R$)
Midwest	60,240	115,658,512	4,771,177	13,618,573	20,100,164
Northeast	140,412	354,242,221	14,613,300	41,711,359	61,563,362
North	308,474	721,893,295	29,779,745	85,001,584	125,457,034
Southeast	210,499	393,652,523	16,239,065	46,351,848	68,412,435
South	66,224	93,527,134	3,858,208	11,012,645	16,253,977
Brazil	**785,850**	**1,678,973,685**	**69,261,495 (4.1%)**	**197,696,009 (11.8%)**	**291,786,972 (17.4%)**

RESULTS

In 2017, the seven NCD considered in the analysis were responsible for 154,017 hospital admissions in adults older than 40 years old, living in the state capitals and Federal District. The NCD corresponded to 6.5% of all hospitalizations and 10.6% of SUS costs in 2017, at an estimated cost of US$ 112,524,914.47 (Table 4). Of this total, US$ 56,491,734.96 was associated with the cost of hospitalizations for male patients, mostly associated with ischemic heart disease (US$ 38,604,338.97), whereas hospitalizations for female patients cost US$ 56,033,179.51 of which US$ 25,555,573.62 were due to ischemic heart disease and US$ 12,000,941.73 to breast cancer. Ischemic heart disease (6.05%), cerebrovascular diseases (2.08%) and breast cancer (10.7%) caused the higher costs of hospitalizations among the NCD.

Since we estimated the burden of NCD at the national level and not only for the 26 state capitals and Federal District, we can say that NCD were responsible for approximately 740 thousand hospitalizations in 2017 (Table 4), costing US$ 482 million. The percentage of this cost attributed to physical inactivity, considering the more comprehensive cut of individuals with insufficient physical activity in their leisure time, reached 17.4% of the estimated NCD costs, totaling US$ 83.9 million in 2017. Using the most recent data available by Datasus, the estimates were updated for the year 2019 (Table 5). Therefore, NCD were responsible for a total of approximately 786 thousand hospitalizations, producing a total cost of US$ 526 million. The percentage of this cost attributed to physical inactivity, considering the most comprehensive cut of individuals with insufficient physical activity in their leisure time, reached US$ 91.4 million.

DISCUSSION

This study updates the cost of physical inactivity for the SUS in Brazil. Furthermore, our estimates considered three levels of physical inactivity. A plethora of scientific investigations provided compelling evidence about the burden of physical inactivity worldwide, and the

urgent need to change the population's behavior to a more active one[2]. About half of the Brazilian population does not reach the recommended physical activity levels, and is more susceptible to developing NCD[8].

Worldwide, physical inactivity levels vary considerably between countries depending on geography, educational status, economic levels, and social status, which leads to large differences between subpopulations[8]. The levels of physical inactivity are higher among females compared with males in all age groups[8]. The economic status, measured in terms of gross domestic product, also exerts a great impact on the physical inactivity levels in the adult population. Thus, developed countries present lower levels of physical inactivity[1].

Data related to the economic costs of physical inactivity in low and middle-income countries are still lacking[14]. In 2016, Brazil presented one of the highest prevalence of physical inactivity in the world, where 40% (95%CI: 38.9–55.3; 40.4% of males, 95%CI: 32.8–48.5; and 53.3% of females, 95%CI: 44.6–61.8) of the population did not reach the recommended level of physical activity, alongside Saudi Arabia (44.9%, 95%CI: 36.7–53.4), Germany (42.2%, 95%CI: 34–46.7), and The United States (40.0%, 95%CI: 33.0–47.3)[1].

The hospitalization costs resulting from NCDs attributable to physical inactivity presented in this study are quite conservative estimates of the economic impact of physical inactivity on the SUS. The information on hospitalization costs available in the Datasus considers the costs for the Brazilian SUS to pay for admissions to public and private hospitals. Several other direct and indirect costs associated with the actual expenses resulting from the hospitalization of patients for NCD are not considered. Even so, the *Sistema de Informações Hospitalares* of the Unified Health System (SIH – Hospital Information System/SUS) is the only database with national coverage, which originates from the hospital admission authorizations, for estimating hospitalization costs.

In this study, the cost of physical inactivity was calculated in a population over 40 years old, since hospitalization due to the NCD in a younger population (< 40 years) might have a stronger relation to other components (i.e.; genetics) than low levels of physical activity. Studies show a higher prevalence of NCD morbidity and mortality in an older population[15]. Furthermore, all NCD that were included to estimate the costs in our study have a decreased risk with increased levels of physical activity[16].

The highest attributable factor of physical inactivity was in osteoporosis, diabetes, and ischemic heart disease. Additionally, men presented the highest population attributable fraction for cerebral vascular disease and women for diabetes and ischemic heart disease. At a national level, NCD were the cause of 739,927 hospital admissions, costing US$ 482.8 million in the year 2017 with cardiovascular and cerebral vascular disease representing the highest cost. The estimated cost attributed to physical inactivity was about 17.4%, encumbering the public health care system at about US$ 83.9 million. Considering the same level of physical inactivity in the population in 2019, the cost of NCD related to physical inactivity was about US$ 91.4 million for the Brazilian SUS.

The impact of physical inactivity in Brazil is evident, and public policy actions must be considered to change sedentary habits to more active behaviors in the populational level. Alongside the Ministry of Health, Municipal and State health secretariats must implement short, medium, and long-term action plans. There is no single, definitive solution, and the different social, cultural, and economic contexts need to be carefully evaluated and understood. The World Health Organization has established an action plan to increase the population's level of physical activity, for a healthier world, which aims to reduce physical inactivity by 10% by 2025 and 15% by 2030[2]. To this end, the plan is promoting more active societies with mass participation in physical activity events,

with the construction of participatory work. Therefore, creating active environments with policies to integrate active means of transport, improving connections for walking and bicycles, improving safety, and improving the population's access to favorable public places are necessary[2], as well as financing research in urban development, creating innovation mechanisms, improving data integration, and strengthening governance policies. Ideally, establishing programs on several fronts, improving structures for older people, expanding school physical education programs, prioritizing programs that reach the less active, promoting community initiatives, and incorporating physical activity in health services would be advisable[2].

However, for promoting a more physically active population globally, the states need deeper effort from policymakers and stakeholders, for instance, the communication for the general public about the importance of physical activity seems inadequate. This means that the knowledge about the importance to maintain the recommended levels of physical activity in the population is still lacking[17]. Physical inactivity produces a high social burden[18] and financial costs, such as loss of productivity[19], poor mental health[20], declined functional capacity and quality of life[21], and premature death[22].

The Brazilian Society of Sports Medicine recognizes the importance of physical activity[23–26]. For the older population, physical activity improves cardiovascular health and decreases the risk of NCD[23,25]. The Brazilian Society of Sports Medicine also brings to attention the importance of physical activity for women's health[27], particularly after menopause since the physical decline is more evident[28]. Encouraging the practice of physical activity during childhood and teenagerhood increases the chances of a more active person throughout life, including during ageing. Furthermore, active children and teenagers grow up with an increased gain of muscle and bone mass[29], improved mental health[30], and decreased chances of obesity[31] and cardiovascular diseases throughout the whole lifespan[32].

Limitations

The interpretation of these results should consider potential limitations. The RR was estimated based on self-reported physical inactivity; therefore, the estimates are expected to be conservative. Ages over 40 years old were included in the estimates, thus the results cannot be extrapolated to a younger population. The Vigitel provides data from the capital cities of the twenty-seven Brazilian states plus the federal district, which are taken as representative of the physical inactivity level of the overall state. Accounting for comorbidity, which could impact the cost attributable to physical inactivity, was impossible.

Future Directions

In this study, we estimate the cost of physical inactivity based on hospitalization costs. However, NCD also cause decreases in productivity and disability, which should be investigated.

Despite being essential to mitigate a virus spread, the measures of social isolation during the covid-19 pandemic increased de levels of physical inactivity worldwide. Therefore, the cost of the increase in physical inactivity due to the covid-19 pandemic must be further investigated.

CONCLUSIONS

This study provides evidence showing the burden of physical inactivity and the economic impact on the Brazilian SUS due to NCD hospitalization. The Brazilian SUS spends half a million reais a year, for the capital cities, due to a modifiable lifestyle. Therefore, promoting a more active community must be one of the major targets of public health care policies.

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