

ORIGINAL ARTICLE

Physical inactivity and sedentary behavior in individuals with stable COPD non-infected by SARS-CoV-2 during the COVID-19 pandemic

Inatividade física e comportamento sedentário em indivíduos com DPOC estável não infectados pelo SARS-CoV-2 durante a pandemia de COVID-19

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Physical Activity
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Social Isolation
Rehabilitation**ABSTRACT**

Objective: to identify factors associated to sedentary behavior and physical inactivity in individuals with stable chronic obstructive pulmonary disease (COPD) non-infected by SARS-CoV-2 during the COVID-19 pandemic, and to identify possible favorable conditions during social isolation in individuals who performed pulmonary rehabilitation in the pre-pandemic period. **Method:** time/day in sedentary activities and moderate/vigorous physical activities (SA and MVPA, respectively), history of previous rehabilitation, laboural activity, symptoms, insecurity and quality of life (Medical Outcomes Study 36-item Short-Form Health Survey [SF-36]) were assessed during strict social isolation due to the COVID-19 pandemic. Individuals were classified as sedentary if presenting time/day in SA >8.5 h/day and physically inactive if presenting time/day in MVPA <150 min/week. **Result:** The sample consisted of 33 individuals (69±7 years; 20 male). Regarding the SF-36, non-sedentary individuals presented better functional capacity than sedentary individuals (65 [38-73] vs. 33 [20-63] points; p=0.01) whereas physically active individuals presented better physical and social function than physically inactive individuals (100 [100-100] vs. 50 [25-100] points, p=0.049; and 100 [100-100] vs. 75 [69-100] points, p=0.022, respectively). Having a professional activity and working outside were associated with non-sedentary behavior ($X^2=5.93$; p=0.025 and $X^2=7.03$; p=0.009, respectively). Having undergone rehabilitation previously to the pandemic was associated with less insecurity to walk outside ($X^2=4.95$; p=0.034) and better perception of symptoms' worsening ($X^2=5.46$; p=0.033). **Conclusion:** non-sedentary behavior was associated with functional capacity and laboural activity; active lifestyle was associated with physical and social function; and previous rehabilitation was associated with better symptoms' recognition and less insecurity.

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PALAVRAS-CHAVE

DPOC

Atividade Física

Covid-19

Isolamento Social

Reabilitação

RESUMO

Objetivo: identificar fatores associados ao comportamento sedentário e inatividade física em indivíduos com doença pulmonar obstrutiva crônica (DPOC) estável não-infectados pelo SARS-CoV-2 durante o isolamento social causado pela pandemia de COVID-19, e identificar eventuais condições favoráveis durante o isolamento social em indivíduos que realizaram reabilitação pulmonar pré-pandemia. **Método:** tempo/dia em atividades sedentárias e em atividades físicas moderadas/vigorosas (AS e AFMV, respectivamente), reabilitação prévia, atividade laboral, sintomas, insegurança e qualidade de vida (Medical Outcomes Study 36-item Short-Form Health Survey [SF-36]) foram avaliados durante a vigência de isolamento social devido à pandemia de COVID-19. Foram considerados sedentários aqueles que apresentassem tempo/dia em AS >8,5 h/dia e fisicamente inativos os que apresentassem tempo/dia em AFMV <150 min/semana. **Resultado:** a amostra consistiu em 33 indivíduos (69±7 anos; 20 homens). Pelo SF-36, indivíduos não-sedentários apresentaram melhor capacidade funcional do que sedentários (65 [38-73] vs. 33 [20-63] pontos; $p=0,01$) enquanto indivíduos fisicamente ativos apresentaram melhor função física e social do que os fisicamente inativos (100 [100-100] vs. 50 [25-100] pontos, $p=0,049$; e 100 [100-100] vs. 75 [69-100] pontos, $p=0,022$, respectivamente). Ter atividade profissional e trabalhar fora de casa associou-se com comportamento não-sedentário ($X^2=5,93$; $p=0,025$ e $X^2=7,03$; $p=0,009$, respectivamente). Ter participado de reabilitação pulmonar pré-pandemia associou-se com menos insegurança para caminhar em lugares públicos ($X^2=4,95$; $p=0,034$) e melhor percepção de piora dos sintomas respiratórios ($X^2=5,46$; $p=0,033$). **Conclusão:** não-sedentarismo associou-se com capacidade funcional e atividade laboral; ser fisicamente ativo associou-se com função física e social; e ter realizado reabilitação prévia com menos insegurança e melhor percepção dos sintomas.

INTRODUCTION

Physical inactivity and sedentary behavior in individuals with Chronic Obstructive Pulmonary Disease (COPD) are associated with worse health conditions, increased risk of mortality, and recurrent hospitalizations due to acute exacerbations¹⁻⁵. It is possible that these individuals, even in stable condition of their disease, further reduced their physical activities during the COVID-19 pandemic because of changes in routine and the need for social distancing. Physical and social isolation is associated with increased difficulty in performing activities of daily living⁶.

Individuals with COPD require support in various areas of health, including symptom management, physical health, independence, and psychosocial aspects⁷. Considering the interruption of healthcare services during the pandemic, these individuals may have experienced overall health impairments. Thus, in addition to the direct impact of social isolation on the level of physical activity in daily life (PADL), health status during the pandemic period could have been a contributing factor leading to a sedentary or physically inactive lifestyle.

Due to the need for social isolation, professional activities had to be performed at home during the pandemic, whenever possible. Individuals with COPD who are professionally active may have experienced this adaptation or even absence from work, especially as they represent a group at higher risk of death from COVID-19⁸. Moreover, physical limitations caused by COPD itself can affect the ability to perform some professional activities and may lead to absence from work or early retirement⁹.

Limitations that impair the ability of individuals with COPD to perform PADL may be alleviated through pulmonary rehabilitation, leading to an improvement in

health-related quality of life^{10,11}. Given the necessary interruption in the functioning of rehabilitation centers and outpatient clinics that offered this intervention, it is inevitable that such limitations may have been accentuated during social isolation. However, it is possible that the experience of having undergone pulmonary rehabilitation before the pandemic could be a differentiating factor for individuals with COPD in coping with the pandemic.

Although a reduction in the PADL level during social isolation has been previously demonstrated in individuals with COPD^{6,12}, it is unclear whether health status and employment situation were associated with sedentary behavior and physical inactivity in these individuals during the COVID-19 pandemic. It is also unknown whether undertaking pulmonary rehabilitation before the pandemic brought any benefit to individuals with COPD that encouraged them to maintain their PADL level during the social isolation period. Thus, this study aimed to identify associations of health and work aspects with sedentary behavior and physical inactivity in individuals with COPD (non-infected by SARS-CoV-2) during social isolation due to the COVID-19 pandemic; and to investigate possible favorable conditions during social isolation in individuals who underwent pulmonary rehabilitation prior to the pandemic.

METHODS

This is a cross-sectional observational study involving individuals with COPD followed by the Laboratory of Research in Pulmonary Physiotherapy (LFIP) at the State University of Londrina (UEL) (Project on the Impact of Social Distancing on Chronic Lung Diseases [PIDS-PC]). For subject recruitment, two participant registration lists were

used: a list of individuals who participated in previous projects conducted at LFIP and another list of patient registrations from the Specialty Outpatient Clinic at the University Hospital of UEL. A randomized sequence was generated, and individuals were consecutively invited, comprising a convenience sample. The inclusion criteria were as follows: diagnosis of COPD according to the criteria of the Global Initiative for Chronic Obstructive Lung Disease (GOLD)¹³; no previous diagnosis of severe and/or unstable heart disease and/or prior surgery that could hinder PADL; and no history of COVID-19 infection. The exclusion criteria were as follows: identification during the initial assessment of clinical conditions that could interfere with PADL (e.g., osteoneuromuscular alterations, neurological dysfunctions) and non-use of physical activity monitors within the acceptability criteria established in the study (see below). The study was approved by the Ethics Committee of the State University of Londrina (4,263,246), and all participants signed an informed consent form. Data collection for the study was conducted between October and December 2020, corresponding to a period of seven to nine months after the start of the COVID-19 pandemic, during full enforcement of social distancing measures.

Data from the last spirometry performed prior to the pandemic were used for sample characterization. The Medical Outcomes Study 36-item Short-Form Health Survey (SF-36) questionnaire was used to assess different aspects of health during social isolation. The SF-36 domains include the following: physical functioning, physical role, bodily pain, general health perception, vitality, social functioning, emotional problems, and mental health. The instrument was translated and validated for the Brazilian population¹⁴.

Individuals also responded to a questionnaire created by the authors regarding their engagement in professional activities and pre-pandemic participation in pulmonary rehabilitation. Conditions that could mitigate the worsening of sedentary behavior and physical inactivity during social isolation were investigated as possible positive effects of pulmonary rehabilitation before the pandemic. These conditions were based on individuals' perceptions and included not perceived reduction in PADL in general, increasing movement within the home as compensation for a possible reduction in PADL performed outside the home, and feeling safe to walk in less crowded places when necessary. The self-reported perception of respiratory symptoms worsening during social isolation was also investigated.

For assessing PADL level, individuals wore the triaxial accelerometer Actigraph (ActGraph wGT3X-BT®, ActiGraph, Pensacola, Florida, United States of America)¹⁵. The monitor was positioned on the right side of the waist and used for 7 consecutive days during waking time. The acceptability criterion was the availability of monitoring data for at least 8.5 h/day. The variables studied were time spent/day in sedentary activities (SA) (i.e., < 1.5 MET) and in moderate-to-vigorous physical activities (MVPA) (i.e., > 3 MET). Participants were classified as sedentary if they had more than 8.5 h/day in SA^{3,16} and as physically inactive if they had less than 150 min/week in MVPA¹⁷.

Statistical analysis

The SPSS version 22 was used for statistical analysis. Normality in data distribution was assessed using the Shapiro-Wilk test. Data are presented as mean ± standard deviation, median [interquartile range 25%-75%], or absolute number (percentage). The Mann-Whitney test was used to compare sedentary versus non-sedentary groups and physically active versus inactive groups, whereas Fisher's exact test was used to assess associations between categorical variables. Statistical significance was determined as $p < 0.05$.

This study was developed following the guidelines of the National Health Council Resolution 466/2012 and the Declarations of Singapore and Hong Kong.

RESULTS

The study involved 34 individuals; however, one was excluded because of not using the physical activity monitor within the acceptability criteria. Therefore, 33 individuals (20 men) were analyzed. The baseline characteristics of the sample are described in Table 1.

As shown in Table 2, individuals classified as non-sedentary had significantly better physical functioning in the SF-36 questionnaire than sedentary individuals (65 [38 - 73] vs. 33 [20 - 63] points; $p = 0.013$). Individuals classified as physically active showed better physical role and social functioning in comparison to inactive individuals (100 [100 - 100] vs. 50 [25 - 100] points; $p = 0.049$) and (100 [100 - 100] vs. 75 [69 - 100] points; $p = 0.022$, respectively). There was no statistically significant difference between the groups regarding the other SF-36 domains. Having a professional activity and working outside the home were significantly associated with non-sedentary behavior ($X^2 = 5.93$; $p = 0.025$ and $X^2 = 7.03$; $p = 0.009$, respectively), but not with the physically active profile.

Table 3 shows that having undergone pulmonary rehabilitation prior to the pandemic was associated with less insecurity when walking in public places ($X^2 = 4.95$; $p = 0.034$) and with a better perception of worsening respiratory symptoms ($X^2 = 5.46$; $p = 0.033$).

DISCUSSION

The present study showed that in individuals with COPD, more pronounced sedentary behavior (i.e., long time sitting and in the reclined position) during the pandemic was associated with worse physical functioning and not engaging in professional activities, whereas being physically inactive (i.e., little time in MVPA) was associated with worse physical role and social functioning. Undergoing pulmonary rehabilitation before the pandemic was associated with less insecurity and better perception of worsening symptoms.

The changes involved in the necessary adaptations in daily life due to the COVID-19 pandemic have led to a less physically active lifestyle in the general population¹⁸. Although individuals with COPD already had a low PADL level^{1,19}, a study showed that after 3 months of staying at home, even after participating in a pre-pandemic pulmonary rehabilitation program, there was an even greater reduction

Table 1 – Baseline characteristics of the sample (n = 33).

Variables	value
Age (y)	69 ± 7
Sex (M/F)	(20/13)
BMI (Kg/m ²)	26.7 ± 5.7
FEV ₁ (% predicted)	51 ± 18
FVC (% predicted)	78 ± 25
FEV ₁ /FVC	54 ± 13
Sedentary (> 8.5h/day in activities ≤ 1.5 MET) / Non-sedentary, n (%)	20 (61) / 13 (39)
Physically inactive (< 150 min/week in activities ≥ 3MET) / Active, n (%)	29 (88) / 4 (12)
Undergone pre-pandemic pulmonary rehabilitation, n (%)	15 (45)
Maintains professional activity, n (%)	6 (18)
<i>Study 36-item Short-Form Health Survey (points)</i>	
General health perception	52 [37 - 71]
Physical functioning	40 [30 - 68]
Physical role	75 [25 - 100]
Emotional problems	100 [33 - 100]
Social functioning	88 [75 - 100]
Bodily pain	61 [41 - 100]
Vitality	65 [53 - 76]
Mental health	88 [54 - 88]

Data described in n (%) and as mean ± SD or median [interquartile range 25-75%] according to data distribution. M: male. F: female. BMI: body mass index. FEV₁: forced expiratory volume in the first second. FVC: forced vital capacity. MET: metabolic equivalent of task.

Table 2 – Comparison of data between individuals with COPD classified as sedentary vs. non-sedentary, and physically inactive vs. Active.

	Non-sedentary (n=13)	Sedentary (n=20)	P	Physically active (n=4)	Physically inactive (n=29)	p
Age (y)	65 ± 4	72 ± 7	0.003	65 ± 3	70 ± 7	0.152
Sex (M/F)	9/4	11/9	0.485	3/1	17/12	1.000
Professional activity, n (%)	5 (38)	1 (5)	0.025	1 (25)	5 (17)	1.000
Professional activity outside the home, n (%)	4 (31)	0 (0)	0.009	1 (25)	3 (10)	0.571
<i>Study 36-item Short-Form Health Survey (points)</i>						
General health perception	57 [42-72]	52 [36-73]	0.530	72 [51-88]	52 [36-67]	0.128
Physical functioning	65 [38-73]	33 [20-63]	0.013	68 [46-70]	35 [28-65]	0.135
Physical role	100 [38-100]	50 [25-100]	0.061	100 [100-100]	50 [25-100]	0.049
Emotional problems	100 [50-100]	100 [0-100]	0.323	100 [100-100]	100 [33-100]	0.084
Social functioning	88 [75-100]	81 [63-100]	0.283	100 [100-100]	75 [69-100]	0.022
Bodily pain	61 [46-100]	62 [34-100]	0.894	100 [71-100]	61 [37-100]	0.098
Vitality	65 [60-78]	65 [46-74]	0.258	73 [66-90]	65 [50-75]	0.141
Mental health	88 [70-92]	80 [52-88]	0.094	88 [82-97]	84 [52-88]	0.237

Data described in n (%) and as mean ± SD or median [interquartile range 25-75%] according to data distribution. M: male. F: female.

in PADL level¹². This change in behavior was demonstrated by a reduction in overall physical activity. However, it

is possible that social confinement has hindered more intense physical activities performed outside the home

Table 3 – Association of performing pulmonary rehabilitation (PR) before the pandemic with possible favorable conditions during social isolation.

Possible favorable conditions during social isolation	Underwent pre-pandemic PR (n=15)	Did not undergo pre-pandemic PR (n=18)	p
Non-sedentary behavior	6 (40)	7 (39)	1.000
Physically active lifestyle	1 (7)	3 (17)	0.607
No reduction in self-reported PADL	7 (47)	8 (44)	1.000
Increased mobility at home	3 (20)	5 (28)	0.374
Safety for walking in public places	13 (87)	9 (50)	0.034
Did not worsen respiratory symptoms	11 (73)	18 (100)	0.033

Data described in n (%). PADL: physical activity in daily life. PR: pulmonary rehabilitation.

while encouraging sedentary behavior indoors. The present study identified that some aspects of health were related to sedentarism and physical inactivity, considering the differentiation of these two forms of PADL impairment, as previously described^{3,16,17}.

Results of this study showed that sedentary individuals had worse self-reported physical functioning capacity than non-sedentary individuals. In the SF-36 questionnaire, the “physical functioning” domain demonstrates how difficult it is to perform physical activities due to health impairment¹⁴. Individuals with COPD who were previously more limited or who experienced more health impairments during social isolation may have adopted more sedentary behaviors. The presence of comorbidities that impair health status is associated with a reduction in the PADL level in this population²⁰. Thus, reduction in healthcare assistance during the pandemic may have worsened some of these comorbidities or generated insecurity and a feeling of incapacity, favoring sedentary behavior.

Regarding physical inactivity, it was observed that inactive individuals with COPD felt more limited because of their physical health. Considering that healthcare assistance is necessary for symptom control of COPD and maintenance of physical health⁷, some of these individuals may have reduced their ability to manage these symptoms due to decreased guidance from healthcare professionals, resulting in more physical debilitation. Once again, the presence of comorbidities or chronic conditions in general may have also contributed to physical limitations during this period.

Physically inactive individuals were also more socially affected. In addition to the restrictions in socialization imposed by the pandemic, the similarity between some respiratory signs of COPD and COVID-19 may have generated a stigma in society, as if these individuals were at a higher risk of spreading the coronavirus, further impairing their social interactions. Additionally, feelings of loneliness were reported by some individuals with COPD who stayed away from family members²¹, indicating a reduction in interactivity. Considering that social activities were more impaired in physically inactive individuals, it is possible that the ability for social interaction is a stimulating factor for engaging in physical activities in this population.

Better physical functioning was identified in individuals with a non-sedentary lifestyle but not in physically active individuals. Likewise, better physical health conditions and social functioning were better only in physically active individuals, with no difference in sedentary behavior. This shows that these two aspects of the PADL level can be influenced by different factors. A positive aspect of these results is that although better physical functioning was not sufficient to maintain a physically active lifestyle, it may have stimulated non-sedentary behavior, probably through the performance of light-intensity activities, even in situations of minimal social interaction. This is an important point because sedentary behavior itself is associated with mortality, regardless of the amount of MVPA performed^{3,22,23}.

Another point to be noted is the possibility of an opposite relationship between these health aspects and physical inactivity and sedentary lifestyle. Perhaps some individuals have reduced their physical activity in general merely due to the obligation to remain at home. Such a change in behavior alone may have led to worsening physical deconditioning and effort intolerance, resulting in worsening of physical functioning and physical and social limitations.

Although prior pulmonary rehabilitation in some individuals did not prevent the reduction in the PADL level¹², a higher prevalence of worsening symptoms in individuals who underwent pulmonary rehabilitation before the pandemic may indicate a better previous health status. Furthermore, it may also indicate a better ability of these individuals to identify clinical worsening, which may actually be a benefit resulting from the rehabilitation program. Another very illustrative outcome of the importance of pulmonary rehabilitation is lower insecurity in individuals who have previously undergone rehabilitation.

The present results showed that not having a professional activity is also associated with a more sedentary lifestyle. A previous study concluded that individuals with COPD without professional activity are neither less physically active nor more sedentary compared with those who are professionally active²⁴. Therefore, it is possible to hypothesize that individuals with COPD who are retired or away from their work activities may have a different behavior in situations of social isolation, with a reduction

in other activities, which previously could be compensating for professional activities not performed. In this sense, the insecurity of moving around in less crowded places due to physical distancing from the general population may have been a limiting factor, resulting in more time spent in sedentary behavior. However, it was observed that insecurity in moving around is associated with non-adherence to pulmonary rehabilitation programs. It is also possible that this association between not working and being sedentary is indirectly linked to the economic situation, as the financial aspect was identified as a barrier to performing physical activities in this population²⁵. Thus, individuals who had a higher family income due to the continuity of their professional activity may have found it easier to maintain some physical activities.

As a limitation of this study, only 12% of the participants worked, which made the size of the groups with and without professional activity disproportionate and may have interfered with the comparisons between them. However, as most of this population is older and has chronic health problems, it is not surprising that a vast majority is retired. Furthermore, even with disproportionate group sizes, the results obtained with these comparisons added potentially valuable information to the literature.

From the point of view of clinical applicability, aspects associated with a reduction in PADL level, such as not performing professional activity and impaired physical functioning, physical role, and social functioning, were identified for the first time in the context of the pandemic. Furthermore, better recognition of clinical symptoms and feeling more secure in situations of little social interaction were detected as additional benefits of pulmonary rehabilitation.

CONCLUSIONS

In individuals with stable COPD not infected by SARS-CoV-2 during social isolation caused by the COVID-19 pandemic, having better physical functioning values and maintaining professional activity were associated with non-sedentary behavior, whereas better physical role and social functioning were associated with physically active behavior. Having undergone pulmonary rehabilitation before the pandemic was associated with feeling less insecure about mobility and a better perception of worsening symptoms during the pandemic.

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