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Article

Sedentary Behavior, Physical Activity and Functionality of Older Care Home Residents

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Abstract: Background: Nursing home residents (NHRs) have special needs and may experience reduced functionality, higher sedentary behavior time (SBT) and decreased physical activity (PA). This study aimed to characterize NHRs based on SBT, PA, and functional performance (FP), and to identify associations between these factors. Methods: Cross-sectional study with 65 NHRs aged ≥60, evaluated by accelerometer (SBT, PA) and the following tests: Timed Up and Go (TUG), Short Physical Performance Battery (SPPB), Barthel Index (BI), and Mini-Mental State Examination (MMSE). Health-related variables and anthropometry were assessed. The FP (TUG, SPPB, BI), SBT, PA intensities were used for K-means clustering analysis. Results: The cluster analysis identified: C1 – better FP, shorter SBT, and longer time in PA intensities; C2 - lower FP, longer SBT, and shorter time in PA. In addition, C2 were older, with lower MMSE, lower body mass index, and walking aids use. The SBT showed a negative weak correlation with BI. The moderate PA (MPA) was moderately correlated with the SPPB and strongly correlated with the TUG and BI. Conclusions: MPA is strongly associated with better FP and independence. NHRs have different physical and cognitive profiles, which indicates the need for personalized strategies to prevent disability and increase PA.

Keywords: older adults; nursing homes; sedentary behavior; physical activity; functionality; disability

1. Introduction

The growth of the older adult population has fostered debates regarding the multifaceted aspects of the aging process, encompassing sociodemographic, economic, health, and functional status [1]. Older adults living in long-term care facilities (i.e., nursing home residents - NHRs) are of particular concern as they require special needs. In addition, projections indicate an expressive growth in longevity [2]. NHRs are generally characterized by reduced functionality, cognitive impairments, diminished physical activity, and decreased mobility and independence [3,4]. There is a general concern regarding the effectiveness of nursing home services in providing proper care to promote healthy aging [5].

Sedentary behavior time (SBT) is a health-related key factor [6] characterized by extended periods of low-energy expenditure activities, such as sitting, reclining, or lying down [7]. The SBT has been associated with disability [7–9] and with all-cause mortality and increased risk of mortality by cardiovascular diseases [10,11]. The average SBT of community-dwelling older adults is 9.4h.day^{-1}, representing approximately 65–80% of their waking time [12], while NHRs spend up to 23% more of their daily hours in SBT [13]. This is particularly concerning as increases in sedentariness are accompanied by reduced physical activity (PA) engagement [12]. Thus, SBT

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decreases combined with PA increases are a critical aspect to counteract and mitigate age-related functional declines [14].

Although the association between PA, SBT, and health-related outcomes among older adults living independently in the community has been explored, studies devoted to identifying such among NHRs are scarce. This is relevant while providing a comprehensive and integrated approach combining health and self-care assistance with increased participation in daily routines and physical activities [15]. In addition, NHRs are not homogeneous, and their care services may differ depending on the older adults' physical conditions and cognitive status [16].

Therefore, this study aimed to characterize NHRs based on SBT, PA levels, functional performance, and their ability to deal with daily living activities to identify multivariate key aspects that could help those involved in NHR care. In addition, it also aimed to verify the association between PA and SBT and health-related outcomes among older adults living in care facilities. Identifying how multivariate aspects involving several domains relate among older adults living in NHR is relevant, as they are crucial while developing effective long-term care strategies.

2. Materials and Methods

2.1. Participants

This cross-sectional study used the data collected at a baseline from a randomized controlled trial registered at the Brazilian Clinical Trials Registry (RBR-95M34PP). The study was approved by the Research Ethics Committee of the Health Sciences Sector of the Federal University of Paraná (protocol number CAAE: 5 2187221.6.0000.0102, report number 5.140.516).

Seven local nursing homes were contacted and agreed to participate. The nursing homes were comparable regarding the care services and assistance characteristics. Two institutions offered physical activities once a week, and five twice a week. Sixty-five older adults were invited to participate and signed an informed consent form. Participants with physical capacity impairments resulting from recent trauma or muscular diseases, such as falls, fractures, and ongoing rehabilitation, and wheelchair users were not included. No cutoff points were applied for cognitive status or physical performance tests.

2.2. Measures

2.2.1. Sedentary Behavior and Physical Activity

The SBT and PA were assessed by a wearable accelerometer (Actigraph, model GT3X) attached to a belt around the hip and sampling at 30Hz. The data were collected continuously for seven consecutive days, except for sleeping and bathing. The analysis was performed considering at least four valid days (i.e., containing > 480 minutes of wearing time) [17]. The number of counts/min used to define SBT was ≤99 counts/min [10]. The number of counts was also used to identify a light PA (LPA; ranging from 100–1040 counts/min) and a moderate PA (MPA; ≥1041 counts/min) [18,19]. SBT and PA intensities were calculated and expressed as a daily average.

2.2.2. Physical Fitness and Functional Capacity

The Timed Up and Go test (TUG) was used to assess functional mobility [21]. The Short Physical Performance Battery (SPPB) was applied to assess static balance, 4 meters gait speed (4MWS), and five times sit-to-stand test (5STS) [22]. The Barthel Index (BI) was used to observe daily living activities (ADLs) [23] and assessed with the help of a staff member.

2.2.3. Sociodemographic data, health-related variables and cognitive status

To characterize the sample, the sociodemographic data collected included sex, age, marital status, and years of schooling. Cognitive status was assessed by the Mini-Mental State Examination (MMSE) [20]. Health-related variables included body mass index, waist circumference, handgrip

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strength, the number of diseases, the number of medicines, hospitalizations, and surgeries in the last year. A staff member or family member confirmed the sociodemographic data.

2.3. Data collection

Initially, participants answered sociodemographic questions and the cognitive assessment. Then, they were assessed for their anthropometrics. The functional tests were performed in the following order: TUG, 4-meter gait speed (4MWS), balance test, and the five-times sit-to-stand test (5STS). The participants received verbal instructions, and a demonstration was also provided. They were offered two opportunities to execute the functional tests, and the best performance was used for further analysis. The tests were conducted on the same day, with a rest interval of 5 minutes between tests and trials. The use of walking devices was permitted in tests involving walking. When participants could not perform the test (e.g., required help, did not understand the instructions, refused to perform a particular test), they were maintained in the study, and the data for a particular test was suppressed. The number of participants in each test is indicated in the results section.

2.4. Statistical Analysis

Initially, a standard descriptive statistical approach was used to characterize the sample. The Kolmogorov-Smirnov test confirmed data normality. Group comparisons distributed by gender were made using a general linear model (GLM) and presented as sample characterization. Pearson's or Spearman's correlation coefficients, according to the nature of the variables to identify associations between SBT, PA levels, and the independent variables. The correlation coefficients were interpreted as very weak (< 0.30), weak (0.30 – 0.50), moderate (>0.50 – 0.70), strong (>0.70 – 0.90), and very strong (> 0.90) [24].

A cluster approach was applied to identify if NHRs could be characterized based on functional performance (TUG, SPPB, BI), SBT and PA intensities. The cluster analysis only considered participants who completed all tests and used the accelerometer (n=43). Cluster analysis is an unsupervised machine learning method that explores the naturally occurring groups within a data set without the need to predefine groups. In this machine learning approach learning, insights are derived from the data without predefined labels or classes and provide high intra-cluster similarity and low inter-cluster similarity. In other words, it naturally separates groups according to their main features. Two groups were used to avoid groups with a small number of participants, using criteria the value G and partitioned into K disjoint clusters [25]. Therefore, the clusters C1 and C2 were obtained using the K-means clustering approach. This approach separates the clusters by considering the distance between the data points in relation to the center of the respective cluster by proximity. Then, a Receiver Operating Characteristic Curve (ROC) was applied to compare the significant variables indicated by the cluster analysis. The Area Under the Curve (AUC) was determined while contrasting the cluster groups (C1 and C2), while sensitivity and specificity were used to establish the cutoff points for each variable.

A GLM was applied to compare age, functional and cognitive performance, and health-related variables. The chi-square and Fisher's exact tests were performed to identify cluster differences in the categorical variables. The statistical tests considered a significance level of $p<0.05$ and a 95% Confidence Interval (CI). The statistical analysis was performed using the Jamovi software, version 2.3.28.

3. Results

The characteristics of the participants indicated that 7.7% studied less than one year, 43.1% studied between 1–4 years, 24.6% between 5–8 years, 16.9% between 9–11 years, and 7.7% more than 11 years. Widower was of the most prevalent marital status (51.6%), and single was the second one (21.9%). Most participants could walk independently (60.0%), while 23.1% used a walking assistive device, 9.2% used a cane, and 7.7% required assistance from another person (7.7%). Approximately one-quarter were hospitalized (n=16, 24.6%), while 7.7% (n=5) had surgery in the last year. In addition, 58.5% participated in physical activities promoted by the institution at least once a week. The characteristics of the participants are presented in Table 1 (grouped by gender and total). Although women were older than men (p<.001), no differences were identified in physical performance, SBT, and PA time (p>0.05).

Table 1. Characteristics of the participants (mean ± sd) grouped by gender and total.

Variables	Men (n=32)	Women (n=33)	Total (n=65)
Physical Characteristics			
Age (years)	74.2 ± 8.13*	83.4 ± 9.05	78.8 ± 9.7
Body Mass (kg)	65.5 ± 12.5	59.7 ± 14.2	62.6 ± 13.7
Stature (cm)	165.0 ± 0.7	154.0 ± 0.6	160 ± 0.8
Body Mass Index (kg.m^{-2})	24.0 ± 4.21	24.1 ± 4.67	24.06 ± 4.41
Waist circumference (cm)	95.4 ± 11.9	93.4 ± 12.8	94.4± 12.3
Health-related aspects			
Number of diseases (units)	2.03 ± 1.18	2.0 ± 1.34	2.02 ± 1.26
Number of medicines (units)	5.72 ± 2.98	5.70 ± 3.34	5.71 ± 3.14
Surgeries – last year	3 (4.6%)	2 (3.1 %)	5 (7.7 %)
Hospitalization – last year	11 (16.9%)	5 (7.7%)	16 (24.6 %)
Functional Performance			
MMSE (score)	16.3 ± 7.84	14.1 ± 7.28	15.18 ± 7.58
TUG (s)	27.3 ± 30.6	32.7 ± 23.5	30.3 ± 26.8
SPPB (score)	6.14 ± 3.59	5.03 ± 2.72	5.56 ± 3.19
4MWS (s)	11.3 ± 11.0	13.3 ± 11.7	12.3 ± 11.3
5STS (s)	16.9 ± 9.84	19.5 ± 6.77	18.3 ± 8.34
HGS (Kgf)	21.0 ± 8.67*	12.3 ± 6.13	16.7 8.63
Barthel Index (score)	78.1 ± 22.7	77.0 ± 18.8	77.5 ± 20.7
Physical Activity			
SBT (h.day^{-1})	11.3 ± 10.5	10.2 ± 2.19	10.8 ± 2.71
LPA (h.day^{-1})	1.45 ± 0.68	1.50 ± 0.82	1.47 ± 0.75
MPA (h.day^{-1})	1.01 ± 1.01	0.68 ± 0.50	0.84 ± 0.79
SBT (%)	81.5 ± 10.8	82.6 ± 8.53	82.1 ± 9.58
LPA (%)	10.7 ± 5.14	11.9 ± 5.88	11.3 ± 5.51
MPA (%)	7.73 ± 7.71	5.51± 3.77	6.57 ± 6.04

MMSE: Mini Mental State Exam; TUG: Timed Up and Go; SPPB: Short Physical Activity Battery; 4MWS: gait speed; 5STS: five times sit to stand test; HGS: handgrip strength; SBT: Sedentary behavior time; LPA: Light physical activity; MPA: Moderate physical activity. *p< 0.05.

The correlation between SBT, LPA, and MPA regarding the characteristics of the participants are described in Table 2. The MPA presented a larger number of correlations with physical and functional characteristics. The highest correlations were found between MPA and 4MWS (r= 0.71), TUG time (r= -0.71), and Barthel Index (r= 0.72). On the other hand, SBT showed a positive weak correlation with the Barthel Index (r= -0.43), while the LPA had a weak and negative correlation with the 5STS (r= -0.42). Age was negatively correlated with MPA.

Table 2. Bivariate correlation between sedentary behavior time (SBT), physical activity levels (light – LPA; moderate - MPA), cognitive status, anthropometric variables, and physical fitness tests.

		Age	MMSE	BMI	WCIRC	HGS	4MWS	5STS	SPPB	TUG	BI
SBT	*r*	0.040	-0.045	0.064	0.066	0.170	-0.129	0.212	0.181	-0.135	-0.430
	p	0.780	0.749	0.653	0.640	0.234	0.392	0.214	0.218	0.389	0.001
LPA	*r*	-0.060	0.252	-0.017	-0.082	0.092	0.137	-0.428	0.161	-0.157	0.264
	p	0.671	0.071	0.906	0.565	0.521	0.365	0.009	0.275	0.316	0.058
MPA	*r*	-0.518	0.541	0.254	0.278	0.503	0.717	-0.562	0.686	-0.715	0.725

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p	<.001	<.001	0.069	0.046	<.001	<.001*	<.001	<.001	<.001	<.001

SBT: Sedentary behavior time; LPA: Light physical activity; MPA: Moderate physical activity; MSME: Mini state mental exam; BMI: Body mass index; WCIRC: waist circumference; HGS: handgrip strength; 4MWS gait speed; 5STS: five times sit to stand test; SPPB: Short Physical Performance Battery; TUG: Timed Up and go; BI: Barthel Index.

The results of the cluster analysis are shown in Table 3. In addition to the variables used to form the cluster, it was possible to observe differences between groups in age, body mass index, and cognitive status (p<0.05). Participants of C1 (n=20) were younger, had the highest BMI, had better cognitive and functional performance, less absolute and relative time spent in sedentary behavior, and had a higher level of PA. Subjects from C2 (n=23) were older than C1, with reduced functional capacity and cognitive status, higher SB, and less physically active. The variables that formed the cluster are described at the top of the table, followed by characterization by age and health-related variables.

Table 3. – Variables according to the Clusters (C1 and C2) by age, functional performance, hours spent in sedentary behavior, and light and moderate physical activity.

Variable	Clusters	Estimated marginal means		95%CI		P-value
		Estimate	SE	Lower	Upper	
Physical Characteristics						
Age (years)	1	72.0	2.01	67.9	76.1	<.001
	2	82.8	1.88	79.0	86.6	
BMI (kg.m^{-2})	1	26.3	1.01	24.2	28.3	.012
	2	22.6	0.94	20.7	24.5	
Health-related aspects						
Disease (units)	1	2.0	0.28	1.42	2.6	.740
	2	1.9	0.27	1.33	2.4	
Medicines (units)	1	5.3	0.71	3.92	6.8	.689
	2	5.7	0.66	4.41	7.1	
Functional Performance						
MSME (score)	1	20.1	1.49	17.0	23.1	.010
	2	14.5	1.39	11.7	17.3	
TUG (s)	1	13.2	3.65	5.87	20.6	<.001
	2	36	3.41	29.1	42.9	
SPPB (score)	1	8.6	0.48	7.69	9.6	<.001
	2	4.1	0.45	3.19	4.9	
HGS (Kgf)	1	20.7	1.91	16.9	24.6	.062
	2	15.7	1.78	12.1	19.3	
BI (score)	1	95.3	2.92	89.4	101.1	<.001
	2	73.5	2.72	68.0	79.0	
Physical Activity						
SB (%)	1	74.4	1.70	71.0	77.8	<.001
	2	86.9	1.58	83.7	90.1	
LPA (%)	1	14.6	1.09	11.85	16.3	.004
	2	9.6	1.02	7.50	11.6	
MPA (%)	1	11.5	1.09	9.33	13.72	<.001
	2	3.5	1.01	1.46	5.56	

MMSE: Mini Mental State Exam; TUG: Timed Up and Go; SPPB: Short Physical Activity Battery; 4MWS: gait speed; 5STS: five times sit to stand test; HGS: handgrip strength; BI: Barthel Index; SBT: Sedentary behavior time; LPA: Light physical activity; MPA: Moderate physical activity. *p< 0.05.

Among the categorical variables, surgeries in the last year (p=.039), participation in PA (p=.010), and the use of mobility aids (p=.004) differed between clusters. The C1 presented a larger number of surgeries (n=4, 20%), while in C2, there were no cases. In the participation in physical activity, C2 showed 82.6% more engagement than C1 (C1: n= 9, 45%; C2: n=19). Regarding the use of walking aid devices, only 1 participant required a walker in C1, while C2 had the following distributions: n=4 (17.4%) cane, n=6 (26.1%) walker, n=2 (8.7%) assisted by another person. Independent walkers in C1 and C2 were 19 (95%) and 11 (47.8%), respectively.

Table 4 shows the results of the analysis of the ROC curve concerning the cluster analysis. Although all variables were significant, a larger area under the curve (>0.9) was observed in some functional performance parameters (TUG, SPPB, Barthel Index, and MPA).

Table 4. The ROC curve results for the parameter identified as relevant in the cluster analysis.

Model	AUC	P-value	Cutoff	Sensitivity	Specificity
TUG (s)	0.911	0.003	21.4	0.783	0.800
SPPB (score)	0.938	0.002	6.0	0.913	0.700
BI (score)	0.902	<0.001	95.0	0.739	0.850
SBT ($h.day^{-1}$)	0.776	0.009	10.5	0.739	0.650
LPA ($h.day^{-1}$)	0.718	0.034	1.10	0.739	0.450
MPA ($h.day^{-1}$)	0.950	0.004	0.78	0.870	0.850

AUC: Area under the curve; TUG: Timed Up and Go; SPPB: Short Physical Performance Battery; Barthel: Barthel Index; SBT: Sedentary behavior time; LPA: Light physical activity; MPA: Moderate physical activity.

4. Discussion

The purpose of this study was to characterize and verify the association between multivariate key aspects regarding physical activity (PA), sedentary behavior time (SBT), and health-related outcomes among older adults living in care facilities (NHRs). Understanding the NHRs' characteristics and their relationships with health-related outcomes is relevant, considering their special care requirements. This better understanding may subside interventions and expand the perspective of care to promote functional capacity, independence, and life quality for institutionalized older adults.

The main finding of the present study was that the SBT and light PA were not associated with most functional performance aspects. Although the SBT and LPA were negatively correlated with most functional performance tests, they were very weak, weak, and non-significant. On the other hand, moderate PA (MPA) showed a moderate and strong negative correlation with the time required to perform most functional tests and a positive correlation with cognitive function, handgrip strength, and the SPPB score. In addition, MPA showed a strong positive association with the performance of daily activities and gait speed and a strong negative correlation with TUG performance. Although correlations are not necessarily causal, it is relevant to highlight that better functional and daily living performances were observed only in the NHRs that were exposed to a moderate physical activity level. Indeed, the ROC curve analysis indicated that MPA was the most relevant variable in the cluster model applied to classify multivariate aspects of NHRs.

Physical activity and sedentary behavior are recognized as independent predictors of health-related outcomes [26]. SBT has been related to functional and cognitive decline in older adults [12]. Although the participants of the present study have spent more than 80% of their waking time in sedentary behavior, our data did not confirm these associations. The results were similar to another study that also found a weak association between SBT and the performance of daily living activities [27]. The weak and negative correlation observed between SBT and Barthel Index (BI) can be explained by the fact that BI data are obtained by self-report or by reports from caregivers, which may present bias. Another fact may have been that the average age of the participants in the present study was lower than the other studies with NH residents who have identified associations between SBT and performance in physical fitness tests [27,28].

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Concerning LPA, a weak and negative correlation with the FTSST test that makes up the SPPB was verified. Indeed, according to a previous study, LPA may improve parameters related to mental health and well-being but is insufficient to significantly improve the components of physical fitness [29]. It can explain the lack of association between LPA and other variables of physical function.

However, there was a strong correlation between MPA and different components of physical fitness. The associations between MPA and performance on the TUG and performance on the ADLs explained between 50 and 52% of the performance of these variables, respectively. The TUG assesses functional mobility and is related to the risk of falls, a major problem in institutionalized older adults as they are a more fragile population. Falls can result in trauma and injuries that can compromise the older's mobility and independence and, in extreme cases, might result in death [30]. The Barthel Index, as mentioned previously, also assesses transfer and mobility tasks, including the ability to walk and use stairs. There is a linearity with the fact that the more active person is more independent in daily life [31], since they will have more opportunities to perform these tasks, which contributes to increased PA engagement. At the same time, these mobility and transfer tasks consist of capabilities also assessed from TUG tests and walking speed (4MWS), both correlated with MPA. The 4MWS was the only component of the SPPB that showed a strong correlation, while the five times sit-to-stand (5STS) test and the total score battery showed a moderate association. Despite the moderate magnitude, this association of MPA with SPPB can explain 46% of the total score of this test battery. Considering that this test evaluates the physical function of the lower limbs like gait speed, balance and strength, skills that enable the performance of PA.

In addition to the 5STS test that assesses lower limb strength, upper limb strength was moderately correlated with MPA through handgrip strength. Although these correlations explain 33% and 25%, respectively, this reinforces that MPA can influence muscular strength, one of the most important components of physical fitness for the functionality and independence of older people [32]. In addition to the components of physical fitness, cognitive status also correlated with MPA. Although the MMSE is not a test focused on assessing cognitive functions, this result reveals that people with higher scores on the test have greater engagement in PA. Similarly, in another study, it was identified that the more active the older person is, the higher the cognitive test score [33]. On the other hand, cognitive decline is one of the biggest challenges to be faced in aging and is related to the capacity for independent living [34], which can influence engagement in PA intensities.

Therefore, encouraging participation in MPA seems to be of paramount importance for older adults living in NH. Additionally, performance in ADLs denotes greater independence, greater possibilities of participating in physical activities at different levels of intensity, and probably a reduction in SB.

Cluster division showed the heterogeneity of the institutionalized elderly population in response to functional profile, SBT, and PA levels. We also discriminated cutoff points between the groups for the variables that formed them to understand how they behave among clusters. The TUG cutoff point was 21.44s, a longer time than that used to classify the risk of falls in NH residents, which is 15s [35]. This means that despite having better performance, C1 may have a portion of residents with a moderate risk of falls. The SPPB cutoff score was 6 points, corroborating the test's classification indicating low performance [36].

On the other hand, although sensitivity and specificity parameters were significant, the cutoff point for the Barthel index was 95, a value close to the test's maximum score (100 points). This may indicate that C1 presented predominantly independent performance in ADLs. SBT (10.5h), LPA (1.1h), and MPA (0.78h) values are important to understand the cutoff point specifically for our study population. Highlights the analysis for MPA, which presented a larger area and significant values for sensitivity and specificity.

The groups differed in age, although this variable was not used to form the clusters. The difference in the average age of approximately ten years possibly affected the other variables

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compared between groups. Although it is known that age-related declines can impact physical activity and independence [37,38], understanding this fact in this population is important to consider practical applications to minimize those declines.

Regarding anthropometric variables, cluster 2 showed a lower BMI. Although we did not evaluate body composition, the difference in BMI found between the clusters might suggest a reduction in lean body mass. Studies show that the muscle mass reduction rate is approximately 1% annually after 50 years [39]. In fact, among the institutionalized elderly population, a decrease in BMI appears to be a predictor of sarcopenia [40].

Regarding cognitive status, although C1 presented better performance in MMSE, the score was low, indicating that cognitive performance characterizes institutionalized older adults. The decrease in scores between groups may indicate age-related cognitive loss. A previous study observed that older residents aged over 85 years showed worse cognitive performance and lower PA when compared to the younger group [41], similar to the results of the present study in reference to C2, a group that presented lower cognitive performance and less engagement in PA.

The need for a walking aid device was observed in more than 50% of C2 subjects, while in C1, just one participant required assistance. This is an important point because institutionalized older people with some mobility limitations have a lower level of PA [42], another characteristic of C2. This aspect possibly influenced performance in functional tests that assess mobility and balance, such as the TUG and SPPB. Therefore, it would be plausible to suggest that the difference observed in performance in physical tests can, to a certain extent, be explained by a possible age-related muscle mass reduction. The reduction in muscle mass compromises muscle function (strength and power) [43], capabilities assessed in these tests. Although not showing statistical significance ($p=0.06$), handgrip strength tended to be lower in cluster 2. Indeed, strength loss in older adults occurs at a higher rate in the lower than in the upper limbs [44].

The functional performance results reveal that group C2 presents greater dependence for all parameters evaluated. Another study using a cluster approach identified that older NH residents have greater dependence on daily life, which demands a higher level of care [16]. Although the present study did not cover factors related to the level of care in NHs, these arguments reveal the relevance of strategies necessary to minimize functional losses and reduce the need for care and supervision in these environments.

The time spent in sedentary behavior was greater in C2, and these results confirm a tendency to increase SB with age. It was verified previously that older adults living in nursing homes presented a 1,9% increase in SB per decade [28]. However, it was interesting to verify that the number of participants in physical activity promoted by the institution was more significant in C2 despite their higher SB and lower PA. This fact might be explained by the better performance of C1 in physical fitness and ADLs, resulting in greater physical activity in daily life. On the other hand, C2 individuals may be more interested in these activities because they have worse physical capacity and greater dependence.

Although time spent in LPA differed between the groups, the PA intensity that showed the greatest difference between the groups was MPA, with the most time spent by C1. This tendency for MPA to decrease with age was noted in another study with older people >85 years old, which identified a significant reduction in MPVA time compared to younger adults [45]. Although physical activity is offered in institutions, the strategies may not be sufficient to increase the PA level of this less functional and more sedentary group.

Planning strategies focused on reducing functional decline and disability, preventing the increase in SB, and promoting PA with aging in older adults living in NH are necessary measures. Based on an analysis of data from octogenarian institutionalized older people, relocating 30 and 60 minutes from SB to LPA significantly improved walking speed, functional mobility, strength, ADL performance, and muscular function of the lower limbs, such as strength and power. More significant gains can be achieved when simulating the relocation from SB to MPA [27]. Given the recognized effects of engaging in PA regardless of the intensity of older people's functionality and

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that replacing SBT with any intensity of activity is recommended [46], the challenge is to develop strategies viable for NH residents and that promote adherence among this population.

This study presented some limitations. Although the accelerometry results in a direct measurement of the SB and PA intensities, these devices do not provide information about body posture or the context of activities in which the resident was engaged. The cross-sectional design does not allow us to indicate cause-and-effect relationships. Another fact is that the time of institutionalization of each subject was not obtained, and as previously shown, longer institutionalization time is associated with greater reduced PA and a decline in cognitive function [47]. On the other hand, not excluding people based on their cognitive score or mobility performance allowed us to visualize the reality of this population. In addition, the cluster approach allowed us to identify the group's heterogenicity from functional and physical activity profiles known as indicators of healthy aging.

5. Conclusions

The findings of this study indicated that time spent in MPA is strongly associated with better physical performance and independence for ADLs. LPA and SBT showed a weak correlation with physical performance (SPPB) and a weak negative association with independence for ADLs (Barthel Index), respectively. Cluster analysis showed that the group with lower physical and functional performance comprises older people with lower body mass index, are more dependent on activities of daily living, and have worse cognitive status than the group with better functional profiles and higher PA engagement. Considering the heterogeneity of NH residents, these data allow us to think about tailored care strategies.

Future studies are suggested to verify the effectiveness of training programs for caregivers, emphasizing the importance of reducing SB and increasing daily physical activity, including tasks necessary for self-care while promoting independence. Proposals aimed at developing strategies to increase adherence to exercise programs and physical activities promoted in institutions should be considered, in line with the recommendations to promote gains in physical fitness for this population.

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