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Original Article

ASSOCIATION OF PHYSICAL ACTIVITY COMBINED WITH SEDENTARY BEHAVIOR WITH DYNAPENIA IN OLDER ADULTS

ASSOCIAÇÃO DA ATIVIDADE FÍSICA COMBINADA AO COMPORTAMENTO SENDENTÁRIO COM A DINAPENIA EM IDOSOS

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ABSTRACT

This research aimed to analyze the association of physical activity (PA) level combined with exposure to sedentary behavior (SB) with dynapenia in older people. Epidemiological, cross-sectional study, conducted with 208 older adults in Aiquara, Bahia, Brazil. Habitual PA and SB were quantified using the International Physical Activity Questionnaire. Based on this information, participants were divided into groups (G): G1) sufficiently active and low SB; G2) sufficiently active and high SB; G3) insufficiently active and low SB; and G4) insufficiently active and high SB. Assessment of dynapenia was performed based on the values of the handgrip strength measured in kilogram-force (kgf) (women: 18.37 kgf; men: 26.75 kgf). Descriptive analysis was conducted using absolute and relative frequencies, mean and standard deviation. For the inferential analysis, Poisson regression was used, with a robust estimator, calculation of Prevalence Ratios (PRs) and their relevant Confidence Intervals (CIs) of 95.0%. It was observed that the mean age of women and men were, respectively, 71.0 ± 6.7 and 72.3 ± 8.1 years and the prevalence of dynapenia observed was about 24.5%. Furthermore, it was found that the insufficiently active older adults with low SB (G3) (PR: 2.28; 95%CI: 1.09-4.76), and those insufficiently active with high SB (G4) (PR: 4, 14; 95%CI: 1.95-8.70), were more likely to experience the assessed outcome. Evidence showed that, among the older adults in Aiquara the prevalence of dynapenia was high in the presence of an insufficient level of PA, especially when combined with greater exposure to SB.

Palavras-chave: Motor activity. Aging. Sedentary lifestyle. Epidemiology

RESUMO

Esta pesquisa teve como objetivo analisar a associação do nível de atividade física (AF) combinado à exposição ao comportamento sedentário (CS) com a dinapenia em idosos. Estudo epidemiológico, transversal, conduzido com 208 idosos de Aiquara, Bahia, Brasil. A AF habitual e o CS foram quantificados pelo *International Physical Activity Questionnaire*. A partir destas informações, dividiu-se os participantes em grupos (G): G1) suficientemente ativos e baixo CS; G2) suficientemente ativos e elevado CS; G3) insuficientemente ativos e baixo CS; e G4) insuficientemente ativos e elevado CS. A avaliação da dinapenia foi realizada a partir dos valores, em quilograma-força (kgf), da força de preensão manual (mulheres: 18,37 kgf; homens: 26,75 kgf). A análise descritiva foi conduzida por meio de frequências absolutas e relativas, média e desvio padrão. Para a análise inferencial utilizou-se a regressão de Poisson, com estimador robusto, cálculo das Razões de Prevalência (RP) e de seus respectivos Intervalos de Confiança (IC) de 95,0%. Observou-se que as médias de idade das mulheres e dos homens, foram, respectivamente, 71,0 ± 6,7 e 72,3 ± 8,1 anos e a prevalência de dinapenia observada foi na ordem de 24,5%. Ademais, averiguou-se que os idosos insuficientemente ativos com baixo CS (G3) (RP: 2,28; IC95%: 1,09-4,76), e os insuficientemente ativos com elevado CS (G4) (RP: 4,14; IC95%: 1,95-8,70), apresentaram maior probabilidade ao desfecho analisado. As evidências verificadas mostraram que, entre os idosos de Aiquara, a prevalência de dinapenia foi elevada na presença do nível de AF insuficiente, especialmente quando combinado a uma maior exposição ao CS.

Keywords: Atividade motora. Envelhecimento. Estilo de vida sedentário. Epidemiologia.

Introduction

Aging is a process inherent to the life cycle and some systemic adaptations occur with advancing age, impacting the functioning of the body and homeostasis[1]. Thus, the changes that occur in the musculoskeletal system stand out, considering the decline in muscle strength, mass and power[2-4].

Evidences point out that the highest level of performance of skeletal muscles is reached between the second and third decade of life, when the peak of muscular aptitude is reached, and then a continuous decline begins with aging[5,6]. Muscle weakness, resulting from advancing age, was defined by Clark and Manini[7] as dynapenia. This condition is recognized as the first criterion for the diagnosis of sarcopenia[8] and may present different epidemiological perspectives according to the sociodemographic and morbidity and mortality profile of the evaluated population[9,10,11].

From an international perspective, a prevalence of about 17.8% dynapenia was observed in European older adults[12]. On the other hand, among older Brazilian people, the prevalence seems to vary from 24.5%[13] to 30.9%[14]. Therefore, dynapenia appears as an important Public Health issue, since it generates implications for the functional capacity and autonomy of older people and is associated with adverse events in health and quality of life, such as a greater probability of falls, hospitalization[9] and mortality[15].

In this framework, a systematic review of 112 studies, which together evaluated 43,796 older people, found that physical activity (PA) and sedentary behavior (SB) also seem to exert a strong influence on the muscular fitness of the older adults. Thus, older people who are insufficiently active or who are highly exposed to sedentary behavior tend to exhibit minor lower muscle strength and power[3] and are more likely to experience dynapenia[13].

Despite this evidence concerning the independent associations of insufficient physical activity level and high sedentary behavior with dynapenia, no epidemiological studies were found in the literature that investigated the combined effect of these two risk behaviors on muscle strength in older people. However, being aware that both behaviors have deleterious repercussions on muscle fitness, the hypothesis that their combination may have a synergistic effect is highlighted, increasing the likelihood of muscle weakness.

Therefore, there is a need to conduct population health surveys for this investigation, as the results found may help health surveillance actions, enabling more effective interventions based on the identification of these behaviors combination impact in the functional performance levels throughout aging. Therefore, this study aimed to review the association between the level of physical activity combined with exposure to sedentary behavior and dynapenia in older people.

Methods

Study design, location and population

This is a study, with a cross-sectional design, built from information from the baseline of the epidemiological and population research: "*Condições de saúde e estilo de vida de idosos residents em município de pequeno porte: coorte Aiquara*", conducted between February and April 2013, with older people from the urban area of Aiquara, BA, Brazil. More details on the procedures adopted and stages of data collection can be found in Casotti et al[16].

Ethical aspects

This survey was carried out in accordance with Resolution No. 466/2012 of the Brazilian National Health Council and approved by the Research Ethics Committee of

Universidade Estadual do Sudoeste da Bahia, under Opinion No. 171.464/2012 and CAAE No. 10786212.3.0000.0055. All participants were informed about the objectives, procedures and the voluntary participation in the investigation. Thus, after receiving information about the study, they signed the Free and Informed Consent Form.

Eligibility criteria

As inclusion criteria, participants should be ≥ 60 years old, not institutionalized, have a fixed residence in the urban area, and report sleeping four days or more per week at home. However, older people who demonstrated cognitive deficit, assessed by the Mini Mental State Examination (MMSE) (< 13 points)[17], those bedridden, and those who had neurological and/or hearing disorders were excluded.

Thus, from a census conducted based on the list of older people registered in the Family Health Strategy, which covers 100.0% of the population of Aiquara, BA, 232 older people living in the urban area of that municipality who met the criteria of eligibility were identified[18]. Out of these, 24 did not perform the handgrip strength (HGS) test due to physical limitations.

Dependent variable

HGS was measured using a Saehan SH5002 handheld hydraulic dynamometer (Saehan Corporation, 973, Yangdeok-Dong, MasanHoewon-Gu, Changwon 630-728, South Korea). The test was conducted on the dominant limb of the older individuals, who remained seated, with the shoulder close to the body, elbow flexed at 90º and the forearm in a neutral position. In addition, the dynamometer was adjusted according to the size of each participant's hand with the first and second finger joints relaxed[19].

During the test, older people were encouraged to press the dynamometer handle with as much force as possible. The test was performed twice, with an interval of one minute, and the highest value identified in kilogram-force (kgf) was used for the assessment. Dynapenia assessment was stratified by gender, with a cut-off point set at the 25th percentile of the HGS (women: 18.37 kgf; men: 26.75 kgf)[20].

Independent variable

The PA level was assessed using the first four domains of the International Physical Activity Questionnaire – IPAQ (PA at work; in transport; in domestic activities; and at leisure)[21,22]. Thus, older people who reported spending < 150 min/week in moderate to vigorous weekly physical activity were considered to be insufficiently active[23].

The high SB exposure time was verified by the fifth domain of the IPAQ, which measures the time spent in a sitting and/or leaning position on a common day of the week and on one day of the weekend. The weighted average of the SB was calculated as follows: (5 x min/weekday) + (2 x min/weekend day) /7) and the cutoff point adopted for the high SB was based on the 75th percentile of the weighted average, with a value around 342.85 min/day (5.71 hours/day)[13].

Subsequently, the population was divided into four groups, regarding the combinations of PA and SB: G1) sufficiently active and low SB; G2) sufficiently active and high SB; G3) insufficiently active and low SB; and G4) insufficiently active and high SB.

Fitting variables

The following variables fitting was listed: gender (male or female); family arrangement (with companion or alone); age group (60-79; 70-79; ≥ 80 years); skin color, categorized as black or non-black (white, brown and yellow); schooling, categorized as with schooling or without schooling (never went to school and/or could not write their own name);

marital status (married/common law marriage, single/separated or widowed); income (≤ 1 minimum wage or > 1 minimum wage; minimum wage in 2013: R$ 678.00); use of alcohol and/or tobacco (yes or no); systemic arterial hypertension and/or self-reported diabetes mellitus (yes or no); occurrence of falls in the last 12 months (yes or no); self-perception of health (excellent/very good/good, fair or poor) and nutritional status (Body Mass Index - BMI), calculated using the following equation: BMI = (body mass (kg)/(height (m)^2)) and classified as low weight (< 22 kg/m^2), adequate (22 to 27 kg/m^2) or overweight (> 27 kg/m^2)[24]. Anthropometric measurements were carried out as described in Casotti et al.[16].

Statistical analysis

The population's characteristics were calculated based on frequencies (absolute; relative) and the percentage of responses for each variable reviewed. Furthermore, for the descriptive analysis, means and standard deviations were considered. For the inferential analysis, the investigation of the combined association between the level of PA and exposure to SB with dynapenia was performed using Poisson regression, with a robust estimator, calculation of Prevalence Ratios (PRs) and their relevant 95.0% confidence intervals (CIs).

The modeling was performed by the backward method, where all the variables listed for fitting, and control of potential confounding factors, were inserted in the model and, later, they were removed one by one, taking into account the highest p-values, up to a critical level of 10.0%. Data analyses were conducted using the Statistical Package for Social Sciences (IBM-SPSS 21.0, 2013, Inc, Chicago, IL).

Results

A total of 208 older people participated in this investigation (58.7% were women). The mean ages of women and men were, respectively, 71.0 ± 6.7 and 72.3 ± 8.1 years. The prevalence of dynapenia observed was 24.5%.

Furthermore, as shown in Table 1, it was found that 61.6% of the participants had had no education, 15.0% lived alone, 87.2% reported an income ≤ 1 minimum wage, 51.4% were insufficiently active, 26.3% showed high sedentary behavior and 59.11% were hypertensive.

Table 1. Descriptive analysis of the sociodemographic, behavioral and health conditions of older people who participated in the study. Aiquara, BA, Brazil, 2013

Variable	Response %	n	%
Gender	100.0		
Female		122	58.7
Male		86	41.3
Age group	100.0		
60-69 years		86	41.3
70-79 years		86	41.3
≥80 years		36	17.4
Skin color	97.1		
Black		53	26.2
Not black		149	73.8
Education	97.6		
No		125	61.6
Yes		78	38.4
Family arrangement	99.5		
With companion		176	85.0
Alone		31	15.0
Income	93.8		
> 1 minimum wage		25	12.8
≤ 1 minimum wage		170	87.2
Smoking	100.0		
No		189	90.9
Yes		19	9.1
Alcohol use	100.0		
No		162	77.9
Yes		46	22.1
Physical activity level	100.0		
Sufficient		101	48.6
Insufficient		107	51.4
Sedentary behavior	100.0		
Normal		150	73.7
High		58	26.3
Nutritional status	99.5		
Low weight		62	30.0
Adequate		84	40.6
Overweight/obesity		61	29.4
Arterial hypertension	100.0		
No		85	40.9
Yes		123	59.1
Diabetes *mellitus*	100.0		
No		172	82.7
Yes		36	17.3
Occurrence of falls	98.1		
No		174	85.3
Yes		30	14.7
Health self-perception	98.1		
Excellent/very good/good		105	51.5
Regular		76	37.3
Bad		23	11.2

Note:%: percentage; **n:** number of participants
Source: Authors

When investigating the association of the PA level combined with exposure to SB and dynapenia it was observed that the insufficiently active older adults with low SB and those insufficiently active with high SB were 2.28 (95%CI: 1.09-4.76) and 4.14 (95%CI: 1.95-8.70) times more likely to be dynapenic respectively (Table 2).

Table 2. Combined association of physical activity level and exposure to sedentary behavior with dynapenia in the study population. Aiquara, BA, Brazil, 2013

Variable	Prevalence (%)	Adjusted PR	95%CI	p-value*
Physical activity level and SB+				0.001
≥ 150 min/week and < 5.71h/day	12.1	1		
≥ 150 min/week and > 5.71h/day	17.9	1.98	0.73-4.32	
< 150 min/week and < 5.71h/day	26.3	2.28	1.09-4.76	
< 150 min/week and > 5.71h/day	66.7	4.14	1.95-8.70	

Note:%: percentage; **SB:** sedentary behavior; **PR:** prevalence rate; **CI:** confidence interval; +adjusted by sex; age group; skin color and nutritional status; *Wald test
Source: authors

Discussion

To the best of our knowledge, this is the first study to assess the combined association of PA and SB with dynapenia in older people. The main results showed that insufficiently active participants with low SB (G3) and insufficiently active participants with high SB (G4) showed, respectively, 2.28 and 4.14 times greater probability for the outcome, when compared to the reference group, composed of sufficiently active older people with low SB (G1).

In view of this, it was found, in Aiquara, Bahia, Brazil, that the level of physical activity appears to be the most influential risk behavior in the prevalence of dynapenia and that its combination with high exposure to sedentary behavior practically doubled the probability for that outcome among the older people evaluated.

Previous epidemiological studies have shown the association between habitual PA and HGS in older people, demonstrating a strong proportional relationship between these variables, since the longer the time spent in PA, the greater the level of muscle strength in older people[13,25-28]. On the other hand, inversely, sedentary activities in different domains, such as watching television and accessing the internet for a long time, have been associated with adverse health outcomes, implying a decline in muscle strength[13,26,29,30].

In this study, it was not possible to ascertain how the time of exposure to SB was accumulated (TV, internet, cell phone), or its pattern of accumulation (fragmented or continuous), which makes further comparisons impossible. However, this being a population aged ≥ 60 years, it is believed that most of the time was spent watching television, as older people tend not to use the internet as much[31]. Furthermore, it has been shown that older people with prolonged time in SB, watching television for ≥ 6 hours, tend to have lower handgrip strength compared to those evaluated who watch TV less (< 2 hours)[26].

In addition, Sánchez-Sánchez et al.[32] conducted a cross-sectional study with 497 older people in Spain (78.08 ± 5.71 years), in which they used isotemporal substitution to analyze the relationships between handgrip strength, exposure to SB and moderate to vigorous PA. These authors showed associations with greater grip strength when replacing time in SB with PA.

The impact caused by the insufficient PA level on dynapenia in older people in Aiquara, Bahia, Brazil, and its enhancement in the face of high exposure to SB, may be a

consequence of the adverse effects of hypokinetic. Probably because the low demand for motor activity can result in muscle atrophy[33] and in the decreased ability of muscle groups to maintain a good dynamic balance, which implies a decline in muscle strength and power[3]. Furthermore, the disuse of skeletal muscles can cause changes in body composition, such as the occurrence of a greater accumulation of fat mass and its infiltration into muscle tissue. Such repercussions contribute to weakening the contraction and stimulation power of skeletal muscles, thus contributing to a dynapenic condition[34,35].

The regular practice of PA has been evidenced as one of the main strategies to improve physical fitness and delay the deterioration of the muscular system, thus collaborating with the maintenance of older adults' independence[36]. In this connection, Guidelines in Public Health, such as those proposed by the World Health Organization[23] and the Physical Activity Guide for the Brazilian Population[37], recommend older people to accumulate at least 150 minutes per week of PA at moderate intensity, or a minimum of 75 minutes/week of vigorous PA. However, they emphasize the possibility of reaching satisfactory levels of PA with the combination of these two types of intensity.

The guidelines also point to the need to perform at least two days a week of muscle-strengthening activities involving major muscle groups, or three days a week of multicomponent activities that emphasize the maintenance of functional balance and force training. In addition, they suggest a decrease in high exposure to SB, highlighting that sitting or laying back watching television or using the cell phone for a long time, for example, should be avoided or minimized[23,37].

In the literature, there is also the possibility of implementing "breaks" to minimize exposure to SB[38,39]. This is because the simple act of leaving the sitting or reclining position results in the need to mobilize skeletal muscles to maintain the orthostatic position, which, in turn, increases energy expenditure above 1.5 metabolic equivalents[40]. Thus, every hour of sedentary behavior, getting up and moving, for example, to drink water, or simply stretching the body, can culminate in mitigating the deleterious effect of SB[37,41].

This study has as a possible limitation: the use of questionnaires with self-reported measures to quantify PA and SB, which are measures that can be forgotten, resulting in overestimation or underestimation of the actual time spent on different activities. However, we highlight prior training of the team, mainly with regard to standardization of the information acquisition. Furthermore, for this study, the MMSE was used as a way to screen older people with cognitive impairment, in order to reduce the impact of memory bias.

On the other hand, as strong points, the hydraulic hand dynamometry stands out; the device used to measure muscle strength is considered a gold standard method for that population. Furthermore, the census perspective is highlighted, which allowed the assessment of a representative contingent of older people of a small municipality in the Brazilian Northeastern region, which has low socioeconomic/demographic indicators and, therefore, has limitations in the offer of health services.

Conclusion

The evidence corroborated the set hypothesis. The results of this study showed that, among older adults in Aiquara, Bahia, Brazil, the prevalence of dynapenia was high in the presence of insufficient physical activity, especially when combined with greater exposure to sedentary behavior. Given this epidemiological scenario, it is essential to maintain a sufficient level of physical activity and the concomitant reduction of time spent in sedentary activities to improve muscle fitness throughout aging. Thus, being aware of the potential adverse effects of the combination of the two risk behaviors investigated on the functionality

of the participants, can help to support the actions of primary health care in Aiquara, Bahia, Brazil, and in other municipalities that present similar characteristics.

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