Original Article

ACTA FISIÁTRICA
www.revistas.usp.br/actafisiatrica

Influence of physical activity on the cognitive performance of middle-aged ans older adults: a longitudinal study carried out before and during the pandemic

Influência da prática de atividade física no desempenho cognitivo de adultos de meia-idade e pessoas idosas: um estudo longitudinal realizado antes e durante a pandemia

Marcelo Kwiatkoski[1], Mariana Tiemi Kajiyama[1], Tatiana Carvalho Reis Martins[1], Bruna Moretti Luchesi[1]

ABSTRACT

Objective: To analyze the influence of physical activity on the cognitive performance of middle-aged and older adults before and during the pandemic. **Methods:** Longitudinal and quantitative study, carried out with 200 individuals aged 45 years or older enrolled in Family Health Units in Três Lagoas/MS. The data collection took place in two moments, before the pandemic (2018/19) and during the pandemic (2021). Socio-demographic data, physical activity practice (International Physical Activity Questionnaire - IPAQ) and cognitive performance (Mini-Mental State Examination - MMSE) were evaluated. Data were analyzed using McNemar, chi-square, t-test and Wilcoxon test for paired samples. **Results:** Regarding the practice of physical activities, 28% of the sample became inactive during the period evaluated, and 12% became active, with a significant difference. There was no difference between participants who became active, became inactive, remained active and remained inactive with regard to sociodemographic characteristics, indicating that the groups are similar. Cognitive performance significantly worsened when comparing the two assessments. When analyzing the groups separately, it was found that the group that became inactive was the only one that had a significantly worse cognitive performance, in the comparison before and during the pandemic. **Conclusion:** The reduction in the practice of physical activity due to the pandemic in middle-aged and older adults negatively influenced cognitive performance. Individuals who stop practicing physical activities should be the main target for tracking and cognitive monitoring, especially in pandemic periods.

Keywords: Cognition, COVID-19, Exercise, Aged, Middle Aged

RESUMO

Objetivo: Analisar a influência da prática de atividade física no desempenho cognitivo de adultos de meia-idade e pessoas idosas antes e durante a pandemia. **Métodos:** Estudo longitudinal e quantitativo, realizado com 200 indivíduos com 45 anos ou mais de idade cadastrados em Unidades de Saúde da Família de Três Lagoas/MS. A coleta aconteceu em dois momentos, antes da pandemia (2018/19) e durante a pandemia (2021). Foram avaliados dados sociodemográficos, a prática de atividade física (Questionário Internacional de Atividade Física - IPAQ) e o desempenho cognitivo (Mini-Exame do Estado Mental – MEEM). Os dados foram analisados pelos testes de McNemar, qui-quadrado, teste T e teste de Wilcoxon para amostras pareadas. **Resultados**: Com relação à prática de atividades físicas, 28% da amostra se tornou inativa no período avaliado, e 12% se tornou ativa, com diferença significativa. Não houve diferença entre os participantes que se tornaram ativos, se tornaram inativos, se mantiveram ativos e se mantiveram inativos com relação às características sociodemográficas, indicando que os grupos são semelhantes. O desempenho cognitivo piorou significativamente na comparação entre as duas avaliações. Ao analisar os grupos separadamente, verificou-se que o grupo que se tornou inativo foi o único que teve um desempenho cognitivo significativamente pior, na comparação antes e durante a pandemia. **Conclusão:** a redução da prática de atividade física decorrente da pandemia em adultos de meia-idade e pessoas idosas influenciou negativamente no desempenho cognitivo. Os indivíduos que deixam de praticar atividades físicas devem ser o principal alvo de rastreamento e monitoramento cognitivo, especialmente em períodos pandêmicos.

Palavras-chaves: Cognição, COVID-19, Exercício físico, Idoso, Pessoa de Meia-Idade

[1]Universidade Federal de Mato Grosso do Sul – UFMS

Corresponding Author
Marcelo Kwiatkoski
E-mail: marcelo.kwiatkoski@ufms.br

Conflict of Interests
Nothing to declare

Submitted: July 31, 2023
Accepted: May 22, 2024

How to cite
Kwiatkoski M, Kajiyama MT, Martins TCR, Luchesi BM. Influence of physical activity on the cognitive performance of middle-aged ans older adults: a longitudinal study carried out before and during the pandemic. Acta Fisiatr. 2024;31(2):87-93.

DOI: 10.11606/issn.23170190.v31i2a214487

ISSN 2317-0190 | Copyright © 2024 | Acta Fisiátrica
Instituto de Medicina Física e Reabilitação – HCFMUSP

INTRODUCTION

Population aging is a process that is taking place all over the world. Data shows that, in 1950, 4.9% of the world's population consisted of older adults, rising to 11.9% in 2015 and estimated to reach 34.1% in 2060.[1] In Brazil, the estimated percentage of older people in the population was 13.4% in 2018 and could reach 32.2% in 2060.[1]

In addition to the demographic transition, Brazil has also been undergoing a process of epidemiological transition, characterized especially by an increase in the prevalence of chronic non-communicable diseases (NCDs), which can anticipate the process of functional decline, resulting in frailty and increasing the risk of hospitalization and mortality.[2] Primary Health Care (PHC) is the priority setting for the assessment of NCDs, where the user's first contact with the health service takes place and longitudinal, coordinated, comprehensive, resolute and person-centered care is offered, especially through health promotion and disease prevention actions.[3]

There is no chronological age that marks the onset of diseases and functional declines, nor is there an exact correlation between age and an individual's health. However, in the aging process, some clinical psychiatric and neurological conditions stand out, such as cognitive impairment, which has a negative impact on the individual's daily life, interfering with his/her functional ability, performance of daily activities and interpersonal relationships, in addition to having a significant impact on public health spending.[4]

Cognitive impairment is characterized as a clinical condition that negatively affects health and can be related to cases of mild cognitive impairment or various types of dementia.[5] In Brazil, unlike developed countries which have a decreasing prevalence of cognitive impairment in older people, there was a significant increase in this rate between 2000 and 2015.[6] In some cases, cognitive impairment can lead to serious consequences, such as functional disability, as well as reduced performance of daily activities and social relationships.[7] Individuals with some degree of cognitive decline have higher rates of hospital admissions, which are accompanied by a greater risk of becoming victims of delirium, dehydration and falls, which in turn can predispose to functional decline, leading to frailty.[8] In addition, cognitive impairment can be associated with depression in older individuals, entailing a greater variety of physical and emotional problems, which negatively affect the quality of life of those involved.[9]

The practice of physical exercise has shown promise, resulting in an improvement in some symptoms in individuals with severe cognitive impairment, and is one of the most effective alternatives for treating these symptoms.[10-12] In addition, it helps to reduce the vulnerability of individuals to adverse outcomes during the aging process, and is responsible for preventing the occurrence of chronic diseases, such as hypertension, diabetes and dyslipidemia, as well as acting as an adjunct in their treatment.[13] Strength exercises can prevent the loss of muscle mass, reducing sarcopenia, frailty and the occurrence of falls and hospitalizations.[14,15] The combination of aerobic exercise and resistance training reduces the symptoms of severe cognitive impairment in older people,[16] whereas sedentary older people have more symptoms associated with cognitive impairment.[17]

In its guideline about physical activity and sedentary behavior, the World Health Organization (WHO) recommends that adults and older adults should engage in at least 150-300 minutes of moderate-intensity physical activity, or at least 75-150 minutes of vigorous-intensity activity, or even a combination of moderate and vigorous activity throughout the week to obtain the benefits related to health and disease prevention.[18] Physical inactivity is characterized when the individual fails to meet the minimum recommendations for physical activity, whereas sedentary behavior is defined by the time spent sitting or lying down, when there is a low expenditure of energy while awake.[18]

In December 2019, China (Wuhan) experienced an epidemic of the new coronavirus, which quickly spread around the world, becoming a global pandemic. COVID-19 is a potentially fatal viral infection, particularly in older individuals, who have a high mortality rate, five times higher than the global average for those over 80.[19]

For this reason, social distancing measures were recommended to contain the rapid spread of the virus and align medical care capacity with the number of cases.[20] These measures have impacted various aspects of people's lives as they have imposed sudden and radical changes on daily life. Among the unintended consequences of confinement and social isolation, are physical inactivity and sedentary behavior, which become even more serious in individuals undergoing the aging process, such as middle-aged and older people, predisposing them to frailty, chronic diseases and conditions related to socioemotional aspects, such as mild and severe cognitive impairment, depression, anxiety, among others.[21,22]

Given the negative impact that cognitive impairment can have on the quality of life of middle-aged and older people, and that physical inactivity can be an aggravating factor in this context; there is a lack of data in the current literature correlating physical activity and cognitive performance during the pandemic in middle-aged and older adults.

OBJECTIVE

To analyze the influence of physical activity on the cognitive performance of middle-aged and older adults before and during the COVID-19 pandemic.

METHOD

The study was carried out using the database of the research group called of Universidade Federal de Mato Grosso do Sul – UFMS.

This is a longitudinal and quantitative study, with a monitoring assessment after two years, carried out in the Primary Health Care Units (PHCUs) in the municipality of Três Lagoas, MS, Brazil. According to the 2010 census, the city had 101,791 inhabitants, 16.1% of whom were aged 45-59, and 9.9% were older adults (≥60 years). In 2018, the city had nine PHCUs.

The population-comprised individuals aged 45 or over, registered at nine PHCUs in the municipality of Três Lagoas, MS, Brazil. The inclusion criteria were: being aged 45 or over, being registered at the municipality is PHCU, being able to answer the interview questions (assessed by the interviewer's perception). Individuals who were bedridden or wheelchair users were excluded.

Participants were randomly selected based on a list of all individuals over the age of 45 provided by the health teams. The baseline assessment took place between November 2018 and June 2019. The sample size was calculated using the formula for estimating proportions in a finite population, with a significance level

of 5% (alpha= 0.05), a sampling error of 6% (e= 0.06) and a conservative estimate of 50% (p= 0.50). Considering a finite population of N= 26,331 (total number of individuals over the age of 45 in the municipality), the minimum sample was 265 individuals, to which 10% was added to mitigate possible losses, resulting in 292 participants. During the collection, 300 individuals were interviewed (resulting in a final sample error of 5.6%).

The follow-up assessment was carried out between February and December 2021. All the participants from the baseline assessment were approached to take part in the follow-up assessment, but 14 had died, 20 refused to participate, 24 could not be found at home after three attempts at alternate times, 19 addresses could not be found due to outdated records and 23 had changed address, resulting in the reassessment of 200 participants (66.7% of the total baseline assessment sample) (Figure 1).

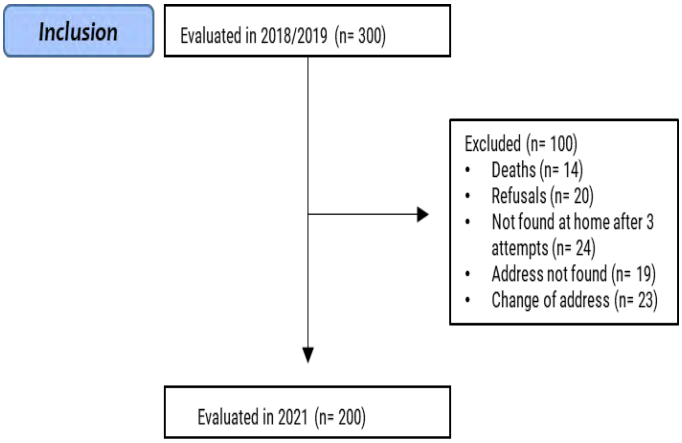

Figure 1. Sample losses flowchart

No significant differences were identified with regard to gender, age group, marital status and schooling between the participants who were lost during the follow-up assessment and those who were reassessed, indicating a non-differential loss.

The interviews were conducted by trained interviewers in the participants' own homes or within the premises of the PFCUs and lasted around 40 minutes each. Follow-up assessments took place, on average, 2.4 years after the baseline assessment.

The data collected at the baseline and follow-up assessments were as follows:

– Sociodemographic data: gender, age, marital status and schooling.

– Physical activity: it was assessed using the International Physical Activity Questionnaire (IPAQ) short version, which takes into account walking activities, moderate- and vigorous-intensity physical activities performed for at least 10 minutes, and sitting time. It has been validated in Brazil for use with adult[23] and older people.[24] The participants were classified as: physically active (at least 150 minutes of moderate activity per week and or 75 minutes of vigorous activity) and inactive (when they did not achieve the aforementioned time, encompassing the groups that fall into physical inactivity and sedentary behavior).

– Cognitive performance: assessed by the Mini-Mental State Examination (MMSE), which is a screening tool for cognitive status and covers the domains of temporal orientation, spatial orientation, immediate memory, attention and calculation, recall memory and language. The instrument has a maximum score of 30 points, where the higher the score, the better the cognitive performance. The instrument has been validated for use in the Brazilian population.[25]

The data were double-entered into Microsoft Office Excel™ for validation and checking. Subsequently, they were exported to SPSS version 25.0 for analysis. Physical activity in 2021 (follow-up assessment) was analyzed in comparison with the assessment carried out in 2018/19 (baseline assessment), using the McNemar test. The normality of the data was tested using the Shapiro-Wilk test. The participants were then divided into: remained inactive, became inactive, became active and remained active. The groups were compared in terms of gender, age and schooling using the Chi-square test for categorical variables (gender and schooling) and the Kruskall-Wallis test for continuous variables (age – non-parametric distribution). After that, the participants' MMSE scores were compared according to the groups of physical activity. The groups whose data showed a normal distribution (became active and remained active) were compared using the Paired sample t-test, whereas those that did not unveil a normal distribution (remained inactive and became inactive) were compared using the Wilcoxon test for paired samples. The significance level adopted was 5%.

The study was approved by the human research ethics committee of Universidade Federal de Mato Grosso do Sul – UFMS. All participants read and signed the Free and Informed Consent Form before the two interviews.

RESULTS

With regard to the practice of physical activity, there was a significant change when comparing the follow-up assessment (2021) with the baseline assessment (2018/2019) (p=0.0003), with 28.0% of the individuals who practiced physical activity becoming inactive and 12.0% of those who did not practice physical activity becoming active (Table 1).

Table 1. Analysis of physical activity from 2018/2019 to 2021 (n= 200)

2018/2019 assessment	2021 assessment	
	Inactive	Physically active
	Frequency (¹%)	
Inactive	93 (46.5%)	24 (12.0%)
Physically active	56 (28.0%)	27 (13.5%)

¹Percentages in relation to the total sample; p= 0.0003

Table 2 shows the analysis of changes in physical activity according to sociodemographic variables. The majority of the sample consisted of females (66.5%), with more than 4 years of schooling (52.5%) and a median age of 60 years. There was no relationship between sociodemographic variables and physical activity, thus indicating that the four groups were similar in terms of sociodemographic variables. The results of the Mini Mental State Examination (MMSE) are displayed in Table 3. There was a significant reduction in the instrument's score, when compared the baseline assessment, in which the average was 22.98 points, to the follow-up assessment, with an average of 22.54 points (p= 0.040). In addition, individuals who became inactive during the assessment period showed a significant reduction in their MMSE score (p= 0.028) (Table 3).

Table 2. Sociodemographic variables (2018/2019) and changes in physical activity (n= 200)

Variable n (%) or Md (min-max)	Total (n= 200)	Physical activity				p-value
		Remained inactive (n= 93)	Became inactive (n= 56)	Became active (n= 24)	Remained active (n= 27)	
Sex						
Male	67 (33.5)	29 (43.3)	19 (28.4)	8 (11.9)	11 (16.4)	0.834♦
Female	133 (66.5)	64 (48.1)	37 (27.8)	16 (12.0)	16 (12.0)	
Age (years)	60 (45-95)	62 (45-95)	60.5 (45-81)	58 (45-90)	58 (45-85)	0.306*
Education						
0-4 years	95 (47.5)	46 (48.4)	26 (27.4)	10 (10.5)	13 (13.7)	0.919♦
> 4 years	105 (52.5)	47 (44.8)	30 (28.6)	14 (13.3)	14 (13.3)	

*Md: Median; ♦ Chi-square; * Kruskall-Wallis test*

Table 3. Average MMSE scores and changes in physical activity from 2018/2019 to 2021 (n= 200)

	MMSE baseline assessment (2018/2019)		MMSE follow-up assessment (2021)		p-value
	M_e (sd)	Md (min-max)	M_e (sd)	Md (min-max)	
Remained inactive	22.34 (3.97)	23 (8-29)	21.87 (4.88)	22 (7-30)	0.266†
Became inactive	23.61 (4.43)	25 (14-30)	22.88 (5.04)	24 (10-30)	0.028†
Became active	23.67 (4.33)	23.5 (11-29)	23.75 (3.26)	24.5 (16-29)	0.891□
Remained active	23.22 (3.54)	23 (14-29)	23.04 (4.33)	24 (13-28)	0.690□
Total	**22.98 (4.11)**	**23 (8-30)**	**22.54 (4.71)**	**23 (7-30)**	**0.040†**

MEEM: Mini Mental State Examination; M_e: Mean; Sd: standard deviation; Md: Median; † Wilcoxon test; □ Paired t-test

DISCUSSION

The social distancing recommended by the authorities due to the COVID-19 pandemic can result in negative consequences for health, especially for the group of middle-aged and older adults, predisposing them to frailty, chronic diseases and socioemotional impacts.[22] This can be due to a decrease in physical activity and even less participation in social, community and family activities.[26]

In the current study, a decrease in physical activity (28% of the sample) was found when comparing before and during the pandemic. Similar results were identified in a study conducted with adults (aged ≥18 years) that investigated the impact of social isolation on physical activity during the COVID-19 pandemic in Brazil and its macro-regions, which identified a decrease in the frequency and duration of physical activity in the Brazilian population and also in the main macro-regions.[27]

Another investigation that identified the impact of social isolation on the practice of physical activity and the sedentary behavior of Spanish university students during the COVID-19 pandemic found a decrease in the practice of moderate and vigorous physical activity, as well as an increase in sedentary behavior. Nonetheless, there was an increase in the practice of physical activity with intervals (High-Intensity Interval Training, HIIT), showing a possible strategy for reducing sedentary behavior.

Changes in lifestyle, such as increased sitting time, reduced energy expenditure for performing tasks and a decrease in the number of steps and walking distance, due to social isolation during the COVID-19 pandemic, have negatively affected the practice of physical activity in older people, leading to a decrease in physical fitness and an increase in sedentary lifestyles in several countries.[29-33] An observational study carried out before and during the pandemic with hypertensive older people showed a significant increase in sedentary behavior, a decrease in the number of steps per day, moderate-vigorous physical activity and a tendency towards a decrease in light physical activity. In addition, the pattern of sedentary behavior was changed, with a reduction in interruptions of this behavior and an increase in prolonged and uninterrupted sedentary time.[34]

Various aspects of life, such as physical health, life satisfaction, functional status and the perception of aging healthily, are positively affected by the practice of physical activity.[35] Physically active individuals have a lower risk of suffering from cardiovascular and respiratory diseases, cancer and diabetes, as well as socioemotional diseases like depression.[36-37] In addition, older individuals benefit from less frailty and sarcopenia.[38]

In the current study, although a decrease in physical activity was found before and during the COVID-19 pandemic, it was also found that 12% of the participants who were physically inactive became active. A previous study found similar discoveries in which individuals classified as "sedentary" and "somewhat active" increased their physical activity.[27] It is worth underlining that the monitoring assessment in this study was carried out during a period when social isolation measures were beginning to loosen, which may have contributed to the result.

In addition to the results found on the practice of physical activity in our findings, we observed a in the MMSE score between the analyzed periods, especially in individuals who practiced physical activity in the baseline assessment and became inactive in the follow-up assessment.

Studies have shown the impact of reduced social interaction on the mental health of older individuals, caused by isolation during the pandemic.[39-41] Increases in psychological stress leading to clinical pictures of anxiety and depression, as well as levels of loneliness, were found during the period of social isolation.[41] Anxiety disorders were also found in a study carried out with the Chinese population, especially in individuals under the age of 35 who spent most of their time focused on the COVID-19 pandemic, which could be a potential factor in terms of psychological problems.[42]

The impact of social isolation on cognitive function and neuropsychiatric symptoms was investigated in older individuals with mild cognitive impairment, Alzheimer's disease and dementia with Lewy bodies. They found an accelerated decline in

cognitive function, assessed by the MMSE, and the main factors were social isolation and physical inactivity.[43] In another study with an older population (average age 80.69 years), decreased cognitive performance and lower quality of life were reported, as well as greater dependence on telephone use and medication management, when comparing the periods before and during the COVID-19 pandemic.[44]

In a longitudinal study investigating cognitive decline in older people before and after the beginning of the COVID-19 pandemic, a more accelerated cognitive decline was found after the beginning of the pandemic when compared to the slow and non-significant decline observed over almost 15 years before the pandemic.[45] The COVID-19 pandemic and social isolation measures have had a significant impact on the lifestyles of middle-aged and older adults, thus reducing physical activity and cognitive functioning in this group, which is especially important for those already affected by chronic diseases and those related to socio-emotional aspects. Maintaining an active lifestyle, even in the home environment, and daily contact with family members, should be encouraged for the aging population, with a view to reducing the negative effects of isolation.

There are limitations that must be considered. The first is the sample loss between the two data collections, which had an impact on the size of the follow-up sample. The fact that the second collection was carried out during a period when isolation measures were more flexible may have influenced our results. Our study was carried out with a small sample and in a municipality located in Brazil, which is why the data cannot be generalized.

The medical diagnosis of cognitive decline may be important for future studies, despite the fact that we used an instrument validated for Brazilian culture and used worldwide for this assessment. On the other hand, the strengths of our study are related to its originality, the fact that the sample consisted of individuals aged 45 or over, assessing them in the aging process and in old age, with a view to favoring early interventions; and the longitudinal design, which made it possible to identify temporal relationships between the variables.

CONCLUSION

The practice of physical activity in the assessed period (before and during the pandemic) influenced cognitive performance, especially in middle-aged and older adults who became inactive. This is the group that requires the most attention to assess and monitor cognition. It is recommended that future research assess physical activity and cognitive performance in the post-pandemic period, in order to monitor the situation.

ACKNOWLEDGEMENTS

We thank the members of the research group of Universidade Federal de Mato Grosso do Sul – UFMS who collaborated with data collection.

REFERENCES

1. Costanzi RN, Fernandes AZ, Santos CF, Sidone OJG. Breve análise da nova projeção da população do IBGE e seus impactos previdenciários [texto na Internet]. Brasília: IPEA [citado 2023 junho 29]. Disponível em: https://repositorio.ipea.gov.br/bitstream/11058/8792/1/NT_51_Disoc_Breve_an%C3%A1lise.pdf
2. Dixe MDA, Braúna M, Camacho T, Couto F, Apóstolo J. Mild cognitive impairment in older adults: analysis of some factors. Dement Neuropsychol. 2020;14(1):28-34. Doi: 10.1590/1980-57642020dn14-010005
3. Brasil. Ministério da Saúde. Portaria nº 2.436, de 21 de setembro de 2017. Aprova a Política Nacional de Atenção Básica, estabelecendo a revisão de diretrizes para a organização da Atenção Básica, no âmbito do Sistema Único de Saúde (SUS). Diário Oficial da Republica Federativa do Brasil, Brasília (DF); 2017 Set 22; Seção 1:68.
4. Lentsck MH, Pilger C, Schoereder EP, Prezotto KH, Mathias TAF. Prevalência de sintomas depressivos e sinais de demência em idosos na comunidade. Rev Eletronica Enferm. 2015;17(3):34261. Doi: 10.5216/ree.v17i3.34261
5. Ren L, Zheng Y, Wu L, Gu Y, He Y, Jiang B, et al. Investigation of the prevalence of Cognitive Impairment and its risk factors within the elderly population in Shanghai, China. Sci Rep. 2018;8(1):3575. Doi: 10.1038/s41598-018-21983-w
6. Ribeiro FS, Oliveira Duarte YA, Santos JLF, Leist AK. Changes in prevalence of cognitive impairment and associated risk factors 2000-2015 in São Paulo, Brazil. BMC Geriatr. 2021;21(1):609. Doi: 10.1186/s12877-021-02542-x
7. Kim BJ, Liu L, Cheung C, Ahn J. Effects of cognitive impairment and functional limitation on depressive symptoms among community-dwelling older Korean immigrants in the U.S. PLoS One. 2018;13(3):e0193092. Doi: 10.1371/journal.pone.0193092
8. Fogg C, Griffiths P, Meredith P, Bridges J. Hospital outcomes of older people with cognitive impairment: An integrative review. Int J Geriatr Psychiatry. 2018;33(9):1177–97. Doi: 10.1002/gps.4919
9. Han FF, Wang HX, Wu JJ, Yao W, Hao CF, Pei JJ. Depressive symptoms and cognitive impairment: A 10-year follow-up study from the Survey of Health, Ageing and Retirement in Europe. Eur Psychiatry. 2021;64(1):e55. Doi: 10.1192/j.eurpsy.2021.2230
10. Thuné-Boyle IC, Iliffe S, Cerga-Pashoja A, Lowery D, Warner J. The effect of exercise on behavioral and psychological symptoms of dementia: towards a research agenda. Int Psychogeriatr. 2012;24(7):1046-57. Doi: 10.1017/s1041610211002365
11. Kales HC, Gitlin LN, Lyketsos CG; Detroit Expert Panel on Assessment and Management of Neuropsychiatric Symptoms of Dementia. Management of neuropsychiatric symptoms of dementia in clinical settings: recommendations from a multidisciplinary expert panel. J Am Geriatr Soc. 2014;62(4):762-9. Doi: 10.1111/jgs.12730
12. Rodrigues SLDS, Silva JMD, Oliveira MCC, Santana CMF, Carvalho KM, Barbosa BJAP. Physical exercise as a non-pharmacological strategy for reducing behavioral and psychological symptoms in elderly with mild cognitive impairment and dementia: a systematic review of randomized clinical trials. Arq Neuropsiquiatr. 2021;79(12):1129-1137. Doi: 10.1590/0004-282x-anp-2020-0539

13. Guthold R, Stevens GA, Riley LM, Bull FC. Worldwide trends in insufficient physical activity from 2001 to 2016: a pooled analysis of 358 population-based surveys with 1·9 million participants. Lancet Glob Health. 2018;6(10):e1077-e1086. Doi: 10.1016/s2214-109x(18)30357-7

14. Liberman K, Forti LN, Beyer I, Bautmans I. The effects of exercise on muscle strength, body composition, physical functioning and the inflammatory profile of older adults: a systematic review. Curr Opin Clin Nutr Metab Care. 2017;20(1):30-53. Doi: 10.1097/MCO.0000000000000335

15. Racey M, Markle-Reid M, Fitzpatrick-Lewis D, Ali MU, Gagne H, Hunter S, et al. Fall prevention in community-dwelling adults with mild to moderate cognitive impairment: a systematic review and meta-analysis. BMC Geriatr. 2021;21(1):689. Doi: 10.1186/s12877-021-02641-9

16. Aman E, Thomas DR. Supervised exercise to reduce agitation in severely cognitively impaired persons. J Am Med Dir Assoc. 2009;10(4):271-6 Doi: 10.1016/j.jamda.2008.12.053

17. Christofoletti G, Oliani MM, Bucken-Gobbi LT, Gobbi S, Beinotti F, Stella F. Physical activity attenuates neuropsychiatric disturbances and caregiver burden in patients with dementia. Clinics (Sao Paulo). 2011;66(4):613-8. Doi: 10.1590/s1807-59322011000400015

18. World Health Organization. WHO guidelines on physical activity and sedentary behavior. Geneva: World Health Organization; 2020 [cited 2023 Jun 29]. Available from: https://www.who.int/publications/i/item/9789240015128

19. Sepúlveda-Loyola W, Rodríguez-Sánchez I, Pérez-Rodríguez P, Ganz F, Torralba R, Oliveira DV, et al. Impact of Social Isolation Due to COVID-19 on Health in Older People: Mental and Physical Effects and Recommendations. J Nutr Health Aging. 2020;24(9):938-47. Doi: 10.1007/s12603-020-1469-2

20. World Health Organization. Overview of public health and social measures in the context of COVID-19 [text on the Internet]. Geneva: WHO; 2020 [cited 2023 Jun 20]. Available from: https://www.who.int/publications-detail-redirect/overview-of-public-health-and-social-measures-in-the-context-of-covid-19

21. American College of Sports Medicine; Chodzko-Zajko WJ, Proctor DN, Fiatarone Singh MA, Minson CT, Nigg CR, et al. American College of Sports Medicine position stand. Exercise and physical activity for older adults. Med Sci Sports Exerc. 2009;41(7):1510-30. Doi: 10.1249/mss.0b013e3181a0c95c

22. Machado CLF, Pinto RS, Brusco CM, Cadore EL, Radaelli R. COVID-19 pandemic is an urgent time for older people to practice resistance exercise at home. Exp Gerontol. 2020;141:111101. Doi: 10.1016/j.exger.2020.111101

23. Matsudo SM, Matsudo VKR, Barros Neto TL. Atividade física e envelhecimento: aspectos epidemiológicos. Rev Bras Med Esporte. 2001;7(1):2–13.Doi: 10.1590/s1517-86922001000100002

24. Benedetti TRB, Antunes PC, Rodriguez-Añez CR, Mazo GZ, Petroski ÉL. Reprodutibilidade e validade do Questionário Internacional de Atividade Física (IPAQ) em homens idosos. Rev Bras Med Esporte. 2007;13(1):11–6. Doi: 10.1590/s1517-86922007000100004

25. Bertolucci PHF, Brucki SMD, Campacci SR, Juliano Y. O Mini-Exame do Estado Mental em uma população geral: impacto da escolaridade. Arq Neuro-Psiquiatr. 1994;52(1):01–7. Doi: 10.1590/s0004-282x1994000100001

26. Goethals L, Barth N, Guyot J, Hupin D, Celarier T, Bongue B. Impact of Home Quarantine on Physical Activity Among Older Adults Living at Home During the COVID-19 Pandemic: Qualitative Interview Study. JMIR Aging. 2020;3(1):e19007. Doi: 10.2196/19007

27. Sonza A, Sá-Caputo DC, Bachur JA, Araújo MGR, Trippo KV, Gama DRN, et al. Brazil before and during COVID-19 pandemic: Impact on the practice and habits of physical exercise. Acta Biomed. 2020;92(1):e2021027. Doi: 10.23750/abm.v92i1.10803

28. Rodríguez-Larrad A, Mañas A, Labayen I, González-Gross M, Espin A, Aznar S et al. Impact of COVID-19 Confinement on Physical Activity and Sedentary Behaviour in Spanish University Students: Role of Gender. Int J Environ Res Public Health. 2021;18(2):369. Doi: 10.3390/ijerph18020369

29. Maugeri G, Castrogiovanni P, Battaglia G, Pippi R, D'Agata V, Palma A, et al. The impact of physical activity on psychological health during Covid-19 pandemic in Italy. Heliyon. 2020;6(6):e04315. Doi: 10.1016/j.heliyon.2020.e04315

30. Meyer J, Herring M, McDowell C, Lansing J, Brower C, Schuch F, et al. Joint prevalence of physical activity and sitting time during COVID-19 among US adults in April 2020. Prev Med Rep. 2020;20:101256. Doi: 10.1016/j.pmedr.2020.101256

31. Qin F, Song Y, Nassis GP, Zhao L, Dong Y, Zhao C et al. Physical Activity, Screen Time, and Emotional Well-Being during the 2019 Novel Coronavirus Outbreak in China. Int J Environ Res Public Health. 2020;17(14):5170. Doi: 10.3390/ijerph17145170

32. Yamada M, Kimura Y, Ishiyama D, Otobe Y, Suzuki M, Koyama S et al. The Influence of the COVID-19 Pandemic on Physical Activity and New Incidence of Frailty among Initially Non-Frail Older Adults in Japan: A Follow-Up Online Survey. J Nutr Health Amp Aging. 2021;25(6):751-6. Doi: 10.1007/s12603-021-1634-2

33. Pérez LM, Castellano-Tejedor C, Cesari M, Soto-Bagaria L, Ars J, Zambom-Ferraresi F, et al. Depressive Symptoms, Fatigue and Social Relationships Influenced Physical Activity in Frail Older Community-Dwellers during the Spanish Lockdown due to the COVID-19 Pandemic. Int J Environ Res Public Health. 2021;18(2):808. Doi: 10.3390/ijerph18020808

34. Browne RA, Macêdo GA, Cabral LL, Oliveira GT, Vivas A, Fontes EB et al. Initial impact of the COVID-19 pandemic on physical activity and sedentary behavior in hypertensive older adults: An accelerometer-based analysis. Exp Gerontol. 2020;142:111121. Doi: https://doi.org/10.1016/j.exger.2020.111121

35. Garatachea N, Molinero O, Martínez-García R, Jiménez-Jiménez R, González-Gallego J, Márquez S. Feelings of well being in elderly people: Relationship to physical activity and physical function. Arch Gerontol Geriatr. 2009;48(3):306-12. Doi: 10.1016/j.archger.2008.02.010

36. Schwendinger F, Pocecco E. Counteracting Physical Inactivity during the COVID-19 Pandemic: Evidence-Based Recommendations for Home-Based Exercise. Int J Environ Res Public Health. 2020;17(11):3909. Doi: 10.3390/ijerph17113909

37. Lippi G, Henry BM, Sanchis-Gomar F. Physical inactivity and cardiovascular disease at the time of coronavirus disease 2019 (COVID-19). Eur J Prev Cardiol. 2020;27(9):906-908. Doi: 10.1177/2047487320916823

38. McPhee JS, French DP, Jackson D, Nazroo J, Pendleton N, Degens H. Physical activity in older age: perspectives for healthy ageing and frailty. Biogerontology. 2016;17(3):567-80. Doi: 10.1007/s10522-016-9641-0

39. Zhang Y, Ma ZF. Impact of the COVID-19 Pandemic on Mental Health and Quality of Life among Local Residents in Liaoning Province, China: A Cross-Sectional Study. Int J Environ Res Public Health. 2020;17(7):2381. Doi: 10.3390/ijerph17072381

40. Lei L, Huang X, Zhang S, Yang J, Yang L, Xu M. Comparison of Prevalence and Associated Factors of Anxiety and Depression Among People Affected by versus People Unaffected by Quarantine During the COVID-19 Epidemic in Southwestern China. Med Sci Monit. 2020;26:e924609. Doi: 10.12659/msm.924609

41. Losada-Baltar A, Jiménez-Gonzalo L, Gallego-Alberto L, Pedroso-Chaparro MDS, Fernandes-Pires J, Márquez-González M. "We Are Staying at Home." Association of Self-perceptions of Aging, Personal and Family Resources, and Loneliness With Psychological Distress During the Lock-Down Period of COVID-19. J Gerontol B Psychol Sci Soc Sci. 2021;76(2):e10-e16. Doi: 10.1093/geronb/gbaa048

42. Huang Y, Zhao N. Generalized anxiety disorder, depressive symptoms and sleep quality during COVID-19 outbreak in China: a web-based cross-sectional survey. Psychiatry Res. 2020;288:112954. Doi: 10.1016/j.psychres.2020.112954

43. Chen ZC, Liu S, Gan J, Ma L, Du X, Zhu H et al. The Impact of the COVID-19 Pandemic and Lockdown on Mild Cognitive Impairment, Alzheimer's Disease and Dementia With Lewy Bodies in China: A 1-Year Follow-Up Study. Front Psychiatry. 2021;12. Doi: 10.3389/fpsyt.2021.711658

44. Sardella A, Chiara E, Alibrandi A, Bellone F, Catalano A, Lenzo V et al. Changes in Cognitive and Functional Status and in Quality of Life of Older Outpatients during the COVID-19 Pandemic. Gerontology. 2022:68(11):1285-1290. Doi: 10.1159/000525041

45. Amieva H, Retuerto N, Hernandez-Ruiz V, Meillon C, Dartigues JF, Pérès K. Longitudinal Study of Cognitive Decline before and after the COVID-19 Pandemic: Evidence from the PA-COVID Survey. Dement Geriatr Cogn Disord. 2022;51(1):56-62. Doi: 10.1159/000521999