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Original Research

Association between specific types of physical activity during the COVID-19 pandemic and the risk of subjective memory decline: findings from the PAMPA Cohort



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ABSTRACT

Objectives: This study aimed to identify the effects of different physical activities practised during the time period when COVID-19 social distancing measures were in place on the risk of subjective memory decline in adults.

Study design: Retrospective cohort study.

Methods: Data from the Prospective Study about Mental and Physical Health (PAMPA), a state-level (Rio Grande do Sul, Brazil), online-based cohort study, were analysed. Respondents were asked to rate their memory before COVID-19 social distancing measures were implemented (retrospectively) and on the day that the survey was completed. Subjective memory decline was defined as a perceived worsening of memory function during COVID-19 social distancing compared with the pre-pandemic period. The types of physical activity practised before and during COVID-19 social distancing measures were assessed.

Results: Data from 2319 adults were included. Out-of-home endurance, muscle strengthening, combined endurance and muscle strengthening, and stretching activities reduced the risk of subjective memory decline during the pandemic. In terms of physical activities practised at home, only muscle strengthening did not protect against subjective memory decline. Participants who sustained any type of physical activity at home during the COVID-19 pandemic showed a reduced risk for subjective memory decline.

Conclusions: Physical activity, regardless of the type of activity and location performed, during the time period when COVID-19 social distancing measures were in place can mitigate the effects of the pandemic on subjective memory decline.

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Introduction

In mid-2021, one in three daily deaths due to COVID-19 in the world occurred in Brazil.¹ The exponential increase in the number of cases and deaths resulted in disruption to the health care system.^{2,3} Strategies to reduce virus transmission, including

mask use and social distancing (e.g. stay-at-home guidance, prohibition of gatherings) were essential for preserving both lives and the integrity of the health care system.^{4–6} However, such strategies, although efficient, have indirect effects, such as the increased prevalence of depression, anxiety⁷ and physical inactivity.⁸

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Previous studies have shown that chronic exposure to traumatic events, such as the COVID-19 pandemic, might result in long-term consequences in cognitive function.^{9,10} We have shown that one-third of adults in southern Brazil reported subjective memory decline during the first few months of COVID-19 social distancing compared with the pre-pandemic period.¹¹ Subjective memory decline is defined as perceived worsening of memory function. This type of cognitive impairment might be used as an early indicator of objectively measured memory impairment^{12–14} and is associated with structural and functional changes in important brain regions, such as the entorhinal cortex,¹⁵ hippocampus^{13,16} and amygdala.¹⁷ Consequently, subjective memory decline is linked to the onset of pre-clinical stages of mild cognitive impairment and Alzheimer's disease, supporting the assessment of this condition in large epidemiological studies.¹⁸ Previous studies have reported that people with subjective memory decline have a higher concentration of Alzheimer's disease biomarkers, including amyloid- β ,¹⁹ and disrupted brain connectivity.²⁰

Physical activity has been proposed as a non-pharmacological antidote to the indirect effects of social distancing on depressive and anxiety symptoms^{21,22} and memory impairment.¹¹ Some of the mechanisms associated with this protective role include, but are not limited to, increased concentration of neurogenic factors (e.g. brain-derived neurotrophic factor [BDNF])²³ and reduction in oxidative stress^{24,25} and inflammation.²⁶ However, decreased levels of physical activity has been documented in several settings since the beginning of the COVID-19 pandemic.⁸

In light of this evidence, home-based physical activities have emerged as an alternative to preserve both mental and physical health and counterattack the increased time spent in sedentary activities during times when COVID-19 social distancing measures are in place.²⁷ Also, online home-based exercise classes have been available from exercise professionals (e.g. personal trainers) on social media platforms to help and encourage people to exercise safely. These activities include endurance and strength activities and stretch-related exercises, all of which can be performed at home using bodyweight only and household items, such as chairs and food packages. In addition, stretching and mind-body activities have been encouraged given their benefits on stress management^{28,29} and because no large spaces are required for practice. However, whether the benefits of different types of home-based physical activities have a similar impact on subjective memory decline in adults during times of social distancing remains to be investigated. Therefore, this study aimed to identify the effects of different physical activities practised during the time period when COVID-19 social distancing measures were in place on the risk of subjective memory decline in adults from southern Brazil. We further investigated whether participants who changed from out-of-home to home-based physical activity during COVID-19 social distancing had a reduced risk of subjective memory decline compared with individuals who completely suspended physical activities during COVID-19 social distancing. The study hypotheses are as follows: (1) participants who engaged in physical activity during the COVID-19 social distancing had a reduced risk of subjective memory decline, regardless of the type of exercise (e.g. endurance, muscle strengthening, combined, stretching) and location (i.e. out-of-home and at home); and (2) participants who practised physical activities out-of-home before the pandemic and sustained their practice at home when social distancing measures were in place had a reduced risk of subjective memory decline compared with individuals who stopped physical activities during COVID-19 social distancing.

Methods

Study design

We analysed data from the Prospective Study on Mental and Physical Health (PAMPA) cohort, a longitudinal observational study that aims to assess the effects of social distancing on the mental and physical health of adults in southern Brazil.³⁰ The study protocol was approved by the institutional research ethics committee of the Superior School of Physical Education at the Federal University of Pelotas (protocol: 4.093.170). More details about the study design, sampling process and data collection can be found elsewhere.³⁰

Study population

Participants aged ≥ 18 years who were residents in the Rio Grande do Sul state during the recruitment phase were included in this study. All included participants provided informed consent before completing the questionnaires. The sample size was calculated based on the prevalence of the main outcomes of the PAMPA cohort (i.e. depression, anxiety, low back pain and access to health care services) in the Rio Grande do Sul state. The largest required sample size of 1767 participants was achieved based on the prevalence of depression of 13.2% (95% confidence interval [CI] 11.8 to 15.0)³¹ to ensure a 95% CI, a 1.8 margin of error and possible loss-to-follow-up up to 30%. Furthermore, the Rio Grande do Sul state is divided into seven macroregions (in Portuguese: *Metropolitana, Vales, Missioneira, Norte, Sul, Centro-oeste, Serra*). The target sample size was proportionally divided based on the population in each macroregion.

Recruitment of participants

The recruitment phase lasted four weeks (22 June to 23 July 2020) using an online questionnaire. We used an online, four-arm approach to reach the target sample size in all macroregions. First, the study was disseminated by local media, including radio, TV and newspapers. Second, professional and personal contacts were used to spread the web link to the questionnaire in different cities within the state. Third, municipal and state health agencies were contacted and asked to help share the research. Fourth, social media (Facebook® and Instagram®) campaigns were used to spread the web link to the questionnaire.

During the COVID-19 pandemic, the state adopted a controlled social distancing system in which regions within the state were classified with different flag colours. In increasing order of restriction severity, the flag colours were yellow, orange, red and black. Some indicators, including the occupation rate of intensive care unit (ICU) beds and virus spreading velocity, have been used to classify the regions since the beginning of the COVID-19 pandemic.³² Approximately 73.4% of the state's regions were in the second-highest level of social distancing restrictions during the recruitment phase of this study. At this level, social clubs, gyms, theatres, commercial centres and shopping malls were closed or had their capacity reduced by up to 75% to prevent gatherings.

Questionnaire

We developed a self-administered online questionnaire (Google® Form) to assess the impact of social distancing on subjective memory function and physical activity. The questionnaire was divided into two sections. First, we assessed memory and physical

activity before the COVID-19 social distancing measures were in place. Next, questions regarding the current week were asked.

Study outcome: subjective memory decline

Participants were asked to rate their memory using the following two questions, where the only difference between them was the time period (before or during social distancing): 'How do you rate your memory before social distancing/today?'. Each question had five answer options, namely: 'excellent', 'very good', 'regular', 'bad' or 'very bad'. Subjective memory decline was defined as the perceived worsening of memory function during social distancing compared with the pre-pandemic. A similar strategy has been used in previous epidemiological studies.^{33,34}

Study exposure: physical activity

We assessed the frequency and time spent on physical activity before social distancing using the following validated question:³⁵ 'Before social distancing, were you engaged in physical activity regularly?'. If the participant answered 'Yes', the number of days per week and duration in each day in minutes during a typical pre-pandemic week were recorded. In the second section, the time reference was the current week (during social distancing). This question showed acceptable agreement ($\kappa = 0.63$; 95% CI: 0.54 to 0.72) to classify subjects as physically active on the Global Physical Activity Questionnaire (GPAQ).

Participants were also asked to identify the types of physical activity they were performing before and during social distancing and whether these activities were performed at home or out of the home. Home-based (or at-home) physical activity was defined as the physical activity performed within the participant's household. Activities performed in shared gyms inside residential condominiums were not considered to be at-home activities. Out-of-home activities included all physical activities practised external to participants' homes, including shared gyms and running/walking. An initial list of physical activities was provided (running/walking, rope jump, cycling, strength exercises, stretching exercises, stair use). Also, a blank space was offered so participants could report other types of activities practised. The main activities reported were running/walking (47.8%), cycling (19.6%), strength exercises (22.3%), stretching exercises (13.8%) and stair use (8.9%). Running/walking, cycling and stair use were merged as 'endurance' activities. Stretching activities were combined with Yoga and Pilates as 'stretching and mind-body' activities category. All other activities summed up less than 1%, and thus, were not analysed. Participants were further classified into two possible categories: remained or suspended. Participants who practised a specific out-of-home physical activity before social distancing and sustained that specific practice at home during social distancing were classified as 'remained'. When participants did not continue the practice, regardless of the context, they were classified as 'suspended'.

Study covariates

Age, sex, education (the highest educational level achieved), ethnicity (White, Black, Mixed [*pardo*, in Portuguese], Other), conjugal situation (living alone or with someone), change in monthly income (reduced, remained, increased), symptoms of depression and anxiety, physical activity level (≥ 150 min per week was classified as active),³⁶ self-reported body mass index (BMI) and chronic diseases were included as covariates.

Depression and anxiety symptoms were assessed using the Hospital Anxiety and Depression Scale (HADS). In each domain (i.e. anxiety or depression), participants who scored < 7 points were

classified as nonsymptomatic for that domain. Scores between 8 and 10 were considered as mild risk, between 11 and 14 as moderate risk, and between 15 and 21 as a severe risk of depression and/or anxiety.³⁷ To assess the frequency of depressive and anxiety symptoms, we asked participants, retrospectively, to answer all the HADS questions using the week before the survey as the reference period.

Diagnosed chronic diseases were assessed based on the question used in the Brazilian Telephone-based Surveillance System for Noncommunicable Diseases.³⁸

Statistical analyses

The normality of data distribution and homoscedasticity of the variances were verified using the Shapiro–Wilk and Bartlett tests, respectively. Data were reported as mean and standard deviation (SD), median and range, and proportion and 95% CI, as appropriate. Differences between proportions were tested using the chi-squared test. Poisson regression models were used to verify the effect of continued 'remained' physical activity practice at home on the risk of subjective cognitive decline. Models were adjusted for age, sex, education, ethnicity, conjugal situation, change in monthly income, risk of depression and anxiety, physical activity before social distancing, self-reported BMI and chronic diseases. Values were reported in prevalence ratio (PR) and 95% CI. All analyses were weighted for the number of responses in each macroregion due to the higher number of responses from one macroregion (Sul; $N = 1247$; 54.5%).

Results

From the initial sample of 2321 respondents at wave 1 of the PAMPA cohort, seven participants did not provide information on memory decline; thus, we analysed data from a final sample of 2314 adults from southern Brazil. Participants were more likely to be female, White, and have a high level of educational, as shown in Table 1. Participants reported a high prevalence of chronic diseases and a low risk of depression. Most participants were classified as physically inactive based on the physical activity before the COVID-19 pandemic.

We found a prevalence of subjective memory decline in 29.3% (95% CI: 26.9 to 31.7) of the respondents. This outcome was more common in women and those living alone, as shown in Table 1. An inverse linear association between age and subjective memory decline was observed, with participants aged between 18 and 30 years more likely to report subjective memory decline. Individuals with decreased monthly income and diagnosed chronic diseases were also more likely to report subjective memory decline. Likewise, an increased risk of depression and anxiety was associated with subjective memory decline. No additional differences in the other variables were observed.

The effect of different types and locations of physical activity on the likelihood of subjective memory decline before and during the COVID-19 pandemic is shown in Table 2. Participants who engaged in endurance activities (PR: 0.82; 95% CI: 0.72, 0.93), combined endurance and muscle strengthening (PR: 0.59; 95% CI: 0.40, 0.87), and stretching/mind-body activities (PR: 0.70; 95% CI: 0.54, 0.91) out of their home before the pandemic were less likely to report subjective memory decline. No effect on the prevalence of subjective memory decline was observed for pre-COVID-19 home-based physical activities.

During the COVID-19 pandemic, practising endurance, endurance/muscle strengthening and stretching/mind-body activities reduced the likelihood of subjective memory decline regardless of the location. Muscle-strengthening activities out of home also

Table 1
Sociodemographic and health-related characteristics of included participants by the presence of subjective memory decline. Rio Grande do Sul, Brazil, 2020 (N = 2314) [% (95% CI)].

Characteristic	Whole cohort (N = 2314)	Subjective memory decline		P-value
		Yes (N = 403)	No (N = 973)	
Sex				<0.001
Male	23.4 (21.3, 25.6)	19.2 (15.3, 23.8)	80.8 (76.2, 84.6)	
Female	76.6 (74.4, 78.7)	33.2 (30.5, 36.1)	66.8 (63.9, 69.5)	
Age (years)				<0.001
18–30	37.3 (34.8, 39.8)	36.0 (32.1, 40.2)	64.0 (59.8, 67.9)	
31–59	54.2 (51.6, 56.7)	28.5 (25.5, 31.8)	71.5 (68.2, 74.5)	
60+	8.5 (7.2, 10.1)	13.4 (8.5, 20.6)	86.6 (79.4, 91.5)	
Ethnicity				0.961
White	90.6 (89.0, 92.0)	30.0 (27.6, 32.5)	70.0 (67.5, 72.4)	
Black	3.4 (2.6, 4.4)	36.5 (24.4, 50.6)	63.5 (49.4, 75.6)	
Mixed	5.6 (4.6, 6.9)	25.9 (18.1, 35.6)	74.1 (64.4, 81.6)	
Other	0.0 (0.0, 0.1)	28.0 (6.7, 67.8)	72.0 (32.2, 93.3)	
Conjugal situation				0.035
Living with a partner	61.6 (59.1, 64.1)	61.7 (57.8, 65.5)	53.7 (47.5, 59.8)	
Living alone	38.3 (35.6, 40.9)	38.3 (34.5, 42.2)	46.3 (40.2, 52.5)	
Highest education level				0.123
High school or lower	33.3 (30.9, 35.7)	33.9 (29.8, 38.2)	66.1 (61.8, 70.2)	
University degree	26.4 (24.2, 28.7)	24.6 (20.6, 29.2)	75.3 (70.8, 79.4)	
Specialised, Masters, PhD	40.3 (37.8, 42.8)	30.2 (26.7, 34.1)	69.8 (65.9, 73.3)	
Decreased monthly income				0.005
No	54.8 (52.2, 57.3)	26.6 (23.7, 29.7)	73.4 (70.3, 76.3)	
Yes	45.2 (42.7, 47.8)	34.0 (30.4, 37.8)	66.0 (62.2, 69.5)	
Self-reported body mass index				0.053
Normal	46.8 (44.2, 49.3)	31.1 (27.8, 34.6)	68.9 (65.4, 72.3)	
Overweight	33.1 (30.7, 35.5)	29.4 (25.5, 33.7)	70.6 (66.3, 74.5)	
Obese	20.1 (18.1, 22.3)	28.5 (23.6, 34.0)	71.5 (66.0, 76.4)	
Chronic diseases				0.011
No	43.1 (40.6, 45.6)	27.9 (24.6, 31.6)	72.1 (68.4, 75.4)	
Yes	56.9 (54.3, 59.4)	31.5 (28.4, 34.8)	68.5 (65.2, 71.6)	
Physical activity before COVID-19 pandemic				0.872
Inactive	56.9 (54.3, 59.4)	29.8 (26.8, 33.0)	70.2 (66.9, 73.2)	
Active	43.1 (40.6, 45.7)	30.2 (26.7, 33.8)	69.8 (66.1, 73.3)	
Depressive symptoms				<0.001
Normal	46.1 (43.6, 48.7)	83.8 (80.8, 86.4)	16.2 (13.6, 19.2)	
Mild	24.8 (22.7, 27.1)	67.0 (62.0, 71.7)	33.0 (28.3, 38.0)	
Moderate-to-severe	29.0 (26.8, 31.4)	50.7 (45.6, 55.5)	49.3 (44.5, 54.1)	
Anxiety symptoms				<0.001
Normal	40.5 (38.0, 43.0)	85.8 (82.8, 88.4)	14.1 (11.6, 17.2)	
Mild	21.7 (19.6, 23.9)	71.3 (66.0, 76.1)	28.7 (23.9, 33.9)	
Moderate-to-severe	37.8 (35.3, 40.3)	52.3 (48.1, 56.5)	47.7 (43.5, 51.9)	

reduced the prevalence of subjective memory decline. Furthermore, we observed that participants who adopted the out-of-home endurance (PR: 0.43; 95% CI: 0.20, 0.93), muscle strengthening (PR: 0.56; 95% CI: 0.35, 0.89), combined endurance and muscle strengthening (PR: 0.32; 95% CI: 0.14, 0.75) and stretching activities (PR: 0.53; 95% CI: 0.29, 0.97) to be performed at home had a reduced risk of subjective memory decline compared with participants who stopped the practice of physical activities during social distancing, as shown in [Table 3](#).

Discussion

Our findings provide evidence that continuing physical activity practice with different at-home modalities during periods when social distancing measures are in place might protect against subjective memory decline. Physical activity prevalence has declined since the beginning of social distancing.⁸ On the other hand, subjective memory has affected approximately one in three adults in southern Brazil.¹¹ Based on our findings, home-based physical activity might be a feasible approach to reduce the risk for this indirect effect of the COVID-19 pandemic on the adult population in southern Brazil.

Previous studies^{11,39} have shown an inverse association between physical activity and the risk of subjective cognitive decline.

Although a dose–response relationship has already been identified, no study has examined the effect of specific physical activity modalities on the risk of subjective cognitive impairment. We observed that predominantly aerobic (e.g. running, walking, stair use) or anaerobic activities (e.g. muscular strengthening), as well as stretch-related activities (e.g. Pilates, stretching, Yoga), can reduce the risk of subjective memory decline during time periods when social distancing measures are in place. It is important to mention some physiological mechanisms in order to understand the biological pathways that are responsible for such findings.

Participants who continued running or walking, cycling, or using stairs had a reduced risk of subjective memory decline than individuals who stopped their practice. Aerobic activities can increase the concentration of important neurotrophic factors, such as the BDNPs²³ and vascular-endothelial growth factors.^{40,41} These proteins are highly associated with neurogenesis⁴² and angiogenesis.⁴³ Also, aerobic physical activity can improve brain structure and function, which is highly associated with cognitive function, including memory performance.^{44,45}

Moreover, activities focusing on muscle strengthening performed at home attenuate the risk of subjective memory decline in adults. The muscle-brain crosstalk has been extensively studied in recent years.⁴⁶ Skeletal muscle contractions release critical cytokines associated with preserve cognitive function, including the

Table 2
Prevalence of subjective memory decline based on physical activity type before and during the COVID-19 social distancing. Rio Grande do Sul, Brazil, 2020 (N = 1376).

	Subjective memory decline [% (95% CI)]		PR (95% CI)
	No	Yes	
Physical activity before COVID-19			
Outside			
<i>Endurance^d</i>			
No	66.7 (62.4, 70.7)	33.3 (29.3, 37.5)	Ref
Yes	77.8 (72.6, 82.3)	22.2 (17.7, 27.4)	0.82 (0.72, 0.93)
<i>Muscle strengthening^b</i>			
No	69.3 (66.5, 71.9)	30.7 (28.1, 33.5)	Ref
Yes	72.6 (67.7, 77.1)	27.4 (22.9, 32.3)	0.89 (0.73, 1.08)
<i>Combined^c</i>			
No	68.8 (65.2, 72.2)	31.2 (27.8, 34.8)	Ref
Yes	81.1 (72.9, 87.2)	18.9 (12.8, 27.1)	0.59 (0.40, 0.87)
<i>Stretching/mind-body^d</i>			
No	68.9 (66.3, 71.4)	31.1 (28.6, 33.7)	Ref
Yes	77.1 (71.1, 82.2)	22.9 (17.8, 28.9)	0.70 (0.54, 0.91)
At home			
<i>Endurance^d</i>			
No	68.9 (66.0, 71.6)	31.1 (28.4, 34.0)	Ref
Yes	73.5 (68.8, 77.6)	26.5 (22.4, 31.2)	0.88 (0.73, 1.06)
<i>Muscle strengthening^b</i>			
No	69.6 (67.0, 72.1)	30.4 (27.9, 33.0)	Ref
Yes	72.0 (66.1, 77.3)	28.0 (22.7, 33.9)	0.92 (0.75, 1.14)
<i>Combined^c</i>			
No	69.3 (66.8, 71.8)	30.7 (28.2, 33.2)	Ref
Yes	76.2 (68.8, 82.5)	23.7 (17.5, 31.2)	0.79 (0.59, 1.04)
<i>Stretching/mind-body^d</i>			
No	69.5 (66.8, 72.0)	30.5 (28.0, 33.2)	Ref
Yes	73.0 (66.9, 78.2)	27.0 (21.7, 33.1)	0.87 (0.69, 1.08)
Physical activity during COVID-19			
Outside			
<i>Endurance^d</i>			
No	67.1 (64.1, 69.9)	32.9 (30.1, 35.8)	Ref
Yes	77.2 (73.0, 81.0)	22.8 (19.0, 27.0)	0.70 (0.58, 0.85)
<i>Muscle strengthening^b</i>			
No	68.9 (66.4, 71.3)	31.1 (28.6, 33.6)	Ref
Yes	81.9 (74.1, 87.7)	18.1 (12.3, 25.9)	0.60 (0.41, 0.86)
<i>Combined^c</i>			
No	69.0 (66.5, 71.4)	31.0 (28.6, 33.5)	Ref
Yes	84.2 (75.8, 90.0)	15.8 (10.1, 24.2)	0.53 (0.33, 0.83)
<i>Stretching/mind-body^d</i>			
No	69.3 (66.8, 71.7)	30.7 (28.3, 33.2)	Ref
Yes	83.8 (74.1, 90.4)	16.2 (9.6, 26.0)	0.56 (0.34, 0.94)
At home			
<i>Endurance^d</i>			
No	67.4 (64.6, 70.1)	32.6 (29.9, 35.4)	Ref
Yes	77.9 (73.3, 81.9)	22.1 (18.1, 26.6)	0.68 (0.55, 0.84)
<i>Muscle strengthening^b</i>			
No	69.6 (67.0, 72.1)	30.4 (27.8, 33.0)	Ref
Yes	72.1 (66.1, 77.4)	27.9 (22.5, 33.9)	0.93 (0.75, 1.15)
<i>Combined^c</i>			
No	68.8 (66.3, 71.3)	31.1 (28.7, 33.7)	Ref
Yes	84.9 (77.2, 90.4)	15.0 (9.6, 22.8)	0.51 (0.33, 0.78)
<i>Stretching/mind-body^d</i>			
No	69.3 (66.8, 71.7)	30.7 (28.3, 33.2)	Ref
Yes	83.8 (74.1, 90.4)	16.2 (9.6, 22.9)	0.67 (0.54, 0.83)

At-home physical activity: physical activity performed within the participant's household; Out-of-home activities: all physical activities practised external to participants' household, including shared gyms and running/walking.

^a Running/walking, cycling, and stair use were merged as endurance activities.

^b Muscle-strengthening activities.

^c Combined: endurance and muscle-strengthening activities.

^d Yoga, Pilates and stretching activities were merged as stretching and mild-body activities.

irisin.⁴⁷ This protein was previously described as a critical product of muscle contraction that triggers neurogenic responses.⁴⁷ Other anabolic responses, such as the increase in insulin-like growth hormone (IGF-1) concentration, have also been associated with improvement in cognitive function and preserved brain functional connectivity.⁴⁸ Nevertheless, we observed that at-home muscle-strengthening activities did not result in a reduced risk of

subjective memory decline. While endurance activities usually demand less equipment, muscle-strengthening activities may require a greater variety of home-based tools that may not be available for some participants. Also, the inexperience of exercise professionals with online-based exercise prescriptions, alongside the lack of adequate training equipment, may impair volume and intensity control in exercise sessions compared with out-of-home activities. For example, a previous meta-analysis of randomised controlled trials showed that the effect of exercise on cognition in people with mild cognitive impairment might be exercise-intensity dependent.⁴⁹

Last, home-based stretching-related activities, including Yoga, Pilates and stretching activities during time periods when social distancing measures were in place, resulted in a decreased risk for subjective memory decline. A previous meta-analysis found that Yoga, Pilates and other mind-body activities improved global cognitive function and domain-specific, such as learning and memory, in older adults.⁵⁰ The authors suggested that such activities may improve memory function through skill-related learning activities requested during the practice. For example, memory-specific brain regions, such as the hippocampus, are stimulated and increased when learning a new movement or exercise.⁵¹ Biazus-Sehn et al.⁵² showed that mind-body activities (e.g. Yoga, Pilates) could improve cognitive function in older adults with mild cognitive impairment. Furthermore, the higher demand to concomitantly focus on breathing and movement techniques has already been shown to be associated with increased hippocampus and frontal lobe stimulation.^{53,54}

Home-based physical activity intervention has been extensively studied as a feasible approach to promote physical activity as a non-pharmacological treatment for people with different health conditions, such as healthy older adults⁵⁵ and people with peripheral artery disease⁵⁶ and dementia.⁵⁷ In light of this, a huge increase in the online tools to either start or continue the physical activity practice during the COVID-19 pandemic was observed. However, worldwide physical activity at the population level has decreased in different settings since the beginning of social distancing.⁸ This augmented prevalence of physical inactivity is associated with several health outcomes, including increased frequency of anxiety and depressive symptoms⁷ and poor management of pre-existent chronic diseases.³ Previously, we showed the dose–response relationship between the time spent on physical activity during social distancing and the risk of subjective memory decline, regardless of the total amount of physical activity performed before the COVID-19 pandemic.¹¹ In the present study, we provided further evidence showing that the benefits of physical activity in reducing the risk of subjective memory decline are seen in physical activity modalities in different settings and with different energetic features. Notwithstanding the barriers induced by the COVID-19 pandemic in different aspects of daily life, physical activity is a low-cost, non-pharmacological strategy to reduce the burden on mental health attributable to the pandemic.^{7,58} The findings from the present study may provide important insights to future experimental studies aiming to improve cognition and mental health in the general population.

Some limitations of this study must be acknowledged. First, we assessed physical activity and subjective memory function before the COVID-19 pandemic retrospectively. Although this approach increases the risk of recall bias, there was no ongoing state-level longitudinal study in the Rio Grande do Sul state before the pandemic, so a prospective longitudinal design was not possible. Second, face-to-face interviews were prohibited by the local ethics board as required by the National Ethics Committee during the recruitment phase. Thus, both outcome and exposures were assessed using online forms. Third, we noted the

Table 3

Prevalence ratio (95% CI) of the risk of subjective memory decline during the COVID-19 pandemic by physical activity practice. Rio Grande do Sul, Brazil, 2020 (N = 1376).

Outside physical activity before COVID-19 social distancing	Physical activity during COVID-19 social distancing				P-value
	Suspended ^f		Remained ^e		
	%	PR (95% CI)	%	PR (95% CI)	
Endurance (n = 1265) ^d	88.1	Ref	11.9	0.43 (0.20; 0.93)	0.033
Muscle strengthening ^b (n = 529)	52.3	Ref	47.7	0.56 (0.35; 0.89)	0.032
Combined ^c (n = 158)	50.6	Ref	49.4	0.32 (0.14, 0.75)	0.009
Stretching/mind-body ^d (n = 329)	49.1	Ref	50.9	0.53 (0.29; 0.97)	0.041

Bold values indicate statistical significance ($P < 0.05$).

Ref = reference category. Adjusted for age, sex, education, ethnicity, conjugal situation, change in monthly income and mental health (i.e. depressive and anxiety symptoms) due to social distancing, commitment with social distancing, physical activity before social distancing, self-reported BMI and chronic diseases.

Social distancing from the couch! Effects of specific types of physical activity on the risk of subjective memory decline: findings from the PAMPA Cohort.

Physical activity practised at home reduces the risk of subjective memory decline during the COVID-19 pandemic in Brazilian adult population.

^a Running/walking, cycling, and stair use were merged as endurance activities.^b Muscle-strengthening activities.^c Combined: endurance and muscle-strengthening activities.^d Yoga, Pilates and stretching activities were merged as stretching and mild-body activities.^e Remained: Previous outside physical activity practice remained at home during social distancing.^f Suspended: Previous outside physical activity practice was suspended during social distancing; At-home physical activity: physical activity performed within the participant's household; Out-of-home activities: all physical activities practised external to participants' household, including shared gyms and running/walking.

overrepresentation of respondents with one or more academic degrees. This sampling bias was expected given that the data collection was based on an online questionnaire. Nevertheless, the COVID-19 pandemic is likely to have a greater impact on less educated and lower economic groups.⁷ Therefore, the overrepresentation of adults who had attended high school or above is likely to have underestimated the prevalence of subjective memory decline in adults from southern Brazil. Also, the proportion of participants self-declared as White and aged ≥ 30 years is similar to the proportion observed in the Rio Grande do Sul state. Fourth, we did not ask about the intensity and volume of each type of physical activity. However, we still observed a significant protective effect of the included physical activities on the risk of subjective memory decline. Future studies are warranted to examine the dose–response relationship between these physical activities and the risk of this memory impairment.

In conclusion, participants who continued the practice of physical activity at home during COVID-19 social distancing, regardless of the type of activity, had a reduced risk of subjective memory decline than participants who stopped the practice of physical activity. Home-based physical activity may be a feasible approach to preserve memory function during time periods when social distancing measures are in place and out-of-home activities are discouraged.

Author statements

Ethical approval

Ethical Approval was given by the Ethics Committee of the Federal University of Pelotas (31906920.7.0000.5313).

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Competing interests

None declared.

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