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Effects of Mat Pilates online on the depressive symptoms and quality of life of older people during the COVID-19 pandemic: a randomized controlled clinical trial

Efeitos do Mat Pilates online nos sintomas depressivos e na qualidade de vida de idosos durante a pandemia de COVID-19: um ensaio clínico randomizado e controlado

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ABSTRACT

The objective is to verify the effects of an online Mat Pilates intervention on the depressive symptoms and quality of life of older adults during the COVID-19 pandemic. This is a randomized controlled clinical trial involving 56 healthy and sedentary older adults (64.38 ± 3.45 years), randomized into two groups: Mat Pilates Training Group (PTG, n = 28) and Control Group (CG, n = 28). The intervention lasted 12 weeks, with two weekly 45-minute sessions using a video calling application. In the main part, the Basic Mat Pilates sequence was performed with progressions in the intensity, volume, and complexity of the exercises. The CG received a booklet with guidance on exercising without supervision and weekly health education lectures. Depressive symptoms were assessed using the PHQ-9 questionnaire. Quality of life was assessed using two questionnaires (WHOQOL-BREF and WHOQOL-OLD) and their respective domains. The analyses were carried out using the Generalized Estimating Equations model. In the per-protocol analysis, there were no significant differences either in time (p = 0.352) or between groups (p = 0.739) for depressive symptoms (Pre: 3.50 ± 2.61 and 4.20 ± 5.92; Post: 3.08 ± 2.57 and 3.40 ± 3.86; PTG and CG respectively). No significant interactions (p = 0.969) were observed in overall quality of life (Pre: 75.00 ± 14.10 and 73.75 ± 13.76; Post: 76.04 ± 8.36 and 75.00 ± 17.68; PTG and CG respectively) nor in the domains analysis of the WHOQOL-BREF questionnaire. Regarding WHOQOL-OLD, there was an improvement in the Death and Dying domain (p = 0.042) for both groups (Pre: 70.31 ± 21.67 and 71.88 ± 20.04; Post: 79.69 ± 15.34 and 74.38 ± 23.65; PTG and CG respectively), with no interactions for overall quality of life (p = 0.820) or for the other domains. Conclusion: Remote Mat Pilates was able to maintain low levels of depressive symptoms and improve some aspects of the quality of life of older adults.

Keywords: Aging; Exercise; Internet-based intervention; Mental health; Physical distancing.

RESUMO

O objetivo foi verificar os efeitos de uma intervenção de Mat Pilates realizada de maneira *online* nos sintomas depressivos e na qualidade de vida de idosos durante a pandemia de COVID-19. Trata-se de um ensaio clínico randomizado e controlado, envolvendo 56 idosos (64,38 ± 3,45 years) saudáveis e sedentários, randomizados em dois grupos: Grupo Treinamento Mat Pilates (GTP, n = 28) e Grupo Controle (GC, n = 28). A intervenção teve duração de 12 semanas com duas sessões semanais de 45 minutos, utilizando aplicativo de vídeo chamada. Na parte principal, foi realizada a sequência de Mat Pilates Básico com progressões na intensidade, volume e complexidade dos exercícios. O GC recebeu uma cartilha com orientações quanto à prática de exercícios sem supervisão e palestras semanais de educação em saúde. Os sintomas depressivos foram avaliados pelo questionário PHQ-9. A qualidade de vida foi avaliada por dois questionários (WHOQOL-BREF e WHOQOL-OLD) e seus respectivos domínios. As análises foram realizadas pelo modelo de Equações de Estimativas Generalizadas. Na análise por protocolo, não houve diferenças significativas nem no tempo (p = 0,352) nem entre grupos (p = 0,739) para os sintomas depressivos (Pré: 3,50 ± 2,61 e 4,20 ± 5,92; Pós: 3,08 ± 2,57 e 3,40 ± 3,86; GTP e GC respectivamente). Não foram observadas interações significativas (p = 0,969) na qualidade de vida geral (Pré: 75,00 ± 14,10 e 73,75 ± 13,76; Pós: 76,04 ± 8,36 e 75,00 ± 17,68; GTP e GC respectivamente) nem na análise por domínios do questionário WHOQOL-BREF. Com relação ao WHOQOL-OLD, houve uma melhora no domínio Morte e Morrer (p = 0,042) para ambos os grupos (Pré: 70,31 ± 21,67 e 71,88 ± 20,04; Pós: 79,69 ± 15,34 e 74,38 ± 23,65; GTP e GC respectivamente), sem interações para a qualidade de vida geral (p = 0,820) ou para os outros domínios. Conclusão: o Mat Pilates remoto foi capaz de manter baixos níveis de sintomas depressivos, e melhorar alguns aspectos da qualidade de vida de idosos.

Palavras-chave: *Envelhecimento; Exercício físico; Intervenção baseada em internet; Saúde mental; Distanciamento físico.*

Introduction

The COVID-19 pandemic forced governments to take a series of health measures to contain the spread of the virus, among which we can mention social isolation and social distancing measures[1,2]. In this sense, the population most affected by the pandemic was the older people, as lethality rates increase dramatically with age, with approximately 8.8% in people aged between 60 and 69 years, up to 13% in individuals aged between 70 and 79 years and 15% to 20% in individuals aged 80 years or older[3,4]. Data for 2021 indicates that 64.6% of deaths from COVID-19 in Brazil were in people over 60 years[5]. Although self-isolation and social distancing are necessary for reducing the infection rate[6], these measures can exacerbate concerns about physical and mental health during the COVID-19 pandemic[7].

With advancing age, is observed an increase in depressive and anxiety symptoms, which are related to the loss of occupational status, social and family support, and physical decline[8]. When associated with social isolation measures and the "fear of the pandemic" there is a negative burden on mental health[1,2]. In this sense, there was a 21% increase in depressive symptoms and a 19% increase in anxiety during COVID-19 compared to previous epidemiological data[9].

Due to increased time spent at home, people kept more virtual connections. Thus, communication technology tools and virtual environments make it possible to maintain an active lifestyle through supervised online physical training, which can be through video calls and exercises performed only with body weight[10]. In this sense, studies with remote training found a maintenance of depressive symptoms and quality of life[11] as well as an improvement in depressive symptoms compared to the control group[12].

An interesting remote training alternative is Mat Pilates, which consists of a set of exercises performed on the Mat (mat), that is, on the floor. It is a safe, effective, low-cost modality and can also be performed without the use of specific equipment[13]. This modality is a variation of the Pilates method, founded by Joseph Pilates in the 1920s, with an emphasis on controlling body posture and movement[14]. Furthermore, literature has already demonstrated the benefits of Mat Pilates can improve physical fitness outcomes, such as strength and balance[15–17]. Due to these characteristics, Mat Pilates is a modality easily adaptable to the virtual environment[18].

Faced with the need to provide interventions to maintain an active lifestyle, respecting isolation measures and reducing the risk of contamination by the virus, the objective of the present study was to evaluate the effects of a Mat Pilates intervention carried out remotely on the depressive symptoms and quality of life in the older people. Our hypothesis is that both outcomes will be improved in the online Mat Pilates group and maintained in the control group after the intervention.

Methods

Study design

The study is a superior, single-blinded, controlled, and randomized clinical trial carried out following the recommendations of CONSORT (Consolidated Standards of Reporting Trials)[19] and registered in the Brazilian Registry of Clinical Trials (ReBEC) (RBR-2t7pt25). Particularly in this study, the secondary outcomes of the registered randomized controlled clinical trial are presented. The study was approved by the Research Ethics Committee of the Federal University of Rio Grande do Sul (nº 4,695,378) and followed the guidelines of the Declaration of Helsinki.

Participants

Fifty-six healthy older people (4 men and 52 women) participated in the study. As inclusion criteria, participants should be: aged between 60 and 70 years old; not practicing physical exercises regularly and systematically for at least twelve months; be a resident of the State of Rio Grande do Sul; have internet access and a device for video calling; not be a smoker; not having uncontrolled cardiovascular diseases or associated complications; and not presenting musculoskeletal problems that would prevent the practice of physical exercise.

The sample was recruited for convenience through virtual posters posted on major social networks and in local media. After checking the inclusion criteria, eligible candidates read and signed the Informed Consent Form (ICF) through an online form and scheduled their evaluations. Then, the participants were randomized (RAND function - Excel 2016) into two groups according to the classification of physical activity levels: Pilates Training Group (PTG, n = 28) and Control Group (CG, n = 28). The sample calculation was performed using the GPOWER program, version 3.1., adopting an $\alpha = 0.05$, a power of 95% and using effect size values of depressive symptoms from the study by Curi et al.[20]. From the calculations, a sample size of at least 11 volunteers in each group, considering possible losses throughout the study, more participants were added to each group.

Assessments

The evaluations were carried out in the pre-intervention (week 0) and post-intervention (week 13) in a virtual way (video call), and the questionnaires were answered in electronic forms (Google Forms). Initially, the evaluator sent the link to the virtual room for the participant to access the video call (Google Meet). Soon after, the evaluator shared the screen of his device to read the ICF with the volunteer, and after solving all doubts, the participant signed the form to give his consent. Then, an anamnesis was made in an interview format, collecting data on age, body mass and height (self-reported). Furthermore, participants responded to the International Physical Activity Questionnaire – short version (IPAQ-bref)[21] in an interview format to obtain the classification of the level of physical activity[22]. After this virtual interview, the evaluator sent a message containing the link that gave access to the electronic form of the Depressive Symptoms and Quality of Life questionnaires for the participant to answer individually within 72 hours after the interview. The raters were familiarized and trained with the assessment instruments and were blinded to depressive symptoms and quality of life outcomes.

Depressive symptoms were assessed using the PHQ-9 questionnaire, consisting of nine questions that can be marked in intensity ranging from zero to three points. Scores of 5, 10, 15, and 20 represent cutoffs for mild, moderate, moderately severe, and severe depression, respectively[23].

Quality of life was assessed using two questionnaires. The first questionnaire was the WHOQOL-BREF[24], which indicates the overall quality of life through 26 questions, with scores ranging from 0 to 100 points. In addition, the analysis of responses can be divided into four domains: Physical, Psychological, Social Relationships, and Environment. The second questionnaire was the WHOQOL-OLD[25], which assesses overall quality of life of older people through 24 questions. The answers follow a Likert scale (1-5), and there are six domains: Sensory Functioning; Autonomy; Past, Present, and Future Activities; Social Participation; Death and Dying; and Intimacy. In both assessments, high scores represent a high quality of life, and low scores represent a low quality of life.

Intervention

In the intervention, the Mat Pilates modality was performed for 12 weeks. The GTP performed a remotely supervised training using a video communication service (Google Meet). The trainings were held twice a week on non-consecutive days (Monday and Wednesday), and the classes were collective. Before starting training, two familiarization sessions with the exercise technique and the virtual environment were held.

The training sessions lasted 45 minutes. First, the warm-up consisted of five exercises (Pelvic Bowl, Knee Sway, Angel Arms, Cat, Fligth) of the fundamentals of the Pilates method, with ten repetitions for each. After, during the main part of the session, the Mat Pilates sequence was performed. In weeks 1 to 6, the adapted Basic Mat Pilates sequence was performed with the following exercises: The Hundred, Roll Up, Single Leg Circles, Roll Down, Rolling Like a Ball, Single Leg Stretch, Double Leg Stretch, and Spine Stretch Forward. In weeks 7 to 12, there was a progression, and the traditional Basic Mat Pilates sequence was performed with the following exercises: Single Straight Leg Stretch, Criss Cross, Saw, and Neck Roll. Intensity was controlled based on three parameters: execution of the adapted or traditional form of the exercise; number of repetitions; and shorter connection time between exercises. The complete periodization can be viewed in the supplementary material (Supplementary Table 1).

The CG received a booklet (Supplementary Material) with guidelines for physical exercises for balance, strength, and flexibility. A researcher was responsible for keeping the participants engaged during the intervention, but there was no supervision and control over how often the exercises were practiced. In addition, only the CG received weekly health education videos (YouTube) focused on healthy aging (Supplementary Material). The topics presented were: Physical activity, physical exercise, and sedentary behavior; Health care in times of pandemic; Diseases and physiological alterations of aging; Mental health; Sleep quality; and Healthy eating.

Statistical Analysis

Data are presented as mean and 95% Confidence Interval (95%CI). Normality was verified using the Shapiro-Wilk test. For the descriptive analysis, Student's t-tests were used to compare the groups in the pre-intervention period. Generalized estimation equations were used for evaluation of outcomes (time effect, group effect and time x group interaction effect). The outcomes were analyzed using the intention-to-treat (ITT) analysis principle and all participants with baseline data were included in this analysis, even if they dropped out or had low attendance. Furthermore, a

per-protocol (PP) analysis was carried out only with participants who achieved more than 70% attendance in the exercise sessions. The calculation of the effect size (Hedges' g) was based on the comparison between the means and standard deviations of the post-intervention moment and the classification used was ignored (0.0 to <0.2), small (≥0.2 to <0.5), moderate (≥0.5 to <0.8), large (≥0.8 to <1.3) and very large (≥1.3)[26]. The significance level adopted was $\alpha = 0.05$, and the statistical program used was SPSS (version 22.0).

Results

Three recruitments were carried out between May 2021 and April 2022 to reach n sample. Of the 246 people who contacted us to participate in the study, only 56 met the inclusion criteria. These participants were randomized into two groups: PTG (n = 28) and CG (n = 28). At baseline, the number of participants in each physical activity level classification was: Very active (PTG = 2; CG = 0), Active (PTG = 15; CG = 15), Irregularly active A (PTG = 2; CG = 4), Irregularly active B (PTG = 9; CG = 6), and Sedentary (PTG = 0; CG = 3). Figure 1 shows the flowchart with the reasons for the exclusion and withdrawal of participants. The average attendance of the PTG was 73.6%, with 13 participants achieving more than 70% attendance at training sessions.

Regarding the characteristics of the sample in the pre-intervention moment, no differences were identified between the groups for the variables of age (p = 0.337), body mass (p = 0.961), height (p = 0.388) and body mass index (p = 0.649) (Table 1).

Depressive symptoms

In the ITT analysis of the PHQ-9, there was a significant interaction between time and group (p = 0.048) with a small effect size (Hedges'g = 0.30). In this interaction, only the CG obtained a significant reduction after 12 weeks of intervention, but there were no significant differences between the groups in time (Table 2).

In the PP analysis of the PHQ-9, there were no significant interactions between groups (p = 0.769) nor significant differences over time (p = 0.352), and the effect size was ignored (Hedges'g = -0.09) (Table 2).

Table 1 – Sample characterization.

Variable	Group	n	Mean	95% CI	p
Age (years)	PTG	28	64.82	63.5 - 66.2	0.337
	CG	28	63.93	62.6 - 65.2	
Body mass (kg)	PTG	28	73.76	65.4 - 82.1	0.961
	CG	28	73.52	67.6 - 79.5	
Height (cm)	PTG	28	162.9	160.1 - 165.6	0.388
	CG	28	161.3	158.6 - 163.9	
BMI (Kg/m²)	PTG	28	27.57	25.0 - 30.2	0.649
	CG	28	28.35	26.0 - 30.7	

BMI = Body mass index; CG = Control group; PTG = Pilates training Group.

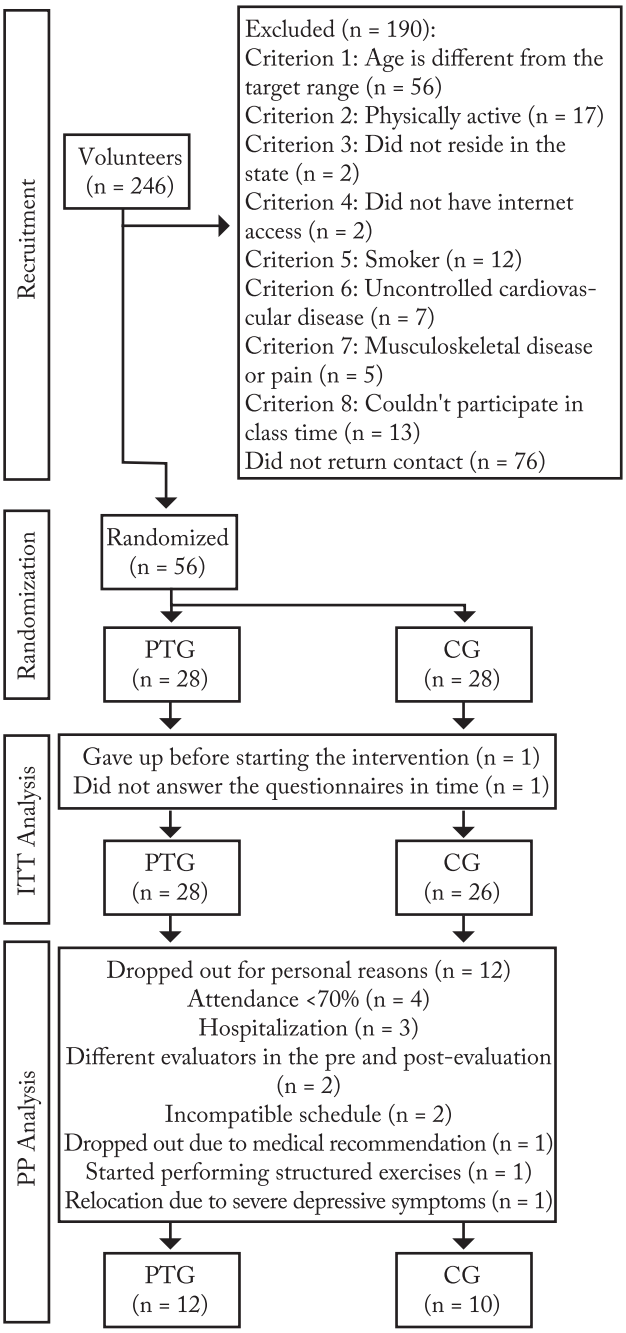

Figure 1 – Flowchart of study participants.
CG = Control Group; ITT = Intention-to-treat; PP = Per-protocol; PTG = Pilates Training Group.

Quality of life

For the overall quality of life (WHOQOL-BREF) in the ITT analysis, there were no interactions between time and group after 12 weeks of training (p = 0.578; Hedges'g = -0.27, small effect) (Table 3). Likewise, no significant interactions were verified for the Physical (p = 0.832; Hedges'g = -0.46, small effect), Psychological (p = 0.285; Hedges'g = -0.32, small effect), Social Relationships (p = 0.483; Hedges'g = 0.23, small effect), and Environment (p = 0.572; Hedges'g = -0.12, ignored effect) domains (Table 3).

Likewise, for the overall quality of life (WHOQOL-BREF) in the PP analysis, there were no interactions between time and group after 12 weeks of training (p = 0.969; Hedges'g = 0.07, ignored effect) (Table 3). In the analysis by domains, no significant interactions were verified for the Physical (p = 0.569; Hedges'g = -0.15, ignored effect), Psychological (p = 0.748; Hedges'g = 0.07, ignored effect), Social Relationships (p = 0.962; Hedges'g = 0.49, small effect),

Table 2 – Results of depressive symptons.

Variable	Group	n	Pre		Post		Hedges' g	Group	Time	Group * Time
			Mean	95% CI	Mean	95% CI				
Intention-to-treat analysis										
Total	PTG	28	3.61	2.4 - 4.8	3.72	2.4 - 5.1	0.30	0.817	0.072	0.048*
	CG	26	5.11	3.0 - 7.2	2.69#	0.8 - 4.6				
Per-protocol analysis										
Total	PTG	12	3.50	2.1 - 4.9	3.08	1.7 - 4.5	-0.09	0.739	0.352	0.769
	CG	10	4.20	0.7 - 7.7	3.40	1.1 - 5.7				

CG = Control group; PTG = Pilates training group. * indicates a significant difference (p < 0.05) # indicates a significant difference in time (pre vs post).

Table 3 – Results of quality of life (WHOQOL-BREF).

Variable	Group	n	Pre		Post		Hedges' g	Group	Time	Group * Time
			Mean	95% CI	Mean	95% CI				
Intention-to-treat analysis										
Physical (0-100)	PTG	28	66.67	61.0 - 72.3	68.05	61.8 - 74.3	-0.46	0.104	0.470	0.832
	CG	26	72.75	68.2 - 77.3	75.27	65.7 - 84.9				
Psychological (0-100)	PTG	28	69.14	65.1 - 73.2	68.20	62.8 - 73.6	-0.32	0.673	0.512	0.285
	CG	26	68.21	62.4 - 74.0	72.12	64.6 - 79.7				
Social Relationships (0-100)	PTG	28	68.52	64.0 - 73.0	69.74	64.0 - 75.5	0.23	0.691	0.782	0.483
	CG	26	68.83	62.6 - 75.1	66.03	55.4 - 76.6				
Environment (0-100)	PTG	28	69.56	65.4 - 73.6	67.60	63.2 - 72.0	-0.12	0.942	0.818	0.572
	CG	26	68.40	62.7 - 74.1	69.23	61.4 - 77.1				
Overall (0-100)	PTG	28	72.69	65.3 - 80.1	72.37	65.6 - 79.1	-0.27	0.505	0.656	0.578
	CG	26	74.07	68.5 - 79.7	76.92	67.7 - 86.1				
Per-protocol analysis										
Physical (0-100)	PTG	12	68.45	61.9 - 75.0	69.05	63.2 - 74.9	-0.15	0.388	0.726	0.569
	CG	10	73.93	70.0 - 77.9	71.43	60.4 - 82.5				
Psychological (0-100)	PTG	12	70.49	64.2 - 76.7	72.22	65.8 - 78.6	0.07	0.748	0.205	0.748
	CG	10	68.33	61.0 - 75.7	71.25	62.6 - 79.9				
Social Relationships (0-100)	PTG	12	70.14	64.2 - 76.1	71.53	64.7 - 78.3	0.49	0.084	0.595	0.962
	CG	10	60.83	54.3 - 67.4	62.50	50.0 - 75.0				
Environment (0-100)	PTG	12	67.45	60.7 - 74.2	67.45	61.4 - 73.5	0.11	0.882	0.705	0.705
	CG	10	67.81	63.5 - 72.6	65.94	58.1 - 73.75				
Overall (0-100)	PTG	12	75.00	67.4 - 82.6	76.04	71.5 - 80.6	0.07	0.821	0.670	0.969
	CG	10	73.75	65.7 - 81.4	75.00	64.1 - 85.4				

CG = Control Group; PTG = Pilates Training Group.

and Environment (p = 0.705; Hedges'g = 0.11, ignored effect) (Table 3).

In the ITT analysis of quality of life in aging (WHOQOL-OLD), there were no significant interactions between time and group (p = 0.074; Hedges'g = -0.42, small effect) (Table 4). However, when analyzing the domains individually, an interaction was observed in the Autonomy domain (p = 0.005; Hedges'g = -0.28, small effect). In this interaction, we observed that the PTG started the intervention with significantly higher values than the CG and maintained the values after 12 weeks of intervention. The CG, on the other hand, obtained a significant improvement in this domain after 12 weeks (Table 4). Furthermore, a significant increase over time was identified in the Social Participation domain (p = 0.003; Hedges'g = -0.58, moderate effect) for both groups (Table 4). Finally, no significant interactions were found for the Sensory Functioning (p = 0.669; Hedges'g = -0.03, ignored effect), Past, Present, and Future (p = 0.413; Hedges'g = -0.50, moderate effect), Death and Dying (p = 0.335; Hedges'g = -0.22, small effect), and Intimacy (p = 0.354; Hedges'g = -0.12, ignored effect) domains.

In the PP analysis of quality of life in aging (WHOQOL-OLD), there were no significant interactions between time and group (p = 0.820; Hedges'g = 0.00, ignored effect) (Table 4). The analysis by domains did not demonstrate significant interactions for Sensory Functioning (p = 0.935; Hedges'g = 0.01, ignored effect); Autonomy (p = 0.169; Hedges'g = -0.30, small

Table 4 – Results of quality of life (WHOQOL-OLD).

Variable	Group	n	Pre		Post		Hedges' g	Group	Time	Group*Time
			Mean	95% CI	Mean	95% CI				
Intention-to-treat analysis										
SA (0-100)	PTG	28	80.80	73.7 - 87.9	81.25	74.1 - 88.4	-0.03	0.883	0.559	0.669
	CG	26	78.85	71.8 - 85.9	81.73	71.5 - 92.0				
A (0-100)	PTG	28	75.89	70.1 - 81.7	69.44	61.9 - 77.0	-0.28	0.462	0.652	0.005*
	CG	26	65.14$	59.2 - 71.1	74.04#	65.9 - 82.1				
PPFA (0-100)	PTG	28	66.74	62.8 - 70.7	66.32	60.3 - 72.3	-0.50	0.141	0.525	0.413
	CG	26	70.19	65.2 - 75.2	73.56	65.4 - 81.7				
SP (0-100)	PTG	28	61.83	56.5 - 67.1	65.63#	59.8 - 71.5	-0.58	0.285	0.003*	0.113
	CG	26	61.78	55.2 - 68.3	74.04#	65.8 - 82.2				
DD (0-100)	PTG	28	69.20	60.6 - 77.8	72.57	62.5 - 82.7	-0.22	0.821	0.058	0.335
	CG	26	67.07	58.3 - 75.8	77.40	66.3 - 88.5				
I (0-100)	PTG	28	71.21	66.6 - 75.8	69.10	63.5 - 74.7	-0.12	0.898	0.857	0.354
	CG	26	68.03	61.3 - 74.8	71.15	60.6 - 81.7				
Overall (0-100)	PTG	28	70.94	67.2 - 74.7	70.72	66.5 - 75.0	-0.42	0.717	0.095	0.074
	CG	26	68.51	63.7 - 73.3	75.32	68.8 - 81.9				
Per-protocol analysis										
SA (0-100)	PTG	12	76.56	66.2 - 86.9	80.21	73.0 - 87.4	0.01	0.994	0.288	0.935
	CG	10	76.88	62.6 - 91.2	80.00	67.6 - 92.4				
A (0-100)	PTG	12	70.83	59.9 - 81.8	70.31	60.9 - 79.7	-0.30	0.867	0.227	0.169
	CG	10	67.50	60.2 - 74.8	75.63	66.4 - 84.9				
PPFA (0-100)	PTG	12	68.23	62.7 - 73.7	69.79	63.9 - 75.7	-0.06	0.604	0.948	0.553
	CG	10	71.88	64.9 - 78.9	70.63	62.1 - 79.1				
SP (0-100)	PTG	12	62.50	53.5 - 71.5	67.19	59.5 - 74.8	-0.23	0.508	0.129	0.961
	CG	10	65.63	57.6 - 73.6	70.63	62.7 - 78.6				
DD (0-100)	PTG	12	70.31	58.6 - 82.1	79.69#	71.4 - 88.0	0.25	0.811	0.042*	0.239
	CG	10	71.88	60.1 - 83.7	74.38#	60.5 - 88.3				
I (0-100)	PTG	12	76.56	69.3 - 83.8	72.40	65.7 - 79.1	0.24	0.210	0.730	0.363
	CG	10	66.25	56.4 - 76.1	68.13	55.8 - 80.4				
Overall (0-100)	PTG	12	70.83	65.1 - 76.6	73.26	68.8 - 77.8	0.00	0.907	0.107	0.820
	CG	10	70.00	65.1 - 74.9	73.23	70.0 - 80.5				

A = Autonomy; CG = Control group; DD = Death and dying; I = Intimacy; PPFA = Past, present, and future activities; PTG = Pilates training group; SA = Sensory abilities; SP = Social participation. * indicates a significant difference (p < 0.05). $ indicates a significant difference between groups in the pre. # indicates a significant difference in time (pre vs post).

effect); Past, Present, and Future (p = 0.553; Hedges'g = -0.06, ignored effect); Social Participation (p = 0.961; Hedges'g = -0.23, small effect); and Intimacy (p = 0.363; Hedges'g = 0.24, small effect). However, a difference over time was observed in the Death and Dying domain (p = 0.042; Hedges'g = 0.25, small effect).

Discussion

To the best of our knowledge, the present study was the first to assess depressive symptoms and quality of life after a remotely prescribed Mat Pilates intervention in older adults during the COVID-19 pandemic. After the 12 weeks of intervention, depressive symptoms were maintained in the PTG and reduced in the CG (ITT analysis), but this interaction was not significant in the PP analysis. The values of overall quality of life and domains evaluated by the WHOQOL-BREF questionnaire were maintained in both groups (ITT and PP analyses). On the other hand, regarding the WHOQOL-OLD questionnaire, the Social Participation (PTG and CG) and Autonomy (only CG) domains were increments in the ITT analysis, but only the Death and Dying domain improved in both groups in the PP analysis. These results contradict our initial hypotheses, as no changes in depressive symptoms were observed in PTG, and CG demonstrated similar improvements to PTG in quality-of-life outcomes.

There are few studies regarding the effects of Pilates performed online during the COVID-19 pandemic[27,28]. Among them, Bulguroglu & Bulguroglu[28] compared the effects of the online and face-to-face Pilates method on depressive symptoms and quality of life in healthy subjects over eight weeks. Unlike our results, the study found a significant interaction in depressive symptoms, in which only the group that practiced online pilates reduced values while the control group only maintained values. However, it should be noted that weekly frequency of pilates sessions in the study by Bulguroglu & Bulguroglu[28] was higher when compared to the intervention of this study (three and two, respectively). In addition, the CG in the present study received a booklet with exercises to be performed without supervision and weekly videos, which generated a feeling of social support, possibly reducing the loneliness caused by social isolation.

Concerning depressive symptoms, the PTG maintained its values over 12 weeks, while the CG reduced values at the end of the intervention with a small effect size (ITT analysis). However, no significant reductions in depressive symptoms were found in the PP analysis with an ignored effect size; it is worth noting that participants in both groups demonstrated minimal levels of depression (<5)[23] even at baseline, which partly justifies the maintenance of the values in the PP analysis. The results agree with a recent meta-analysis[29], which compared the effects of Pilates training in healthy older people with a physically active control group. In this meta-analysis, the pilates intervention group and the physically active control group had a small effect size for psychological variables. However, when comparing groups, there was no superiority for the intervention group. In addition, other studies in the literature have shown a beneficial effect of Pilates practice on depressive symptoms for the general population[30], for individuals with depression and anxiety disorders[31], as well as for older people[32].

Some literature reviews have shown that Pilates can be beneficial for older people in several physical and functional parameters, well-being, and quality of life[15,33,35]. The clinical trial by Liposki et al.[35] evaluated the long-term (6 months) effects of a Pilates exercise intervention on quality of life (SF-36) in older women. Improvements were found in the Functional Capacity, Physical Aspects, Pain, General Health, Vitality, Social Aspects, and Mental Health domains. Likewise, in a short-term Pilates intervention (8 weeks) for older people, Rodrigues et al.[36] observed improvements in quality of life (WHOQOL-OLD), in addition to finding increments in the "Sensory Functioning", "Past, Present and Future Activities", and "Social Participation" domains.

Our findings differ from the studies mentioned above, as in the PP analysis, no changes were found in the overall quality of life, and, in the analysis by domains, only Death and Dying improved in PTG and CG. During the pandemic, high prevalence rates of death anxiety (56.4%) were observed in the older adults[37]. In this sense, the inclusion of a physical exercise program (PTG) or physical activity (CG) may have provided benefits for mental health despite there being no apparent improvements in depressive symptoms. Another possible explanation is that older people are experiencing a critical period of the pandemic, with restrictions and social distancing measures, which may have offset the benefits of supervised remote physical exercise. Furthermore, both groups showed good values for quality of life even in the pre-intervention period. According to the normative values for age and sex[38], the PTG presented values close to those in the

Psychological (Normative: 69.9; Result: 69.14) and Social Relationships (Normative: 69.9; Result: 68.52) domains. In addition, it presented values slightly below the normative for the Physical (Normative = 72.3; Result = 66.67) and Environment (Normative = 76.1; Result = 69.56) domains.

Some limitations must be highlighted in the interpretation of the results. The first is the fact that volunteers were recruited at different times during the pandemic. Given this context, participants in the last recruitment may have experienced greater relaxation of social isolation measures than the first individuals. Another fact was the lack of monitoring of the amount of exercises that the CG performed, as there was no guidance on the weekly frequency that the booklet could be performed. Even without adequate supervision, it is important to provide some assistance to the CG volunteers as a form of support in the crucial period, resulting in improvements of quality of life and depressive symptoms.

Finally, online Mat Pilates training was able to maintain low levels of depressive symptoms, maintain good values in overall quality of life, and improve the Death and Dying domain of older adults during the COVID-19 pandemic. Future studies could investigate whether Mat Pilates prescribed online is equivalent to face-to-face training in aspects of attendance, adherence, and quality of life, considering the end of restriction measures and the possibility of maintaining this type of training, even with the return to face-to-face activities.

Conflict of interest

The authors declare no conflict of interest.

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Author's contributions

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Declaration regarding the use of artificial intelligence tools in the article writing process

For the development of this manuscript, the artificial intelligence tool My Grammarly was used for the activity text revision. The authors declare that all material derived from such process has been reviewed, and the authors assume full responsibility for all the content of the manuscript.

Availability of research data and other materials

The data of this study is available on demand from referees.

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Supplementary

Table 1 – Periodization of Mat Pilates training group.

Mesocycle (weeks)	Exercises*	Number of repetitions	Duration of the main part (min)
1 (1 a 3)	Adapted Basic Mat Pilates sequence	5 - 8	20
2 (4 a 6)	Adapted Basic Mat Pilates sequence	8 - 10	25
3 (7 a 9)	Traditional Basic Mat Pilates sequence	5 - 8	25
4 (10 a 12)	Traditional Basic Mat Pilates sequence	8 - 10	30

* Based on the Manual of the Associação Brasileira do Método Pilates e Posturologia (ABMPP). Available in: https://youtu.be/AN_9ENWQMv0

Control Group physical exercise booklet

ESEFID UFRGS

PHYSICAL ACTIVITY BOOKLET

Home-based exercises

- FLEXIBILITY-

All exercises:
hold for 30 seconds and repeat twice

EXERCISE1

Purpose: These exercises will stretch your neck.

You must sit in a chair with both feet flat on the floor and your spine straight.

1st - join your hands, interlacing your fingers, and place them behind your head. Slowly bring your chin towards your chest without forcing it. You will feel the back of your neck stretch.

Reference image:

EXERCISE 2

2nd - take your right hand above your head, close to your ear. Lightly pull your head towards your right shoulder. You will feel the left side of your neck stretching.

Reference image:

3rd - perform the same activity as before, but now on the left side.

Reference image:

EXERCISE 3

Purpose: This exercise will stretch the back of your legs.

You will need a chair against the wall.

Sit on the edge of the chair, stretch one leg in front of you with your heel resting on the floor and your toe pointing up to the ceiling. The other leg is bent. With your arms extended, move your torso forward, trying to reach your foot without bending your knee. You will feel the back of your leg stretch.

Reference image:

Do not forget to repeat for the other side.

EXERCISE 4

Purpose: This exercise will stretch the front of the thigh.

You will need a chair.

With your hands resting on a wall or chair, bend your right knee, pointing your knee toward the floor. Hold the foot with just one hand. If not, just hold the position. You will feel the front of your thigh stretch.

Reference image:

Do not forget to repeat for the other side.

EXERCISE 2

Purpose: Increase leg muscle strength.

You will need a chair against the wall.

Sitting on the chair with your arms crossed over your chest and feet flat on the floor, stand up and stand completely upright. Afterward, sit down again until your back rests on the backrest. Do three sets of 10 repetitions with a 1-minute break between sets. If you feel it's too light, you can increase the repetitions but reduce the repetitions if it's too heavy.

Reference image:

ESEFID UFRGS

PHYSICAL ACTIVITY BOOKLET

Home-based exercises

- MUSCLE STRENGTH -

EXERCISE 3

Purpose: Increase arm strength.

You will need a chair and two equal weights (can be water bottles or bags of food)

Sitting on the chair, with your back resting against the back and your arms stretched out at your sides, holding the chosen weight, one in each hand. Raise your straight arms to shoulder height, keeping your palms down. Do three sets of 15 repetitions with a 1-minute break between sets.

Reference image:

EXERCISE 1

Purpose: Increase the strength of the calf muscles.

You will need a chair.

With your hands resting on the chair, stand on your toes with your knees straight, and return to the starting position with your entire foot flat on the floor. Do three sets of 15 repetitions with a 1-minute break between sets. You can do one leg at a time if it's getting too easy.

Reference image:

EXERCISE 3

Suggested loads:
Start with 500ml or 1l water bottles, progressing to 1.5l and 2l.

Remember, if it's too heavy, reduce the load or the number of repetitions; if you feel it's too light, you can increase the load or increase the number of repetitions.

Health education videos

Week	Topic
1	Physical Activity and Physical Exercise. What is the difference?
2	Sedentary behavior.
3	Health care in times of pandemic.
4	How does aging affect the health of our muscles?
5	Do you know the exercises that improve muscle strength?
6	How does aging affect our heart health?*
7	Do you know the exercises that improve our heart health?
8	Mental health and aging.
9	The importance of sleep for our health
10	Some diseases related to aging.
11	Healthy eating
12	Final instructions.

* A sample of a health education video can be viewed at the following link: https://youtu.be/tzDBQ_B0TR4