

Effects of the MIND&GAIT physical exercise programme on depressive symptoms in institutionalised frail older adult: A Pilot Study

Efectos del programa de ejercicio físico MIND&GAIT sobre los síntomas depresivos en adultos mayores frágiles institucionalizados: Un estudio piloto

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Abstract. The main purpose of this study was to analyse the effects of MIND&GAIT, a physical exercise programme, on depressive symptoms in frail institutionalised older people. Through a pilot study, thirty-five Portuguese frail older people (19 female, 16 male), with a mean age of 83.45 ± 9.73 years, participated in this study. The participants were randomly assigned into an experimental group ($n = 19$) and a control group ($n = 16$). Intervention was based on MIND&GAIT, physical exercise programme for frail older people. Depressive symptomatology was assessed using the Beck Depression Inventory (BDI-II) before and after 12 weeks of intervention. Results showed significant differences in depressive symptoms between the experimental group and the control group after the intervention. Depressive symptomatology decreased in the experimental group, while the participants in the control group had a significant increase in this indicator at the post-intervention moment. In general, the older people who were involved in the intervention group, improved their depressive symptoms, and the older who did not participate in the MIND&GAIT physical exercise programme, worsen this indicator. Considering the present results, we can conclude that this pilot study has presented initial findings that MIND&GAIT can contribute to improving depressive symptomatology in this population. This study has yielded essential data to construct subsequent randomized-controlled trials that can be effectively and feasibly executed within the community.

Keywords: physical exercise, depressive symptoms; frail older people

Resumen. El objetivo principal de este estudio fue analizar los efectos de MIND&GAIT, un programa de ejercicio físico, sobre los síntomas depresivos en personas mayores frágiles institucionalizadas. A través de un estudio piloto, participaron en este estudio treinta y cinco portugueses mayores frágiles (19 mujeres, 16 hombres), con una edad media de $83,45 \pm 9,73$ años, participaron en este estudio. Los participantes fueron asignados aleatoriamente a un grupo experimental ($n = 19$) y a un grupo de control ($n = 16$). La intervención se basó en MIND&GAIT, un programa de ejercicio físico para personas mayores frágiles. La sintomatología depresiva se evaluó mediante el Inventario de Depresión de Beck (BDI-II) antes y después de 12 semanas de intervención. Los resultados mostraron diferencias significativas en los síntomas depresivos entre el grupo experimental y el grupo de control después de la intervención. La sintomatología depresiva disminuyó en el grupo experimental, mientras que los participantes del grupo control tuvieron un aumento significativo de este indicador tras la intervención. En general, las personas mayores que participaron en el grupo de intervención mejoraron sus síntomas depresivos, y las personas mayores que no participaron en el programa de ejercicio físico MIND&GAIT empeoraron este indicador. Teniendo en cuenta los resultados actuales, podemos concluir que este estudio piloto ha presentado hallazgos iniciales de que MIND&GAIT podría contribuir a mejorar la sintomatología depresiva en esta población. Este estudio ha arrojado datos esenciales para contruir ensayos controlados aleatoris posteriores que puedan ejecutarse de manera efectiva y factible dentro de la comunidad.

Palabras-clave: ejercicio físico; síntomas depresivos; personas mayores frágiles

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Introduction

According to the World Health Statistics, its unquestionable the growing prevalence of an ageing population (World Health Organization [WHO], 2023). Associated to this, the health of older people, has become an important public health issue worldwide and is becoming a major focus of geriatric research who tries to find how to slow down the process of ageing (Li et al., 2022; Wang et al., 2022).

Frailty in older people refers to a state of vulnerability to poor resolution of homeostasis following a stressor event, resulting from a cumulative decline in multiple physiological systems over a lifespan (Clegg et al., 2013). Frail older adults are often weak, have multiple medical illnesses, and have a lower ability for independent living (Torpy et al., 2006), these being the main users of medical and social care services (Kojima et al., 2019).

Advanced age is a significant risk factor for frailty and a quarter of those aged 80 years or older are frail (Kojima et al., 2019), and the prevalence of frailty in institutionalised

older persons may be as high as 88.8% (Siviero et al., 2021). Depression is consistently identified as one top ten causes of disability worldwide (Murray et al., 2012), and in this population, it refers to feelings of sadness, hopelessness, and loss of interest that can interfere with daily life (Fyske et al., 2009), being an association between depressive symptoms and frailty in older adults (Zhao et al., 2020).

Exercise has been identified as one of the core strategies to counteract frailty-related physical weakening in the elderly (Angulo et al., 2020). Furthermore, studies have shown an inverse relationship between depressive symptoms and physical activity, indicating that regular physical exercise can also help to improve mental health and quality of life in this population (Aguirre & Villareal, 2015; Araque-Matinez et al., 2021; Vázquez et al., 2023). Regular exercise has been found to be an auspicious intervention for managing depressive symptoms in older people, including those who are frail (American Psychological Association [APA], 2019; Hu et al., 2020; Jin et al., 2019). Exercise

intervention programmes have also been shown to improve the consequences of frailty, such as low body mass, strength, mobility, physical activity levels, energy, and cognition as well (APA, 2019). A systematic review of eight meta-analyses found that physical exercise interventions, predominantly those based on aerobic or resistance training, were effective in reducing depressive symptoms in older people (Hu et al., 2019). Nevertheless, more studies are essential to determine the optimal type, intensity, and duration of exercise for managing depressive symptoms in frail older people (APA, 2019).

Despite the benefits of exercise, several frail older adults fail to achieve the minimum recommended amount of physical activity (Aubertin-Leheudre & Rolland, 2020). According to Chodzko-Zajko et al. (2009), physical limitations and chronic health conditions like arthritis can be major barriers to this population be physically active. However, the study also proposes that tailored physical exercise programmes may be necessary to overcome these barriers and promote regular physical activity in this population.

Considering the specific needs and limitations of frail older adults, the MIND&GAIT, physical exercise programme (Santos-Rocha et al., 2019), was designed to promote independent living, improve cognition, and gait ability in this population (Apóstolo et al., 2019).

Therefore, considering the expression of depressive symptoms in frail institutionalised older people, the positive effect that exercise in management of depressive symptoms, and the need of more research to determine better exercise options to improve depressive symptoms, we aimed to analyse the effect and feasibility of proposed MIND&GAIT physical exercise programme in depressive symptoms in frail institutionalised older adults.

Methods

Study Design

A pilot study was led from 1 February 2023 to 18 April 2023, for 12 weeks. Prior to participation in the study, after institutional authorisation, participants provided written informed consent, and the study followed ethical standards in line with the Declaration of Helsinki update in 2013 (World Medical Association [WMA], 2013). There was no monetary remuneration.

Participants

To determine the minimum sample size needed for the study, the G*Power 3.1 (Faul et al., 2009) was used, which considered several parameters such as effect size (0.9), α level (0.05), and statistical power (0.80). The analysis indicated that a minimum of 32 participants required, 16 in experimental group and 16 in control group, and this number was indeed met in the study as per the researchers' protocols and designs. The effect size of 0.90 was adopted in line with the results of previous research (Blumenthal et al., 1999; Singh et al., 2005; Such et al., 2016).

A total of 35 Portuguese frail older people (19 female, 16 male), institutionalised, from Ribatejo area of Portugal,

with age between 65 and 98 years old (mean \pm SD, 83.45 \pm 9.73y), were enrolled in this study. All participants were classified as frail (FRAIL scale 3-5) (Thompson et al., 2020; Woo et al., 2012), and all had normal cognition (Mini-Mental State Examination, MMSE 28-30) (Folstein et al., 2001), and were randomly allocated into experimental group, who performed the MIND&GAIT physical exercise programme (n = 19) and in the control group (n = 16). Randomization sequencing was obtained using random group generator in R (Team, 2015). All participants remained in all activities of the institution as usual (prior to intervention), and maintained their usual health care as before starting the intervention. The exclusion criteria were no psychiatric history and no current or previous psychiatric medication. None were medicated for depression disease.

To achieve a homogenous sample for mental health, there was an identification of mental disorders in the recruited persons. After we applied exclusion criteria of no psychiatric history and no current or previous psychiatric medication, the convenience sample consisted of 35 mentally healthy older persons.

Intervention

The experimental group performed the MIND&GAIT physical exercise programme, validated to this population by Santos-Rocha et al. (2019), two times per week, with duration of 30 to 45 minutes, in the morning, in group, in institutional context, for 12 weeks. All sessions had a guidance of a trained technician, with the collaboration of the institution's assistants and technicians. This programme respects the defined training variables and consider the specific conditions of the group and each subject. The MIND&GAIT physical exercise programme sessions were composed of three main phases:

a) Warm-up phase ensured a gradual and smooth transition from resting (pre-workout) to exercise state, and included postural awareness, breathing and joint mobility exercises.

b) The fundamental phase was constituted by aerobic exercises, such as activities involving large muscle groups and cardiovascular training (e.g., walking); considered gradual increase in activity time, followed by increments in intensity (i.e., speed, mechanical load, and/or complexity). Intensity was assured to be maintained within the range of 40 to 50% of the estimated maximum heart rate for age. It means that subjects were asked to maintain the intensity between level five and six of the modified Borg rating of the perceived exertion scale, Borg CR-10 Scale (Borg, 1998). The rating of perceived exertion (RPE) scale is a perceptual-based assessment method that uses a combination of numbers and verbal descriptors. On the scale, category 10 corresponds to maximum exhaustion and 0 to rest. During a session, before the start of intervention, the instructions of Borg's CR-10 Scale were explained to participants. In all sessions, the participants were educated about this tool.

In this phase, were also provide resistance exercises for upper and lower limbs (e.g., elbow and arm flexion and extension - touches shoulder and roof with the ball; leg

extension - ball between ankles) with two to three sets of eight to 12 repetitions. Resistance exercises with functional action (e.g., seating and getting up from a chair) three to four sets up to eight repetitions or by execution time up to 45 seconds were performed.

Balance, coordination, and sensorimotor exercises were also included in this phase (e.g., decrease/increase the supports used during the exercises).

c) Cool-down and stretching phase of each session aimed to transition from exercise to a resting state, and included stretching, relaxation, and breathing exercises.

Throughout each session, the technician maintains a record of the participant's attendance, the exercises performed, as well as any adverse incidents, facilitating the monitoring and tracking of individual and group progress and intensity control. Verbal corrective and encouraging feedback was given to subjects during sessions by the technician. In each session, the control of training intensity was performed through the Borg CR-10 Scale, as suggested by American College of Sports Medicine (ACSM, 2021). After about 20 min of the end of each session, the technicians asked how the participants felt relatively effort/tiredness when the exercises were performed.

As recommend, the sessions were held in an area free of materials on the floor, and during the activities support structures for the participants such as chairs/walls/tables/pillars and chairs without side support arms were used. During the sessions were also used specific equipment like: balloons; bottles; sticks; arches; tissues and elastic bands.

The full programme is available through following link of protocols.io platform: <https://ipdj.gov.pt/documentos/20123/0/Mind%26Gait-ProgramaExerc%C3%ADcio-IdosoFragilidade2019.pdf/17a621a9-09b0-054c-7192-a819abbdedc1?t=1585913519528>

Outcomes measures

The Beck Depression Inventory-II (BDI-II) (Beck et al., 1996) is a widely used self-report measure of depressive symptoms with good internal reliability among older adults (Segal et al., 2008). The BDI-II was administered as a self-report questionnaire in accordance with the manual (Beck et al., 1996; Preiss & Vacíř, 1999). The questionnaire was applied in one room at institutions with help of professionals, at baseline and post-intervention in the total sample and the forms were checked for completeness.

The BDI-II consists of 21 items, each rated on a scale from zero to three, with a total score range of zero to 63. The BDI-II has been validated in several languages and populations, including Portuguese (Campos & Gonçalves, 2011). BDI-II scores are interpreted as follows: zero-13 minimal depression; 14-19 mild depression, 20-28 moderate depression, 29-63 severe depression.

Statistical analysis

After performing the Shapiro-Wilk test, it was found that the data did not follow a normal distribution ($p < 0,05$)

and non-parametric methodology was followed in the statistical analysis. Considering that the data did not follow a normal distribution, Shapiro-Wilk test ($p < 0.05$), our statistical analysis were performed through non-parametric methodology. Mann-Whitney U tests were used to compare differences between two independent groups (i.e., to analyse the difference in BDI-II scores between the experimental group and the control group), while Wilcoxon signed-rank tests were used for paired samples (i.e., to analyse the difference in BDI-II scores before and after the intervention in both groups). All statistical analyses were done using IBM SPSS Statistics for Windows, version 25.0 (IBM Corp, 2017). The significance level was set at $p < 0.05$. The effect sizes were interpreted as small (0.2), medium (0.5), and large (0.8) (Cohen, 1988).

PORTUGAL 2020

PROGRAMA DE EXERCÍCIO FÍSICO

MIND & GAIT PROJECT

Sessão de treino para idosos fragilizados que promove as capacidades físicas e mentais dos participantes.

PLANO DE SESSÃO

Controlo de Intensidade

Atividade	Tempo	Intensidade
Mexer e hidratar-se	5 min	Leve
Hidratar-se	5 min	Leve
Mexer e hidratar-se	5 min	Leve
Hidratar-se	5 min	Leve
Mexer e hidratar-se	5 min	Leve
Hidratar-se	5 min	Leve
Mexer e hidratar-se	5 min	Leve
Hidratar-se	5 min	Leve

**Mexa-se
Hidrate-se
Respire Fundo
Divirta-se**

Alinhamento Postural

"Pés para a frente à largura da anca ; Coluna cresce; Ombros para trás; Braços ao longo do corpo; Cabeça no prolongamento da coluna Sorriso no rosto"

ABERTURA

FootWork

Mobilidade Coluna

Mobilidade Braços

Mobilidade Pernas

Duração: 7 a 10 minutos
Intensidade: 2 a 3 séries de 4 a 8 repetições
5 a 6 ESE, leve a moderada
(Controle os sinais de sobre-esforço)
Movimento: dinâmico/estático (10° a 30°), unilateral/simultâneo
Incluir exercícios de respiração 4 a 5 ciclos

FASE FUNDAMENTAL

Componente de Força e Cardiovascular

Variações com Material

Duração: 15 a 20 minutos
Intensidade: 2 a 3 séries de 8 a 12 repetições
5 a 6 ESE, moderada
(Controle os limites de dor e amplitude)
Movimento: dinâmico/isométrico (10° a 30°), unilateral/simultâneo
Progressões: diminuição da base de apoio, movimentos combinados: braços e pernas, reduzir apoio do tronco, recorrer a materiais de carga externa

FECHO

Duração: 5 a 8 minutos
Intensidade: Leve
Movimento: dinâmico/estático (10° a 30°)
Incluir exercícios de alongamentos e dinâmicas de grupo com desempenho físico individual

UNICO EUROPEIA COMPETE 2020 FCT

Figure 1. Example of physical exercise session of the MIND&GAIT programme.

The example (in Portuguese) indicates the main goals of the session and describes duration, intensity and progressions of exercises in each main phase of the gait physical exercise programme sessions (warm-up; fundamental phase and cool down).

Results

The study included a total of 35 participants with age mean of 83.46 ± 9.73 y. The experimental group was constituted by 19 participants with age between 65 and 95 years old (83.16 ± 9.87 y), been 13 women (68.4%) and 6 male (31.6%). The control group was constituted by 16 participants with age between 67 and 98 years old (mean, 83.81 ± 9.89 y), been eight male (50%) and eight female (50%). During the intervention, we had a dropout of two participants, one woman in the experimental group and one man in the control group. All individuals performed the programmed sessions and there were no adverse events during the programme duration, and all participants maintained the perception of effort between 0 and 10 on Borg Scale during intervention.

Baseline measurements were collected for all groups, at baseline and post-intervention moments. The mean score of BDI-II in the total sample was 14.77 ± 5.52 , which means mild depression.

In line with the BDI-II scores provided, it was observed that there are no differences statistically significantly ($p > 0.05$) between experimental group (14.73 ± 5.63) and control group (14.81 ± 5.56) at baseline (Table 1). After intervention, 12 weeks, were observed differences statistically significantly ($p < 0.05$) between experimental group (11.37 ± 4.92) and control group (16.94 ± 6.15) with a reduce effect. We also can observe that experimental participants decreased BDI-II scores (vs.). In opposite, the

participants of the control group raised BDI-II scores from baseline to post-intervention.

Table 1.
Comparison of BDI-II scores between groups

		n	BDI-II		U	Z	p	η^2
			Mean	SD				
Baseline	Experimental	20	14.73	5.63	151.500	-0.17	0.987	0.009
	Control	17	14.81	5.56				
Post-Intervention	Experimental	19	11.37	4.92	65.000	-2.89	0.004*	0.237
	Control	16	16.94	6.15				

Note: BDI-II, Beck Depression Inventory II; SD, standardised deviation; η^2 , eta-squared; *, significantly different for $p < 0.05$

Based on the Wilcoxon test results (Table 2), the experimental group showed a significant ($p < 0.05$) decrease in mean BDI-II scores from baseline (14.73 ± 5.63) to post-intervention (11.37 ± 4.92), with a medium effect size ($z = -3.107$, $p = 0.002$). We observed that 18 participants in the experimental group had a decrease in their BDI-II values at the post-intervention moment, while only one subject had an increase in their values relative to the baseline.

On the other hand, in the control group, there was a significant increase ($p < 0.05$) in the BDI-II scores from baseline (14.81 ± 5.56) to post-intervention (16.94 ± 6.15), with a large effect ($z = -3.216$, $p = 0.001$). In this group, 13 of them increased the depression outcome from baseline to post-intervention, with three presenting the same BDI-II value at post-intervention compared to baseline.

Table 2.
Comparison of BDI-II scores between baseline and post-intervention in experimental group and control group

	BDI-II Mean \pm SD	Positive Ranks	Negative Ranks	Ties	Z	p	r
Experimental Group Baseline	14.73 \pm 5.63	-	-	-	-3.107	0.002*	0.71
Experimental Group Post	11.37 \pm 4.92	1 ^a	18 ^b	-			
Control Group Baseline	14.81 \pm 5.56	-	-	-	-3.216	0.001*	0.80
Control Group Post	16.94 \pm 6.15	13 ^a	-	3 ^c			

Note: SD, standardised deviation; ^a, Pos > Pre; ^b, Pos < Pre; ^c, Pos = Pre; r, Point biserial correlation; *, significantly different for $p < 0.05$

Discussion

This pilot study aimed to investigate the effectiveness of the MIND&GAIT physical exercise programme in reducing depressive symptoms in institutionalised frail older people. The results of this study indicate that there are no differences between experimental group and control group at baseline in depressive symptoms. However, after the intervention, the differences between the two groups were significant, with a large effect size. The experimental group showed a significant decrease in BDI-II scores from baseline to post-intervention, while the control group's scores increased significantly, meaning that, in general, those who did the intervention improved their depressive symptoms and, conversely, those who did not participate in the MIND&GAIT physical exercise programme worsened this outcome.

It should also be noted that the programme provides intervention with equipment accessible, and it may be a sustainable intervention that can be easily incorporated into

daily life in this population. The efficiency of this programme in reducing symptoms of depression is consistent with previous research that has shown physical activity to be an effective treatment for depressive symptomatology (Moya et al., 2021).

Depression symptoms in frail older adults are usual due to various factors. Physical limitations, chronic pain, and social isolation are common in this population, which can lead to decreased physical activity behaviour and worsen depression symptoms (Dagnino & Campos, 2022; National Institute on Aging [NIA], 2019). Additionally, the loss of loved ones can also contribute to depression symptoms in older adults. In this way, physical activity can improve depressive symptoms in this population through various mechanisms, such as reducing inflammation, improving brain function, and releasing endorphins (Gerber et al., 2018; Mikkelsen et al., 2017).

The MIND&GAIT programme is based on combined exercise, through aerobic and resistance exercise. The effectiveness of this type of intervention on depression in

older adults depends on the depression's severity. In this population, science has revealed that combined exercise is more effective in improving depressive symptomatology in older adults with mild to moderate depression relative to those with severe depression (Schuch et al., 2016; Singh et al. 2005). Aerobic exercise also improves depressive symptoms in older adults with mild to moderate depression (Miller et al., 2020). However, when it comes to frail older adults with mild to moderate depression, combined exercise may be more effective in reducing depressive symptoms than aerobic exercise alone (Mahmoudi et al., 2022).

Effectively, physical exercise has been seen as an effective intervention in reducing depressive symptoms in older adults with mild to moderate depression, and the benefits has been sustained over time (Blumenthal et al., 2007). It could be a complementary action that can be integrated into a comprehensive treatment plan for this population, since exercise has a similar accomplishment to pharmacological interventions in reducing depressive symptomatology in the elderly (Recchia et al., 2022).

Therefore, it is important to work with a multidisciplinary healthcare system to manage depressive symptoms in older adults, and physical exercise should be part of this intervention (EII, 2006).

We observed a decrease in BDI-II scores in the intervention group at the post-intervention moment, while, in the control group, there was an increase from baseline to post-intervention. This indicates that individuals who maintained their normal lifestyles experienced an increase in depressive symptoms. It is important to note that older adults often have low rates of physical activity behaviour, and it is associated with higher levels of depressive symptoms (Overdorf et al., 2016). Moreover, social support can also play a crucial role in preventing and reducing depressive symptoms in this population. A study found that social support mediated the relationship between depression and social isolation in older adults, suggesting that social support can help alleviate the negative effects of social isolation on mental health (Liu et al., 2016). These data reinforce the importance of physical exercise programmes in group in this population, since it has a positive effect on support social in older adults (Ruiz-Comellas et al., 2022). This statement allows us to understand why the control group worsened the depressive symptomatology, since these individuals maintained the usual lifestyle and were not involved in group activities such as the MIND&GAIT programme.

Conclusion

In conclusion, the findings of this study suggest that the MIND&GAIT, physical exercise programme, can be an effective intervention to improve depressive symptomatology in frail older adults when applied over 12-weeks. The significant decrease in mean BDI-II scores in the experimental group suggests that the intervention had a clinically significant impact on the participants.

Based on the preliminary results, we can suggest that

this programme as an easily applicable tool, which uses simple equipment and can be realized in institutions, as a strategy to improve depressive symptomatology in the frail older adult population with mild depression.

Despite the results of this work indicating that the MIND&GAIT programme could be considered as a tool to reduce depressive symptoms in frail older people with mild depression, there are limitations of this work that should be attended to future research, essentially as this study is pilot, and the results should be considered preliminary. Thus, we consider essential in upcoming studies: analyse these variables with larger samples and in different settings and with diverse populations with different levels of disease severity; long-term follow-up assessments are also necessary to determine the durability of the programme's effects on depressive symptoms; consider that BDI-II is a self-reported measure; the assessment of physical activity of the subjects before the intervention should be performed; the trial registration, ethical committee's approval and the blindness in futures studies also should be considered.

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Conflict of interest

The authors declare no conflict of interest.

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