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# Changes in anxiety and depression levels after two exercises programs with women attending the Health Academy Program

## Mudanças nos níveis de ansiedade e depressão após dois programas de exercícios com mulheres participantes do Programa Academia de Saúde

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ABSTRACT

This study investigated changes in anxiety and depression symptoms after two exercise programs with adult women attending the Health Academy Program. Based on non-probabilistic sampling, a total of 93 adult women (aged range: 19–77 years) were recruited into two health units, selected to receive exercise programs with continuous (CT; n = 53) or intermittent (IT; n = 40) characteristics. The activities were supervised for six months (twice a week; ~60 min) by a physical education professional. The primary outcome of the study was the assessment of the level of changes of anxiety and depression using the Hospital Anxiety and Depression scale. Physical function was assessed by a 1-mile walk test, handgrip strength, and sit-to-stand test. No significant group-by-time interaction was observed for any of the investigated outcomes. Regarding the comparisons between moments, there were significant improvements in anxiety ($F = 16.52$; $p = <0.001$; $\eta_p^2 = 0.15$) and depression scores ($F = 9.29$; $p = 0.003$; $\eta_p^2 = 0.09$). Furthermore, there were significant improvements in the one mile walk test ($F = 70.36$; $p = <0.001$; $\eta_p^2 = 0.44$), sit-to-stand test ($F = 141.53$; $p = <0.001$; $\eta_p^2 = 0.61$) and handgrip strength performance ($F = 10.12$; $p = 0.002$; $\eta_p^2 = 0.10$). In conclusion, both exercise programs were equally effective in promoting beneficial changes on anxiety, depression levels, and improved physical function in women attending the Health Academy Program. Therefore, the decision to choose which protocol to use should be based on community preference and practical considerations.

**Keywords**: Physical activity; Public health; Mental health; Physical fitness; Female.

RESUMO

*Este estudo investigou mudanças nos sintomas de ansiedade e depressão após dois programas de exercícios com mulheres adultas participantes do Programa Academia da Saúde. Com base em amostragem não probabilística, um total de 93 mulheres adultas (faixa etária: 19 a 77 anos) foram recrutadas em duas unidades de saúde, selecionadas para receber programas de exercícios físicos com características contínua (CT; n = 53) ou intermitente (IT; n = 40). As atividades foram supervisionadas durante seis meses (duas vezes por semana; ~60 min) por um profissional de educação física. O desfecho primário do estudo foi a avaliação do nível de alterações de ansiedade e depressão por meio da escala Hospitalar de Ansiedade e Depressão. A função física foi avaliada por meio do teste de caminhada de 1 milha, força de preensão manual e teste de sentar e levantar. Nenhuma interação grupo-por-tempo significativa foi observada para qualquer um dos resultados investigados. Em relação às comparações entre os momentos, houve melhora significativa nos escores de ansiedade ($F = 16,52$; $p = <0,001$; $\eta_p^2 = 0,15$) e depressão ($F = 9,29$; $p = 0,003$; $\eta_p^2 = 0,09$). Além disso, houve melhorias significativas no teste de caminhada de 1 milha ($F = 70,36$; $p = <0,001$; $\eta_p^2 = 0,44$), teste de sentar e levantar ($F = 141,53$; $p = <0,001$; $\eta_p^2 = 0,61$) e desempenho de força de preensão manual ($F = 10,12$; $p = 0,002$; $\eta_p^2 = 0,10$). Em conclusão, ambos os programas de exercícios foram igualmente eficazes na promoção de mudanças benéficas nos níveis de ansiedade, depressão e melhora da função física em mulheres participantes do Programa Academia de Saúde. Portanto, a decisão de escolher qual protocolo aplicar deve ser baseada na preferência da comunidade e em considerações práticas.*

**Palavras-chave**: *Atividade física; Saúde pública; Saúde mental; Aptidão física; Mulher.*

## Introduction

Anxiety and depression are considered the most common mental disorders and the main causes of disability globally[1]. Projections from World Health Organization indicate that depression will be the leading cause of disease burden in the coming years[2]. In addition, mental disorders are associated with several non-communicable diseases and a substantially higher health care utilization, thus creating a significant economic burden for the public health system[3].

According to the Global Burden of Disease Study (GBD)[1], Brazil has one of the highest disability-adjusted life-years (DALYs) rates for mental disorders, and national surveys indicate that women, with lower educational levels, and those living in the Southern region are the most affected by depression and anxiety disorders[4,5].

While pharmacological agents are generally administered to manage and treat anxiety and depression disorders, concerns have been raised about their unpleasant side effects and some patients have developed treatment-resistance[6]. Psychotherapy counseling is an alternative or adjunct to medicines; unfortunately, access to therapies and psychosocial care programs is deficient in primary public care[7]. In this regard, low-cost primary health care strategies for preventing and controlling non-clinical cases are considered the best strategy to deal with this complex public health issue.

The National Health Promotion Policy, which was approved in 2006, was an important milestone for strengthening and promoting bodily practices and physical activities in the primary care network in the Unified Health System (*Sistema Único de Saúde*, SUS in Portuguese)[8]. The subsequent creation and articulation of the Family Health Support Centers (*Núcleo de Apoio à Saúde da Família* - NASF in Portuguese) and the Healthy Academy Program (*Programa Academia da Saúde* in Portuguese) were essential public policies to implement availability of spaces and offers of supervised bodily practices programs for the population.

The effects of exercise in primary and secondary prevention of cardiometabolic diseases are well-established[9] and recent meta-analyses of randomized controlled trials revealed that exercise programs are similarly effective in treating anxiety and depression disorders just as pharmacological treatments and psychotherapy[10-12]. However, there is sparse evidence of whether exercise programs improve symptoms of non-clinical cases of anxiety and depression in primary health care settings.

Considering the presence of physical education professionals in the Brazilian public health system (by Family Health Support Centers and the Healthy Academy Program), it is essential to test the effects of low-cost physical exercise programs on the promotion of health, including mental health. Besides, the characteristics of different exercises programs (for example, continuous or intermittent) can alter adherence to the exercise regimen and affect the magnitude of therapeutic responses.

Therefore, this study investigated changes in anxiety and depression symptoms after two supervised group exercise programs on anxiety and depression symptoms with adult women attending the Health Academy Program. The study further examined the improvements on physical function based on one-mile walk, handgrip strength, and sit-to-stand test. We hypothesized that positive changes in anxiety and depression followed by changes in physical function parameters would be independent of which exercise program was performed by each group of women attended by the Health Academy Program.

## Methods

This quasi-experimental study is based on a pre- and post-test design with two groups. A non-probabilistic sampling involved adult women attending public primary health care settings. This project was developed in partnership with the health department from Brazópolis, a small city in the state of Minas Gerais (Latitude: 22° 28' 28" South, Longitude: 45° 36' 39" West).

The study was carried out within the Health Academy Program, in which a physical education professional was responsible for providing supervised body practices. During the study period, the city had one physical education professional and five basic health units that are classified as the *Estratégia Saúde da Família* (ESF) where primary and specialized health care is provided to the local population.

The recruitment of participants was done through the dissemination of NASF professionals in two basic health units. The selection of locations was based on convenience due to the physical structure of the environment (covered room, ventilated, with safe drinking water and available washroom) close to the health units for carrying out activities in groups. The study was restricted to only two health units because the exercise protocol had to be adapted to fit in amongst other health care activities. One unit was located in the central region and the other was in a peripheral location. For each selected unit, the indication of the physical exercise program (with continuous or intermittent characteristics) was randomly chosen by raffle.

The eligibility for the study was based on the following inclusion criteria: (a) must be a female; (b) ≥ 18 years old; (c) having no clinical contraindications to physical exercise, as indicated by the physician of the health unit; (d) not pregnant; (e) and not performing supervised exercises outside the limits of what the public health system offered. This study was approved by

the Research Ethics Committee (*Universidade Metodista de Piracicaba*, number: 3.229.095), and all participants signed an informed consent form.

The sample size was estimated for anxiety and depression changes following exercise intervention. Based on a group-by-time interaction of a mixed ANOVA, using a small effect size (F = 0.160; partial eta squared [$\eta_p^2$] = 0.025) and a correlation among repeated measures of 0.50, it was calculated that a total sample size of 80 participants would be required to achieve 80% power and α value of 0.05 (G*Power, version 3.1.9.2, Universitat Kiel, Germany).

The outcomes of this study were assessed before and at the end of the intervention period, which lasted six months. The measurements were performed by the same team of trained evaluators that were not involved with the intervention. The primary outcome of the study was the assessment of anxiety and depression levels by the Hospital Anxiety and Depression (HAD) scale. This scale comprises 14 items, seven measuring anxiety symptoms, and seven depression symptoms. Each item has a four-point Likert response scale (between 0 and 3 points per item) through which each participant responded based on how they felt during the last week. The global score for anxiety and depression by the instrument is the range of 0–21, with higher scores indicating greater symptoms severity. Although the scale was developed for its application in a hospital environment[13], it has been widely used in research conducted in primary care studies[14]. The version of the instrument used in this study was adapted and validated for Portuguese by Botega et al.[15]. In this study, the internal consistency indices of the HAD scale was proven acceptable according to Cronbach's alpha coefficient (anxiety pre = 0.78; anxiety post = 0.76; depression pre = 0.75; and depression post = 0.71) and McDonald's omega coefficient (anxiety pre = 0.79; anxiety post = 0.78; depression pre = 0.76; and depression post = 0.75).

The secondary outcomes of this study were changes in physical function and body mass. Physical function was based on one-mile walk tests, handgrip strength, and sit-to-stand test. In brief, the one-mile walk test was conducted in a flat and covered gym, where the volunteers were instructed to walk as fast as they could (without running or jogging) for a distance of 1,609 meters[16]. The total time (in seconds) to complete the test was considered for analysis. The sit-to-stand tests were done with an armless chair (43 cm high) and the participants were instructed to stand up and sit down as quickly as possible for 30 seconds, with arms crossed on their chest. Two trials were performed with one-minute rest intervals and the highest number of repetitions was obtained for analysis[17]. A mechanical grip dynamometer (TKK, Grip Strength Dynamometer 0–100 kg, Takei, Japan) adjusted according to the size of the hand prior to evaluation was used to measure the handgrip strength[18]. After a verbal command from the evaluator, the participants performed the handgrip movement for six seconds with as much effort as possible, with the elbows extended. For each hand, three trials were performed (30-seconds intervals) and the highest value in kg was obtained for analysis. Following the International Society for the Advancement of Kinanthropometry, anthropometric measurements (height and body mass) were performed[19]. Sociodemographic and lifestyle information (age, household income, skin color, education, current smoking and drinking alcohol) was obtained with a multiple-choice questionnaire.

Interventions were performed between April and October 2019. The continuous training (CT) program was prescribed with blocks of exercises with continuous characteristics, with minimum bouts of 10 minutes and at ~2 minutes rest intervals to change the stimulus. During the activities, the participants were instructed to perform physical efforts that allowed them to talk but not sing during the activity[20] associated with the 12-13 effort domain based on the Borg Scale[21], available on posters. Therefore, the effort intensity control was self-adjusted by the participants during the activities based on their preference (talk test and/or Borg scale). The exercises performed included aerobic gymnastics, dancing, walking, and/or jogging in an obstacle course, with a total duration of 50 minutes, preceded by warm-up with light effort and concluded with stretching (~10 minutes). The intermittent training (IT) program was prescribed with blocks of intermittent exercises in a circuit format, with each repetition lasting ~60 seconds, with ~2 minutes for recovery between stations. During the activity, the participants were instructed to perform physical effort that allowed them to say more than a few words at a time[20] associated with the 14–17 effort domain on the Borg Scale[21]. The IT activities were performed with accessories (bars, dumbbell [weighting ~2 kg], and swiss ball) and bodyweight exercises for a total duration of 50 minutes, which was preceded by warm-up with light effort and ended with stretching (~10 minutes). Both programs were held twice a week

(Monday and Wednesday) and supervised by NASF physical education professional. All activities were paced by music (axé, sertanejo, dance, mpb, and funk music) and the teacher encouraged social interaction among participants in a playful way.

Statistical analyses were performed using R statistical software (version 4.1.3). Data were analyzed by intention-to-treat (including all study participants in the model, regardless of non-compliance, withdrawal, and anything that happened after the group selection) and the per-protocol approach (including only participants who completed both evaluations). Initially, the distributions of the study variables were visually inspected using histogram and quantile-quantile (QQ) plots in order to identify the characteristics of the data distributions. Data that did not meet normality were transformed using Turkey's ladder of powers technique (to fit the normal distribution as closely as possible) using the 'rcompanion' package (version 2.4.15). Baseline characteristics were compared using the independent t-test, chi-square ($\chi^2$), or as indicated. Linear mixed models were used to assess longitudinal associations (correlated data) between independent and dependent variables using the 'lmerTest' package (version 3.1-3). Age (covariate), group (CT and IT), time (pre and post) and group-by-time interaction were fixed factors, while participants (ID) were the random factors. Estimated marginal means and 95% confidence intervals (95% CI) of the models (including back-transformed) were obtained by the 'emmeans' package (version 1.7.3). The partial eta-squared ($\eta_p^2$) of the models and within-group rank-biserial correlation (rrb) were calculated using the 'effectsize' package (version 0.6.01). The effect size was interpreted as very small ($\eta_p^2 < 0.01$; rrb < 0.12), small ($\eta_p^2 \geq 0.01$ or < 0.06; rrb 0.12 or < 0.24), moderate ($\eta_p^2 \geq 0.06$ or < 0.14; rrb ≥ 0.24 or < 0.41) or large ($\eta_p^2 \geq 0.14$; rrb ≥ 0.41)[22,23]. Assumptions and quality of the models such as collinearity, linearity, normality of residuals, normality of random effects, homogeneity of variance, and posterior predictive check were confirmed using the 'performance' package (version 0.9.0). The level of significance was established at $p < 0.05$. As the results were not different between the two analysis strategies, we present the data using the intention-to-treat approach. Data are expressed as mean ± standard deviation or as indicated.

## Results

Figure 1 shows the flowchart of the study. A total of 114 adult women were evaluated for eligibility in this study. Eighteen women did not meet the inclusion criteria (pregnant women [n = 1], medical contraindication [n = 4], and participation in other physical activity programs [n = 13]) and three women opted out in the study. Five participants dropped out of the study (one due to pregnancy during the study, two due to a change of location, and two for medical reasons) and one participant did not participate in the final measurements. The mean adherence of all research participants to the proposed intervention was 80 ± 19%. The mean adherence of participants who completed the intervention period was 85 ± 14%.

Characteristics of the study participants are shown in Table 1. The mean age of the participants was 51 years (range: 19–77 years). Mean BMI was 29 kg/m$^2$ (range: 16–42 kg/m$^2$). Most of the participants were white (83%), had ≤ 8 years of education (68%), were non-smokers (95%), and non-alcoholics (83%). Forty-four percent of the participants reported a family income ≤ 1 minimum wage. Participants in the CT group were significantly older compared to those in the IT group. No other differences between the groups were observed at baseline.

Table 2 shows the changes on the study outcomes, and Figure 2 illustrates the variability in intervention response on levels of anxiety and depression. There was no group-by-time interaction effect (between-groups comparisons) for any of the investigated outcomes. There was a significant time effect (between moments comparisons), suggesting significant improvements in anxiety ($F = 16.52$; $p = <0.001$; $\eta_p^2 = 0.15$; large effect) and depression scores ($F = 9.29$; $p = 0.003$; $\eta_p^2 = 0.09$; moderate effect) among the study participants after the intervention period (Figures 2A and 2B). Regarding secondary outcomes, the main effect of time was also observed, indicating a significant body mass loss ($F = 8.21$; $p = 0.005$; $\eta_p^2 = 0.08$; moderate effect) and improvements in the one-mile walk test ($F = 70.36$; $p = <0.001$; $\eta_p^2 = 0.44$; large effect), sit-to-stand test ($F = 141.53$; $p = <0.001$; $\eta_p^2 = 0.61$; large effect), and handgrip strength performance ($F = 10.12$; $p = 0.002$; $\eta_p^2 = 0.10$; moderate effect).

The effect size based on rank-biserial correlation is shown in Figure 3. Large and moderate effects were observed in both groups for anxiety (IT rrb = 0.53; CT rrb = 0.41) and depression (IT rrb = 0.40; CT rrb = 0.30), respectively. Regarding the secondary outcomes, both groups had large effects on one-mile walk (IT rrb

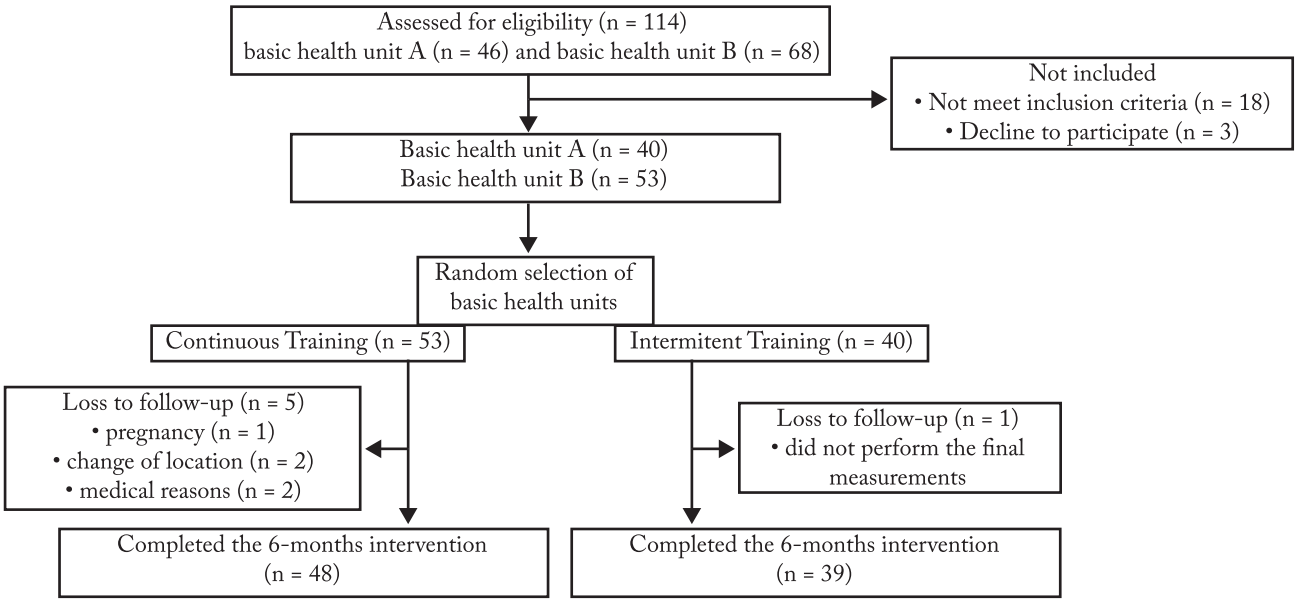


**Figure 1 –** Flowchart of the study.

**Table 1 –** Characteristics of the study participants

| Continuous variables | Total (n = 93) mean ± SD | CT (n = 53) mean ± SD | IT (n = 40) mean ± SD | p-value |
|---|---|---|---|---|
| Age (years) | 51 ± 14 | 55 ± 12 | 47 ± 15 | <0.001 |
| Body Mass (kg) | 69 ± 13 | 68 ± 13 | 69 ± 13 | 0.672 |
| BMI (kg/m²) | 29 ± 5 | 29 ± 6 | 29 ± 5 | 0.523 |
| Categorical variables | n (%) | n | n | |
| Household income | | | | |
| ≤ 1 minimum wage | 41 (44) | 23 | 18 | 0.955 |
| > 1 minimum wages | 52 (56) | 30 | 22 | |
| Skin Color | | | | |
| White | 77 (83) | 40 | 37 | 0.061 |
| Black/Pardo/Indigenous/East Asian | 16 (17) | 13 | 3 | |
| Years of schooling | | | | |
| ≤ 8 years | 63 (68) | 37 | 26 | 0.789 |
| > 8 years | 30 (32) | 16 | 14 | |
| Current smoking ǂ | | | | |
| Yes | 5 (5) | 5 | 0 | 0.068 |
| No | 88 (95) | 48 | 40 | |
| Drinking alcohol | | | | |
| Yes | 16 (17) | 13 | 3 | 0.061 |
| No | 77 (83) | 40 | 37 | |

Legend: BMI = body mass index; CT = continuous training; IT = intermittent training. ǂ Fisher's exact test.

= 0.78; CT rrb = 0.83) and sit-to-stand test (IT rrb = 0.91; CT rrb = 0.97) performance, and moderate effects on body mass loss (IT rrb = 0.32; CT rrb = 0.35). On the other hand, the IT group induced large effects on handgrip strength (rrb = 0.48), while a moderate effect (rrb = 0.26) was observed for the CT group.

## Discussion

To the best of our knowledge, this is the first study investigating changes in anxiety and depression after two exercise programs with adult women attending the Health Academy Program. Our main findings indicate that the two interventions positively changed anxiety

**Table 2 –** Changes in primary and secondary study outcomes.

| Variables | Time Effect ǂ | | | | CT group | | IT group | | Time-by-Group ǂ | |
|---|---|---|---|---|---|---|---|---|---|---|
| | pre | post | F-value | p-value | pre | post | pre | post | F-value | p-value |
| Anxiety (score) | 6.6 (5.8 - 7.43) | 5.2 (4.5 - 6.0) | 16.52 | <0.001 | 6.7 (5.6 - 7.8) | 5.7 (4.7 - 6.7) | 6.5 (5.3 - 7.9) | 4.8 (3.8 - 6.0) | 1.49 | 0.226 |
| Depression (score) | 4.2 (3.5 - 5.0) | 3.2 (2.6 - 3.9) | 9.29 | 0.003 | 4.3 (3.4 - 5.3) | 3.6 (2.7 - 4.5) | 4.2 (3.1 - 5.3) | 2.9 (2.0 - 3.9) | 0.80 | 0.375 |
| Body Mass (kg) | 68.7 (66.1 - 71.3) | 68.0 (65.4 - 70.6) | 8.21 | 0.005 | 68.1 (64.6 - 71.6) | 67.4 (63.9 - 70.9) | 69.4 (65.4 - 73.5) | 68.6 (64.5 - 72.6) | 0.12 | 0.732 |
| 1-mile-walk Test (seconds) | 1126 (1102 - 1150) | 1059 (1035 - 1083) | 70.36 | <0.001 | 1128 (1096 - 1160) | 1157 (1025 - 1089) | 1124 (1087 - 1161) | 1061 (1024 - 1098) | 0.31 | 0.582 |
| Sit-to-stand Test (repetitions) | 19 (18.2 - 19.9) | 23.6 (22.7 - 24.4) | 141.53 | <0.001 | 18.1 (17.0 - 19.2) | 22.4 (21.3 - 23.6) | 19.9 (18.6 - 21.2) | 24.7 (23.4 - 26.0) | 0.36 | 0.550 |
| Handgrip Strength (kg) | 26.4 (25.6 - 27.3) | 27.3 (26.5 - 28.2) | 10.12 | 0.002 | 26.2 (25.1 - 27.3) | 26.7 (25.6 - 27.9) | 26.7 (25.4 - 28.0) | 27.9 (26.5 - 29.2) | 1.15 | 0.287 |

ǂ Linear mixed linear model (age, time, and group as fixed factor and participants as random factor). Data are expressed as estimated marginal means and 95% confidence interval.

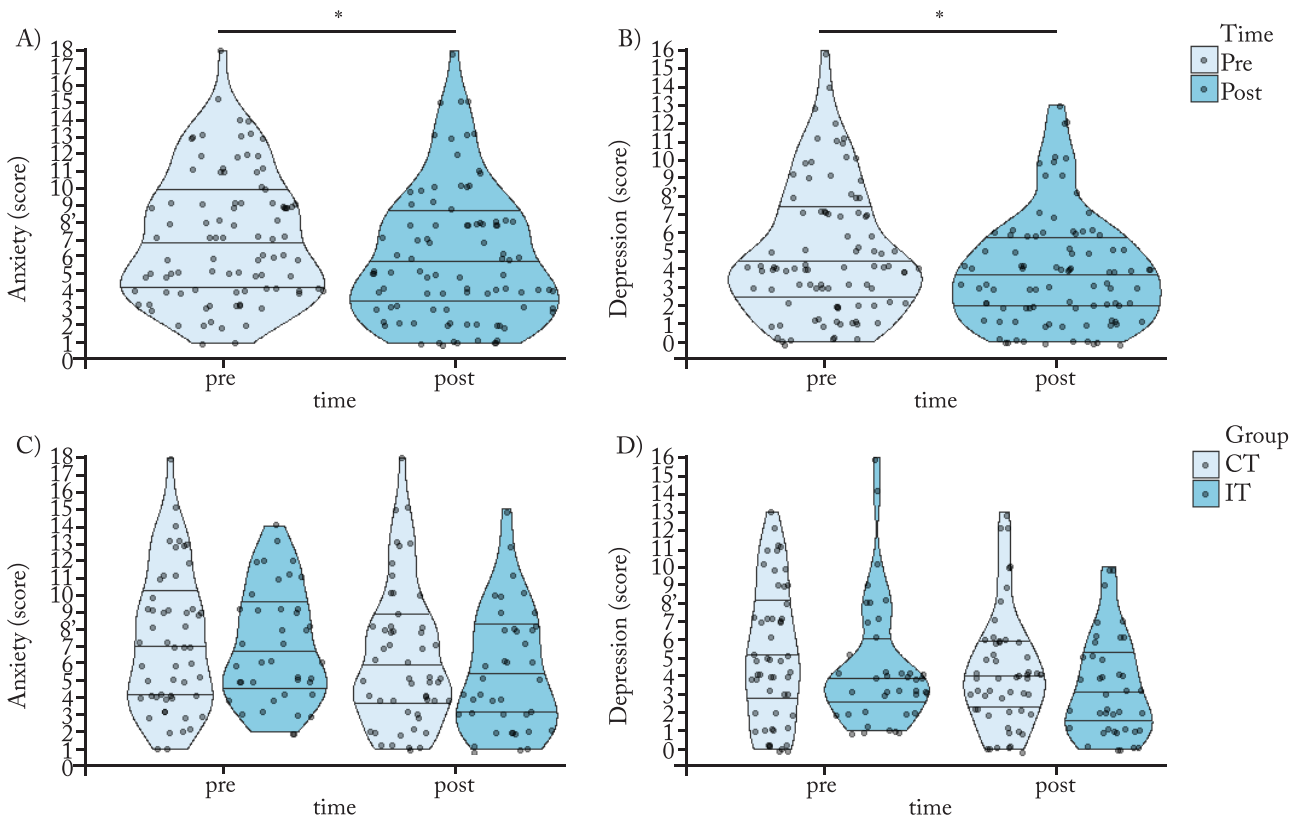


**Figure 2 –** Violin plot showing data distribution, median, interquartile range, minimum, and maximum values. Panel A presents pre-and post-intervention anxiety scores. Panel B presents pre-and post-intervention depression scores. Panel C presents pre-and post-intervention anxiety scores by group. Panel D presents pre-and post-intervention depression scores by group. * represents the significant time interaction ($p < 0.001$) derived from a linear mixed model.

and depression levels (large and moderate effects), thus suggesting that group activities supervised by physical education professionals in primary health care can act preventively and therapeutically on mental health. Furthermore, high adherence to the six-month program and improvements in different parameters of physical function confirm our hypothesis that both group exercise programs were equally suitable for health promotion.

There is promising evidence on physical activity promotion programs in the Brazilian Unified Health System. However, longitudinal intervention studies investigating the impact of exercise programs in primary

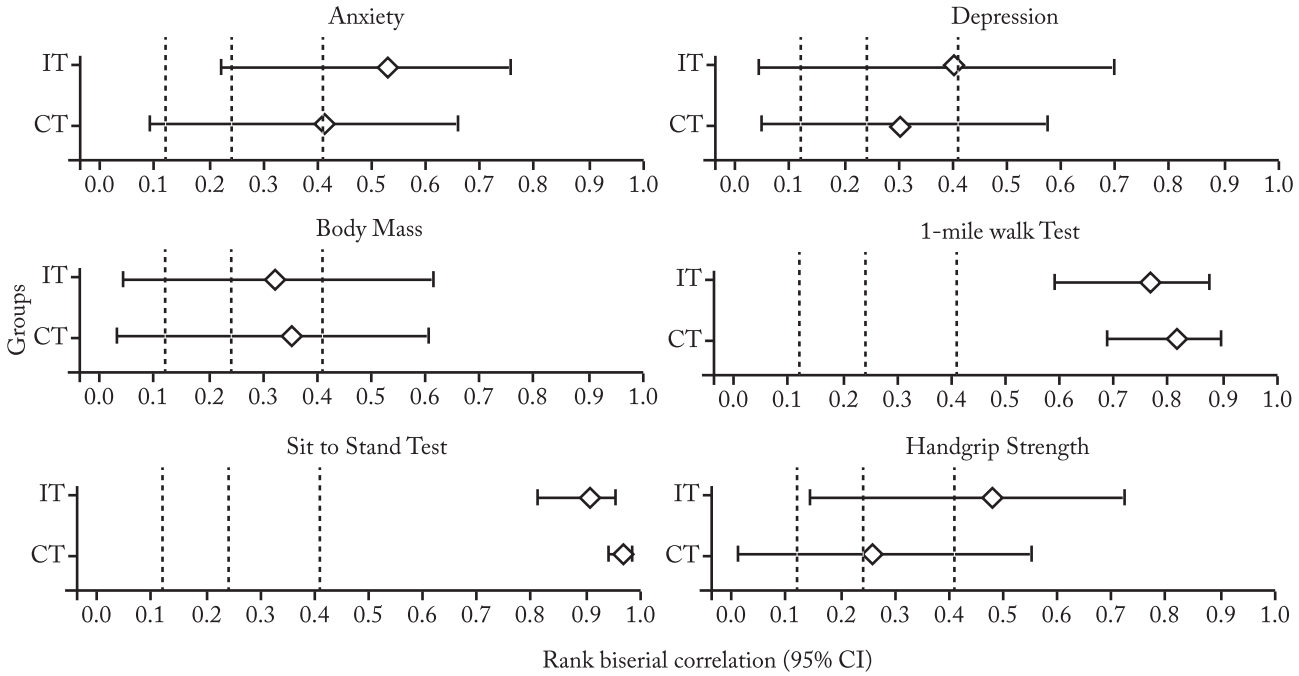


**Figure 3 –** Within-groups rank-biserial correlation (rrb). IT = intermittent group; CT = continuous group; Vertical dashed line represents the threshold for very small (<0.12); small (≥0.12 or <0.24); moderate (≥0.24 or < 0.41), and large (≥ 0.41) effect size.

health care are scarce[24]. The major strength of the present study is in the fact that the exercise program was designed in the real context of the Health Academy Program in a municipality with a simple structure to meet the demands of the local population. Furthermore, our data strengthen the importance of incorporating physical education professionals into primary care settings to coordinate supervised body practices that generates motivation and community involvement.

Despite the low weekly volume of exercise (~120 min/week) offered by the program, we observed significant improvements in the study outcomes after the six-month supervised intervention. This result aligns with that of da Silva et al.[25] who found similar improvements in quality of life (psychological, social, and overall domains) of women attending primary care, especially when the volume of the exercise program was 120 and 270 minutes per week.

Although the optimal dosage of exercise for preventing mental disorders remains unclear, the positive changes may occur at a volume below the standard recommendations for physical activity[26]. For instance, in a Norwegian cohort study (11 years follow-up), a protective effect for depression was observed at low levels of leisure-time exercise, with no additional benefit beyond 1-hour per week in adults with no previous history of mental disorder[27]. Moreover, the present study found that the characteristics of the exercise programs (continuous vs. intermittent) were not decisive to change the magnitude of the response, thus suggesting that the quality of the experience by the subjects during the activities is more relevant than just the exercise prescription per se (such as volume and intensity) for anxiety and depression symptoms.

Although the benefits of exercise on mental health are investigated through several varied physiological pathways (e.g., endorphins, neurotrophic growth factors, oxidative stress, and inflammatory markers), aspects, such as social interactions, enjoyment, distractions from stress, adherence, and sense of belonging during the activities, have been highlighted by experts[28,29]. Therefore, our findings reinforce the importance of promoting enjoyable exercise programs with social interactions opportunities for the population, which can be done by large groups and coordinated by popular music, apart from maintaining the proposed intensity and volume of the exercises.

Our data indicated that both interventions tested resulted in improvements (large effects) in essential physical capacities such as cardiovascular fitness and muscular endurance of the lower extremities. This finding is consistent with that of Azevedo and Mundstock[30], who also reported performance improvements on the one-mile test after a 6-month supervised combined exercise program in patients referred by physicians from the Family Health Strategy teams. This

information is relevant to public health, since a longitudinal cohort study[31] indicated that each additional minute per mile of walking pace was associated with cardiovascular diseases (2.4% increase), ischemic heart disease (2.8% increase), heart failure (6.5% increase), diabetes (6.3% increase), dementia (6.6% increase) and all-cause mortality (1.8% increase).

Furthermore, a positive change in handgrip strength was also observed, which is considered a useful indicator of general health status, disability, and all-cause mortality[32]. The magnitude of the effect size was higher for the IT group (Figure 3), reinforcing the importance of effort intensity for its best response. This may be even more relevant for postmenopausal women, who naturally experience a decrease in hormonal status and muscle strength levels.

This study has some limitations that must be considered. First, the selection of basic health units that would receive physical exercise programs was based on convenience. The lack of physical structure to offer activities in groups is a reality of the Brazilian public health system, a factor that would compromise the standardization of our study protocol. Second, since it was a quasi-experimental study, it is impossible to infer the results for the whole municipality. Additionally, the lack of a control group (without intervention) is a factor that compromises understanding the causality of the outcomes studied. Third, our inclusion criteria were broad and probably recruited motivated individuals who are more susceptible to responses from the group exercise program. Thus, replicating this intervention model with better control over confounders and conducting investigations in other municipalities and social contexts is vital.

In practical terms, both intervention proposals were adequate to be applied in the context of primary care in a small town with limited physical resources. Although the study focused on adult women (due to the lower demand by men for the services offered by NASF in the study's city), the proposed group exercise program was coordinated by a single physical education professional and offered to the entire community, serving an average of 160 individuals (~40 families) per month in both units.

In conclusion, both group exercise programs were equally beneficial in promoting changes in anxiety, depression levels, and improved physical function in women attending the Health Academy Program. Therefore, the decision to choose which protocol to use should be based on the community preference and practical considerations. These findings are relevant for public health managers in Brazil since they provide evidence about low-cost group exercise programs to prevent and control non-communicable chronic diseases. The intervention model applied by this study emphasizes the importance of incorporating the physical education profession in Unified Health Systems.

## Conflict of interest

The authors declare no conflict of interest.

## Author's contributions

Barbosa CGR, conceptualization, data curation, and writing of the manuscript. Crisp AH, conceptualization, administration, and formal analysis. Oliveira JJ, data collection and data curation. Ribeiro AGSV, data collection and data curation. Oliveira MVA, data collection and data curation. Verlengia R, conceptualization and administration. All authors interpreted the data and participated of critical revision and final approval.

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