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Can different degrees of resistance training improve mood states in patients with fibromyalgia? A randomized controlled trial

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SUMMARY

The purpose of this study was to look at the effects of low and high intensity resistance training (RT) on the mood states of fibromyalgia patients (FM).

A total of 69 women participated in the study, with 31 healthy women serving as control group (HC), and 28 women diagnosed with FM being randomly assigned to one of two RT groups: low intensity or high intensity. Ten women diagnosed with FM formed a group of preferred intensity (PI).

FM patients were subjected to 8 weeks of supervised RT with low, high, or PI doses. The exercise protocol was the same for both groups, with large muscle group exercises. Each intervention group performed a specific number of repetitions and rest periods based on the intensity. Training sessions took place twice a week. The HC received no type of intervention. The Brunel mood scale was used to assess mood states.

When the mood profiles of patients with FM and healthy women were compared, patients with FM showed a worse mood profile. Low and high intensity RT for eight weeks did not improve the mood profile of FM patients. Anger showed a significant difference between LIRT and HIRT groups in the follow-up period (p=0.01); similarly significant differences between HIRT and HC were seen at baseline and at the 4 week evaluation in vigor (p=0.01 and p=0.001) and fatigue (p=0.01 and p=0.03). FM patients have a worse mood profile than healthy women, and eight weeks of low and high intensity RT did not result in significant improvements.

Key words: *Brums, exercise, strength training, fibromialgia.*

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INTRODUCTION

In addition to the chronic pain that characterizes the syndrome, patients with fibromyalgia (FM) have a proclivity for mental health deterioration, as high levels of depression and anxiety are frequently observed in this population, reflecting a negative change in their mood profile (1, 2). Mood states have been studied as an excellent indicator of mental health in a variety of contexts and populations, including athletes (3, 4), children and adolescents (5, 6), healthy individuals (7), and patients with rheumatic diseases (8).

Some researchers have recently begun to focus on this variable in FM patients. Brandt et al. (9) discovered a recurring mood profile in FM patients that included low vigor and elevated levels of depression, tension, fatigue, anger, and mental confusion.

Due to the lack of a cure for FM, research on non-drug treatment options such as physical exercise (PE) and cognitive behavioral therapy has been stimulated. Some research has suggested that PE could be used to improve the mental health of FM patients (8, 10-12). Resistance training (RT) has been extensively studied among physical education (PE) modalities (13-16); however, few studies have examined its effect on mood states (10). A recent study evaluating the mood states of patients with FM who underwent RT, walking, or stretching discovered that PE can improve mood because it reduces tension,

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depression, and mental confusion and improves quality of life (8). Another study by the same group of researchers looked at the significant effect of RT on FM patients and discovered that mood improved after just one session of RT (11).

Despite the fact that mood changes are detrimental to mental health and are extremely common in FM patients, this variable has received little attention in research to date. No studies appear to have examined mood state in recently published systematic reviews (10, 17), as the most commonly studied psychological variables in this population are depression and anxiety, and few studies present mental health as the primary outcome. Furthermore, we could not find any research comparing the effects of low and high intensity exercise on the mood of FM patients undergoing RT.

As a result, the current study aims to fill this gap by examining the effects of low and high intensity RT on the emotional state of FM patients.

MATERIALS AND METHODS

This study is a randomized, controlled, blinded clinical trial conducted at a university in southern Brazil in accordance with the Consolidated Standards of Reporting Trials (CONSORT) (18). The study was conducted from August 2019 to February 2020 in accordance with the Declaration of Helsinki and Resolution 466/12 of the National Health Council of Brazil, and it was approved by the local Research Ethics Committee. The study was submitted to the Brazilian Registry of Clinical Trials (no. RBR-74pcmw).

Participants

The study included 38 women with FM diagnosed using the American College of Rheumatology's criteria (19) and 31 healthy women as controls. Patients with FM were eligible if they had a medical diagnosis of FM, were between the ages of 18 and 70, were female, and had a medical certificate allowing them to practice PE. Patients with heart, lung, muscle, or joint problems that prevented them from participating in the assessment and exercise sessions, as well as those who had participated in PE regularly in the three months preceding the study, were excluded. In the healthy control group, the inclusion criteria were women between the ages of 18 and 70, who were healthy (not receiving regular medical treatment for any disease) and had no complaints of pain, joint stiffness, or sleep disorders. The study also included a group of ten FM patients who received RT at their preferred intensity.

Procedures

Patients were recruited through postings in hospitals and health units, advertisements in local newspapers, and the Center for Health and Sports Sciences. Patients who were interested were contacted by phone and scheduled for an interview. The research procedures, evaluations, and interventions were thoroughly explained during the interview, and those who agreed to participate signed the free and informed consent form. The participants were then divided into groups after answering questionnaires about the evaluated outcome. Patients with FM were randomly assigned

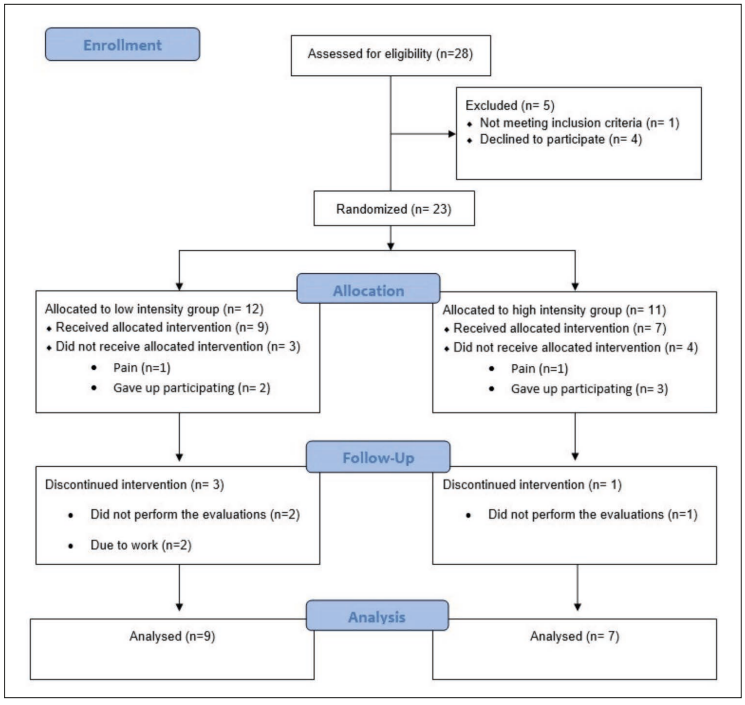

Figure 1 - Flowchart of inclusion of study participants.

to one of two intervention groups: low intensity resistance training (LIRT) or high intensity resistance training (HIRT). Patients were randomized 1:1 to groups using computer-generated allocation (http://www.randomization.com). Nobody knew which group the patients belonged to. The preferred intensity group was made up of patients from the extension project database (PI). Participants in the HC and PI groups were not randomly assigned. Figure 1 depicts the flowchart for including participants in the low and high intensity groups. The exercise sessions and assessments were held at the same time of day to avoid any circadian effect on the symptoms.

Intervention

The patients received supervised RT twice a week for eight weeks. Each training session lasted between 45 and an hour. All participants went through two familiarization sessions in which they were taught how to do the exercises. The exercises were the same in all three intervention groups. The patients began with a warm-up that included dynamic stretches for the muscle groups that would be worked out, followed by the protocol exercises with a light load. Bench press, low row, squat, leg press, shoulder press, and standing calf raise were the exercises performed. The LIRT exercises consisted of two sets of 12 repetitions each, with a one-minute rest in between. The exercises in the HIRT were divided into four sets of six maximum repetitions each, with a two-minute break between sets. The exercises were performed in three sets of eight to twelve repetitions, depending on the patient's tolerance, with a one-minute interval between sets. HC women did not exercise and were not asked to change their daily routines during the study period.

Outcome measures

Data regarding age, educational level, time since diagnosis, and main symptoms at baseline were collected through a standardized interview prepared by the authors. For the analysis of mood state, the Brunel mood scale (BRUMS) was used, with data collection from LIRT and HIRT performed at baseline, after 4 weeks and 8 weeks of intervention, and 4 weeks after the end of the intervention (follow up). Assessments were carried out by researchers previously trained and blinded to theallocation of patients. The PI was not evaluated in the follow up and the HC was evaluated at 4 weeks.

Mood states

The Brunel mood scale (BRUMS) is a mood assessment instrument developed by Terry et al. (20) and validated in Brazil by Rohlfs et al. (21), which evaluates tension, depression, anger, vigor, fatigue, and mental confusion. The scale consists of 24 items, and the subject selects a numerical option ranging from 0 (none) to 4 (extremely) based on how they feel at the time of the evaluation. Each mood state is assigned a score ranging from 0 to 16 based on the sum of the answers to the questions relating to each construct. When an individual has high vigor and low levels of the other variables, they have an ideal mood profile (dubbed the Iceberg profile) (22). When negative subscales are close to or higher than vigor, it indicates a significant change in mood, which can impact individuals' mental health and quality of life (23).

Statistical analysis

Because there are no comparable studies in the literature, a sample calculation based on the standard deviation was not possible, so a power analysis of the sample was performed. The statistical program GPower 3.1 was used for this, with a type 1 error of 5% and a type 2 error of 20%, resulting in a sample power (1-ß err prob) of 86%.

The obtained results were analyzed using the Statistical Package for the Social Sciences (SPSS), version 20.0 software (IBM Corp., Armonk, NY, USA). The analyses employed descriptive and inferential statistics. In terms of descriptive statistics, exploratory data analysis was performed to verify data distribution (Kolmogorov-Smirnov test), and distribution of frequencies, percentages, maximums and minimums were assessed using data and data dispersion (standard deviation). Inferential statistics were computed using Generalized Estimating Equations (GEE), which compared the values of

the groups (LIRT, HITR, PI, and HC) and the moments (baseline, four weeks, eight weeks, and follow up). Group, time, and group interaction with time (group*time) effects were investigated. To identify differences between means in all variables, the Bonferroni post-hoc test was used.

To assess the magnitude of significant differences between the pre and post intervention moments and between groups, Hedges g was calculated (g) ($\bar{x}1$-$\bar{x}2$/DP grouped). The effect size magnitudes were interpreted as follows: <0.2 without effect; 0.2-0.4 small; 0.5-0.7 moderate; ≥8 large (24). For all analyses, a significance level of p≤0.05 was adopted.

RESULTS

The final sample consisted of 26 FM patients and 27 healthy women, with an av-

Table I - Sociodemographic and clinical characteristics of the participants in each group.

	LIRT (n=9)	HIRT (n=7)	PI (n=10)	HC (n=27)
Age (year)	57.8±9.9	46.2±8.3	57±9.0	48.6±11.9
Marital status (%)				
With partner	5 (55.6)	4 (57.1)	4 (40)	16 (59.3)
Without a partner	4 (44.4)	3 (42.9)	6 (60)	11 (40.7)
Have an occupation? (%)				
Yes	6 (66.7)	3 (42.9)	3 (30)	13 (56.5)
No	–	2 (28.6)	2 (20)	10 (43.5)
On leave	3 (33.3)	2 (28.6)	3 (30)	–
Retired	–	–	2 (20)	–
FM diagnosis time (months)				
1 to 24 months	1 (11.1)	2 (28.6)	–	–
25 to 60 months	2 (22.2)	–	1 (10)	–
More than 60 months	6 (66.7)	5 (71.4)	90 (90)	–

Tabella II - Confronto dei domini dello stato d'animo tra i partecipanti con FM sottoposti a diverse intensità di allenamento di resistenza e il gruppo di controllo.

BRUMS	Group	Baseline (mean±SD)	4 weeks (mean±SD)	8 weeks (mean±SD)	Follow up (mean±SD)
Anger	LIRT HIRT PI HC	1.66±3.27 1.42±1.81 2.10±2.68 1.88±3.11	2.11±4.19 3.0±4.28 2.11±3.14 1.77±2.53	2.66±2.8 0.5±1.22 2.4±3.20 -	0.4±0.89* 4.0±3.67* - -
Confusion	LIRT HIRT PI HC	3.33±3.12 5.28±5.08 3.0±4.08 1.34±2.52	3.88±4.01 5.5±4.59 2.11±2.8 1.50±2.09	2.5±2.07 7.33±6.4 3.10±3.75 -	3.4±2.88 6.8±6.37 - -
Depression	LIRT HIRT PI HC	5.11±4.75 5.28±4.99 2.6±2.59 1.15±1.93	5.33±4.58 5.5±4.23 2.0±2.87 1.58±2.20	5.5±5.31 6.16±5.74 2.7±3.65 -	4.0±2.91 6.6±6.65 - -
Fatigue	LIRT HIRT PI HC	4.4±3.94 8.28±3.19* 6.3±3.46 4.50±3.25*a	4.66±3.53 8.16±4.57* 6.55±4.21 3.05±2.88*a	5.83±5.11 8.5±6.59 5.7±4.57 -	6.6±4.82 10.2±4.96 - -
Tension	LIRT HIRT PI HC	5.55±3.6 5.57±4.5 4.2±3.11 4.03±3.66	5.66±4.58 5.5±3.88 3.11±2.93 4.11±3.51	5.16±3.48 6.16±6.04 4.10±3.14 -	3.6±2.4 7.0±5.33 - -
Vigor	LIRT HIRT PI HC	5.33±4.06 4.42±2.69* 7.1±2.96 8.23±3.86*	6.88±3.37 4.57±2.43* 7.55±2.83 9.26±2.70*	5.66±3.66 5.66±3.55 6.9±2.99 -	5.6±2.88 3.6±3.2 - -

Comparison between groups and moments through generalized estimating equations. *Significant difference between groups; asignificant difference at the moments; p<0.05.

erage age of 50.85±11.47 years. There were no adverse events reported during the intervention period. During the study period, the majority of FM patients were employed, and the majority had been diagnosed for more than 60 months (Table I).

Table II compares the mood states of the four groups of participants at baseline, 4 weeks, 8 weeks, and follow up. Except for fatigue in the HC, which showed a significant reduction between baseline and 4 weeks (p=0.04, g=0.63), no significant differences were found in the mood subscales. When comparing mood states between groups, we found that anger in the follow-up period differed significantly between the LIRT and HIRT groups, with the LIRT having the lowest values (p=0.01, g=0.84). Significant differences in baseline and 4 weeks vigor were also observed between HIRT and HC (p=0.001, g=0.76 and p=0.001, g=0.89), as well as from baseline to 4 weeks fatigue between HIRT and HC (p=0.01, g=0.79 and p=0.03, g=0.86), with the worst values observed in the HIRT. Although not statistically significant, we found that the HIRT had less anger and more vigor after 8 weeks, and the LIRT had less mental confusion after 8 weeks. Furthermore, we observed an increase in anger during the HIRT follow-up period. This finding suggests that high-intensity PE for patients with FM can keep anger at bay. Despite the fact that no significant differences were observed between the PI group and the others, none of the mood variables were significantly altered with PI training after 8 weeks.

In terms of mood profiles, as shown in Figure 2, only the HC displayed a profile similar to the Iceberg (baseline and after 4 weeks). We did not find any positive mood profiles in the other groups or moments studied.

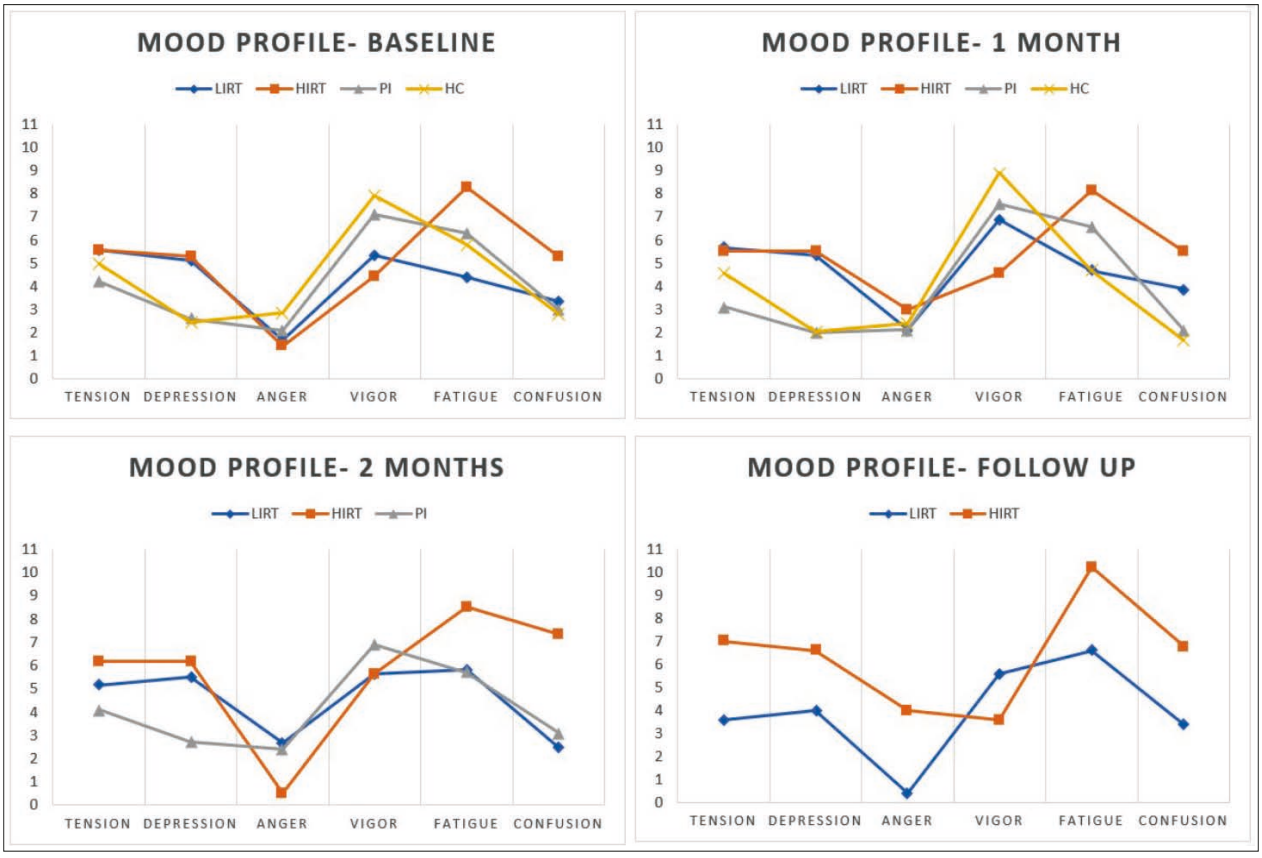

Figure 2 - Mood profile of study participants at the evaluated moments.

DISCUSSION

The purpose of this study was to investigate the effects of low, high, and preferred intensity RT on the mood of FM patients. In general, women with FM had a worse mood profile than healthy women, and after eight weeks of RT, they did not show significant improvements in the BRUMS subscales.

At baseline, none of the FM patients had an Iceberg mood profile (high vigor and lower other variables), and they all had high levels of fatigue and depression regardless of group. A similar finding was confirmed in a study conducted by Andrade et al. (9), who discovered that patients with FM have a depressed mood, feelings of vulnerability and helplessness, and thus do not have good mental health. Psychological illnesses are common in patients with this syndrome, according to Alciati et al. (25) In our study, only the HC members had a mood profile similar to Morgan's (22) Iceberg profile, so the differences between women with FM and women without the syndrome were clear. Tassa et al. (26) discovered differences between patients with FM and the HC group, with patients with FM having a worse mood profile.

The findings of these studies highlight the importance of researching treatment options for psychological disorders such as depression, excessive anxiety, and mood disorders. Among the treatment options, RT has been studied and shown to have significant effects on psychological variables such as anxiety, depression, and mood states. Four weeks of RT reduced depression and anxiety in FM patients, according to Andrade et al. (27) Another study discovered that just one session of RT has a positive effect on these patients' mood (11) However, our findings show that eight weeks of twice-weekly RT are insufficient to improve the mood profile of FM patients.

Some type of mood disorder, as well as high levels of anxiety and depression, are common in patients with chronic pain, such as FM (28-30). Tassa et al. (26) discovered a positive correlation between pain intensity and depressive symptoms in their study: the more pain, the worse the depressive symptoms. According to Gracely et al. (31), this is due to a cognitive process known as catastrophizing, in which the patient defines the pain as unbearable. We did not verify the patients' pain in our study, but this variable is related to psychological aspects and could thus interfere with the results.

In our study, there were significant differences in anger levels between LIRT and HIRT during the follow-up period, with LIRT having the lowest. The highest anger scores in the HIRT were found in the follow-up assessment, which can be explained initially by the interruption of RT. The frustrating feeling of transitioning from a state of intense exercise conducted actively by the person, which was perceived to be the direct cause of the feeling of physical exhaustion and fatigue, to a state of passive subjection to the pain and fatigue induced by the disease, could be a second explanation for the increase in anger. Training at high intensity is likely to have increased the perceived difference between the two conditions more than training at low intensity.

Fernandez and Wasan (32), who saw anger as a major component in the affective component of pain, investigated the relationship between chronic pain and anger. According to them (32), anger can act as a predisposing factor, a precipitant factor, an exacerbating factor, and a perpetuating factor in pain, in addition to being an appraised consequence of pain. Because variations in this component of FM patients' mood profiles emerged among the study results, we believe that future studies should further investigate the role of this negative emotion in pain management and mitigation in FM patients.

There have been no studies to date that compare the effects of different exercise intensities on the mood of FM patients, which is another unique aspect of our study. However, studies have shown that physical activity can reduce anger levels in healthy populations (33). Furthermore, based on the investigation of the acute ef-

fects of RT on the mood of FM patients, it appears that just one session is sufficient to significantly reduce anger in this population (11). In the HIRT, we observed a trend toward decreased anger after the training period, as observed in another study (8), and a significant increase in the follow-up period, albeit with no statistically significant difference. These findings suggest that high-intensity training for FM patients may be beneficial for reducing anger, as there was a significant increase when the patients stopped the practice. The average anger of LIRT participants, on the other hand, increased between baseline and 4 weeks and between 4 and 8 weeks, with a decrease in the follow-up period. Based on these findings, we can conclude that HIRT is more effective than low intensity RT in reducing the anger of FM patients.

To manage the FM patient over time, it could be hypothesized that a high-intensity PE intervention could be followed by a period of low-intensity administration to maximize the benefits in terms of anger limitation in a subsequent phase of interruption or cessation of PE treatment. Of course, this should be tested in a separate ad hoc study.

In terms of vigor, we found significant differences between the HIRT and HC at baseline and after 4 weeks of training, with the HC having a more positive mood profile. This fact supports the theory that FM patients have a more depressed mood than healthy people (9); however, it also shows that 4 weeks of high intensity practice was insufficient to improve the vigor of these patients. Although not statistically significant, the increase in vigor in the HIRT after 8 weeks of training suggests that high intensity RT may be beneficial for mood when compared to low intensity RT and thus warrants further investigation.

In terms of fatigue, we found that FM patients had higher values than the healthy group, but only the high intensity group showed a significant difference at baseline and four weeks. RT did not significantly reduce fatigue during the study period, regardless of intensity. Andrade et al. (8) reported a similar result, with no significant reductions in fatigue after 12 weeks of intervention with physical exercise.

Strengths, limitations, and future directions

The experimental design is a strength and innovation of our study. We are not aware of any other studies that have looked into the effects of different intensities of RT on the mood of FM patients. Another plus is that the LIRT and HIRT participants were randomly assigned and blinded. Despite its strengths, the study has some limitations, such as the fact that, while the sample power was high, there were few individuals in each group of FM patients. Furthermore, the intensity was determined by the number of repetitions rather than specific strength tests. More research is needed to investigate the effects of different RT intensities on the mood states of FM patients, particularly by using a larger number of RT sessions and including a control group of FM patients, in order to draw more conclusions about effective treatment strategies for this population.

CONCLUSIONS

After eight weeks of RT with female FM patients, no significant changes were noted in their mood, but when the RT was interrupted, the levels of anger showed significant differences between the LIRT and HIRT groups. Since the literature emphasizes a close association between anger experiences and chronic pain conditions, the variation in anger experiences as an effect of PE interventions in FM patients could open an interesting line of intervention, deserving further articulated research on the functional interconnections between the physical and mental aspects in a highly impacting and disabling condition such as FM.

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Contributions
The final version of the article was read and approved by all authors. GTV and AA conceptualized and designed the study, collected data, analyzed it, interpreted it, and wrote the article; DRC, GGB, LF, and PD revised it critically for important intellectual content and wrote the article.

Conflict of interest
The authors declare no potential conflict of interest.

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