HHS Public Access

Author manuscript

J Psychosom Obstet Gynaecol. Author manuscript; available in PMC 2017 January 01.

Published in final edited form as:

J Psychosom Obstet Gynaecol. 2016 ; 37(2): 68–72. doi:10.3109/0167482X.2016.1155552.

Muscle strengthening exercises during pregnancy are associated with increased energy and reduced fatigue

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Abstract

INTRODUCTION—Physical inactivity likely contributes to fatigue and low energy during pregnancy but whether acute resistance exercise attenuates these symptoms is unknown.

METHODS—Twenty-six women performed six low-to-moderate intensity resistance exercises twice per week from weeks 23 to 35 of pregnancy and measurements were made before and after each workout using the Mental and Physical State Energy and Fatigue Scales.

RESULTS—Acute resistance exercise usually increased perceived physical and mental energy (92% to 96% of workouts, respectively). These increases did not differ significantly across the 24 exercise sessions for feelings of physical energy or mental energy, even after adjusting for variations in attendance (median = 22/24 workouts). Acute resistance exercise usually decreased perceived physical and mental fatigue (79% to 88% of workouts, respectively), and ANCOVA showed these decreases did not differ significantly across the 24 exercise sessions for feelings of physical fatigue or mental fatigue even after adjusting for variations in attendance.

DISCUSSION—The results suggest acute, low-to-moderate intensity muscle strengthening exercise during pregnancy is effective for transiently improving feelings of energy and fatigue.

Keywords

mood; pregnancy; resistance exercise; vigor; weight lifting

Introduction

Feelings of fatigue and low energy are common problems during pregnancy. A prospective study showed that fatigue was the most common symptom reported by pregnant women [1]. A cross-sectional study showed mean vitality scores more than one standard deviation below

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Declaration of Interest

The authors report no conflicts of interest.

age-norms among 2,427 pregnant women [2]. Fatigue during pregnancy reduces quality-of-life and can predict caesarean delivery after controlling for age and obstetrical risks [3]. Potential contributors to fatigue that can co-occur with pregnancy include poor sleep, various medical conditions (e.g., depression) and physical inactivity.

Among non-pregnant samples a single bout of exercise, regardless of mode, consistently increases feelings of energy but only decreases feelings of fatigue after 20 minutes or more of low-to-moderate intensity exercise that is accompanied by at least moderate increases in feelings of energy [4].

Mood states can be improved in pregnant women after a single physical activity class [5]. At least four prior studies have described the influence of acute exercise performed by pregnant women on feelings of energy and/or fatigue. Feelings of energy, but not fatigue, were improved after 45–50 minutes of low-to-moderate intensity unspecified exercises (described as “rhythmic aerobic and muscular endurance”) in water (n=25) or a typical studio (n=21) [6]. Feelings of fatigue were reduced among 44 pregnant women following 45-minute water aerobics classes involving unspecified moderate intensity exercises [7]. Feelings of energy were increased and fatigue symptoms were reduced among 56 pregnant women who completed 50-minutes of unspecified strengthening and stretching exercises of an unspecified intensity that involved exercise-balls, Pilates and yoga type movements [8]. Feelings of energy were improved to a greater extent after a 45–50 minute exercise class involving unspecified balance and stretching activities (n=46) compared to a relaxation class (n=46) [9].

There is a need to better understand the psychological effects of strength training because only ~10% of studies examining the psychological consequences of exercise have focused on strength training [10]. Strength training is safe and effective for healthy pregnant women [11] but could yield different psychological effects than aerobic exercise because brain molecular adaptations to strength training may differ from those that accrue after aerobic type exercise [12].

This paper describes changes in physical and mental energy and physical and mental fatigue following 24 separate bouts of low-to-moderate intensity resistance exercise. It was hypothesized that feelings of physical and mental energy would increase after each exercise session and feelings of physical and mental fatigue would decrease after each exercise session.

Methods

Participants were pregnant women who were part of a clinical trial of resistance training during pregnancy. Participants provided informed consent approved by the University of Georgia Institutional Review Board. Participants were healthy and required to be at low risk for pregnancy-related complications, between 17–38 years, between 21–25 weeks gestation and with back pain or a history of back pain. Excluded were those who reported regular resistance exercise training (≥ twice per week during the past month), an orthopedic or cardiovascular limitation, a psychiatric disorder, or had in the current or a prior pregnancy

any of the following: (a) two or more miscarriages, (b) premature labor, (c) placental previa, (d) poor fetal growth, (e) low pre-pregnancy body weight (BMI < 17.5), (f) a multiple birth pregnancy, (g) pre-eclampsia, (h) preterm rupture of membranes, (i) uterine growth retardation, (j) incompetent cervix/cerclage, (k) recurrent vaginal bleeding, (l) anemia or (m) diabetes.

Six participants were excluded from the final analysis because they failed to attend at least 70% of the 24 exercise sessions. At enrollment, mean age of the 26 participants was 29.7 (±4.70 years; range 20–37 years) and mean body mass index was 25.7 (±4.7 $kg \cdot m^{-2}$). Gestational week at study start ranged from 21–25 weeks (22.7 ± 1.3 weeks).

Exercise Training

Participants completed low-to-moderate intensity strength training two days per week for 12 weeks on Tuesdays and Thursdays between 9 am and 4 pm in the Center for Physical Activity and Health.

Individual exercise sessions were performed at the same time of day. Exercise sessions lasted ~45 minutes. A ~5 minute treadmill walking warm-up was performed prior to engaging in resistance exercises. Seated resistance exercises included dual leg extension, dual leg press, dual arm lat pull, dual leg curl, and lumbar extensions. Participants always completed 2 sets of 15 repetitions of each exercise at a low-to-moderate intensity and velocity (~2 second concentric and ~2 second eccentric contractions), with 1 minute of rest between sets and 2 minutes of rest between exercises. The external load was increased in the smallest amount allowed by the equipment whenever perceived exertion ratings for a given exercise were lower than the prior workout. Mean training volume (load × repetitions × sets) increased from the start to the end of the program for each of these exercises: leg press (1,380 to 1,860 kg), leg curls (450 to 630 kg), leg extension (150 to 225 kg), lat pull (440 to 645 kg), and back extension (450 to 625 kg). A standing abdominal exercise without an external load was performed to activate the transverse abdominis muscles (8 repetitions per set, 1 minute of rest between sets). Further details are provided elsewhere [11].

Energy and Fatigue

The Mental and Physical State Energy and Fatigue Scales (EFS-Scale) measured mood states immediately before and after each exercise session [13]. Participants indicated their current subjective feelings of physical energy, physical fatigue, mental energy and mental fatigue on a series of 100 mm visual analog scales. Three items for each dimension of energy and fatigue were presented and added together for a score ranging from 0 – 300. Higher scores indicate more intense feelings. Energy items were anchored with “I feel I have no energy”, “I feel I have no vigor” and “I feel I have no pep” on the left, and anchored with “Strongest feelings of energy every felt”, “Strongest feelings of vigor ever felt” and “Strongest feelings of pep ever felt”, respectively, on the right. Fatigue items were anchored with “I feel no fatigue”, “I feel no exhaustion”, and “I have no feelings of being worn out” on the left side and anchored with “Strongest feelings of fatigue ever felt”, “Strongest feelings of exhaustion ever felt”, and “Strongest feelings of being worn out ever felt” on the right side. The manual for the EFS scales reports that the internal consistency reliability of

the scales exceed .81, that the four-factor structure of the EFS is supported by a confirmatory factor analysis, and that correlational data support the validity of the scales including positive correlations between the energy scale scores and physical activity, negative correlations between the fatigue scale scores and physical activity, and negative correlations between the energy scale scores and body mass index (unpublished manual, available from the authors). Additional evidence supports the validity of the scales, including sensitivity to change in response to mental and physical activity as well as drug and nutrient treatments[14–17].

Attendance

Median attendance was 22/24 sessions and average percentage attendance was 87.1%.

Statistical analysis

Missing data were imputed, if participants were missing data for one session in a given week then the data for the other session attended during that week were used as the criterion score. Analyses were performed using SPSS v22. To test whether there was significant variation in mean changes in feelings of physical and mental energy and physical and mental fatigue across 24 exercise sessions, a series of one-way repeated measures ANOVAs was used. Each ANOVA was rerun with attendance used as a covariate to test whether missing data influenced the results. When needed, adjustments for sphericity were made using Huynh-Feldt epsilon. Statistical significance was indicated at $p<0.05$. Dependent t-tests on post-exercise minus pre-exercise scores were used to determine if energy and fatigue states changed significantly after exercise. Descriptive data are presented as mean (±SD).

Results

Figure 1 illustrates the changes in energy and fatigue feelings for the group over the 24 workouts. Across all 24 exercise sessions the mean increases in feelings of physical and mental energy were 19.9 ± 39.7 and 17.3 ± 42.9, respectively. ANOVA revealed that these increases did not differ significantly across the 24 exercise sessions for feelings of physical energy ($F_{12.79,\ 319.66}=1.45$, $\eta_p^2=.055$, p=.136) or mental energy ($F_{13.04,\ 326.04}=1.25$, $\eta_p^2=.048$, p=.242) though for a few workouts (1/24 for physical energy and 2/24 for mental energy) the mean changes were small and statistically insignificant based on dependent t-test analysis (i.e., physical energy = workout 20; mental energy = workouts 8 & 9).

Across all 24 exercise sessions the mean decreases in feelings of physical and mental fatigue were 11.1 ± 52.5 and 16.7 ± 44.9, respectively. ANOVA revealed these decreases did not differ significantly across the 24 exercise sessions for feelings of physical fatigue ($F_{13.14,\ 328.50}=1.66$, $\eta_p^2=.062$, p=.067) or mental fatigue ($F_{12.45,\ 31\ 1.18}=1.71$, $\eta_p^2=.064$, p=.06) though for two workouts physical fatigue increased and with several other workouts the mean changes were small and statistically insignificant based on dependent t-test analysis (i.e., physical fatigue = workouts 8,11, 16, 17, 20 & 22; mental fatigue = workouts 9, 14 & 21). The group ANOVA results for all of the energy and fatigue variables remained statistically insignificant when days of program attendance was included as a covariate.

Figure 2 illustrates the change in energy and fatigue feelings separately for each individual averaged across all exercise sessions. For most women resistance exercise resulted in a mean improvement in physical energy (23/26 [89%]), physical fatigue (20/26 [77%]), mental energy (23/26 [89%]), and mental fatigue (21/26 [81%]).

Discussion

Low energy and fatigue are common among pregnant women and can have serious consequences. Feelings of fatigue and low energy have been associated with cesarean births as well reduced quality-of-life, including poorer work productivity and depression [3]. Health care providers have not generated consensus guidelines for improving low energy and fatigue among pregnant women. Drugs, such as anti-depressants or modafanil, have been used to treat fatigue but are avoided by many pregnant women and health care providers over concerns about potential adverse effects on the fetus [18]. In short, fatigue and low energy during pregnancy are common concerns that are often inadequately managed by pregnant women and their health care providers. Thus, there is a need for empirically-based techniques for improving feelings of energy and fatigue among pregnant women.

A small body of evidence, in which the exercise stimulus was not well described but appeared to focus on low resistance, aerobic type exercise [6–9] ,supports that acute, low-to-moderate intensity aerobic exercise offers transient improvements in feelings of energy and fatigue to pregnant women. Most of the prior studies focused on the results of a single exercise bout performed once during pregnancy [6, 8, 9].

The primary novelty of the present investigation was the documentation of the repeatability across 12 weeks of the positive psychological changes after acute bouts of resistance exercise. The results showed that the majority of a small group of generally healthy pregnant women (i.e., ≥ 77%), on average across 24 workouts, reported increased feelings of energy and reduced feelings of fatigue after a single bout of low-to-moderate intensity muscle strengthening exercise. Generally consistent with studies of non-pregnant samples [4], increases in energy were somewhat larger (e.g., 8.8 larger VAS change for feelings of physical energy compared to physical fatigue) and more common than decreases in fatigue (e.g., only 3/48 analyses showed nonsignificant pre-to-post exercise changes in energy compared to 8/48 for fatigue).

The study has at least three limitations. Because a non-exercise control group was not included in the present study, alternative explanations for the findings cannot be excluded. Plausible alternative explanations include that psychological improvements may have stemmed from attention from the study staff, placebo responses and even simply a taking breaks from the usual daily routine [19]. It is typical to have missing data when daily assessments are made during exercise training studies because of missed workouts. We cannot rule out that missing data potentially could have changed the results and conclusion; however, this possibility was not supported by our analysis which showed that including attendance as a covariate did not change the statistical significance of the results. The participants self-selected in response to advertising and were not randomly selected from a

defined population. Accordingly, the extent to which the findings generalize to other groups of pregnant women will require further investigation.

In conclusion, acute bouts of resistance exercise are consistently associated with increases in feelings of energy and decreases in feelings of fatigue in pregnant women during the second and third trimesters. While additional controlled research with larger samples is needed to better understand the causes and generalizability of the findings, based on the present results practitioners have a preliminary evidence base for recommending to healthy patients that acute, low-to-moderate intensity muscle strengthening exercise during pregnancy is effective for transiently improving feelings of energy and fatigue.

Acknowledgments

James F. Clapp, III, deceased, was a consultant on this project and an internationally known expert on exercise and pregnancy. Appreciation is expressed to the pregnant women participants, study administrator Tameka Gude, exercise specialist Cheryl Maldonado, project assistants Emily Davis and Sarah Reynolds, obstetrical consultant Thomas W. Goggin, M.D., co-investigator Elaine Cress, exercise specialist and founder of the Atlanta, Georgia based FitFor2, Inc., Lisa Stone, UGA Fitness Center Director Harry DuVal and the participating obstetricians and midwives in the Athens, Georgia area.

This project was supported by funding from the National Institutes of Health (RO1NR008131).

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Current knowledge on the subject

- Feelings of low energy and fatigue are common during pregnancy.
- Fatigue is often poorly managed during pregnancy and drug treatments are avoided.
- Physical inactivity contributes to fatigue and is reduced during pregnancy.

What this study adds

- Feelings of physical and mental energy are reliably increased after a single bout of low-to-moderate intensity resistance exercise performed by pregnant women.
- Feelings of physical and mental fatigue are reliably reduced after a single bout of low-to-moderate intensity resistance exercise performed by pregnant women.
- Most pregnant women increase feelings of energy (>88%) and reduce feelings of fatigue (>76%) after acute low-to-moderate intensity weight lifting.

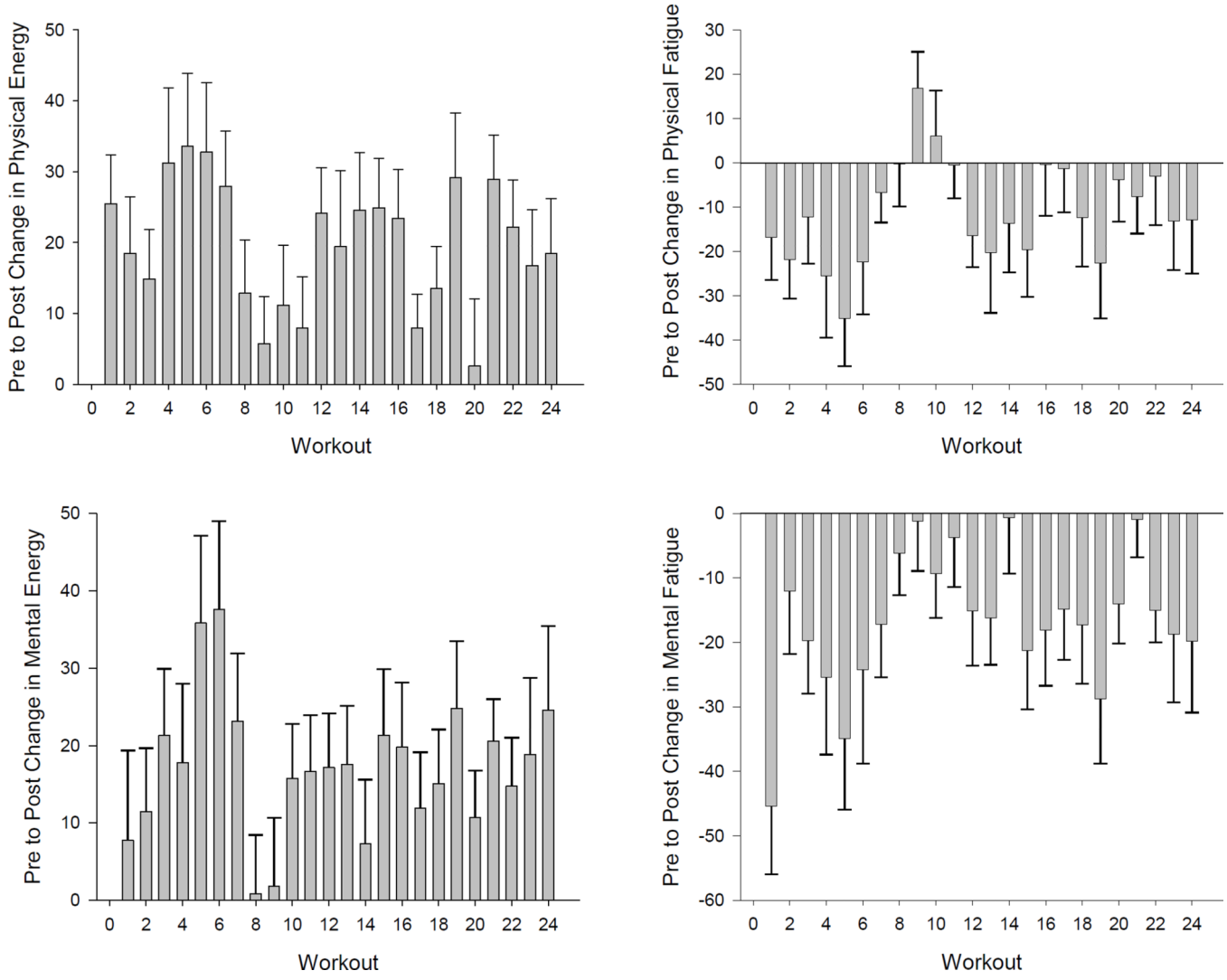

Figure 1.

Group (n=26 pregnant women) mean (±SE) changes in the intensity of feelings of physical energy (top left), mental energy (bottom left), physical fatigue (top right) and mental fatigue (bottom right) after 24 separate resistance exercise workouts. The group increased significantly in physical energy after each workout except for workout 20. The group increased significantly in mental energy after each workout except for workouts 8 & 9. The group decreased significantly in mental fatigue after each workout except for workouts 9, 14 & 21. The group increased significantly in physical fatigue in response to workouts 9 & 10 and decreased in physical fatigue after the other workouts except for workouts 8, 11, 16, 17, 20 & 22.

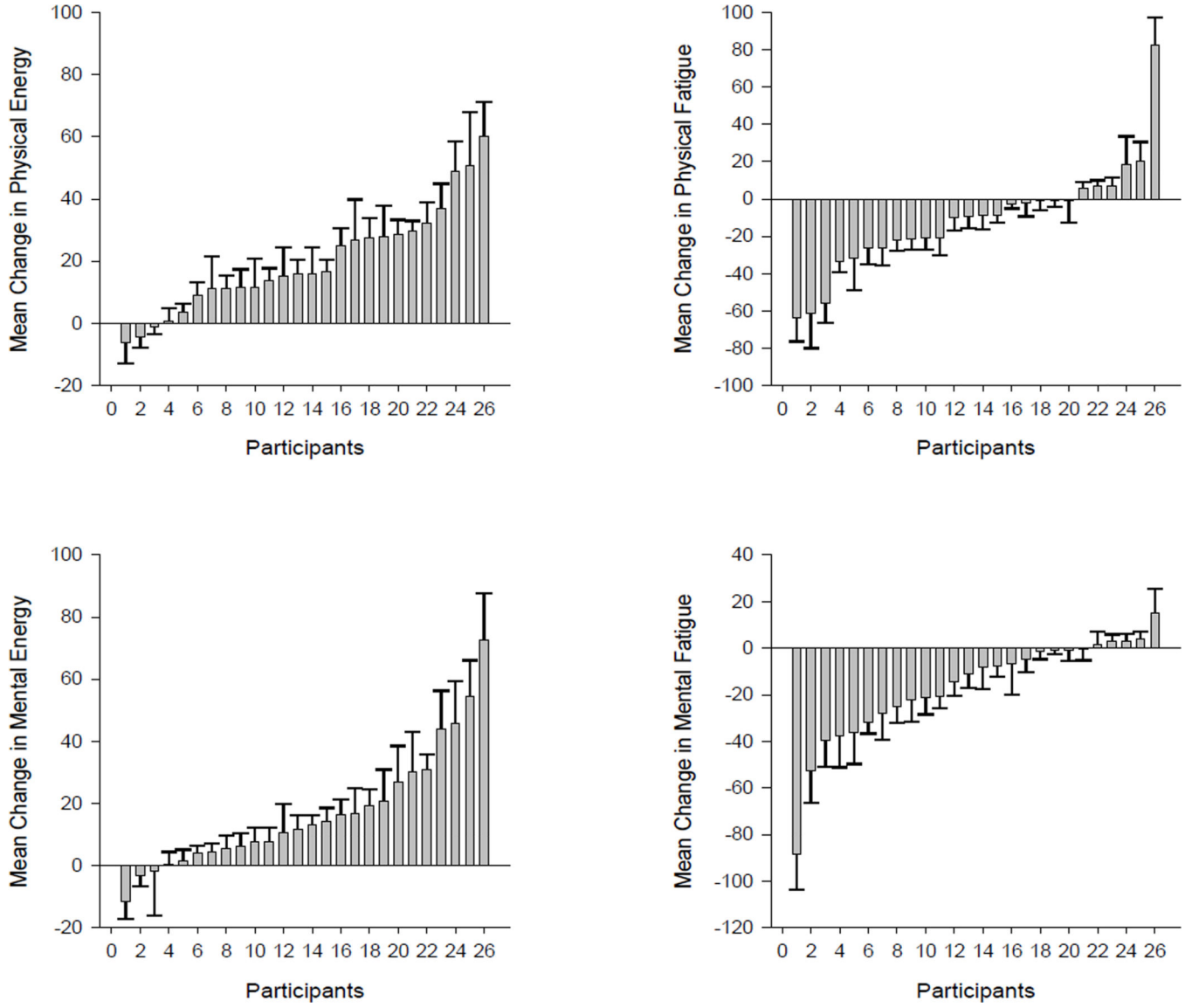

Figure 2.

Individual mean (±SE) changes for 26 pregnant women participants in the intensity of feelings of physical energy (top left), mental energy (bottom left), physical fatigue (top right) and mental fatigue (bottom right). The means represent the post-exercise minus pre-exercise change scores averaged across 24 separate resistance exercise workouts for each participant.