AEROBIC EXERCISE VOLUME, NOT PRESCRIPTION, INFLUENCES POST-CONCUSSION SYMPTOMS: A RANDOMIZED CLINICAL TRIAL

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Abstract

Background: Current recommendations for sport-related concussion uniformly emphasize the importance of physical activity. However, specifics of this recommendation remain vague and do not account for an exercise dosage or compliance.

Purposes: First, we examined if an 8-week individualized sub-symptom threshold aerobic exercise prescription, initiated within the first two weeks of concussion, alleviates symptom severity or affects the amount of exercise performed during the study. Second, we examined whether prescription adherence, rather than randomized group assignment, reflects the actual impact of aerobic exercise in post-concussion recovery.

Methods: For this single-site prospective randomized clinical trial, participants completed an aerobic exercise test within 14 days of injury, and were randomized to an individualized aerobic exercise program or standard-of-care, and returned for assessments 1 month and 2 months after the initial visit (Table 1). The aerobic exercise group was instructed to exercise 5 days/week, 20 minutes/day, at a target heart rate based on an exercise test at the initial visit. Participants reported their symptom exercise volume each week over the 8-week study period, and reported symptoms at each study visit (initial, 1 month, 2 month).
Results: Initial symptom severity was not different between randomized groups (Figure 1A), and no
significant differences in symptom severity were found at the 4-week (Figure 1B) or 8-week (Figure 1C)
assessment. In addition, there was no significant differences between groups for average weekly exercise
volume during the first four weeks (Figure 2A) or second four weeks (Figure 2B) of the study. During the
first four weeks of the study, 65% (n=11/17) of the exercise intervention participants were compliant with
their exercise recommendation (≥100 min/week), compared to 45% (n=9/20) of the standard-of-care group
(p=0.33). During the second four weeks of the study, 71% (n=12/17) of the exercise prescription group
exercised ≥100 min/week, compared to 55% (n=11/20) of the standard-of-care group (p=0.50).
When grouped by exercise volume, the group who exercised ≥100 minutes/week during the first month of
the study reported significantly lower symptom severity scores than those who exercised <100
minutes/week (Figure 3B), despite similar initial symptom severity scores (Figure 3A).
Conclusion: Participant randomization within 14 days of concussion did not lead to a significant reduction
in symptoms, or greater exercise volume. Given that greater exercise volume was associated with lower
symptoms after one month of the study, researchers and clinicians should pay particular attention to
adherence to aerobic exercise programs for the treatment of concussion.
| Variable                              | Exercise Intervention \( n=17 \) | Standard-of-care \( n=20 \) | P value |
|--------------------------------------|-----------------------------------|-----------------------------|---------|
| Age (years)                          | 17.2 (2.0)                        | 16.8 (2.2)                  | 0.49    |
| Sex (female)                         | 7 (41%)                           | 10 (50%)                    | 0.74    |
| Concussion history                   | 9 (53%)                           | 13 (65%)                    | 0.52    |
| Time of Post-Injury Test 1           | 11.3 (2.8)                        | 10.7 (3.2)                  | 0.53    |
| (days post-injury)                   |                                   |                             |         |
| Time of Post-Injury Test 2           | 42.3 (7.1)                        | 39.7 (7.5)                  | 0.30    |
| (days post-injury)                   |                                   |                             |         |
| Time of Post-Injury Test 3           | 75.6 (2.5)                        | 67.8 (8.4)                  | 0.01    |
| (days post-injury)                   |                                   |                             |         |
| Sport/activity of participation      | Basketball: 5 (29%)               | Soccer: 5 (25%)             | -       |
| during injury                        | Football: 2 (12%)                 | Skiing/snowboarding: 4 (20%)|
|                                     | Ice hockey: 2 (12%)               | Football: 2 (10%)           |
|                                     | Soccer: 2 (12%)                   | Ice hockey: 2 (10%)         |
|                                     | Activity of daily living: 2 (12%) | Volleyball: 2 (10%)         |
|                                     | Cheerleading: 1 (6%)              | Basketball: 1 (5%)          |
|                                     | Equestrian: 1 (6%)                | Rugby: 1 (5%)               |
|                                     | Ice-skating: 1 (6%)               | Softball: 1 (5%)            |
|                                     | Ultimate Frisbee: 1 (6%)          | Wrestling: 1 (5%)           |
|                                     |                                   | Activity of daily living: 1 (5%) |
Figure 1. Individual data points describing the distribution of symptom severity for those randomized to the exercise intervention and standard-of-care groups at (A) the initial evaluation (≤14 days post-injury), (B) the 1 month evaluation, and (C) the 2 month evaluation. The solid black line represents the median value for each group.

Note: No significant differences were identified between groups at the initial (p=0.26), one month (p=0.96), or two month (p=0.11) evaluations.
Figure 2. Individual data points describing the distribution of average weekly exercise volume (mins/week) for those randomized to the exercise intervention and standard-of-care groups (A) during the first 4 weeks of the study, and (B) the second 4 weeks of the study. The solid black line represents the group median value.

Note: There were no significant differences between groups during the first 4 weeks (p=0.52) or second 4 weeks (p=0.59) of the study.
Figure 3. Individual data points describing the distribution of symptom severity, compared between those who did and did not report an average exercise volume $\geq 100$ minutes per week during the first month of the study. The solid black line represents the median value for each group.

Note: Those who exercised $<100$ min/week reported significantly higher symptom severity ($p=0.034$) at the 1 month evaluation compared to those who exercised $\geq 100$ min/week. No significant differences were identified at the initial ($p=0.14$) or 2 month ($p=0.66$) evaluations.