

Effect of Aerobic Exercise for Improving Concussion Symptoms Compared to Traditional Rest or Placebo-Like Stretching in Adolescents

Rylee L. Holman, MAT-II, Cayla A. Lee, MAT-II, Aric J. Warren, PhD, LAT, ATC, CSCS, TSAC-F



Clinical Scenario

Adolescents are at prime risk for obtaining a sports-related concussion (SRC) while participating in athletics at an early age. Children under the age of 18 are still developing in terms of physically, cognitively, neurologically, and emotionally. When adolescents obtain a concussion, it can hinder their developmental skills and put them at high risk for future concussions and/or second impact syndrome. Previous research states that the standard of care for SRC is prescribed rest until symptoms have resolved. However, recent studies have suggested that early activity within the first week of injury had decreases in rate of delayed recovery and reduction in concussive symptoms.³ As health care providers, the goal is to rehabilitate these injuries as quickly, yet efficiently, as possible. The purpose of this Critically Appraised Topic (CAT) is to determine whether early aerobic exercise will reduce patient reported symptoms quicker than traditional rest.

Focused Clinical Question

Is sub-symptom aerobic exercise more effective at improving concussion symptoms in adolescents compared to traditional rest or placebo-like stretching?

Search Strategy

Search Criteria:

A computerized search was conducted in October-November of 2022. The search terms included were: Concussion AND aerobic exercise AND symptom provocation OR concussion symptoms

Sources of Evidence Searched:

- PubMed
- Google Scholar

Inclusion Criteria:

- Studies limited to the past 10 years (2012-2022)
- Adolescents diagnosed with a concussion or mTBI
- Studies in English
- Randomized control trials (RCTs)
- CEBM⁸ levels 2 to 4

Exclusion Criteria:

- Studies outside of the United States and Canada
- Patients with previous history of neurological or psychological conditions
- Systematic reviews and meta-analyses
- Adult and geriatric populations

RESULTS

	Chan et al. ³	Leddy et al. ⁴	Willer et al. ⁵
Study Title	Safety of Active Rehabilitation for Persistent Symptoms After Sport-Related Concussion: A Randomized Control Trial	Early Subthreshold Aerobic Exercise for Sport-Related Concussion	Comparison of Rest to Aerobic Exercise and Placebo-like Treatment of Acute Sport-Related Concussion in Male and Female Adolescents
Participants	19 eligible participants (14 females, 5 males) ages 12 to 18 who sustained SRC	103 eligible participants (48 females, 55 males) ages 13 to 18 presenting within 10 days of SRC	151 eligible participants (60 females, 91 males) ages 13 to 18 presenting within 10 days of SRC
Interventions	Both groups completed a 6-week intervention Control group: (N=9) randomized into treatment as usual which consisted of an educational session, school consultation, and psychiatric consultation Experimental group: (N=10) randomized into active rehabilitation where participants completed submaximal aerobic training, light coordination and sport-specific exercises, visualization and imagery techniques, and home exercise program	Each group completed a 4-week intervention and were all re-assessed weekly using the Buffalo Concussion Treadmill Test (BCTT) Control group: (N=51) participants completed 20 minutes of prescribed progressive stretching that did not considerably increase heart rate every day Experimental group: (N=52) participants engaged in 20 minutes of subthreshold stationary biking, treadmill, walking, or jogging daily which was calculated at 80% of their heart rate achieved at symptom exacerbation	Each group completed a 4-week intervention and were all re-assessed weekly using the Buffalo Concussion Treadmill Test (BCTT) Exercise group: (N=52) participants completed subthreshold aerobic exercise that was calculated at 80% of their heart rate achieved at symptom exacerbation. Daily activities included walking, jogging, or biking for 20 minutes per day Placebo group: (N=51) participants were prescribed a progressive stretching program that did not significantly elevate heart rate. Participants performed prescribed stretches for 20 minutes per day Rest group: (N=48) participants did not perform in any sport or other forms of exercise, including gym class and were told to limit activities that would exacerbate symptoms such as watching television and phone usage
Inclusion/Exclusion Criteria	Inclusion: ages 12 to 18, diagnosed with a SRC, greater than 4 weeks post-injury, reported 2 or more persistent post-concussion symptoms Exclusion: history of a developmental disorder, previous moderate to severe traumatic brain injury, currently in mental health treatment, and a previous concussion within past 6 months of the index injury	Inclusion: adolescents (male and female) aged 13-18 presenting to reported clinic within 10 days of sports-related concussion Exclusion: evidence of focal neurological deficit, inability to exercise due to orthopedic injury, cervical spine injury, diabetes, or known heart disease, increased cardiac risk according to American College of Sports Medicine criteria, history of moderate to severe traumatic brain injury (Glasgow Coma Scale score of 12 or less), current diagnosis of and treatment with medication for attention deficit/hyperactivity disorder, learning disorder, depression, anxiety, history of more than 3 prior concussions, sustaining another head injury during research period before recovery, symptom severity score of less than 5 points on the post-concussion symptom scale during initial clinical visit, ability to exercise to exhaustion without symptom exacerbation on the first visit, and/or limited English proficiency	Inclusion: male and female adolescents, ages 13 to 18, diagnosed SRC within 10 days of injury Exclusion: evidence of focal neurologic deficit, history of moderate or severe traumatic brain injury, current diagnosis of attention deficit hyperactivity disorder, learning disorder, depression, anxiety, or history of more than 3 prior concussions, inability to understand English, and having a symptom severity score of less than 5 on initial clinic visit symptom questionnaire.
Outcome Measures	Primary outcome: participant's self-reported post-concussion symptoms Secondary outcomes: measures of health-related quality of life, mood, fatigue, balance, cognitive performance	Primary outcome: number of days to recovery since injury date Secondary outcome: proportion of participants with a delayed recovery (symptom recovery longer than 30 days)	Primary outcome: number of days participants took to make a full recovery from date of their injury Secondary outcome: incidence of delayed recovery (longer than 30 days) and daily symptom scores
Results	No significant differences were reported in age, sex, previous concussions, time since injury, initial symptom severity score, or initial BCTT and physical examination results. Participants in the aerobic exercise group recovered in a median of 13 days while participants in the stretching group recovered in a median of 17 days (P=0.009). The logistic parametric survival model demonstrated the best fit after adjusting for age, sex, time from injury to first clinical visit, and concussion history. These results proved that the aerobic exercise group recovered significantly quicker than the stretching group (P=0.005). Participants with delayed recovery since injury (recovery lasting longer than 30 days) was higher in the stretching group when compared to the aerobic exercise group, but these results did not reach significant differences (P=0.08).	No significant differences were reported in age, sex, previous concussions, time since injury, initial symptom severity score, or initial BCTT and physical examination results. Participants in the aerobic exercise group recovered in a median of 13 days while participants in the stretching group recovered in a median of 17 days (P=0.009). The logistic parametric survival model demonstrated the best fit after adjusting for age, sex, time from injury to first clinical visit, and concussion history. These results proved that the aerobic exercise group recovered significantly quicker than the stretching group (P=0.005). Participants with delayed recovery since injury (recovery lasting longer than 30 days) was higher in the stretching group when compared to the aerobic exercise group, but these results did not reach significant differences (P=0.08)	According to the ANOVA measures, a significant measure was reported between each of the 3 groups for symptom severity score (PCSS) over a 14-day time period (P=0.343). When observing relative rest, participants took longer to recover than those participants who were prescribed symptom threshold aerobic exercise. The rest group also had outcomes such as delayed recovery (symptoms lasting more than 30 days). Cox regressions demonstrated a significant difference between treatment (P=0.015) but not between sex (P=0.367). However, the Log-rank test on Kaplan-Meier curves resulted in a significant difference between treatment and recovery time for male adolescents (P=0.019) but not female adolescents (P=0.412)
CEBM⁸ Level of Evidence	2	2	3
PE德罗⁶ Score	9/10	7/10	7/10

CONCLUSION

Sufficient evidence has demonstrated that sub-symptom threshold aerobic exercise is more effective in self-reported symptom reduction in adolescents with sport-related concussion. Little evidence was found for decreased concussion symptoms when observing placebo-like stretching and traditional rest for adolescents with sport-related concussion. Significant results suggest a higher effectiveness for sub-symptom threshold aerobic training within the first week of injury in adolescent populations with fewer reports of delayed recovery. Components from traditional rest such as little to no screen time on devices should also be considered in conjunction with sub-symptoms threshold aerobic exercise.

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