Exercise Parameters for Post-Concussion Symptom Rehabilitation: A Systematic Review

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Context

Post-concussion symptoms (PCS) are physical, cognitive, behavioural, and emotional symptoms that manifest in individuals after a concussion. Acute symptoms can occur immediately after a concussion (aPCS) and up to 10-15% of concussed individuals can experience persistent symptoms (PPCS). Individuals with PCS can face considerable social and economic burden [1,].

Effective PCS rehabilitation is necessary but there is yet to be a universally agreed evidence-based approach [2]. Over the past decade, controlled aerobic exercise has gained traction as a promising rehabilitation approach targeting different symptom domains (e.g., physical, cognitive) [3] . While several exercise rehabilitation programs have been trialled and reviewed, most of these programs combine multiple modalities of rehabilitation, making it difficult to isolate effective exercise parameters.

Objective: To determine (1) if unimodal exercise interventions are useful for PCS rehabilitation and if so, (2) identify a set of clearly defined and effective exercise parameters for future research (i.e., frequency, intensity, time of program, type of exercise, time to exercise post-concussion [FITTT])

Method

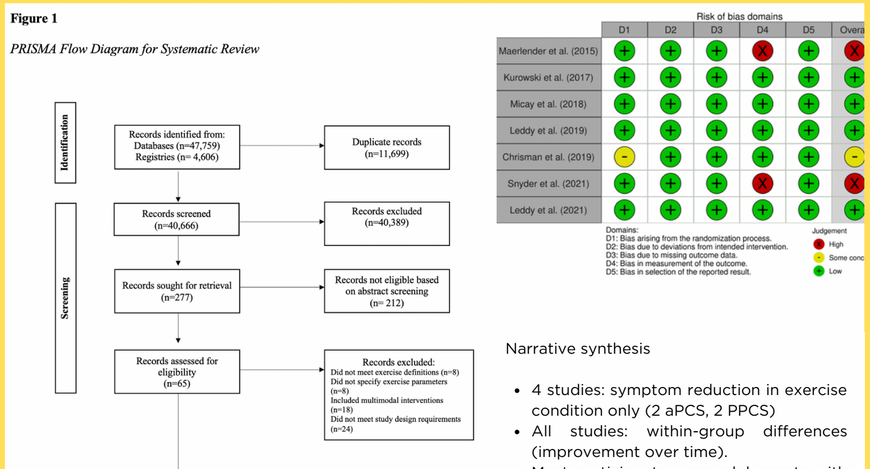
Relevant health databases and clinical trial registries were searched from inception to June 2022. The searches used a combination of subject headings and keywords related to mild traumatic brain injury, post-concussion symptoms and exercise. Two independent reviewers screened and appraised the literature. The Cochrane Collaboration's Risk of Bias-2 (RoB-2) tool for RCTs was used to assess methodological quality of studies (See Figure 1 for final results).

Inclusion criteria: (1) Primary research or a completed clinical trial; (2) randomised control trials (RCTs); (3) mTBI/concussion as the primary source of injury; (4) post-concussion symptoms as an outcome measure; (5) exercise intervention that met the definition; and (6) only exercise used as a rehabilitation modality.

Exclusion criteria: (1) Non-RCTs; (2) included moderate or severe traumatic brain injuries; (3) did not use exercise as an intervention; (4) expert opinion and /or commentaries; (5) used exercise as part of multimodal rehabilitation; and (6) not published in English.

Results

Figure 1: Article selection using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines and ROB analysis.



Narrative synthesis

- 4 studies: symptom reduction in exercise condition only (2 aPCS, 2 PPCS)
- All studies: within-group differences (improvement over time).
- Most participants were adolescents with sports-related concussion.
- Most studies: contained a risk of bias.

In summary: support for controlled exercise after 24-48 hrs rest & medical clearance.

Table 1 presents a summary of the exercise parameters used in the 7 reviewed studies. The recommendation for future research is to use a progressive approach, starting with exercise for 10-15 minutes, at least 4 times/week, at a intensity of 50% HR. Program duration will depend on recovery.

Table 1

Recommended Exercise Parameters (FITTT) for Further Research

Frequency	Intensity	Time (Duration)	Type	Time Post-Injury (Mean)
Starting with 4 days/week and increase based on patient response. Starting from 10-15 minutes and progressive increments tailored to individual fitness	Starting with 50% and up to 80%-90% sub-symptom HR during baseline test Complemented with subjective measures (i.e., Borg's RPE)	Up to 1 week till asymptomatic, whichever is sooner. Program can be customised to individual needs and extended for those with delayed recovery.	Participant choice with adherence to prescribed guidelines. Close monitoring strongly recommended in early stages.	After 24-48hrs of rest and suitability assessed through a baseline test*

*This is based on studies limited to athletes and adolescents. Further studies may be required to determine time to commence exercise rehabilitation in different population groups and symptom profiles

Conclusion

This is the first systematic review of exercise for PCS to focus on exercise-only interventions from RCTs. This review found moderate evidence in favour of exercise via between-group differences (i.e., exercise versus control). Notably, between-group differences showing improvement over time were observed in both studies on aPCS and PPCS, suggesting that exercise can have a positive effect on PCS regardless of symptom duration. However, the absence of an interaction in several studies suggest the possibility of spontaneous remission or natural recovery, highlighting the need to interpret the benefits of exercise with caution.

A strength of this review is the identification of the exercise parameters from the RCTs. While not intended to be prescriptive, drawing from a high-quality evidence base allows a reasonable inference for a minimum effective dose of exercise on which further research can build. This review used studies of exercise only; it did not include other potentially beneficial exercise-related interventions (e.g., multimodal programs). Other limitations include a restricted range of participants, use of narrative synthesis, and interpretations based on a small pool of studies with small samples.

This review supports the current shift in consensus from rest to active rehabilitation after a concussion. Future research could use the recommended parameters to guide further applications of this approach, including in wider populations.

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Note

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