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Does exercise modality affect the differences in time to task failure and fatigability between children and young adults? A systematic review and meta-analysis.

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Introduction

Several studies investigated differences in task to time failure (TTF) and fatigability (i.e. the objective changes in performance during and/or after a physical task) between children and adults. While the current literature suggests that children present lower level of fatigability and longer TTF, the lack of consistency in the experimental designs prevent a robust interpretation of the data. Moreover, it is unclear how the type of exercise (e.g. whole-body versus isolated) may influence the reported differences in children versus adults regarding TTF and fatigability. The aim of this study was to systematically compare TTF and performance fatigability between children and adults and assess the potential influence of exercise modality.

Methods

This review was pre-registered on PROSPERO (CRD42020184549). Studies were searched using three databases (Medline, SPORTDiscus, Cochrane Library) and were included in the review if they met the following PICOS criteria: i) studies that compared children (< 18 years old) versus adults (18–35 years old); ii) studies with a fatiguing protocol (whole body, e.g. cycling or running, or isolated, e.g. isometric contractions); iii) studies assessing fatigability (i.e. evaluated by changes in muscle force and/or power and/or velocity during and/or after the exercise) and/or TTF (i.e. evaluated by a time to exhaustion or a total number of repetitions needed to reach a certain amount of fatigability); iv) cross-sectional and longitudinal studies. The quality assessment of all included studies was performed using the modified Newcastle-Ottawa Quality Assessment Scale. Meta-analytic statistical comparisons between children and adults were made regarding outcomes of interest, i.e. TTF and indices of fatigability. A separate meta-analysis investigated the influence that the type of exercise may have on the reported differences in TTF and fatigability between children and adults.

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Results

Among the 4468 records identified, 54 studies met the inclusion criteria. Children have longer TTF than adults [0.95 (95% IC: 0.25,1.65), $p = 0.008$]. The type of exercise has an influence on these differences, with children presenting longer TTF when isolated [1.28 (95% IC: 0.68,1.88), $p < 0.001$] rather than dynamic [-0.18 (95% IC: -2.78,2.41), $p=0.88$] exercises are used. Children are less fatigable than adults [-3.06 (95% IC: -3.80,-2.33), $p < 0.001$], independently of the type of exercise being performed. The results present a high heterogeneity (I² ranging from 84.8–91.8).

Discussion

Our results confirm that children present longer TTF than adults. There is an effect of exercise modalities on the observed differences in TTF. While we also demonstrated lower level of fatigability in children, the interpretation of this results lacks robustness since statistical analysis were made on absolute data, and ongoing statistical analysis are performed on relative values to allow an appropriate interpretation of the fatigability data. High heterogeneity was observed in the meta-analytic comparisons, suggesting variability in the protocols of pooled studies. Ongoing moderation analyses are performed to investigate variables that could partly explain this heterogeneity. Future studies should target protocols that help to understand how exercise modalities interact with the differences in TTF between children and adults.

Keywords: muscle fatigue, endurance, children, adolescent