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Effects of resistance training interventions on physical literacy components in children and adolescents: A Systematic Review with Meta-Analysis

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ADMINISTRATIVE INFORMATION

Support - None.

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Conflicts of interest - None declared.

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Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 17 March 2024 and was last updated on 17 March 2024.

INTRODUCTION

Review question / Objective The objective of the present systematic review and meta-analysis is to synthesize and quantify the effects of resistance training interventions (randomized controlled trials and quasi-experimental trials) on different components of physical literacy in children and adolescents.

Rationale Currently, there is a concerning physical weakness observed in children and adolescents compared to previous generations. It is alarming that a large majority of them fail to accumulate at least 60 minutes of moderate to vigorous physical activity (MVPA) daily. Despite public health guidelines recognizing the physical, psychosocial, and cognitive benefits of MVPA, only one in five adolescents meet international physical activity recommendations, which include both aerobic and muscle-strengthening exercises.
In this way, we can refer to the triad of pediatric inactivity, which encompasses three distinct but interconnected components that drive physical inactivity in young people: exercise deficit disorder, pediatric dynapenia, and physical illiteracy. In this sense, the World Health Organization's Global Action Plan on Physical Activity (PA) aims to increase PA and reduce sedentary behavior. It proposes actions to transform social norms and attitudes, including enjoyable, affordable, socially and culturally appropriate PA experiences that promote mass participation, behavior change, health, and physical literacy (PL). This universal document invites the world to perceive PL as an important component of individual and collective actions to promote PA and health in the global population. PL refers to a set of characteristics or attributes that enhance an individual's potential to engage in and maintain PA throughout their life. Therefore, it is important to consider that the domains of PL do not exist in isolation but in relation to each other, meaning that PL not only involves behaviors in the physical domain but also components related to the psychological, affective, and cognitive domains.
In addition to this lack of PL, a decrease in cardiorespiratory and muscular fitness measures

has also been observed in children and adolescents. Current trends indicate a consistent decline in muscular fitness measures among youth worldwide. This is concerning as strength production and reduction are necessary for skilled movement and play. Weaker youth are less likely to meet the 60 minutes of daily MVPA and are more likely to experience functional limitations, physical activity-related injuries, and associated comorbidities.

Strength training interventions in children and adolescents have been identified as potentially effective in improving components of physical literacy to gain competence and confidence in their abilities to be physically active in different environments. In this way, young people can be better prepared to participate in sports and physical activities, increasing their levels of muscular fitness and physical activity. In this sense, the National Strength and Conditioning Association (NSCA) and the United Kingdom Strength and Conditioning Association (UKSCA) indicate that appropriately designed and supervised resistance training programs can benefit youth of all ages, reducing the risk of cardiovascular diseases, metabolic risk factors, improving body composition, and enhancing self-esteem. It has also been demonstrated that motor skills (such as jumping, running, throwing) improve in young people after a period of resistance training.

However, to date, there has not been a comprehensive systematic review that examines the impact of resistance training on PL components, including all of them in the same construct, i.e., physical literacy of children and adolescents. These findings would be of great scientific value as they would help inform healthcare professionals, educators, and other stakeholders involved in promoting physical activity in this population about the effectiveness of strength training as an intervention.

Condition being studied It is concerning to observe a decline in cardiorespiratory and muscular fitness measures in children and adolescents. This translates to a decrease in strength and functional capacity, which affects their ability to meet daily physical activity recommendations. In this context, the pediatric inactivity triad is mentioned, where each of its three components influences ongoing participation in physical activities and sports, thus requiring a comprehensive approach. It is highlighted that resistance training interventions in children and adolescents can be effective improving physical literacy components, providing competence and confidence in their abilities to be physically active in different settings, thus improving the pediatric activity triad. However, there has not been a comprehensive review examining the impact of strength training on these components. It would be of great scientific value to have research that evaluates the effectiveness of strength training interventions on different components of physical literacy in children and adolescents.

METHODS

Search strategy Keywords and synonyms were entered in various combinations in the title, abstract or keywords: (“child” OR “adolescent” OR “Youth” OR “Teen” OR “Young people” OR “Young person” OR “Juvenile”) AND (“resistance training” OR “resistance activity” OR “resistance exercise” OR “muscular endurance” OR “muscle strengthening” OR “strength training” OR “strength exercise” OR “weight training” OR “bodyweight training”) AND (“movement skills” OR “physical fitness” OR “cardiovascular” OR “stability” OR “strength” OR “agility” OR “power” OR “muscular endurance” OR “aerobic” OR “motor control” OR “skills” OR “motor competence” OR “coordination” OR “performance” OR “well-being” OR “affective” OR “self-regulation” OR “self-efficacy” OR “self-confidence” OR “confidence” OR “behaviour” OR “motivation” OR “enjoyment” OR “emotion” OR “attitude” OR “belief” OR “cognitive” OR “knowledge” OR “understanding” OR “safety” OR “perceptual” OR “value”).

Participant or population Children and adolescents between the ages of 5 to 17 who are seemingly healthy.

Intervention Resistance training (RT) interventions that involve the progressive use of a wide range of resistive loads, different movement speeds and a variety of training types (e.g. machine-based RT, free weight RT, elastic bands, plyometrics) and school-based intervention projects on PE classes.

Comparator Control conditions (passive control).

Study designs to be included RCT and non-RCT.

Eligibility criteria Inclusion of criteria following PICOs framework: 1) Apparently healthy children and adolescents (between five and seventeen years); (2) Resistance training interventions (machine-based RT, free weight RT, elastic bands, plyometric exercises) or school-based strength interventions; (3) Evaluate at least one specific component of physical literacy; (4) Designs (randomized and non-randomized trials); (5) Only original studies and full-text written in English.

Exclusion criteria: (1) Other populations distinct from children and adolescents (e.g., adults); (2) Children and adolescents with any type of injury, chronic or acute illness; (3) Other physiological or physical conditions unrelated to the included outcomes; (4) Written in a language other than English 5) Other types of articles besides original research (e.g., reviews, letters to the editor, trial registries, protocol proposals, editorials, book chapters, and conference abstracts) 6) Duplicate articles 7) Articles will be excluded if the authors, once contacted, do not report a study's outcome of interest.

Information sources Electronic databases (PubMed, Scopus, SPORTDiscus, Cochrane Library and, Web of Science) were searched for relevant publications prior to 1 April 2024.

Main outcome(s) Evaluate at least one specific component of physical literacy.

Data management The data extraction process will involve organizing the data in a Microsoft Excel spreadsheet using the Cochrane Consumers and Communication Review Group's data extraction template. This spreadsheet will be used to assess the inclusion criteria for all selected studies. In addition, the bibliographic manager Ednote version X9 will be utilized to extract articles and make decisions about their inclusion or exclusion from the review.

Quality assessment / Risk of bias analysis The risk of bias (RoB) assessment was implemented using the Cochrane tool for randomized controlled trials (RCT), following the Cochrane Handbook for Systematic Reviews of Interventions. The tool consists of five different domains that are used to generate the assessment of the intervention's risk of bias. Each domain was assessed with the following options: "Low risk," "Some concerns," and "High risk." RoB for each study was assessed by two authors, and disagreements were resolved through negotiation. Additionally, the ROBINS-I tool was used to assess ("Risk Of Bias In Non-randomized Studies of Interventions") which is used to evaluate the risk of bias in estimates of the effectiveness or safety (benefit or harm) of an intervention from studies that did not use randomization to assign interventions.

Strategy of data synthesis The analysis and interpretation of the results of this systematic review will be grouped using the PL checklist developed and validated by Shearer et al., (2021). This checklist emphasizes grouping different components of PL into three domains: physical, affective, and cognitive. Additionally, data extraction from the selected articles will be provided based on: study and country, images and instructions, design, intervention, type of bike, physical literacy component, and outcomes.

Subgroup analysis Chronological age; Maturation status; practice time; Age; Sex.

Sensitivity analysis The individual impact of each study on the meta-analysis outcome will be analyzed, and it will be verified whether the results could be influenced by studies with low-quality methodologies, unpublished works, or those that do not strictly meet the selection criteria to ensure the validity and reliability of the study. The presentation of the sensitivity analysis results will allow readers to assess the robustness of the synthesized results in relation to the decisions made during the review process.

Language restriction English.

Country(ies) involved Spain, Brazil, Ecuador, Chile and EEUU.

Other relevant information N/A.

Keywords health; physical literacy; resistance training; interventions.

Contributions of each author

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