DEVELOPMENT OF EXPLOSIVE POWER IN PRIMARY SCHOOL STUDENTS

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REVIEW SCIENTIFIC ARTICLE

Abstract: The goal. The aim of this systematic review is to investigate the development of explosive strength in school-age children. Method. The literature search was performed using the Google Scholar and PubMed databases. Results. Analysis of the studies showed significant and consistent improvements in key parameters of explosive power, including, but not limited to, increased jump height, decreased sprint time, improved agility, as well as greater speed and precision in the execution of specific sports skills, indicating the potential of training . to contribute to better athletic performance and physical fitness of children. Conclusion. Studies suggest that structured training can significantly improve explosive power.

Ključne reči: strength, jump, children, physical education

INTRODUCTION

The importance of physical fitness in the health and development of children is increasingly recognized in the scientific community and educational systems around the world. Among the various components of physical fitness, explosive power—a critical element for numerous physical activities and sports—has received considerable attention. Explosive strength refers to the ability to exert maximum force in a minimum amount of time and is fundamental to performing activities that require sudden bursts of power, such as jumping, sprinting and throwing.

Recent studies emphasize the importance of explosive strength from early childhood, highlighting its connection to overall health, athletic performance and injury prevention. Standing long jump (SBJ), a widely accepted measure of explosive lower body strength, serves as a practical and reliable assessment tool in school settings. Research by Tomkinson et al. (2021) conducted among children, especially in the early stages of life, is universally recognized for its contribution to overall health and development. Explosive power, a critical component of physical fitness, refers to the ability to exert maximum force in minimum time. It is crucial not only in athletic contexts, but also in everyday activities and movements. Despite its

importance, the comprehensive development of explosive strength in elementary school-age children has not been thoroughly examined, representing a gap in current literature and practice (Carnevale Pellino et al., 2020; Tomkinson et al., 2021).

Recent research highlights the long jump (SBJ) as an effective, practical measure of explosive lower body strength, offering insight into children's physical fitness and general health (Carnevale Pellino et al., 2020). Such assessments are crucial, as studies reveal a worrying trend of declining physical fitness among young people, explosive strength being no exception (Tomkinson et al., 2021). This decline is particularly alarming given the established relationship between muscle strength in youth and numerous health outcomes, including cardiovascular disease risk, metabolic profiles, skeletal health, and adiposity levels (Carnevale Pellino et al., 2020).

Explosive strength assessment methodology, particularly through field tests such as the SBJ, offers a viable alternative to laboratory assessments, facilitating wider application and potential for widespread application in educational settings. However, these evaluations often overlook critical factors such as growth and maturity, which can significantly affect performance outcomes. As such, there is a compelling need for models that take these variables into account, providing a more nuanced understanding of explosive strength development in children (Carnevale Pellino et al., 2020).

Moreover, the correlation between socioeconomic status and physical fitness suggests that external factors may also play a role in the development of explosive strength, indicating the necessity of comprehensive approaches that take into account both biological and environmental influences (Tomkinson et al., 2021). Given the multifaceted nature of explosive strength development, a holistic review of current elementary school practices, challenges, and opportunities is essential.

This study aims to provide a systematic review of explosive strength development in elementary school students. The effectiveness of existing training programs on the development of explosive strength will be examined. By synthesizing existing research and identifying areas for future research, this review seeks to contribute to the optimization of physical education practices and the promotion of a healthier, more active lifestyle among children.

METHODOLOGY

This review includes a systematic literature search that identified studies and articles related to the development of explosive strength in elementary school students. The search was performed in two main databases: PubMed and Google Scholar. These platforms were chosen for their comprehensive coverage of medical, physiological and educational fields, providing a wide array of peer-reviewed articles, reviews and empirical studies.

The search strategy used a combination of keywords and phrases to capture all relevant literature. Primary keywords included 'explosive strength', 'childhood fitness' and 'basics and physical activity'. Logical operators (AND, OR) were used to widen the scope of the search and effectively combine different concepts. For

example, the search term “explosive strength and children” was used to ensure that studies were focused specifically on the pediatric population.

Inclusion and exclusion criteria

Studies were selected based on the following inclusion criteria:

- Published within the last 20 years to ensure relevance and timeliness of data.
- It is conducted with children of primary school age (6-15 years).
- Included measurable outcomes related to explosive power, such as jump height, sprint times or similar indicators of physical performance.
- Available in English or Serbian.

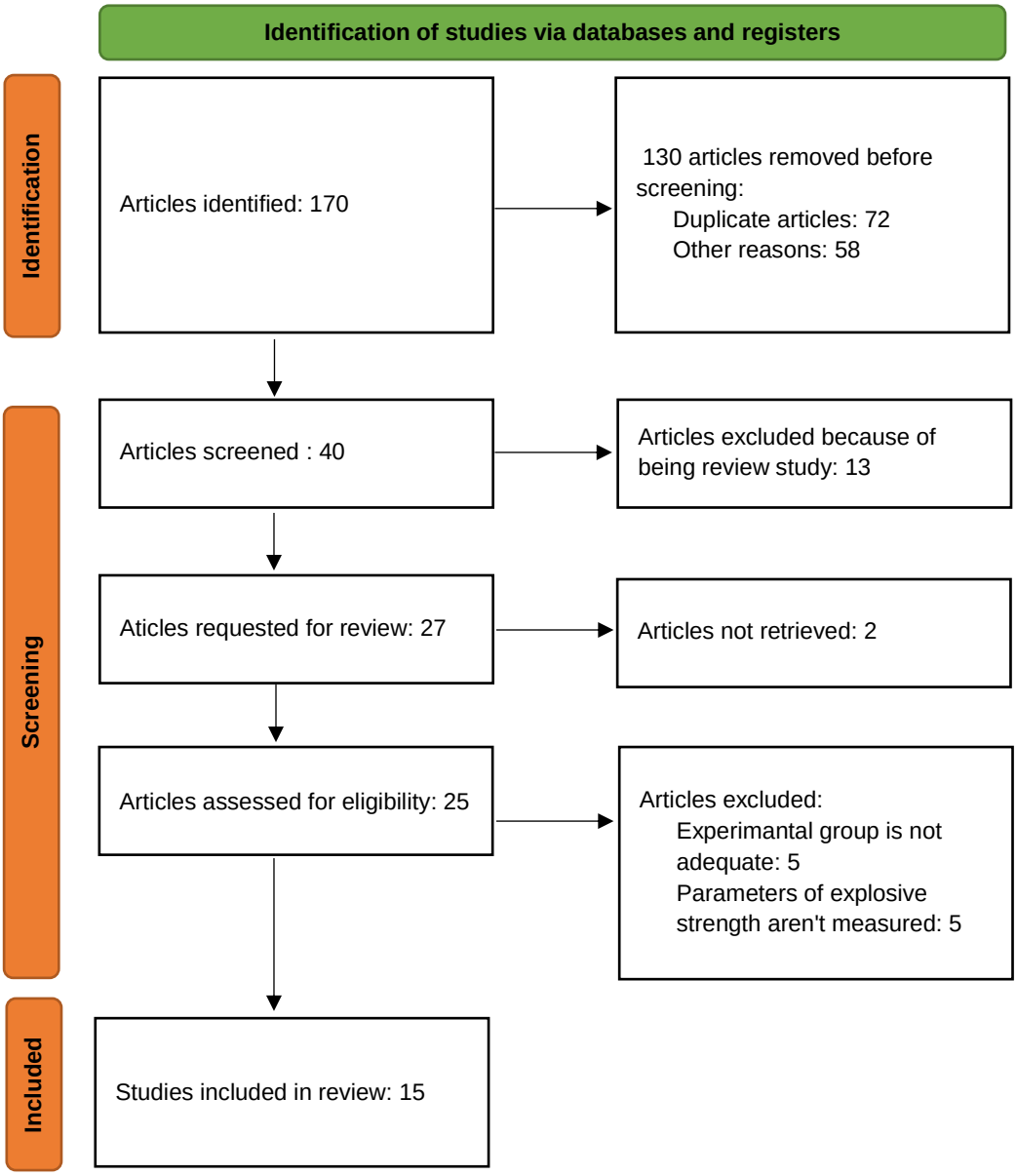
The exclusion criteria were as follows:

- Studies that focus on high school students or adults.
- Articles that do not specifically measure explosive power or its development.
- Non-peer-reviewed articles, such as editorials or commentaries.

RESULTS

Based on the database search, a total of 170 potentially relevant papers were identified. Careful examination led to the exclusion of 130 papers, of which 72 were duplicates, and 58 did not meet established inclusion criteria or met exclusion criteria. This process resulted in 40 papers for analysis. Further examination revealed that 13 of these 40 papers were systematic reviews and, although relevant to the context, were not considered for the analysis of individual studies. After the initial screening, 27 studies remained for further examination. Finally, 15 studies were found to meet the inclusion criteria for this review. Chart 1 provides a visual representation of the process of selection of papers and elimination of inappropriate studies, providing readers with an insight into the methodological approach of this research.

Chart 1. Selection proces (Origin: Prisma 2020 flow diagram for new systematic review[6])



[6] http://prisma-statement.org/prismastatement/flowdiagram.aspx?AspxAutoDetectCookieSupport=1

Table 1. Results

Reference	Participants			Duration of intervention in weeks	Intervention type	Results
	Sex	Number	Age			
Cabrejas et al. (2023)	F	44	10.5 ± 1.8	8	CPT	CMJ+, SJ+
Ahmadabadi et al. (2023)	F	20	NS	4, 2/1	PT	ToF+, ELP+
Kurt et al. (2023)	M	32	12.09 ± 0.89	6	PT	VJH+, SLJ+
Bouguezzi et al. (2020)	M	30	NS	8, 2/1	PT	5MS+, SLJ+, MICODT+, CMJ+, SJ+, RSI+, KD+
Hammami, Gaamouri, Shephard & Chelly, (2019)	M	28	15.8 ± 0.4	8	PT	SV+, SJ+, CMJ+
Hammami et al. (2018)	F	41	13.5 ± 0.3	9	PT	SV+, CoD+, VJ+
Di Giminiani & Visca (2017)	M/F	19	13.3 ± 0.1	24	PT	CMJ+, SJ+, CCMJ+
Negra et al. (2017)	M	33	12.1 ± 0.5	8, 4/1	PTS PTC	CMJ+, SLJ+
Negra et al. (2017)	M	34	12.7 ± 0.2	8, 3/1	SPT	CMJ+, SLJ+, IAT+, SYBT+, UYBT+
Negra et al. (2016)	M	22	NS	8	PT	HS+, CMJ+, CoD+, SLJ+
de Hoyo et al. (2016)	M	32	NS	8, 2/1	PT	CMJ+, SP+
Ramírez-Campillo et al. (2015)	NS	24	13.0 ± 2.3	6	PT	CMJA+, DJ+
Ramírez-Campillo et al. (2015)	NS	40	10-14	6	PT	SP+, DJ+, CoDS+
Chely, Hermassi & Shephard, (2015)	M	27	11.9 ± 1.0	10, 3/1	PT	SJ+, CMJ+, DJ+, SV+,
Ramírez-Campillo et al. (2014)	NS	54	11.4 ± 2.2	6, 2/1	PT	CMJA+, SP+

CMJ (Countermovement Jump), CCMJ (Continuous Countermovement Jump), CMJA (CMJ with Arms), CoDS (Change of Direction Speed, DJ (Drop Jump), ELP (Explosive Leg Power, F (Female), HS (Half-Squat), IAT (Illinois Agility Test), KD (Kicking Distance, M (Male), MICODT (Modified Illinois Change of Direction Test), NS (Not Specified), RSI (Reactive Strength Index), SJ (Squat Jump), SLJ (Standing Long Jump, SP (Sprint Performance), SV (Sprint Velocities), SYBT (Stork Balance Y Test Stable), PT (Plyometric training), ToF (Time of Flight), UYBT (Unstable Stork Balance Y Balance Test), VJ (Vertical Jump), 5MS (5 meter sprint), +-improvement;

DISCUSSION

The collected data reveal a gender-specific approach to the study of explosive strength development, with three studies focusing exclusively on female participants (Hammami et al., 2018; Ahmadabadi et al., 2023; Cabrejas et al., 2023) and the rest mainly including male participants. participants or does not specify gender. This

gender distribution highlights the necessity of more inclusive research to fully understand the dynamics of explosive strength development across genders. In particular, the Di Giminiani & Visca (2017) study stands out for including both male and female participants, providing valuable insight into comparative gender-based outcomes.

The intervention lasted from 4 to 24 weeks, and most studies opted for a period of 8 weeks (de Hoyo et al., 2016; Ramírez-Campillo et al., 2015; Negra et al., 2017; Hammami et al., 2018; Hammami, Gaamouri, Shephard, & Chelly, 2019; Bouguezzi et al., 2020; Cabrejas et al., 2023; Ahmadabadi et al., 2023). This trend suggests a consensus among researchers that 8 weeks is sufficient to see significant improvements in indicators of explosive power such as counter-movement jump (CMJ), squat jump (SJ), and sprint performance (SP). The Di Giminiani & Visca (2017) study is an exception, lasting over 24 weeks and offering a unique perspective on the long-term effects of plyometric training on explosive strength development.

The youngest participants were found in the study by Cabrejas et al. (2023) focusing on girls aged 10.5 ± 1.8, investigating the impact of plyometric training on performance. This study highlights the potential for early plyometric interventions to improve performance in the context of explosive strength in preadolescent children, emphasizing the importance of introducing such training methodologies at an early age to maximize developmental benefits.

In contrast, the oldest participants were observed in the study by Hammami et al. (2019), with children aged up to 15.8 years. The inclusion of the oldest subjects of primary school age allows examination of training results at a time of significant hormonal and physical changes that may affect the response to strength training.

These studies, which range in age from 10 to 15.8 years, offer a valuable perspective on how children at different stages of maturation respond to plyometric and resistance training. Findings point to a critical window for implementing training interventions that can meet the unique physiological and developmental needs of younger and older youth athletes. The comparison between the youngest and oldest participants in these studies highlights the approach needed in designing and implementing training programs for children to optimize physical development and improve athletic performance.

Development of explosive power, as measured by various performance indicators, showed consistent improvement in all studies. Key outcomes included improvements in CMJ, SJ, vertical jump height (VJH), long jump (SLJ) and sprint speeds (SV). The widespread improvement in these metrics across studies and interventions underscores the effectiveness of plyometric training in increasing explosive strength among elementary school students. In particular, improvements in specific performance metrics such as the Modified Illinois Change of Direction Test (MICODT) and reactive power index (RSI) in the study by Bouguezzi et al. (2020) suggest that plyometric training not only increases explosive power but also improves agility and reaction time.

A wide range of results related to the development of explosive power has been presented. For example, studies by Bouguezzi et al. (2020) and Cabrejas et al. (2023) highlight significant improvements in CMJ and SJ performance, indicating the

effectiveness of plyometric exercises in increasing lower body explosive power. This is crucial for activities that require sudden bursts of power, such as jumping and sprinting. The consistency of these findings across studies suggests a strong relationship between plyometric training and improvements in explosive power metrics.

Moreover, the diversity in participant profiles, with some studies focusing exclusively on female participants, such as those by Hammami et al. (2018) and Cabrejas et al. (2023), and others on men, provides insight into gender-specific responses to explosive strength training. Interestingly, a study by Di Giminiani & Visca (2017) that included both male and female participants offers a unique perspective on comparative training outcomes across genders, although no details on gender-specific outcomes are provided. This inclusion highlights the need for future research to delve deeper into gender as a significant factor in training effectiveness.

CONCLUSION

The studies reviewed offer a compelling story of the benefits of training for children and adolescents across a wide age range, with data consistently showing that structured training can significantly improve explosive power including improvements in sprint speed, jump height, and overall muscular strength and endurance.

The breadth of age groups covered in these studies highlights the adaptability and effectiveness of different training at different stages of physical and developmental maturity. This suggests that with appropriate design and supervision, such training can be a valuable component of school-age children's physical education and athletic development programs. These findings highlight the potential for early and sustained intervention in physical training to promote long-term benefits in physical fitness, athletic performance, and potentially in health outcomes as children grow into adulthood.

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