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IMPACT OF PHYSICAL ACTIVITY AND PHYSICAL FITNESS ON ACADEMIC PERFORMANCE: META ANALYSIS PROTOCOL

UGOTAVLJANJE VPLIVA TELESNE AKTIVNOSTI IN TELESNE ZMOGLJIVOSTI NA UČNO USPEŠNOST: PROTOKOL META ANALIZE

ABSTRACT

Physical activity and physical fitness are well-documented contributors to overall health, affecting various physiological and psychological outcomes. While some studies have reported a positive impact on academic performance, others have not found significant effects. Given these mixed results, the aim of this meta-analysis is to explore the effects of physical activity and physical fitness specifically on academic performance. Additionally, the research will examine whether the competencies of teachers delivering the physical activity interventions significantly influence the implementation of the intervention and how this impact manifests in the academic performance of children and adolescents. The Meta-Analysis will include searches in PubMed, Scopus, and ScienceDirect. The results will be crucial for understanding how measured physical fitness, in addition to increased physical activity, influences the academic performance of children and adolescents. By identifying the most effective types of interventions and the critical role of instructor competence, we can guide the development of more targeted and effective physical activity programs.

Keywords: Physical activity, physical fitness, academic performance, teaching qualifications, children

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IZVLEČEK

Telesna dejavnost in telesna zmogljivost pomembno prispevata k splošnemu zdravju, saj vplivata na različne fiziološke in psihološke kazalce. Medtem, ko nekatere študije poročajo o pozitivni povezanosti telesne dejavnosti in telesne zmogljivosti z učno uspešnostjo, pa nekatere niso ugotovile statistično značilnih učinkov. Glede na mešane rezultate prejšnjih študij, je cilj te meta-analize raziskati učinke telesne dejavnosti in telesne zmogljivosti, posebej vezano na učno uspešnost. Poleg tega bo raziskava preučevala, ali kompetence učiteljev, ki izvajajo telesno dejavne intervencije, pomembno vplivajo na izvedbo teh intervencij in kako se ta vpliv kaže na učno uspešnost otrok in mladostnikov. Meta-analiza bo vključevala iskanja v PubMed, Scopus in ScienceDirect. Poleg vpliva na povečano telesno dejavnost otrok in mladostnikov, bodo rezultati ključni tudi za razumevanje vpliva telesne zmogljivosti na njihovo učno uspešnost. Identificiranje najučinkovitejših vrst intervencij in vloge učiteljevih kompetenc, bo lahko v pomoč razvoju bolj ciljanih in učinkovitih programov telesne aktivnosti.

Ključne besede: Telesna dejavnost, telesna zmogljivost, učna uspešnost, pedagoške kompetence, otroci

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INTRODUCTION

Regular physical activity (PA), with appropriate intensity and duration, has a significant impact on the health of children, adolescents, and adults (Zhang et al., 2020). It contributes to improved cardiorespiratory endurance, metabolism, skeletal health, and psychosocial functioning (Franklin et al., 2022; Smith et al., 2014). Physical fitness (PF) is the ability to perform daily activities effectively without excessive fatigue (Clarke, 1979). It encompasses a range of physical attributes such as cardiorespiratory endurance, muscle strength and power, speed, agility, coordination, flexibility, and body composition. Better physical fitness is associated with a longer lifespan and a reduced risk of premature death, as it helps lower the risk of developing cardiovascular and other chronic diseases (Bouchard et al., 2012; Kvaavik et al., 2009; Laukkanen et al., 2016; Myers et al., 2015; Warburton & Bredin, 2017).

The fast pace of modern life and increasingly sedentary lifestyles contribute to a reduction in PA (Park et al., 2020; Sember, Jurak, Kovač, Đurić, et al., 2020) and consequently to issues such as overweight and obesity (Di Maglie et al., 2022). According to the recommendations of the World Health Organization (WHO), children and adolescents aged 5 to 17 should engage in an average of at least 60 minutes of moderate to vigorous physical activity daily. This activity should be mostly aerobic, spread throughout the week, and include both high-intensity activities and those that strengthen muscles and bones (World Health Organization, 2020).

While it is well-known that regular PA and good PF positively impact overall health (Laukkanen et al., 2016; Moon et al., 2020; Warburton & Bredin, 2017), we are interested in their impact on the academic performance (AP) of children and adolescents. Research indicates a positive correlation between cognitive abilities, PF and PA (Davis & Cooper, 2011; Fisher et al., 2011; Hillman et al., 2014; Kim et al., 2003; Sember, Jurak, Kovač, Đurić, et al., 2020). Sember et al. (2020) found with meta-analysis that there are positive (although relatively small) relationships between PA and AP. AP is not only influenced by the frequency and duration of PA but also by the intensity of the activity. Regular physical education classes and extracurricular activities are often the only regular PA (de Greeff et al., 2016; Garaulet et al., 2011; Sember, Jurak, Kovač, Morrison, et al., 2020) for many children. Therefore, the competencies of physical education teachers and other professionals conducting sports activities within school programs are crucial and can significantly influence the PA of pupils. The positive effect of PA is greater when conducted by more competent instructors, such as

physical education teachers or trained sports coaches (Jurak et al., 2013; Sember, Jurak, Kovač, Morrison, et al., 2020; Zorc & Pišot, 2003).

The aim of this meta-analysis is to investigate the impact of PA and PF on the AP of healthy children and adolescents aged 5 to 16 years. Additionally, it will explore whether the competencies of teachers delivering the PA interventions significantly influence the implementation of the intervention and how this impact manifests in the AP of children and adolescents. Given the mixed conclusions from systematic reviews with meta-analyses (Sember, Jurak, Kovač, Morrison, et al., 2020), which analysed 44 interventions where nearly half showed a positive impact on AP while the other half did not show a significant effect, it is crucial to understand how measured PF, in addition to increased PA, influences the AP of children and adolescents.

RESULTS

The meta-analysis will follow the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Moher et al., 2009) and will be registered with PROSPERO (ID: CDR132118).

Literature Search

Two reviewers (VS and JP) will independently search PubMed, Scopus, and ScienceDirect from June 2024 to September 2024. Unpublished studies will be excluded. Titles and abstracts will be screened using a predefined search string (children OR adolescents OR pupil) AND intervention AND school AND (physical fitness OR physical performance OR muscular fitness OR skill-related fitness OR motor abilities) AND (physical activity OR physical education OR extracurricular activity) AND (cognition OR academic performance OR academic achievement). References will be managed and deduplicated using Mendeley software.

Inclusion Criteria

Included studies will focus on the impact of physical activity or physical fitness, targeting individuals aged 7 to 15 years with no socio-economic disadvantages and an even gender distribution. Studies must report measurable outcomes related to physical activity or physical fitness, last longer than 12 weeks, include control and experimental groups, and involve more than 30 participants. Results with $p < 0.05$ will be recalculated using effect size (ES) metrics.

Data Extraction and Statistical Analysis

Data will be independently extracted by two reviewers (VS and JP). Discrepancies will be resolved through discussion. Data consistency will be checked against trial protocols and reports. The Hunter-Schmidt estimate and Fisher's z transformation will be used to address bias.

Studies will provide data to calculate standardized mean differences (ES) between groups, using Cohen's and Rosenthal's formulas. When multiple ES values will be available, the average ES will be used. The Hunter-Schmidt approach will convert ES to correlation (r_w), weighted by sample size to calculate the population effect (r_p). Variance due to sampling error (V_s) and the variance in ES (V_p) will be calculated, with 95% credibility intervals (CI_w) and heterogeneity assessed using I² and Q statistics. ES magnitudes will be described per Cohen and Sawilowsky. Risk of bias assessment will be performed and GRADE qualitative approach will be utilized (Iorio et al., 2015; Schünemann et al., 2013).

DISCUSSION

This protocol outlines the methodology for a comprehensive meta-analysis examining the impact of PA or PF on AP among individuals aged 6 to 15 years. By adhering to the PRISMA guidelines and registering with PROSPERO, we aim to ensure a rigorous and transparent approach to synthesizing existing research.

Relevance and Importance

PA and PF are well-documented contributors to overall health, affecting various physiological and psychological outcomes. This meta-analysis aims to explore these effects specifically on AP, a critical area that has garnered mixed results in previous studies (Álvarez-Bueno et al., 2017; Hapala, 2012; Mura et al., 2015; Singh et al., 2019). By focusing on peer-reviewed articles and dissertations, and ensuring the inclusion of control and experimental groups, this study will provide robust and generalizable findings.

Expected Contributions

We anticipate that this meta-analysis will clarify the extent to which physical activity and physical fitness influence AP. The recalculation of significant outcomes using effect size metrics will provide a nuanced understanding of these relationships. Furthermore, the examination of how the competencies of educators and intervention deliverers influence

outcomes will offer valuable insights into best practices for implementing physical activity programs.

Potential Challenges

Several challenges may arise during this meta-analysis. The heterogeneity of study designs, intervention types, and outcome measures could complicate data synthesis. However, the use of Hunter-Schmidt and Fisher's z transformation methods will help address potential biases and enhance the reliability of our findings. Additionally, the stringent inclusion criteria may limit the number of eligible studies, but this approach is necessary to ensure the validity of the results.

Future Directions

The findings from this meta-analysis will inform future research and policy recommendations. By identifying the most effective types of interventions and the critical role of instructor competence, we can guide the development of more targeted and effective physical activity programs. Moreover, understanding the relationship between physical activity, physical fitness, and academic performance will help educators and policymakers prioritize resources and strategies that maximize health and academic outcomes for children and adolescents.

CONCLUSION

In conclusion, this meta-analysis will provide a comprehensive assessment of the impact of physical activity and physical fitness on academic performance, contributing to the evidence base and informing future interventions and policies. Through rigorous methodology and thorough analysis, we aim to advance the understanding of how these critical factors influence the well-being and performance of young individuals.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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