

## REL Southwest Ask A REL Response

September 2019

### Question:

*What is the relationship between physical activity and academic skills in the early years?*

### Response:

Thank you for the question you submitted to our REL Reference Desk. We have prepared the following memo with research references to help answer your question. For each reference, we provide an abstract, excerpt, or summary written by the study's author or publisher. Following an established Regional Educational Laboratory (REL) Southwest research protocol, we conducted a search for research reports as well as descriptive study articles on the relationships between academic skills and physical skills in the early years.

We have not evaluated the quality of references and the resources provided in this response. We offer them only for your reference. Also, we searched the references in the response from the most commonly used resources of research, but they are not comprehensive, and other relevant references and resources may exist. References provided are listed in alphabetical order, not necessarily in order of relevance. We do not include sources that are not freely available to the requestor.

### Research References

Abadie, B. R., & Brown, S. P. (2010). Physical activity promotes academic achievement and a healthy lifestyle when incorporated into early childhood education. *Forum on Public Policy Online*, 2010(5), 1–8. Retrieved from <https://eric.ed.gov/?id=EJ912979>

*From the ERIC abstract:* “The detrimental effects of physical inactivity within children have enormous personal health consequences. These health conditions have the potential to impact the economic vitality of society as a whole. Studies have indicated that inactive children are far more likely to suffer from obesity, type II diabetes, and hypertension than their physically active peers. Research also indicates that these health problems tend to follow the individual into adulthood. Seventy percent of obese adolescents will become obese adults (Reilly, 2007). In addition to the health benefits of physical activity, physical activity has also been positively correlated to academic achievement when integrated into early childhood educational programs. This paper will primarily review the evidence that demonstrates the positive influence of physical activity on academic achievement in early

childhood education. This paper will further provide basic guidelines for developing an early childhood education program.”

Carlson, S. A., Fulton, J. E., Lee, S. M., Maynard, L. M., Brown, D. R., Kohl, H. W., III, et al. (2008). Physical education and academic achievement in elementary school: Data from the Early Childhood Longitudinal Study. *American Journal of Public Health, 98*(4), 721–727. Retrieved from <https://ajph.aphapublications.org/doi/pdfplus/10.2105/AJPH.2007.117176>

*From the abstract: “Objectives.* We examined the association between time spent in physical education and academic achievement in a longitudinal study of students in kindergarten through fifth grade. *Methods.* We used data from the Early Childhood Longitudinal Study, Kindergarten Class of 1998 to 1999, which employed a multistage probability design to select a nationally representative sample of students in kindergarten (analytic sample = 5316). Time spent in physical education (minutes per week) was collected from classroom teachers, and academic achievement (mathematics and reading) was scored on an item response theory scale. *Results.* A small but significant benefit for academic achievement in mathematics and reading was observed for girls enrolled in higher amounts (70–300 minutes per week) of physical education (referent: 0–35 minutes per week). Higher amounts of physical education were not positively or negatively associated with academic achievement among boys. *Conclusions.* Among girls, higher amounts of physical education may be associated with an academic benefit. Physical education did not appear to negatively affect academic achievement in elementary school students. Concerns about adverse effects on achievement may not be legitimate reasons to limit physical education programs.”

Carson, V., Hunter, S., Kuzik, N., Wiebe, S. A., Spence, J. C., Friedman, A., et al. (2016). Systematic review of physical activity and cognitive development in early childhood. *Journal of Science and Medicine in Sport, 19*(7), 573–578. Retrieved from <https://www.researchgate.net/publication/280329085>

*From the abstract: “Objectives:* To comprehensively review all observational and experimental studies examining the relationship between physical activity and cognitive development during early childhood (birth to 5 years). *Design:* Systematic review. *Methods:* Electronic databases were searched in July, 2014. No study design, date, or language limits were imposed on the search. Included studies had to be published, peer reviewed articles that satisfied the a priori determined population (apparently healthy children aged birth to 5 years), intervention (duration, intensity, frequency, or patterns of physical activity), comparator (various durations, intensity, or patterns of physical activity), and outcome (cognitive development) study criteria. Study quality and risk of bias were assessed in December 2014. *Results:* A total of seven studies, representing 414 participants from five different countries met the inclusion criteria, including two observational and five experimental studies. Six studies found increased or higher duration/frequency of physical activity had statistically significant ( $p < 0.05$ ) beneficial effects on at least one cognitive development outcome, including 67% of the outcomes assessed in the executive function domain and 60% in the language domain. No study

found that increased or higher duration/frequency of physical activity had statistically significant detrimental effects on cognitive development. Six of the seven studies were rated weak quality with a high risk of bias. *Conclusions:* This review provides some preliminary evidence that physical activity may have beneficial effects on cognitive development during early childhood. Given the shortage of the information and the weak quality of available evidence, future research is needed to strengthen the evidence base in this area.”

Davis, C. L., Tomporowski, P. D., McDowell, J. E., Austin, B. P., Miller, P. H., Yanasak, N. E., et al. (2011). Exercise improves executive function and achievement and alters brain activation in overweight children: A randomized, controlled trial. *Health Psychology, 30*(1), 91–98. Retrieved from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3057917/>

*From the abstract:* “*Objective:* This experiment tested the hypothesis that exercise would improve executive function. *Design:* Sedentary, overweight 7- to 11-year-old children ( $N = 171$ , 56% female, 61% Black,  $M \pm SD$  age  $9.3 \pm 1.0$  yrs, body mass index (BMI)  $26 \pm 4.6$  kg/m<sup>2</sup>, BMI z-score  $2.1 \pm 0.4$ ) were randomized to  $13 \pm 1.6$  weeks of an exercise program (20 or 40 minutes/day), or a control condition. *Main outcome measures:* Blinded, standardized psychological evaluations (Cognitive Assessment System and Woodcock-Johnson Tests of Achievement III) assessed cognition and academic achievement. Functional magnetic resonance imaging measured brain activity during executive function tasks. *Results:* Intent to treat analysis revealed dose response benefits of exercise on executive function and mathematics achievement. Preliminary evidence of increased bilateral prefrontal cortex activity and reduced bilateral posterior parietal cortex activity due to exercise was also observed. *Conclusion:* Consistent with results obtained in older adults, a specific improvement on executive function and brain activation changes due to exercise were observed. The cognitive and achievement results add evidence of dose response, and extend experimental evidence into childhood. This study provides information on an educational outcome. Besides its importance for maintaining weight and reducing health risks during a childhood obesity epidemic, physical activity may prove to be a simple, important method of enhancing aspects of children’s mental functioning that are central to cognitive development. This information may persuade educators to implement vigorous physical activity.”

*REL Southwest Note:* This report meets What Works Clearinghouse (WWC) standards without reservations.

Fedewa, A. L., & Ahn, S. (2011). The effects of physical activity and physical fitness on children’s achievement and cognitive outcomes: A meta-analysis. *Research Quarterly for Exercise and Sport, 82*(3), 521–535. <https://eric.ed.gov/?id=EJ967153>. Retrieved from <https://www.researchgate.net/publication/51680069>

*From the ERIC abstract:* “It is common knowledge that physical activity leads to numerous health and psychological benefits. However, the relationship between children's physical activity and academic achievement has been debated in the literature. Some studies have found strong, positive relationships between physical activity and

cognitive outcomes, while other studies have reported small, negative associations. This study was a comprehensive, quantitative synthesis of the literature, using a total of 59 studies from 1947 to 2009 for analysis. Results indicated a significant and positive effect of physical activity on children's achievement and cognitive outcomes, with aerobic exercise having the greatest effect. A number of moderator variables were also found to play a significant role in this relationship. Findings are discussed in light of improving children's academic performance and changing school-based policy.”

Sibley, B. A., & Etnier, J. L. (2003). The relationship between physical activity and cognition in children: A meta-analysis. *Pediatric Exercise Science*, 15, 243–256. Retrieved from <https://pdfs.semanticscholar.org/2c7d/463dbf6b35a870e81eaf1754cc780f169eb3.pdf>

*From the abstract:* “The purpose of this study was to quantitatively combine and examine the results of studies pertaining to physical activity and cognition in children. Studies meeting the inclusion criteria were coded based on design and descriptive characteristics, subject characteristics, activity characteristics, and cognitive assessment method. Effect sizes (ESs) were calculated for each study and an overall ES and average ESs relative to moderator variables were then calculated. ESs ( $n = 125$ ) from 44 studies were included in the analysis. The overall ES was 0.32 ( $SD = 0.27$ ), which was significantly different from zero. Significant moderator variables included publication status, subject age, and type of cognitive assessment. As a result of this statistical review of the literature, it is concluded that there is a significant positive relationship between physical activity and cognitive functioning in children.”

St. Laurent, C. W., Burkart, S., & Alhassan, S. (2018). Effect of a school-based physical activity intervention on number and letter recognition in preschoolers. *International Journal of Exercise Science*, 11(5), 168–178. Retrieved from <https://digitalcommons.wku.edu/cgi/viewcontent.cgi?article=2178&context=ijes>

*From the abstract:* “The aims of this study were to determine if physical activity (PA) and sedentary behaviors were correlated to components of school readiness skills (i.e., symbol recognition – numbers and letters) in preschoolers and to evaluate the efficacy of a 12-week, academically connected PA intervention on letter and number recognition in preschoolers. Two preschool centers were randomized to a 12-week preschool-based PA intervention (INT) that incorporated short-bout PA lessons embedded into the Massachusetts Early Learning Standards or a health-tracking control group (CON). INT preschoolers completed two 10-minute (as part of morning circle time) and three 5-minute bouts (afternoon after naptime) of PA each week. One hundred fourteen students (INT,  $n = 60$ ; CON,  $n = 54$ ) participated in the study, but assessment was completed in 52 children (INT,  $n = 26$ ; CON,  $n = 26$ ). Whole day PA was measured over one week (including one weekend day) by accelerometry at baseline. School readiness skills were assessed by recognition of symbols (i.e. letters and numbers) at baseline and at 12-weeks. Spearman rank correlations were used to assess a relationship between PA and symbol recognition. Multiple linear regression models were used to assess the effect of the intervention on symbol recognition. There were no significant correlations between PA and symbol recognition and no significant effect of the intervention on pre- to post-

scores. Further research may be valuable to examine the benefits of a preschool PA intervention by utilizing longer intervention periods, additional bouts of academically-tailored PA, and more comprehensive measures of school readiness skills.”

Tomprowski, P. D., Davis, C. L., Miller, P. H., & Naglieri, J. A. (2008). Exercise and children’s intelligence, cognition, and academic achievement. *Educational Psychology Review*, 20(2), 111–131. <https://eric.ed.gov/?id=EJ791097>. Retrieved from <https://www.ncbi.nlm.nih.gov/pmc/articles/pmc2748863/>

*From the ERIC abstract:* “Studies that examine the effects of exercise on children’s intelligence, cognition, or academic achievement were reviewed and results were discussed in light of (a) contemporary cognitive theory development directed toward exercise, (b) recent research demonstrating the salutary effects of exercise on adults’ cognitive functioning, and (c) studies conducted with animals that have linked physical activity to changes in neurological development and behavior. Similar to adults, exercise facilitates children’s executive function (i.e., processes required to select, organize, and properly initiate goal-directed actions). Exercise may prove to be a simple, yet important, method of enhancing those aspects of children’s mental functioning central to cognitive development.”

## Methods

### Keywords and Search Strings

The following keywords and search strings were used to search the reference databases and other sources:

- [ (“physical activity”) AND (“academic achievement”) ]
- [ (“physical activity”) AND (“academic performance”) ]
- [ (“physical activity”) AND (“academic achievement”) AND (“early childhood”) ]
- [ (“physical activity”) AND (“academic performance”) AND (“early childhood”) ]

### Databases and Resources

We searched [ERIC](#) for relevant, peer-reviewed research references. ERIC is a free online library of more than 1.7 million citations of education research sponsored by the Institute of Education Sciences (IES). Additionally, we searched the [What Works Clearinghouse](#).

### Reference Search and Selection Criteria

When we were searching and reviewing resources, we considered the following criteria:

- *Date of the publication:* References and resources published from 2004 to present, were included in the search and review.

- *Search priorities of reference sources:* Search priority is given to study reports, briefs, and other documents that are published and/or reviewed by IES and other federal or federally funded organizations, academic databases, including ERIC, EBSCO databases, JSTOR database, PsychInfo, PsychArticle, and Google Scholar.
- *Methodology:* The following methodological priorities/considerations were given in the review and selection of the references: (a) study types—randomized control trials, quasi-experiments, correlational studies, descriptive data analyses, literature reviews, mixed methods analyses, and so forth; (b) target population, samples (representativeness of the target population, sample size, volunteered or randomly selected, and so forth), study duration, and so forth; and (c) limitations, generalizability of the findings and conclusions, and so forth.

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This memorandum is one in a series of quick-turnaround responses to specific questions posed by stakeholders in the Southwest Region (Arkansas, Louisiana, New Mexico, Oklahoma, and Texas), which is served by the Regional Educational Laboratory (REL) Southwest at AIR. This memorandum was prepared by REL Southwest under a contract with the U.S. Department of Education’s Institute of Education Sciences (IES), Contract ED-IES-91990018C0002, administered by AIR. Its content does not necessarily reflect the views or policies of IES or the U.S. Department of Education nor does mention of trade names, commercial products, or organizations imply endorsement by the U.S. Government.