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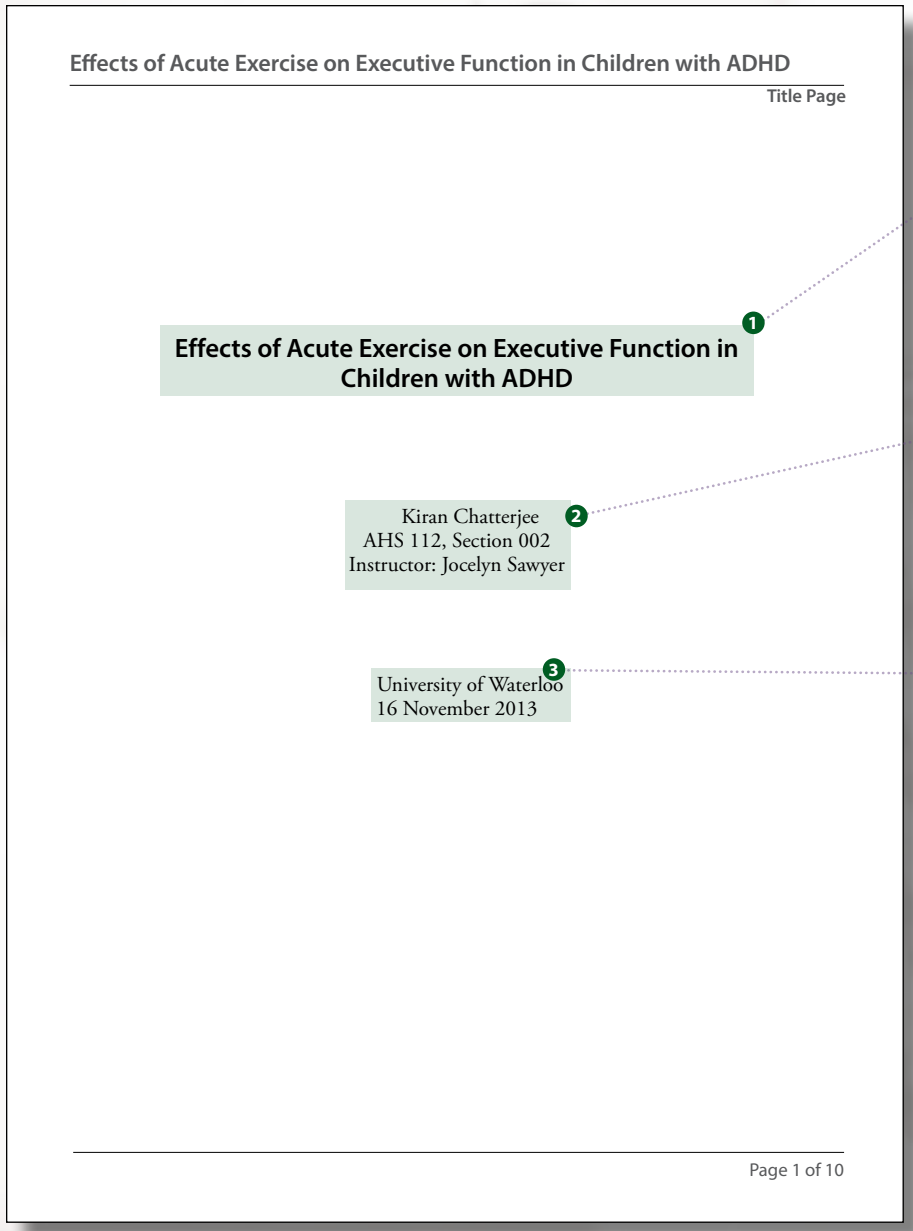

Effects of Acute Exercise on Executive Function in Children with ADHD

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1. The title is a single line and written as a phrase.
2. The writer includes her name and the name of the instructor.
3. The date is included on the title/cover page.

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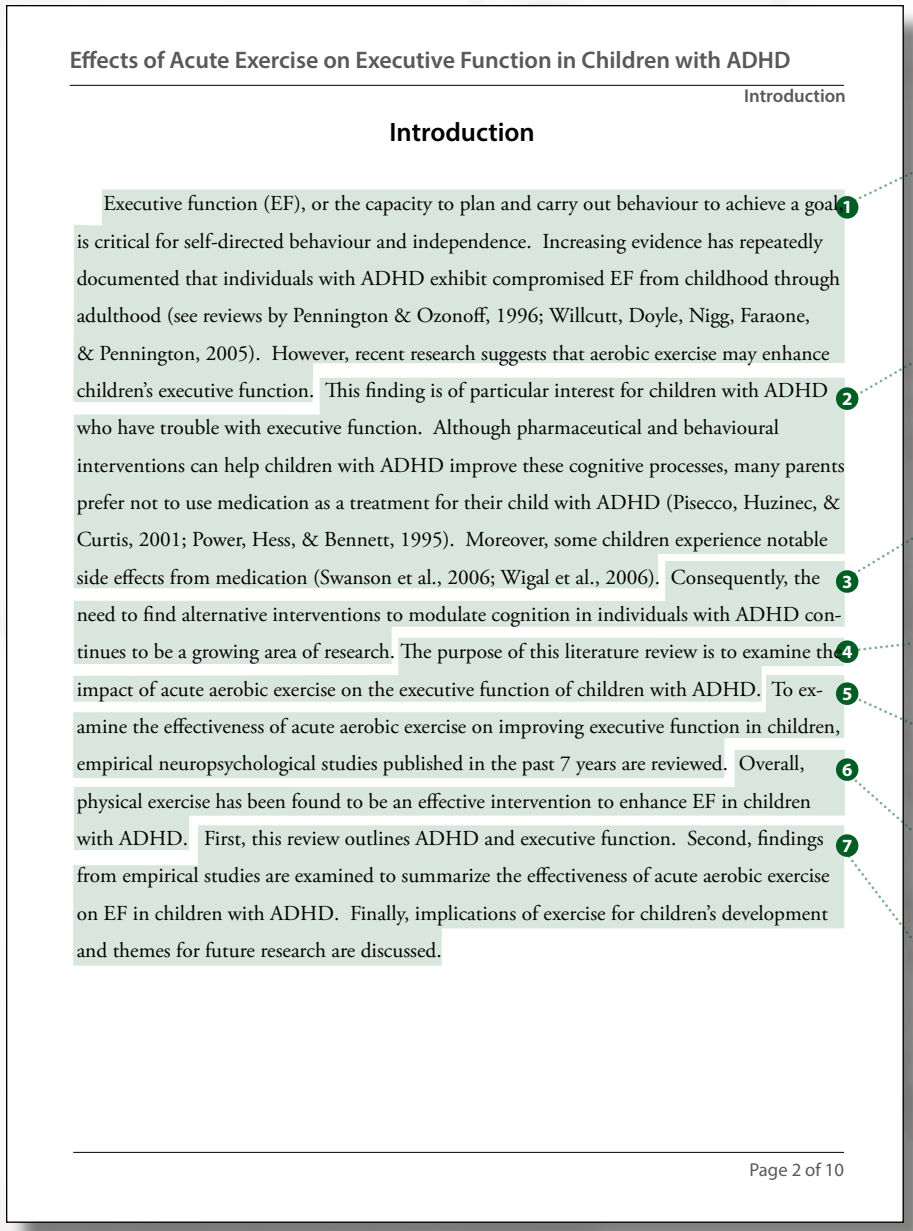

Effects of Acute Exercise on Executive Function in Children with ADHD

Introduction

Introduction

Executive function (EF), or the capacity to plan and carry out behaviour to achieve a goal, is critical for self-directed behaviour and independence. Increasing evidence has repeatedly documented that individuals with ADHD exhibit compromised EF from childhood through adulthood (see reviews by Pennington & Ozonoff, 1996; Willcutt, Doyle, Nigg, Faraone, & Pennington, 2005). However, recent research suggests that aerobic exercise may enhance children's executive function. This finding is of particular interest for children with ADHD who have trouble with executive function. Although pharmaceutical and behavioural interventions can help children with ADHD improve these cognitive processes, many parents prefer not to use medication as a treatment for their child with ADHD (Pisecco, Huzinec, & Curtis, 2001; Power, Hess, & Bennett, 1995). Moreover, some children experience notable side effects from medication (Swanson et al., 2006; Wigal et al., 2006). Consequently, the need to find alternative interventions to modulate cognition in individuals with ADHD continues to be a growing area of research. The purpose of this literature review is to examine the impact of acute aerobic exercise on the executive function of children with ADHD. To examine the effectiveness of acute aerobic exercise on improving executive function in children, empirical neuropsychological studies published in the past 7 years are reviewed. Overall, physical exercise has been found to be an effective intervention to enhance EF in children with ADHD. First, this review outlines ADHD and executive function. Second, findings from empirical studies are examined to summarize the effectiveness of acute aerobic exercise on EF in children with ADHD. Finally, implications of exercise for children's development and themes for future research are discussed.

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1. Context and background information.
2. The writer explains why this research is important and who would benefit from it.
3. The gap in current literature.
4. The reviewer's objective.
5. The literature review's scope.
6. Thesis statement.
7. Overview or structure of the literature review.

Literature Review

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ADHD (1)

Attention Deficit/Hyperactivity Disorder (ADHD) is characterized by developmentally (2) inappropriate symptoms including difficulty sustaining attention, impulsive behaviour, and high activity levels (Murphy, 2005). ADHD is a developmental disability with an onset in childhood that may persist into adolescence and adulthood. Extant literature suggests that EF is compromised in individuals with ADHD (see reviews by Douglas, 1999; Pennington & Ozonoff, 1996; Sergeant, Geurts, & Oosterlaan, 2002; Tannock, 2002). However, most (3) of the deficits in EF have been studied in the laboratory, and thus, it is unclear to what degree these deficits are present in everyday situations (Lawrence et al., 2004). A possible explana- (4) tion for the EF deficits characteristic of children with ADHD is the delayed brain development (approximately 2-3 years behind children without ADHD) observed in neuroimaging studies (Shaw et al., 2007). This finding suggests that alternative interventions (such as exercise) intended to encourage neural growth and development in brain regions facilitating EF may be effective and sustainable treatments.

1 Subheadings organize the literature review. The headings match the overview the writer provided in their introduction.

2 The topic sentence indicates what the paragraph is about and provides useful information.

3 The writer paraphrases their sources and represents the researchers' idea accurately. They also cite the sources using APA style.

4 The writer includes evidence to support their claim and explains why the source is significant.

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Executive Function [1]

Executive function (EF) comprises cognitive processes that organize and control task completion (Eslinger, 1996; Lezak, Howieson, & Loring, 2004). One theory posits that EF consists of inhibition, working memory, and shifting attention (Diamond, 2006; Miyake, Friedman, Emerson, Witzki, Howerter, & Wager, 2000). Effective executive functioning is related to the connections among neurons in the prefrontal cortex (PFC) (Shimamura, 2000; Stuss & Benson, 1984). However, the PFC does not fully mature until late adolescence (O'Hare & Sowell, 2008). During this period, brain development is largely shaped by children's experiences. As children mature, they demonstrate competence not only in individual EF tasks, but also in the capacity to coordinate among EF components (e.g., working memory and inhibition). Therefore, one reason that aerobic exercise may positively impact EF and the related neural circuitry is that the PFC is immature in adolescence and shaped by experiences, such as exercise.

1. Subheadings organize the literature review. The headings match the overview the writer provided in their introduction.
2. The writer uses a topic sentence that indicates what the paragraph is about and provides useful information.
3. The writer paraphrases their sources and represents the researchers' ideas accurately. They also cite the sources using APA style.

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Effects of Acute Exercise on Executive Function in Children with ADHD

Acute Aerobic Exercise (1)

Acute aerobic exercise is a single bout of physical activity. Rather than determining the long-lasting effects of exercise programs on cognition, acute exercise studies examine the short-term effects immediately following a single bout of exercise. (2) Increasing empirical evidence supports the positive impact of aerobic exercise on children's executive functioning (Delis et al., 2007; Hinkle, Tuckman, & Sampson, 1993; Tomporowski et al., 2008). (3) Researchers have posited that exercise modality may determine its impact on EF. (4) For example, coordinative exercises, such as bouncing a ball alternating between left and right hands or bouncing two balls simultaneously with each hand, involve considerable cognitive control and activate the cerebellum—influencing motor functions, attention, and working memory among other neurobehavioural responses (Budde, Voelcker-Rehage, Pietraßyk-Kendziorra, Ribeiro, & Tidow, 2008). (5) Thus, these coordinative exercises may have a greater positive impact on EF than other kinds of exercise.

(6) Similarly, simple repetitive aerobic exercise, such as treadmill running or walking, has been compared to rest periods using a within-subjects design to determine its impact on EF. (3) While some researchers have found acute treadmill walking had no effect on a component of EF called shifting (i.e., switching between tasks) (Tomporowski, Davis, Lambourne, Gregoski, & Tkacz, 2008), others have found acute treadmill walking impacts the inhibitory control component of EF in adolescents (Hillman et al., 2009). (7) Although Stroth et al. (2009) found no difference in several aspects of EF (i.e., selective attention, inhibition, and working memory) between exercise and control groups when using stationary cycling at moderate intensity, Drolette et al. (2014) found that children with lower inhibitory control improved the most following a single bout of moderate intensity treadmill walking. The empirical evidence is not conclusive, but the differences in exercise modality and experimental design may explain the observed differences. Overall, it appears that acute aerobic exercise may impact certain aspects of EF in children with ADHD.

1. Subheadings organize the literature review. The headings match the overview the writer provided in their introduction.
2. The topic sentence indicates what the paragraph is about and provides useful information.
3. The writer provides sufficient evidence to support the claim while using their Matrix to search for patterns.
4. The Present Perfect tense shows the findings' ongoing relevance.
5. These paragraphs work together to create a cohesive argument. The second paragraph logically follows the first and builds on previous points. Transition words are used to help guide the reader.
6. This topic sentence is used to transition from the last paragraph to the current paragraph.
7. The writer provides an analytical comparison of the sources and explains the dialogue they create. The writer accomplishes this by treating the sources in relation to each other, not individually.

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The most robust and compelling finding to support the positive impact of exercise on EF in children with ADHD is the increased amplitude of the P3 event-related potential component observed following a 20-minute bout of treadmill running (Pontifex, Saliba, Raine, Picchietti, & Hillman, 2013). The P3 component demonstrates the allocation of attentional resources in response to a stimulus (Polich, 2007). Moreover, the rest condition deteriorated task performance compared to the exercise condition (Pontifex et al., 2013). Interestingly, variations in exercise intensity did not affect P3 amplitude; therefore, these findings suggest the positive impact activity breaks throughout the day may have on attention in children with ADHD.

Collectively, the evidence demonstrates that acute aerobic exercise seems to enhance EF, and more complex exercises have stronger impacts on EF than simpler exercises. However, differences in study design, assessment tools, and participant characteristics make comparisons across studies challenging. Moreover, these differences may explain the inconsistent findings. Another possible explanation for the inconsistent findings across studies is that the link between aerobic exercise and EF may be moderated by brain development stage and EF component being measured. Therefore, the EF component being measured in each study may be more or less sensitive to the effects of acute exercise depending on the age of the participants. For example, inhibition may be less sensitive to the effects of exercise during adolescence (Hillman et al., 2009; Stroth et al., 2009). Nevertheless, acute bouts of aerobic exercise may be effective for improving EF in children, which may have implications for scholastic achievement.

1 While informative, this topic sentence uses evaluative adjectives to analyze the research.

2 These paragraphs work together to create a cohesive argument. The second paragraph logically follows the first and builds on previous points. Transition words are used to help guide the reader.

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Conclusion

The existent literature indicates that acute aerobic exercise enhances some of the processes and brain areas related to EF in children with ADHD. Physical activity may aid in brain development, particularly in the prefrontal cortex, which can improve EF in children with ADHD already experiencing delayed brain development in this area. While this impact may differ depending on the complexity and type of exercise, the suitable duration of physical activity to optimize these effects remains unclear. Moreover, the degree to which these impacts persist outside of the laboratory setting requires further study. Taken together, the current findings suggest a role for physical exercise as a treatment for children with ADHD. Teachers and parents may find the potential for physical exercise as an intervention promising, especially for children with ADHD.

1. The Present tense generalizes about the current body of literature.
2. The writer provides their overall conclusions about the current state of research.
3. The writer addresses the limitations of the current literature and suggests areas of future study.
4. The writer provides a brief summary of findings.
5. Practical applications for the findings are provided.

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1. References are listed on a separate page.
2. The writer uses APA style for their citations.

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Please Note: References intentionally shortened for the purposes of this sample. A literature review must include all citations.