The Relationship of Sport and Physical Activity Participation on Cognitive Function Among Youth in Poverty

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Sport for Development - Other (Youth Sport)  
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Introduction
According to the United States Census Bureau, approximately 43.1 million individuals were living in poverty in the United States in 2015, approximately 13.5% of the United States population (Proctor, Semega & Kollar, 2016). Living in poverty is associated with a plethora of factors that negatively impact mental and physical well-being (Rafael, 2011; Walker & Druss, 2016). Cumulative exposure to adverse experiences (e.g., abuse, violence, neglect) including experiencing socioeconomic disadvantage during childhood is related to the many leading causes of death among adults (Felitti, et al., 1998), as well as being predictive of age-related disease risks (Danese et al., 2009). Studies show how the brain development and function of individuals living in poverty are negatively affected, compared to more affluent peers (Hanson et al., 2012; Johnson et al., 2015; Shonkoff et al., 2012). The areas of the brain that are predominateley affected include the prefrontal cortex and the hippocampus, which are associated with higher-level thinking, executive functions and memory (Hair, Hanson, Wolfe, & Pollak, 2015; Hanson et al., 2012). Moreover, the prefrontal cortex is primarily responsible for executive functions, which include working memory, inhibition and cognitive flexibility (Diamond, 2013).

Individuals from low socio-economic status are disproportionately exposed to adversity during childhood, which affects the development of the prefrontal cortex and its executive functions. However, recent studies show how the brain displays plasticity and the resilience to overcome adverse experiences with the proper interventions. Liston, McEwen, and Casey (2009) assessed the role of stress on the brain and elucidated how one month of exposure to psychosocial stress resulted in disrupted connectivity within the prefrontal cortex. Nevertheless, an encouraging finding was that the disruption of connectivity was reversible after one month of reduced stress, revealing the plasticity of the brain and its ability to recover from chronic exposure to traumatic experiences.

Additionally, the prefrontal cortex does not fully mature until late adolescence, providing exciting opportunities for practitioners and clinicians to foster the development of executive functions. These encouraging findings grant hope into improving and reversing the negative effects of adversity on the prefrontal cortex and its executive functions, which can have a cascade of positive impacts on academic and social outcomes. With executive functions being so critical to academic and life outcomes, a number of studies have examined exercise and physical activity interventions and have shown promise in improving these executive function skills.

Recent studies examining the impact of exercise on brain function have been promising, with moderate aerobic exercise improving aspects of executive functions and memory among predominately Caucasian, middle class older adults (> 65 years) and school-aged children (8-9 years old) (Chaddock et al., 2010; Colcombe et al., 2006; Erickson et al., 2011; Hillman, 2014). A unique study that used Tae Kwon Do to develop executive functions, found that after 3 months of participating in the intervention, the Tae Kwon Do group demonstrated greater improvements in cognitive self-regulation, affective self-regulation, prosocial behavior, classroom conduct, and in the performance on a mental math test than the control group (Lakes & Hoyt, 2004). Despite the promising research on the impact of exercise and physical activity on executive functions, there is a paucity of research that specifically examines this impact among youth living in poverty.

Additionally, there is no research that has assessed whether any type of sport participation (team or individual sport), in any context (in-school, after school, recreation leagues, etc.) has an effect on executive functions among children, youth or adolescents. With the potential lifelong effects of early childhood adversity on executive functions, along with its education implications, it is of upmost importance to assess whether sport participation, physical activity or
exercise improves executive functions among youth in poverty.

Methods
The participants in the study will be approximately 200-250 (ages 10-14) randomly selected students who are enrolled in three different K-8 schools (School A, B and C) that predominately serve children in poverty. All students enrolled in School A engage in approximately 45 minutes of muscular and aerobic training, four days a week, for the entire duration of the academic year. Students in School A are also required to participate in one after-school sport, 5-days a week, throughout the school year, comprising of an additional 120 minutes of physical activity a day. Schools B and C are neighborhood public schools, with a typical curriculum focusing on academic enrichment. Students attending school’s B and C are generally allotted 50 minutes of physical education classes two-times a week, and are not required to participate in after-school sports with very few opportunities for school-sponsored sports available.

Design
In order to explore the relationships between sport participation, physical activity and exercise on executive functions among youth in poverty, this study will utilize a cross-sectional study design. Data for the study will be collected at one time point during the end of the Fall of 2017 and in the beginning of the Spring of 2018. A validated physical activity questionnaire (PAQ-C) will be utilized to measure sport and physical activity participation. Cognitive function measures will be assessed through validated psychological tests that measure executive functions such as: The Flanker task, which measures inhibition, the list sorting working memory task, which measures working memory, and the dimensional change card sort task, which measures cognitive flexibility.

Data Analysis
Pearson moment correlations will be used to elucidate any relationship between the executive functions measures and sport and physical activity participation. Additionally, the relationship between participation in various types of sport and physical activity with executive functions scores will be assessed. For further analysis of mean differences of executive functions scores between schools, and between active and sedentary individuals, an ANOVA will be utilized. Lastly, an ANOVA will be used to examine if there are mean differences with participation in certain sports or activities and executive functions scores. All data will be analyzed in the early Spring of 2018.

Implications
Results from this study will provide novel insight into the potential importance of sport and physical activity participation on executive functions among youth in poverty. Specifically, this study will be the first to examine the relationship between participation in various types of sports on executive function. Findings from this study may also inform school administrators, teachers, and community organizations that operate within the context of poverty to include and/or increase physical activity time for their participants. Sport management professionals can also use the findings from this study to advocate for more sport opportunities, especially among communities in poverty. Lastly, the results of this study may also help inform future sport and physical activity interventions that aim to improve cognitive health among youth in poverty.