CHILDREN WITH ATTENTION DEFICIT HYPERACTIVITY DISORDER (ADHD) IN A PHYSICAL EDUCATION/PHYSICAL ACTIVITY ENVIRONMENT: META ANALYSIS

By

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Abstract

CHILDREN WITH ATTENTION DEFICIT HYPERACTIVITY DISORDER IN A PHYSICAL EDUCATION/PHYSICAL ACTIVITY ENVIRONMENT: META ANALYSIS

Jessica Giesige

Researchers have reported a limited number of studies on best-practices to improve performances in the physical education setting for children with attention deficit hyperactivity disorder (ADHD; Verret, 2010). The purpose of this study was to provide an analysis of literature on the current teaching practices to improve student performance in the physical education environment for children with ADHD. The following databases SportsDiscus, PsychINFO, PsychARTICLES, PubMed/Medline, ProQuest, Child Development and Adolescent Studies, and ERIC from 1970 to 2017 were used for this literature search. Results from this investigation demonstrated no significant results in behavioral outcomes in aggression, anxiety/depression, attention, externalized/internalized problems, and skill related fitness when participating in physical activity. Between study variance showed insignificance among moderators including country, design, diagnosis, duration, environment, gender, measure, school, status, and support. During the intervention a few moderators including training, medication, interaction, and activity level caused a negative impact on children with ADHD while participating in the intervention. Due to lack of understanding and studies

completed in the field of physical activity and children with ADHD our knowledge cannot provide accurate data to help provide best practices in a physical education setting.

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Introduction

The purpose of this study was to provide an analysis of literature on the current teaching practices to improve student performance in the physical education environment for children with ADHD. Best practices are instructional strategies applied by the instructor to achieve positive changes in performance (National Best Practice Center, 2016; U.S. Department of Education; 2008). Children with ADHD are characterized by persistent patterns of inattention and/or hyperactivity-impulsivity that interferes with the child's ability to function and is not due to defiance or a lack of comprehension and can be diagnosed as early as 4 years of age (American Psychiatric Association [APA], 2013). In 2017, the Mayo Clinic reported that ADHD was diagnosed in over three million adolescents in the United States (i.e., 3-5%) and is prevalent in both males and females, with males being diagnosed at a higher rate (i.e., 2 to 1 ratio; APA, 2013).

Attention Deficit Hyperactivity Disorder

Children diagnosed with ADHD may demonstrate the following behaviors: (a) difficulty sustaining attention during task or play activities, (b) difficulty organizing task or activities, (c) difficulty following directions for long periods of time, and (d) difficulty completing regular task (e.g., chores, schoolwork) for at least six months at a degree that impacts the child's development (APA, 2013). Researchers have reported that while not specific to a diagnosis of ADHD motor delays have been reported for

children within this population when compared to their typical developing peers (Pan, Tsui, & Chu, 2009). Specifically, Harvey and Reid (1997) reported that children with ADHD demonstrated fewer components on both the locomotor and object control skills when assessed using the *Test of Gross Motor Development* (*TGMD*; Ulrich, 2000). These reports have been confirmed by several researchers (i.e., Pitcher, Piek, & Hay, 2003; Harvey et al., 2007). Therefore, the researcher believes that identifying best practices for this population will increase the opportunities for professionals working with children with ADHD in the physical education setting.

Best Practices. When working with children with ADHD instructors should have a variety of instructional techniques that have demonstrated efficacy in improving understanding (i.e., psychomotor, cognitive, affective), as well as, increasing student engagement, motivation, and performance (Tserkun, 2003). For instance, when delivering instruction, the teacher should have an assortment of strategies (e.g., visual, auditory, kinesthetic) that promote a universal design for learning. By providing students with ADHD consistent instruction throughout the period teachers can better manage student behavior and (i.e., on task) and time management (Teasley, 2008). The above strategies offer children with ADHD the opportunity to process the information specific to their need and can assist in positive task performance (U.S Department of Education, 2008). Therefore, it is important that the teacher is knowledgeable of his or her students and also a variety of teaching practices that provide maximum opportunities for success for his or her students.

Barriers within Physical Education. In the physical education environment, the symptoms of ADHD are critical to task performance outcomes (Healthy Place; 2016). Due to the symptoms associated with ADHD, such as attention difficulty, hyperactivity, and impulsive behaviors remaining engaged during the class can be difficult and may impact student learning for this population of students (APA, 2013). Specifically, APA (2013) has identified the following behaviors, which include; disruptive behaviors and difficulty in obtaining information to be associated with ADHD. Students demonstrating these behaviors may be disruptive to their classmates and interfere with their own learning which may account for low performance levels reported within the physical education setting for this population (Neto & Goularadans, 2015). These behaviors have also been directly linked to lower levels of performance, deficits in motor skills, poor levels of physical activity, and a secondary diagnosis of developmental coordination disorder (Harvey & Reid, 2003).

Benefits of Physical Education. Physical activity is one of the most vital factors to physical and mental health and is vital to children understanding the importance of living a healthy and being physically active (Fox, 2007; Physical Education Standards of California, 2005). The Centers of Disease and Control and Prevention (CDC; 2017), states that physical activity on a regular basis can help children improve their cardiorespiratory fitness, improve muscular strength and control weight. Mercola (2016) went on to state that regular physical activity reduces symptoms of depression and anxiety, while releasing dopamine and serotonin which have been linked to mood control. Further, Verrett (2012) reported that physical

activity is highly important for children with ADHD as it impacts the negative characteristics, such as impulsivity and off-task behaviors associated with this population. For this reason, identifying teaching strategies that maintain or increase physically activity levels should be a focus of instruction within the physical educational setting for children with ADHD.

Purpose Statement. The purpose of this study was to provide an analysis of literature on the current teaching practices to improve student performance in the physical education environment for children with ADHD.

Research Question. Two research question guided this study:

1. Are children with ADHD receiving best practices within the physical education setting to increase positive behavior outcomes?

2. Are children with ADHD who receive best practices within the physical education setting demonstrating higher task performance?

Definition of Terms. The following terms and definitions are essential to understanding this investigation:

Attention Deficit Hyperactivity Disorder (ADHD) is a mental disorder associated with comparable indications of hyperactivity, attention difficulty, and impulsive behaviors (APA, 2013).

Best practices in education are defined as a range of activities, approaches, and strategies used to achieve positive changes in a student's academic behavior (EOA National Best Practice Center, 2016).

Physical Education is high-quality physical education instruction contributes to good health, develops fundamental and advanced motor skills, improves students' self-confidence, and provides opportunities for increased levels of physical fitness that are associated with high academic achievement (Physical Education Standards of California, 2005).

Physical activity is the skill of bodily movement that exploits energy associated with maintaining physical and mental health (World Health Organization, 2018).

Limitations. Although this research was conducted through precise measurement and carefully documented, there are some influencing factors that could have skewed the results related to the outcome. Databases used for the initial search were limited which may result in an absence of relatable articles from other databases not available. Additionally, key terms were identified from previous studies and thus may have limited full range of selection.

Moderators of the Study. The following variables are believed to be moderators of the current investigation: (a) sex, (b) developmental level, (c) setting, (d) parental support (e) activity, (f)teacher training, (g) perceived barriers, (h) publication type, (i) location of study, (j) specific outcomes measure.

Delimitations. Precise boundaries were provided for this study that included articles and information specific to the research questions. The participants for each study were between 3 to 22 years of age. Participants had a previous diagnosis of ADHD. Participant's participated in an intervention related to a physical education environment. Studies included ranged from 1970 and 2017 which covers when physical

education research began and up until present day. All results consisted of quantitative statistical measures to show an effect size between variables of measurements.

Literature Review

Educating children on the physical and mental health benefits of being physically active and maintaining a nutritional lifestyle is important for future development (CDC; 2017). Children who have been diagnosed with ADHD display symptoms that can often impact their performance in the physical education setting (APA, 2013). Recently, researchers have reported physical activity as having a positive influence on physical, behavioral, and cognitive task performance for children with ADHD (Hoza, Hart, & Emmerson, 2010). In particular, Smith (2013) reported that daily moderate to vigorous physical activity (MVPA) improved task performance (i.e., motor timing, memory). Similarly, Verret et al. (2011) reported MVPA resulted in positive outcomes in locomotor (i.e., run, hop, slide) and behavior (i.e., attention, aggressiveness, social) for children with ADHD. Therefore, this literature review will focus on best practices for children with ADHD in the physical education setting.

Physical Activity Levels for Children with ADHD

Physical activity has been reported to have a positive impact on characteristics (e.g., motor coordination) associated with a diagnosis of ADHD (Verret, 2010). Specifically, Chien and Pan (2011) reported a positive increase in physical performance (i.e., strength, agility) following an exercise program for children with ADHD. Additionally, Silva and Alessandro (2015), reported that physical exercise improved on-task behaviors (i.e., attention) for children with ADHD. For these reasons, the

researcher believes that MVPA when used within the daily routine of children with ADHD can produce positive outcomes in the physical educational setting.

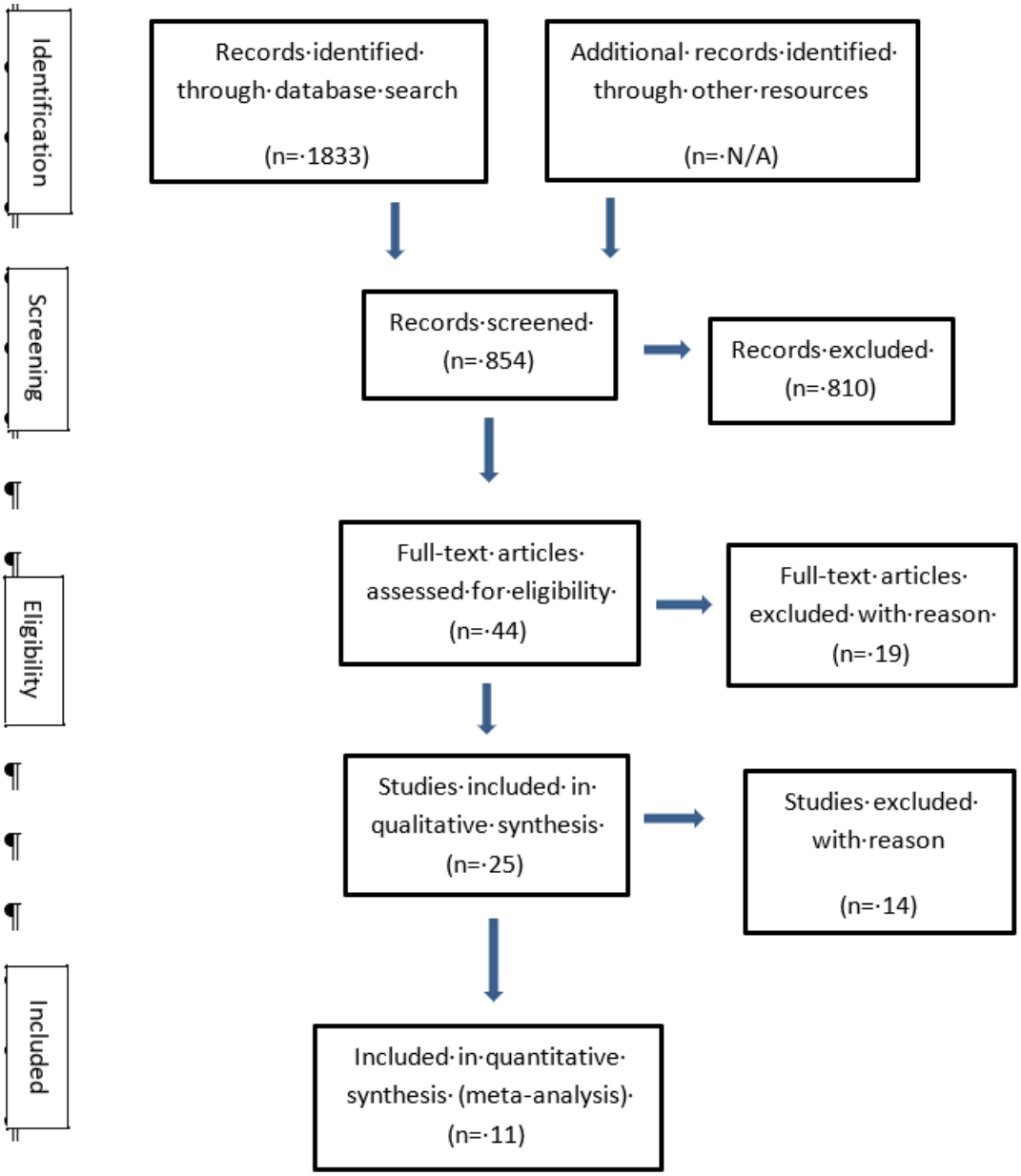
Barriers to Exercise for Children With ADHD. Children with ADHD have demonstrated delays in motor development when compared to their typically developing peers (Francisco & Neto, 2015). Children with ADHD tend to have difficulty with motivational output in physical activity environments resulting in drop-out rates and lack of participation (Vancampfot & Davy, 2015). For this reason, individuals working with children with ADHD need to determine instructional strategies that have shown efficacy over time with this population.

Best Practices for Children with ADHD. Including physical activity as a supporting factor for children with ADHD has shown positive outcomes for assisting in best practices for academic achievement. Particularly, Hart (2015), states that incorporating MVPA at the beginning of class for children with ADHD increased student behavior. Additionally, Vancampfort and Davy (2016) reported motivational factors play a significant role in activity participation for children with ADHD. While providing motivational techniques, it has been demonstrated that students with ADHD prefer to choose between smaller reinforcers sooner than larger reinforcers later (Marco & Miranda, 2009). Similarly, Emmerson (2010) reported the use of electronic diaries to log physical activity levels improved behavior outcomes for children with ADHD. These finding support the need for a variety of instructional strategies within the physical education classroom for children with ADHD.

Methods

Search Strategy

The terms used for this analysis of literature were determined by the researcher through a review of related research. Specifically, the search terms included a combination of terms that allowed for a wide range of potential literature related to best practices for children with ADHD in the physical education environment. The full list of search terms was placed into three categories: (a) disability, (b) physical activity setting, and (c) teaching style. All search terms were conducted over seven academic databases which included SPORTDiscus, PsychINFO, PsychARTICLES, PubMED/Medline, ProQuest, ERIC, and Child Development and Adolescent Studies. Findings were recorded and screened by title and abstract to determine inclusion. Endnote x8 database was used to save all articles and remove all duplicates. See Figure 1 below for an illustration of the search strategy implemented for this investigation.



Figure·1·Search·Strategy·and·Article·Screening·Process

Figure 1 Search Strategy and Article Screening Process

Inclusion Criteria. For literature to be included within this investigation the following criteria had to have been met: (a) the study had to be written in the English Language and published between 1970 and 2017, (b) the study had to be published in a peer-reviewed journal that used a valid and reliable measure to verify the assessment tool being administered with the given measurement of results for utilization of best practice in a physical education environment for adolescents with ADHD, (c) the study had to be conducted in the context of a physical education/physical activity setting, (d) the study had to include participant's with ADHD aged 3-22 years, (e) the study had to directly measure physical activity and student achievement towards task performance, (f) the study had to include quantitative descriptive statistics and/or correlations to be able to estimate an effect-size, and (g)

Limitations. Reviewing the results of the included literature, the two researchers concluded a list of potential moderators that could have impacted the effect-size between the independent variable and dependent variable(s). Potential moderators included: sex, developmental level, setting, peer interactions, parental support, activity, teacher training, perceived barriers, country, study type, funding, publication type, intervention characteristics, research design, and specific outcomes measure. Understanding potential moderators of these studies provided the researcher with a variety of factors that could skew the results in which to provide evidence for best practices.

Screening Procedures. Screenings of all articles collected in the Endnote8x database were collected by the researcher. During this initial screening, articles were

sorted into subgroups of "in, out, or maybe" with those placed in the maybe category screened by abstract to determine relevancy. Once completed, the researcher had a condensed version of their Endnote8x library with completed subgroups of "in or out" and sent it to a committee member to determine eligibility. Articles that were deemed as "in" for inclusion were attained for full-text versions for a final screening of relevancy for a statistical review. If the researcher had uncertainty about the inclusion of an article the researcher met with the committee member to review inclusion criteria and make a final decision. Finally, a statistical synthesis was administered to analyze if the quantitative information provided a positive relationship between task performance in a physical education environment and best practice for adolescents with ADHD.

Statistical Analysis and Data Extraction. When conducting a statistical synthesis, outliers and publication biases can be challenging conditions that need to be addressed when working through issues with data screening to determine whether results were influenced. Outliers are large residual values (*z*-scores) two standard deviations (+/- 1.96) above or below the study's mean effect size. Decisions made to retain or exclude outliers were based on whether overall results remained significant ($p \leq .05$) and within the 95% confidence interval. Methods that are used to determine and regulate for publication bias include review of the funnel plot (Egger, Davey Smith, Schneider, & Minder, 1997), a fail-safe N calculation (Rosenthal, 1979), and a "trim and fill" procedure (Duval & Tweedie, 2000; 2001). All analysis was completed using Comprehensive Meta-Analysis V2 software. To deliver an overview of the literature, further analyses of the outcome and moderator were used to determine the magnitude of

effect for precise relationships (outcome) as well as how effect sizes vary between moderating variables. A random effects model was used to interpret findings and apply real-world data (Field, 2001, 2003; Hunter & Schmidt, 2000). Analyses completed using a random effects model adjusts affect sizes by the inverse weight of the variance to consider both the sampling and between-study error (Borenstein et al., 2009).

Subgroup Analysis. Random effects models assume data will be heterogeneous due to sampling and between study variance (Borenstein et al., 2009). Subgroup (moderator) analyses provide the strength and/or direction of relationships between independent and dependent variables (Shaddish & Sweeney, 1991). The current investigation was interested in differences between number of levels of independent variables and types of outcomes. Three statistics were used to evaluate heterogeneity and included the Q_{Total} (Q_T) tau-squared (T^2), and I-square (I^2) values. The Q_T value is based on a chi-square distribution and is used to determine overall heterogeneity (Hedges and Olkin, 1985). When the Q_T statistic is significant then variance is categorized into $Q_{Between}$ (Q_B) and Q_{Within} (Q_W) values with significant Q_B values ($p < .05$) requiring statistical techniques (i.e., t-test or analysis of variance, ANOVA) to determine subgroup differences (Borenstein et al., 2009; Hedges & Olkin, 1985). The tau-square (T^2) value estimate total variance between studies and is also used to calculate study weights (Borenstein et al., 2009; Higgens et al., 2003). The I-square (I^2) value provides an estimate of the overlap of confidence intervals and is interpreted as low (25%), moderate (50%), or high (75%), values of the total variance attributed to covariates (Higgins, Thompson, Deeks, & Altman, 2003). Small subgroup

sample sizes ($k \leq 5$) may influence the precision of r^2; therefore, a pooled estimate of variance was used for all calculations (Borenstein et al., 2009).

Results

The purpose of this study was to provide an analysis of literature on the current teaching practices to improve student performance in the physical education environment for children with ADHD. A total of 11 studies with 11 independent samples (e.g., between groups, different participants in intervention) which included a total of 516 participants were reviewed. Figure 1 includes the overall search strategy and article screening process that was utilized throughout chapter II of this Thesis, while Table 1 displays the coded methodological, participant, and study features for each study, as well as, each study's overall treatment effect. When interpreting the treatment effects, Cohen's (1998) criteria was used for interpretation of standardized means differences and summarized effect sizes as small (i.e., $p \geq 0.20$), medium (i.e., $p \geq 0.50$), and large (i.e., $p \geq 0.80$). Positive effect sizes within each study were determined when the treatment group demonstrated a larger effect size than the control group. Conversely, negative effect sizes were determined when the control group produced a larger effect size than the treatment group.

Random Effects Model, Outlier Analysis, and Publication Bias

Based on the data collected throughout each study within this investigation the average treatment effect for all physical activity interventions was moderate ($g = 0.15$; SE = 0.12; 95% C.I. = -0.08, 0.37; p = 0.16). This data represented about 1/10 (i.e., 10%) of a standard deviation advantage for treatment groups over control groups.

Figure 2 displays the relevant statistical analysis utilized when evaluating the overall effect sizes. Moderator analysis of characteristics coded for studies were conducted in order to further explain the between-study variation based on a significant heterogeneous distribution ($Q_t = 14.22$, $p < 0.16$; $I^2 = 29.67$) that was indicative of small amount between-study variation.

Outliers and Publication Bias. One independent sample (Verret, 2011) was determined to be an outlier ($z = -2.12$), thus analysis was conducted through evaluation of residual values and a "one-study removed" procedure was performed. The single effect was retained in the analysis as results indicated an effect size change ($p < .04$), becoming significant ($p > 0.05$) and within the 95% confidence interval. Based on these results the researcher made the decision to include the outlier based on a smaller sample size. Publication bias was assessed across all constructs of outcomes referenced in Table 2 and reported with the 'Fail Safe N' measurement. Across seven outcomes there were no significant findings and publication bias may have affected the results due the small number of studies reviewed within this study.

Outcome Analysis. Several outcome analysis were conducted produced both positive and negative effects, which ranged from $g = -.48$ to $g = .69$. Only one outcome was positive out of all the groups (i.e., 14 groups) and it was hyperactivity/impulsivity. The positive effect found in hyperactivity/impulsivity was ($k = 2$, $g = 0.69$, $p = 0.367$). The largest negative effects were found in anxiety/depression ($z = -1.11$), aggression ($z = -0.85$), externalized problems ($z = -0.47$), internalized problems ($z = 0.06$), and

skill related fitness (z = 1.93). Outcomes that were negative for groups included aggression (k = 4, g = -0.26, p = 0.10), anxiety/depression (k = 3, g = -0.48, p = 0.06), attention (k = 5, g = 0.21, p = 0.02), externalized problems (k = 3, g = -0.12, p = 0.34), internalized problems (k =3, g = 0.02, p = 0.44), and skill related fitness (k = 3, g = 0.62, p = 0.09).

Moderator Analysis. Statistics for the random effects model confirmed that there was a heterogeneous distribution and that a large level of between-study variation existed to justify conducting sub-group analysis for coding characteristics. These results indicated that between-study variance was not random and could be explained as a result of the confidence interval overlap. It should be mentioned, that subgroup results can be imprecise when there are not a critical number of studies ($k \geq 5$) used in the analysis (Borenstein et. al., 2009). The researcher selected to report subgroup findings with imprecise estimates of effects for discussion purposes. Table 3 displays all relevant statistical results from moderator analysis on intervention characteristics, participant characteristics, and study characteristics.

Intervention Characteristics. None of the intervention characteristics produced significant differences between subgroups including design, duration, environment, training, and activity level. However, two studies within group comparisons showed negative insignificant results (PE/APE training z = -1.88, moderate/vigorous activity level z = -0.51). Studies employing were PE/APE training (k = 1, g = -1.02, z = -1.88) displaying that there was a negative effect from the

intervention on children with ADHD when administered by a PE/APE instructor. Additionally, moderate/vigorous activity level (k = 3, g = -0.12, z = -0.51), demonstrated that moderate to vigorous activity levels had a negative impact on performance for children with ADHD. All intervention categories producing insignificant findings within group comparisons displayed a lower to moderate degree of heterogeneity ($Q_t < 0.05$).

Participant Characteristics. None of the participant characteristics produced significant differences between subgroups including diagnostic, interaction, gender, and school. Still, one study exhibited a negative effect from interaction of ADHD (k = 6, g = -0.03, z = -0.21) children compared with other children diagnosed with ADHD during the intervention. There was also a moderate showing of results in variance between subgroups as indicated by the Q and t^2 values with potential to explain variance between studies ($I^2 > 29$).

Study Characteristics. No significant differences between subgroups were found for study characteristics including support, status, measure, country, and medication. Smaller subgroups within the study were country (i.e., Canada, Combined, Korea, Japan, Netherlands, Spain k = 1), measure (objective, k = 1), and status (unpublished, k = 2) prevent precise estimates of the effect size. However, one study shows a negative insignificant result between subgroups as whether medication was taken by the participants (k = 2, g = -0.18, z = -0.58).

Table 1 Study Characteristics Meeting Inclusion Criteria

Study	Des	Dur	Med	Train	Diag	Act	N	Age	Se	Env	Coun	Sch	Supp	Inter	Mea
Choi_2014	E	6W	P	CT	C	V	30	13-18	M	'A	O	COM	NR	TD	C
Fliers_2010	E	NR	NP	O	C	M	82	10	B	'A	O	COM	P	TD	C
Emmerson_2010	QE	1W	P	O	C	MO	109	8-12	B	'A	US	COM	P	TD	SR
Garcia-Gomez_2016	QE	3M	P	CT	C	M, MO	14	7-14	N R	'A	O	COM	P	AD	SR
Morand_2004	E	12W	NP	CT	C	MO	18	8-11	M	, PA	US	E	P	AD	SR
Pan _2016	E	12W	P	PE/APE, SE, O	C	M, MO	32	6-12	M	'A	O	COM	NP	AD	C
Pan _2017	E	12W	P	O	C	MO	48	7-14	M	'A	O	COM	NP	B	O
Smith_2013	QE	8W	NR	O	C	MO, V	14	5.2-8.7	B	'A	US	E	P	AD	C
Smith_2017	E	15W	B	CT	C	M, MO	112	7.4	B	'A	US,O	E	P	AD	C
Tsujil_2007	QE	1W	NP	CT	C	M, MO	36	9	B	'E, PA	O	E	NR	TD	C
Verret_2011	E	10W	B	PE/APE	C	MO, V	21	9	B	'A	O	E	P	AD	C

Note. Design: QE=Quasi-Experimental; E=Experimental. Duration: W=Weeks; M=Months; NR=Not Reported. Medication: P=Prescription; NP=No Prescription; B=Both; NR=Not Reported. Training: PE/APE=Physical Education or Adapted Physical Education; CT=Credentialed Teacher; SE=Special Education; O=Other. Diagnosis: C=Clinical. Activity Level: M=Mild; MO=Moderate; V=Vigorous. Sex: NR=Not Reported; B=Both; M=Male. Environment: PA=Physical Activity; PE=Physical Education; S=Sport. Country: US=United States; UK=United Kingdom; O=Other. School: E=Elementary; COM=Combined. Support: P=Parent Support; NP=No Parent Support; NR=Not Reported. Interaction: AD=ADHD; TD=Typically Developing; B=Both. Measure: O=Objective; SR=Self-Report; C=Combined.

Table 2 Outcome Analysis

		Effect Size Statistics				Null Test	Heterogeneity Statistics			Publication Bias
VARIABLE	*k*	*g*	*SE*	s^2	95% *C.I.*	*Z*	*Q*	τ^2	I^2	Fail Safe *N*
Aggression	4	-0.2	0.31	0.09	(-0.86,0.34)	-0.85	7.44	0.22	59.70	0
Anxiety Depression	3	-0.48	0.44	0.19	(-1.33,0.37)	-1.11	5.57	0.36	64.11	0
Attention	5	0.21	0.25	0.06	(-0.27,0.70)	0.85	11.39	0.18	64.89	0
Externalized Problems	3	-0.12	0.25	0.06	(-0.61,0.37)	-0.47	2.15	0.01	6.89	0
Internalized Problems	3	0.01	0.24	0.06	(-0.45,0.48)	0.06	1.65	0.00	0.00	0
Hyperactivity/Impulsivity	2	0.69	0.19	0.03	(0.33,1.06)	3.75*	0.81	0.00	0.00	17
Skill Related Fitness	3	0.62	0.32	0.10	(-0.01,1.24)	1.93	4.77	0.18	58.05	0

Note. Note. *k* = Number of effect sizes. *g* = Effect size (Hedges g). *SE* = Standard error. s^2 = Variance. *95% C.I.* = Confidence intervals (lower limit, upper limit). *Z* = Test of the null hypothesis. τ^2 = Between-study variance in random effects model. I^2 = Total variance explained by moderators. *Indicates a significant QTotal value, $p \leq 0.05$.

Discussion

Discussion, Conclusions, and Recommendations for Future Research

The purpose of this study was to provide an analysis of literature on the current teaching practices to improve performances in the physical education environment for children with ADHD. Results from this study indicated an insignificant effect size for all moderator aspects for ADHD. In addition, only one outcome showed a significant effect (i.e., hyperactivity/impulsivity), which improved inattention/hyperactivity for participants with ADHD after being exposed to physical activity interventions.

Activity Level, Environment, and Training

Throughout all interventions no significant results between subgroups of training, activity level, and environment were demonstrated. Researchers have demonstrated that proper training and extensive knowledge is key for physical educators to impact the behavior of children with disabilities, including those with ADHD (APENS, 2012). Specifically, physical educators who are unable to provide a variety of instructional strategies and techniques for the specific needs of their students has been reported as leading to miscommunication and a misunderstanding for those children participating (U.S. Department of Education, 2008). Therefore, a physical education teacher will need to understand how to accommodate activities and the environment to construct successful and appropriate activities that will enhance the

performance levels of their students with ADHD. Additionally, these activities should be filled with specific and precise feedback, one-on-one help, and within a safe environment. Results from this study, demonstrated negative performances levels in aggressive behaviors and attention from the participants when moderate to vigorous activity was incorporated within the physical education classroom. These results may be caused by fatigue or a lack of clarification for the participants to accurately perform the correct bodily function. These results have been supported by previous studies by Piek (2007) and Pan (2017) who also reported children with ADHD having undeveloped performance in physical activity.

Children who are diagnosed with ADHD display symptoms of inattentiveness and behavioral issues. For this reason, physical educators working within this population need to provide an environment that provides the student with the best opportunity for success. In relation to training, having the knowledge to create a safe environment is essential when working with children diagnosed with ADHD (Individuals with Disabilities Education Act, 2004). Examples of a safe environment include providing appropriate equipment, activity levels, surroundings, and activity outcomes. Primarily, those physical educators working with children with ADHD have had difficulty when the environment allows for an access of external stimuli (APA, 2013). Additionally, inappropriate outcomes without providing the child with the opportunity to make a choice may lead to a lack of motivation (Trocki-Ables, 2001).

Design and Duration. Interventions are designed specific to the desired outcomes in order to discover a significant/non-significant result reported by the determined measurement(s). In this study, the designs of the interventions were either experimental (e.g., randomized placement) or quasi-experimental where the participants were compared to the control groups in order to establish the effects of desired outcomes. When an intervention was reported as having no significant effect between subgroups of design, this would illustrate that the intervention could have targeted more specifically towards the control group then intervention. Similarly, duration of the study can facilitate a similar product by not allowing for enough time for the participants to acquire the information and physical performance needed in order to produce a significant outcome. Additionally, past research has demonstrated that the duration of the intervention is vital for reliable data. It is important to note that due to the characteristics associated with ADHD intervention length may be difficult.

Diagnosis, interaction, gender, school, support, country, and medication. In total the researcher reviewed a total of 11 studies. Of these studies every study, but one had participants who had a previous diagnosis of ADHD. Additionally, 64% of the participants within the total number of studies were currently taking medication during the intervention phases. Therefore, medication may have impacted the results between the subgroups when reporting on effect size. Further, as ADHD is more prevalent in males, there was a high number of males to female ratio within the results reported. It should be noted that the researcher did not identify a significant effect between the

males/females which indicates gender is not a defining characteristic associated with performance.

Relative to gender, interaction between the intervention group and control groups was insignificant; both between those who were diagnosed with ADHD and those of typically developing peers. When compared to those both diagnosed with ADHD, there was a negative result indicating one of two things: (a) those with ADHD had a difficult time working alongside others with ADHD due to similar characteristics, and (b) the intervention program did not accommodate well for individuals with ADHD.

The association with interacting peers and parental support during the interventions for a majority of the studies (64%) involved parent consent, diagnosis, and or support throughout the duration of the interventions. Therefore, the researcher determined there was no significant relationship between participants with ADHD and parental support. Past researchers have reported that children with ADHD usually lack motivation and display defining emotional behaviors. Thus, having support or not throughout the intervention can be presented by drive for participating and the relationship with parent. Associated outcomes amongst young developmental age and motivation postulates the interventions ability to stimulate enthusiasm. Being that individuals with ADHD are usually diagnosed at a young developmental age, it is apparent that most of the intervention participants were of a range between elementary

and middle school. Despite these findings, the results in each study did not produce a positive relationship between age level and the program's outcomes. With a small variety of studies reported in the United States and a variety of other countries, insignificant results indicate variability and a diverse understanding of how to assist symptoms and provide outcomes for children with ADHD in physical activity.

Status and measure. Measurement is one of the most important values as the application of assessment type must be able to measure specific outcomes related to the study. With a non-significant result within the studies reviewed, the researcher can assume that measurement had no particular effect on the individuals with ADHD performance. These results do not support past researcher as researchers have reported that the characteristics associated with ADHD may impact the overall outcome of these measurements (APA, 2013).

Outcomes. The desired outcomes reviewed in this study were aggression, anxiety/depression, attention, hyperactivity/impulsivity, externalized problems, internalized problems, and skill related fitness; hyperactivity/impulsivity showed significance declaring that physical activity improves this behavior for children with ADHD. From analyzing 11 studies that developed programs including physical activity as the intervention and examined its effects on behavioral symptoms and physical performance outcomes, hyperactivity/impulsivity showed a positive relationship. This concurs that when delivered physical activity, children with ADHD are more acceptable

to reduce their hyperactivity/impulsivity levels in order to maintain behaviors. Granted that the other outcomes resulted with non-significant values, it is still in question that physical activity addresses symptoms and outcomes related to ADHD; more research needs to occur in this subject matter in order to support the theory behind physical activity.

Conclusions, Summary or Recommendations

The physical activity interventions examined in this study have been shown to have an overall moderate insignificance effect (g = 0.15). Specifically, moderate to large negative results were revealed for ADHD participants exposed to medication, moderate to vigorous activity level, training of PE/APE, and interaction with participants with ADHD. Conversely, a significant value was shown in hyperactivity/impulsivity for children with ADHD after participating in a physical activity when performing studied action and behavior outcomes. Current teaching practices that are being used for children with ADHD have been supported through minimum research and present assistance in physical education, but do not offer beneficial help that is demanded for behavior and physical performance outcomes. Undergoing physical activity does not display promising data does not promote higher task performance; children with ADHD performed adequately well in the cognitive levels, but still struggled in physical performance. Physical activity interventions appear to increase positive behavior outcomes for children with ADHD related to hyperactivity/impulsivity.

Recommendations for Future Research

This meta-analysis provides a comprehensive synthesis of the literature base on physical activity interventions involving children with ADHD. The potential for

physical activity interventions to effect change in task performance outcomes has been unsupported. To continue impactful research for children with ADHD, experimental investigation must grow within the physical education environment. Research should evolve in all countries so that we are capable of knowing and understanding all instructional and teaching strategies that work and do not work in order to provide best practices for these children. It is significant that we continue interventions studying both male and females who are diagnosed with ADHD to further educate individuals according to what works best according to gender. Precisely, interventions should study physical performance in children with ADHD and ways to help aide in motor functioning/development.

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Appendix

Table 3 Moderator Statistics

		Effect Size Descriptive Statistics				Null Test	Heterogeneity Statistics		
	k	*g*	*SE*	s^2	95% *C.I.*	*Z*	*Q*	τ^2	I^2
Random Effects Model[A]	11	0.15	0.12	0.01	(-0.08,0.37)	1.27	14.22	0.04	29.67
Intervention Characteristics[b]									
Design2							0.38		
Experimental	7	0.09	0.16	0.02	(-.0.22,0.39)	0.55	11.52	0.10	47.91
Quasi	4	0.24	0.19	0.04	(-0.14,0.61)	1.24	1.94	0.00	0.00
Duration2							0.36		
Short	5	0.11	0.19	0.04	(-0.26,0.49)	0.59	7.45	0.08	46.30
Moderate	5	0.24	0.22	0.05	(-0.19,0.66)	1.09	6.28	0.08	36.33
Not Reported	1	0.00	0.37	0.13	(-0.72,0.72)	0.00	0.00	0.00	0.00
Environment 1							4.12		
PA	9	0.12	0.11	0.01	(-0.09,0.33)	1.12	10.01	0.02	20.04
PE/PA	1	0.46	0.39	0.15	(-0.30,1.22)	1.18	0.00	0.00	0.00
Sport/PA	1	33.80	18.18	330.60	(-1.84, 69.44)	1.86	0.00	0.00	0.000
Training 1							5.39		
Credential	5	0.26	0.18	0.03	(-0.09,0.61)	1.44	4.05	0.00	1.14
Other	4	0.20	0.15	0.02	(-0.09,0.48)	1.34	4.33	0.03	30.74
PE/APE	1	-1.02	0.54	0.30	(-2.09,0.04)	-1.88	0.00	0.00	0.00
All	1	0.00	0.28	0.08	(-0.55,0.56)	0.00	0.00	0.00	0.00

	Effect Size Descriptive Statistics					Null Test	Heterogeneity Statistics		
	k	*g*	*SE*	s^2	95% *C.I.*	*Z*	*Q*	τ^2	I^2
Random Effects									
Model[A]	11	0.15	0.12	0.01	(-0.08,0.37)	1.27	14.22	0.04	29.67
Activity Level 1							2.26		
Mild	1	0.00	0.31	0.10	(-0.61,0.61)	0.00	0.00	0.00	0.00
Mod	7	0.28	0.15	0.02	(-0.01,0.57)	1.88	7.00	0.02	14.22
Mod/Vig	3	-0.12	0.24	0.06	(-0.60,0.35)	-0.51	4.34	0.16	53.95
Participant Characteristics[b]									
Diagnosis3							0.00		
Clinical	11	0.15	0.12	0.01	(-0.08,0.37)	1.27	14.22	0.04	29.67
Interaction3							4.063		
ADHD	6	-0.03	0.12	0.02	(-0.33,0.26)	-0.21	7.92	0.07	36.89
Typically Developing	4	0.25	0.15	0.02	(-0.05,0.54)	1.64	1.70	0.00	0.00
Both	1	0.80	0.44	0.19	(-0.06,1.67)	1.83	0.00	0.00	0.00
Gender3							0.64		
Both	6	0.08	0.16	0.02	(-0.23,0.38)	0.48	7.59	0.04	34.15
Male	4	0.29	0.24	0.06	(-0.18,0.77)	1.21	6.22	0.18	51.80
Not Reported	1	0.29	0.59	0.35	(-0.87,1.44)	0.49	0.00	0.00	0.00

		Effect Size Descriptive Statistics				Null Test	Heterogeneity Statistics		
	k	*g*	*SE*	s^2	95% *C.I.*	*Z*	*Q*	τ^2	I^2
Random Effects Model[A]	11	0.15	0.12	0.01	(-0.08.,0.37)	1.27	14.22	0.04	29.67
School3							0.841		
Elem/Middle	5	0.22	0.17	0.03	(-0.12,0.56)	1.30	3.99	0.00	0.00
Elementary	5	0.00	0.20	0.04	(-0.40,0.40)	0.00	9.22	0.18	56.63
Middle/High	1	0.31	0.44	0.20	(-0.56,1.18)	0.69	0.00	0.00	0.00
Study Characteristics[b]									
Support3							1.21		
No Parents	2	0.27	0.28	0.08	(-0.28,0.83)	0.97	2.76	0.21	63.75
Not Reported	2	0.38	0.31	0.10	(-0.23,0.99)	1.24	0.09	0.00	0.00
Parents	7	0.05	0.16	0.02	(-0.26,0.35)	0.29	10.18	0.06	41.05
Status4									
Published	9	0.11	0.13	0.02	(-0.15,0.36)	0.82	9.36	0.02	16.98
Unpublished	2	0.34	0.29	0.09	(-0.24,0.92)	1.16	3.39	394.69	70.48
Measure4							3.63		
Combination	7	0.04	0.12	0.02	(-0.20,0.28)	0.31	6.37	0.01	5.82
Objective	1	0.80	0.44	0.20	(-0.07,1.67)	1.82	0.00	0.00	0.00
Self-Report	3	0.33	0.22	0.05	(-0.11,0.77)	1.47	3.40	0.22	41.11
Canada	1	-1.02	0.68	0.46	(-2.35,0.30)	-1.52	0.00	0.00	0.00
Combined	1	0.13	0.48	0.23	(-0.81,1.07)	0.27	0.00	0.00	0.00
Japan	1	0.46	0.56	0.31	(-0.63,1.54)	0.82	0.00	0.00	0.00
Korea	1	0.31	0.56	0.31	(-0.79,1.40)	0.55	0.00	0.00	0.00
Netherlands	1	0.00	0.48	0.23	(-0.94,0.95)	0.00	0.00	0.00	0.00
Spain	1	0.29	0.68	0.46	(-1.04,1.61)	0.42	0.00	0.00	0.00
Taiwan	2	0.33	0.38	0.14	(-0.41,1.07)	0.86	2.75	0.21	63.75
United States	3	0.16	0.34	0.12	(-0.52,0.83)	0.45	4.90	0.17	59.23
Medication							2.15		
Both	2	-0.18	0.31	0.10	(-0.78,0.42)	-0.58	4.05	0.50	75.32

No Prescription	3	0.19	0.28	0.08	(-0.37,0.74)	0.66	4.57	0.23	56.19
Not Reported	1	-0.08	0.39	0.15	(-0.85,0.69)	-0.20	0.00	0.00	0.00
Prescription	5	0.30	0.19	0.04	(-0.07,0.68)	1.60	2.96	0.00	0.00

Note. *k* = number of effect sizes. *g* = Effect size (Hedges *g*). *SE* = Standard Error. S*2* = variance. 95% *C.I.*= Confidence Intervals (lower limit, upper limit). Z = test of the null hypothesis. τ^2 = Between study variance in Random Effects Model. I^2 = Total variance explained by moderators. *p $\leq$ .05