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OCCUPATIONAL THERAPY INTERVENTIONS FOR ADHD: A
SYSTEMATIC REVIEW

by

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Advisor: Dr. Sarah Nielsen, PhD, OTR/L

A Scholarly Project

Submitted to the Occupational Therapy Department

of the

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In partial fulfillment of the requirements

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This scholarly project, submitted by Kamela L. Kelsch, MOTS and Kaci L. Miller, MOTS in partial fulfillment of the requirement for the Degree of Master's of Occupational Therapy from the University of North Dakota, has been read by the Faculty Advisor under whom the work has been done and is hereby approved.

Sarah Nelson PhD, OTR/L
Faculty Advisor

12-10-15
Date

PERMISSION

Title Occupational Therapy Interventions for ADHD: Systematic Review
Department Occupational Therapy
Degree Master's of Occupational Therapy

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Signature Yamda Kebech Date 12-10-15

Signature Kari Miller Date 12/10/15

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ABSTRACT

Background: ADHD can have a negative impact on occupational performance of a child, interfering with ADLs, IADLs, education, leisure, and play. However, at this time, a cumulative review of evidence based occupational therapy interventions for children with ADHD do not exist.

Purpose: The purpose of this scholarly project was to complete a systematic review of what occupational therapy interventions are effective for school-aged children with ADHD.

Methods: An extensive systematic review for level I, II, or III research articles was completed using CINAHL and OT Search. Inclusion, exclusion, subject terms, and words or phrases were determined with assistance from the librarian at the Harley French Library at the University of North Dakota.

Results: The systematic review yielded 13 evidence-based articles with interventions related to cognition, motor, sensory, and play. Upon completion of the systematic review, articles were categorized based upon an initial literature search understanding common occupational therapy interventions for children with ADHD. Specifically, level I, II, and III occupational therapy research is available for interventions addressing cognition, motor, sensory, and play.

Conclusion: Implications for practice and education include the need for foundational and continuing education opportunities reflecting evidenced-based interventions for ADHD. Further research is needed to solidify best practices for children with ADHD including more rigorous studies across interventions.

CHAPTER I

INTRODUCTION

Attention Deficit Hyperactivity Disorder (ADHD) affects approximately 11% of children between the ages of 4 and 17 (Center for Disease Control & Prevention [CDC], 2015). Although it is prevalent in the younger population, it may persist into adulthood (CDC, 2015). ADHD symptomology can have a negative impact on occupational performance. More specifically, ADHD has been found to have an impact on activities of daily living (ADLs), instrumental activities of daily living (IADLs), education, rest and sleep, leisure, play and social participation (Kaneko & Okamura, 2005; Poulsen, 2011; Racine, Majnemer, Shevell, & Snider, 2008; Wehmeier, Schacht & Barkley, 2010).

Due to the deficits ADHD has on a child's occupational performance, occupational therapists are able to provide interventions to enhance engagement in everyday activities. Occupational therapists have the ability to address deficits related to social skills, play, executive functioning, impulsivity, inattention, and motor coordination (Kaneko & Okamura, 2005; Poulsen, 2011; Racine et al., 2008; Wehmeier et al., 2010; Barkley, 2004; Kirby, Salmon, & Edwards, 2007). Within this systematic review, methods that are most effective with these deficits will be addressed.

An atheoretical approach was utilized in this research study due to the nature of a systematic review. However, the *Occupational Therapy Practice Framework—Domain and Process – 3rd Edition* was used as a guide throughout

(American Occupational Therapy Association [AOTA], 2014). Interventions were categorized based on type, inclusion of occupation, performance skills, client factors, or patterns. Utilizing the *Occupational Therapy Practice Framework* (AOTA, 2014) allowed us to complete an initial review of literature and organize interventions accordingly.

In the scope of occupational therapy practice, these areas of occupation can be addressed through treatment and specific interventions. Interventions can focus on cognition, motor, sensory, or play. In regards to cognition, the Cognitive-Functional (Cog-Fun) (Hahn-Markowitz, Manor, & Maeir, 2011) intervention program has been utilized to address executive functioning (Hahn-Markowitz et al., 2011; Rosenberg, Maeir, Yochman, Dahan, & Hirsch, 2015; Maeir, Fisher, Bar-Ilan, Boas, Berger, & Landau, 2014). Interactive Metronome Training (Casper, Lee, Peters, & Bishop, 2009) and Three Dimensional Haptic Pathway (Palsbo & Hood-Szivek, 2012) have been documented as interventions to use with motor coordination deficits. Sensory interventions that have been utilized include stability balls (Fedewa & Erwin, 2011) and weighted vests (Lin, Lee, Chang, & Hong, 2014) to address inattention and hyperactivity. Parent focused interventions (Wilkes-Gillan, Bundy, Cordier, & Lincoln, 2014a), as well Theraplay (Fourie, van Vuuren, Venter, & Nel, 2007) and video feedback/feedforward (Wilkes, Cordier, Bundy, Docking, & Munro, 2011) are some interventions to address social skills and play with playmates. While a variety of interventions are being utilized, there is not clear guidance on evidence-based occupational therapy interventions for children with ADHD. At this time, it

is unknown which interventions are effective and evidence-based within this population.

Purpose

The purpose of this scholarly project is to complete a systematic review of what occupational therapy interventions are effective for school-aged children with ADHD. A systematic review was completed Fall 2015 with consultation from the librarian at Harley French Library of the University of North Dakota. The process will be described further in chapter III.

Definitions

The following terms are defined in relation to ADHD and interventions utilized for children with ADHD. Consistent definitions are provided in order to inform readers about all aspects of this research study.

Attention Deficit Hyperactive Disorder (ADHD): refers to “a persistent pattern of inattention and/or hyperactivity-impulsivity that interferes with functioning or development” (American Psychiatric Association [APA], 2013, p.59).

Cognitive-Functional (Cog-Fun) (Hahn-Markowitz et al., 2011) intervention program: refers to “acquisition and transfer of cognitive strategies to enable occupational performance in the child’s natural environment” (Hahn-Markowitz et al., 2011, p. 384).

Cognitive Orientation to daily Occupational Performance (CO-OP) (Polatajko & Mandich, 2004): refers to “enabling children to perform their motor-based goals by using cognitive strategies in order to improve motor function problems” (Gharebaghy, Rassafiani, & Cameron, 2015, p. 14).

Interactive Metronome Training: refers to “a PC-based, noninvasive technique that requires participants to practice timing and rhythmicity of varied movements of the hands and feet in synchrony with auditory cues” (Cospers et al., 2009, p. 332).

Theraplay: refers to “a short-term attachment-based therapeutic approach for children and parents that focuses on building a relationship using activities, which include touch and physical contact” (Fourie et al., 2007, p. 11).

Client factors: refers to “specific capacities, characteristics, or beliefs that reside within the person and that influence performance in occupations” (AOTA, 2014, p. S7). The following client factors were found to be relevant to the literature: “movement functions, sensory functions, and specific mental functions” (AOTA, 2014, p. S22-S23).

Occupation: refers to “the daily life activities in which people engage” (AOTA, 2014, p. S6). The following occupation was found to be relevant to the literature: “play” (AOTA, 2014, p. S21).

Summary

Chapter I consists of an introduction to this scholarly project, an introduction to the population, an introduction to the literature review, explanation of atheoretical approach, purpose of the study, and definition of terms. Chapter II includes a review of the literature related to ADHD, occupational performance deficits, and common occupational therapy interventions. Chapter III consists of a description of the research methods utilized in this study and a figure of the process. Chapter IV includes a summary of the results, more specifically, the

articles implemented into the organizational framework. Chapter V includes a summary, discussion, strengths and limitations, as well recommendations for practitioners, future research, and educators.

CHAPTER II

REVIEW OF STUDIES & LITERATURE

This literature review will inform the reader about Attention Deficit Hyperactivity Disorder (ADHD). The symptoms and diagnostic criteria will be discussed, as well as the impact the disorder has on the development of children. Furthermore, interventions to improve functioning of individuals with ADHD will be discussed.

Attention Deficit Hyperactivity Disorder

ADHD is, “A persistent pattern of inattention and/or hyperactivity-impulsivity that interferes with functioning or development” (APA, 2013, p.59). Diagnostic criteria entails that the individual have six or more symptoms of inattention and/or hyperactivity-impulsivity, which have continued for a minimum of six months (APA, 2013). The symptoms must be “to a degree that is inconsistent with developmental level and negatively impacts directly on social and academic/occupational activities” (APA, 2013, p.59). Symptoms pertaining to inattention include, but are not limited to: “often fails to give close attention to details or makes careless mistakes in schoolwork, at work, or during other activities; often has difficulty sustaining attention in tasks or play activities; often does not seem to listen when spoken to directly; and often does not follow through on instructions and fails to finish schoolwork, chores, or duties in the workplace” (APA, 2013, p.59). Hyperactivity-impulsivity symptoms include, but again are not limited to: “often fidgets with or taps hands or feet or squirms in seat; often leaves seat in situations when remaining seated is expected; often runs

about or climbs in situations where it is inappropriate; and often unable to play or engage in leisure activities quietly” (APA, 2013, p.60).

It is still unknown as to the causes of ADHD; however, researchers are finding genetics may play a role (CDC, 2015). ADHD is prevalent in younger populations, affecting approximately 11% of children between the ages of 4 and 17, and may persist into adulthood (CDC, 2015). The rates of children with ADHD being diagnosed continues to increase by an average of 5% a year, with boys more likely to be diagnosed than girls (CDC, 2015). The diagnosis is made by ruling out various other disorders and taking into account the vision and hearing of the child as possible problems presenting as ADHD symptoms (CDC, 2015). It should be noted, the symptoms are required to be apparent before the individual is 12 years of age and must be existent in at least two settings (APA, 2013).

Impacts on Occupational Performance

Children with ADHD experience a multitude of occupational deficits. ADHD can have an effect on a child’s activities of daily living (ADLs), instrumental activities of daily living (IADLs), education, rest and sleep, leisure, play and social participation. ADLs are an area of occupation greatly affected. According to Kaneko and Okamura (2005), deficits in motor coordination in this population often have an effect on a child’s ability to complete their ADLs. Motor coordination deficits cause difficulties with self-cares, dressing, eating, writing, drawing and playing (Kaneko & Okamura, 2005; Poulsen, 2011). More specifically, children with ADHD may be inconsistent with their self-cares,

develop different eating patterns and demonstrate difficulty with dressing tasks such as buttons and zippers (Poulsen, 2011). In regards to IADLs, children may experience difficulty maintaining a clean room and putting away their toys (Poulsen, 2011).

Education is another occupation that can be affected by ADHD. Paying attention, sitting still in their desk, and maintaining a clean work space are shown to be problematic with this population (Poulsen, 2011). In addition, handwriting can be a difficulty in relation to education. According to Racine, Majnemer, Shevell, and Snider (2008), the handwriting produced can be illegible and require longer amounts of time. Children with ADHD have also been shown to have different rest and sleep compared to normally developing children. More specifically, these children have restless sleep patterns and irregular breathing while sleeping (Poulsen, 2011). Poor sleep patterns often have a negative effect on daily behaviors (Wehmeier et al., 2010).

Leisure, social participation, and play are similarly affected by ADHD. Children with ADHD experience a difficult time taking turns, paying attention to rules of a game, and regulating their emotions during play and leisure while interacting with others (Poulsen, 2011). According to Kaneko and Okamura (2005), this population is known to have social problems and a lower social maturity level compared to their peers. Problems with peer relationships, lack of friendships, and inability to participate in social exchanges, such as sharing, cooperating and turn taking, are also common of children of this diagnosis (Wehmeier et al., 2010).

Interventions

ADHD can have an impact on multiple occupations in a child's life, making it difficult to function in the home, school, and social environments. Children of this population may experience failure in every aspect of their life, negatively affecting their self-esteem and confidence (Kaneko & Okamura, 2005). Interventions focusing on ADLs, IADLs, education, rest and sleep, leisure, play, and social participation are important to maintain a child's quality of life and participation in their everyday occupations.

Psychological/medical based interventions

At an early age, it is recommended behavioral therapy be the primary intervention (CDC, 2015). If there are minimal signs of improvement, or if the child is diagnosed when he or she is school age, medication may then be prescribed (CDC, 2015). The Centers for Disease Control and Prevention (2015) recommend stimulant medication as the first line of medication, followed by atomoxetine, guanfacine, and clonidine. Medication prescribed should take into consideration the ability to achieve maximum benefit, but have as little adverse effects as possible (CDC, 2015).

Occupational therapy interventions

While we have described the impact of ADHD on occupational performance, in a review of literature, we found that performance skills/client factors were more specifically addressed than areas of occupation. Specifically, we found that occupational therapy interventions for this population commonly

focus on four areas including cognition, motor, sensory and the area of occupation of play.

Cognition.

ADHD is a disorder that has an effect on a child's cognitive state (Spencer, Biederman, & Mick, 2007). More specifically, executive functioning is impaired, which includes working memory, planning, and emotional regulation (Barkley, 2004). Deficits in executive functioning can cause deficits in occupational functioning; therefore, occupational therapy focuses on assessing and gaining a better understanding of what cognitive deficits a child may have and how it is affecting their daily occupations. The Dynamic Occupational Therapy Cognitive Assessment for Children (DOTCA-Ch) (Katz, Golstand, Traub Bar-Ilan, & Parush, 2007) is one of the assessments used with this population. This assessment is designed to evaluate the cognitive abilities and potential for learning in children (Katz et al., 2007). The Assessment of Motor and Process Skills (AMPS) (Fisher, 1997) is another assessment used to evaluate cognition in children with ADHD (Prudhomme White & Mulligan, 2005). The AMPS looks more specifically at processing skills utilized during daily activities, which allows occupational therapists to understand how a child's cognition is affecting their daily occupations (Prudhomme White & Mulligan, 2005). Once an occupational therapist has a better understanding of a child's cognition and what is limiting cognitive functioning, intervention begins.

The Cognitive-Functional (Cog-Fun) (Hahn-Markowitz et al., 2011) intervention program is an intervention focusing specifically on executive

functioning and enabling cognitive strategies for occupational performance (Hahn-Markowitz et al., 2011). The Cog-Fun (Hahn-Markowitz et al., 2011) program produced significant improvements in executive functioning, which were sustained at follow-up (Hahn-Markowitz et al., 2011). The Cog-Fun (Hahn-Markowitz et al., 2011) intervention was also found to be successful in a group setting with improvements in daily functioning, executive function, and social functioning (Rosenberg et al., 2015).

Motor.

Motor coordination has been found to be an area of difficulty for children with ADHD as well (Kirby et al., 2007). Kaneko and Okamura (2005) found that out of 15 children diagnosed with ADHD, the majority of the participants had some type of motor impairment, mainly with balance. On the contrary, Racine et al. (2008) found their participants difficulties with motor coordination were related to fine motor coordination, such as handwriting. Lavasani and Stagnitti (2011) also found problems in relation to fine motor coordination, which extended to tasks with higher levels of motor sequencing and cognition, including cutting, threading beads, and finger movements. Baudinette, Sparks, and Kirby (2010) suggested many therapists may not be fully aware of the motor coordination problems children with ADHD face.

It is important to address these motor difficulties in therapeutic interventions in order for the child to carry out other occupations, such as cleaning their room and self-grooming (Kaneko & Okamura, 2005). Lavasani and Stagnitti (2011) reported fine motor interventions can be taken from the

assessment the individuals participated in, which include cutting tasks, placing dots in a grid pattern, threading beads, finger movement, Purdue pegboard, drawing, and handwriting. To address motor difficulties in relation to balance, both static and dynamic balancing activities are ideal (Kaneko & Okamura, 2005).

Sensory.

Sensory processing is another area focused on in children with ADHD. According to Yochman, Parush and Ornoy (2004), children with ADHD experience a higher risk of deficits in sensory processing abilities. Children with deficits in sensory processing and ADHD may experience more adverse symptoms than those without (Reynolds & Lane, 2009). In a study completed by Reynolds and Lane (2009), it was found that children with ADHD and sensory processing deficits experienced higher levels of anxiety than children with ADHD only and children without ADHD.

Interventions focusing on sensory processing may help reduce the deficits these children face. Weighted vests are commonly used by occupational therapists to provide direct somatosensory input to children with deficits in sensory processing (Lin et al., 2014). According to Olson and Moulton (2004), the use of weighted vests is one of the most frequently used interventions by occupational therapists to promote on-task behavior. The most notable changes seen by the occupational therapists were changes in the amount of wandering, attention, on-task behavior, balance, and stability (Olson & Moulton, 2004). Weighted vests were also shown to improve inattention, speed of processing and responding, consistency of executive management, ability to stay seated, and on-

task behaviors (Lin, et al., 2014; Olson & Moulton, 2004; VandenBerg, 2001). In a study done by VandenBerg (2001), there was a significant increase in on-task behavior with children with ADHD wearing a weighted vest while completing fine motor activities. Another sensory intervention utilized by occupational therapists includes the use of stability balls. According to Schilling, Washington, Billingsley and Deitz (2003), while seated on a stability ball in the classroom, children with ADHD improved their in-seat behavior and legible work productivity. Similar results were found by Fedewa and Erwin (2011), who found an improvement in in-seated behavior and on-task behavior. Teachers also reported enhanced levels of attention, in-seat behavior, and work completion (Fedewa & Erwin, 2011).

Play.

More recently play has been researched in relation to children diagnosed with ADHD in terms of playmates, play preferences, and considerations for play in interventions. A model for play-based intervention was developed by Cordier, Bundy, Hocking, and Einfeld (2009) for children with ADHD. The researchers determined interventions should take into consideration intrinsic motivation of the child, the lack of empathy the child has towards others, and the playmates involved in intervention (Cordier, Bundy, Hocking, & Einfeld, 2009).

Lack of empathy may be addressed in terms of decentering with interventions, such as collective symbolism and collective pretend play (Cordier et al., 2009). One way Cordier et al. (2009) found decentering to be effective was incorporating typical developing children into the play interventions to enhance

social play and allow for generalizability within the interventions. Cordier, Bundy, Hocking, and Einfeld (2010b) found children with ADHD dominate play interactions and as a result, the playmates modify the play if their ideas are rejected, or mirror the negative behaviors demonstrated by the child with ADHD. When considering playmates for interventions, it is important to include typical developing children as playmates of the children with ADHD in order to work on social interactions, in comparison to other children with ADHD as playmates who are having the same difficulties (Cordier, Bundy, Hocking, & Einfeld, 2010a; Wilkes et al., 2011). By including the child with ADHD's day to day playmates in therapy sessions, the occupational therapist is able to facilitate joint and cooperative play (Wilkes et al., 2011). This will allow for the playmate to not only support the child with ADHD, but advocate for him or herself in regards to his or her own needs during play (Wilkes et al., 2011).

Other considerations for play interventions are the types of play that are preferred by children with ADHD (Pfeifer, Terra, dos Santos, Stagnitti, & Panuncio-Pinto, 2011). Although children with ADHD have preferred playmates, Pfeiffer, Terra, dos Santos, Stagnitti, and Panuncio-Pinto (2011) found the preferred type of play to engage in is play with no partner or rules and toys with educational context. By incorporating playmates and rules into interventions, social skills can be addressed in a way that would transfer to everyday interactions and play opportunities (Cordier et al., 2010a). Wilkes, Cordier, Bundy, Docking, and Munro (2011) suggested video self-modeling, peer-

modeling, and therapist-modeling as interventions specifically to work on social skills for children with ADHD.

Conclusion

ADHD can have a limiting impact on a child's occupations in many areas including, ADLs, IADLs, education, rest and sleep, leisure, play, and social participation. Through the literature review it was found that performance skills/client factors were discussed more in depth than areas of occupations in terms of areas to address in intervention. Although medication is a form of intervention for ADHD, therapy is advised as a co-treatment or as a sole form of intervention for those individuals affected (CDC, 2015). Cognition, motor, sensory, and the area of occupation of play were the four main areas explored and with that, multiple interventions were found for therapists to improve those performance skills/client factors in order for the child to be functioning and develop on a more consistent level.

CHAPTER III

RESEARCH METHODOLOGY

Chapter III explains the methods applied in order to complete this systematic review. An extensive electronic systematic review of literature was completed. We consulted with a librarian at the Harley French Library of the University of North Dakota in order to determine appropriate databases and subject terms for this project. OT Search and CINAHL were utilized as databases due to their emphasis on allied health and the connection to occupational therapy. OT Search was used to identify articles because it specifically catalogs occupational therapy journals, while CINAHL was used as it captures a broader range of journals that publish occupational therapy studies.

The first step in selecting search terms was to complete a literature review for articles related to occupational therapy and Attention Deficit Hyperactivity Disorder (ADHD). The most common key words were recorded for each article in the literature. Common key words included cognition, motor, sensory, and play. Next, we consulted with the Harley French librarian to select terms reflected key words and themes located in our literature review and were consistent with the database search process for OT Search and CINAHL.

The following subject terms were selected for the CINAHL database: *Attention Deficit Hyperactivity Disorder, occupational therapy, children, pediatric occupational therapy, child, cognitive therapy, play and play things, sensory motor integration and motor skills*. The following words or phrases were

used in the OT Search database: *Attention Deficit Hyperactivity Disorder, cognition, motor, sensory, and play.*

In addition, specific inclusion and exclusion criteria were chosen prior to the search for articles. This process was completed to narrow the research parameters and determine the applicability to the study being conducted. Quantitative research articles were chosen because we were able to identify interventions of the highest rigor for children with ADHD. Inclusion criteria consisted of level I, II, and III articles, occupational therapy interventions for children with ADHD, and published in English. In order to have current research, a ten year time frame was chosen. Exclusion criteria consisted of level IV and V articles, systematic reviews, articles not of the occupational therapy discipline, and research articles older than 10 years.

Once inclusion and exclusion criteria were identified, a form was developed to provide a checklist for determining if each article met the inclusion criteria. In addition, another checklist was developed to keep track of exclusion criteria. Each search was saved on CINAHL in order for the researchers to access the original searches at any point. Each researcher reviewed the abstract of the chosen articles and determined if it fit within the criteria. When utilizing OT Search, the articles were retrieved from other accessible sources prior to the researchers reviewing the abstract. The articles that did not meet the criteria were excluded from the research study. If the researchers were unsure of applicability of the article to the study, the research team and our advisor then reviewed the article and discussed its relevance to form a decision of whether to keep it or not.

The articles that fit the inclusion criteria were read independently by each reviewer and then placed in an Excel spreadsheet and in an organizational framework. The following describes the steps involved in the process to complete this systematic review.

The first search was completed using the terms “Pediatric Occupational Therapy and Attention Deficit Hyperactivity Disorder,” in the CINAHL database. A total of 54 results were retrieved. From these article titles and abstracts, 45 articles were excluded as they did not meet the inclusion criteria. Fourteen articles were excluded due to being greater than 10 years old, 6 were not of the English language, 1 was excluded due to not being in the scope of occupational therapy, 20 for not being a specific ADHD intervention and 3 were level IV or V. After review of the articles in question by our research team, 1 article was excluded due to being a level IV or V and 1 article was included. Nine articles met the criteria to have their full text reviewed and evaluated for inclusion in the organizational framework.

The second search was carried out using the terms “Attention Deficit Hyperactivity Disorder, Occupational Therapy and Child,” in the CINAHL database. A total of 11 articles were retrieved. From these article titles and abstracts, 11 articles were excluded as they did not meet the inclusion criteria. Five articles were greater than 10 years old, 3 were not of the occupational therapy domain, 1 was not an ADHD intervention, and 2 were of a level IV or V. As a result of this, no articles were reviewed.

The third search was completed using the terms “Attention Deficit Hyperactivity Disorder and Occupational Therapy” and an “All Child” filter in the CINAHL database. A total of 15 articles were retrieved. From these articles and abstracts, 15 were excluded as they did not meet the inclusion criteria. Seven articles were greater than 10 years old, 3 were not of the occupational therapy domain, 1 was not an ADHD intervention, and 4 articles were level IV or V. As a result of this, no articles were reviewed.

The fourth search was carried out using the terms “Attention Deficit Hyperactivity Disorder and Occupational Therapy,” in the CINAHL database. A total of 24 articles were retrieved. From these articles and abstracts, 24 articles were excluded as they did not meet the inclusion criteria. Nine articles were greater than 10 years old, 2 were not of the English language, 1 was not of the occupational therapy domain, 5 were not an ADHD intervention, and 7 articles were level IV or V. This search resulted in no articles being reviewed.

The fifth search was carried out using the terms “Attention Deficit Hyperactivity Disorder and Cognitive Therapy,” in the CINAHL database. A total of 88 articles were retrieved. From these articles and abstracts, 87 articles were excluded as they did not meet the inclusion criteria. Seventeen articles were greater than 10 years old, 68 were not of the occupational therapy domain, and 2 were excluded due to replication from a previous search. One article met the inclusion criteria to have their full text reviewed and evaluated for inclusion in the organizational framework.

The sixth search was carried out using the terms “Attention Deficit Hyperactivity Disorder and Play and Play Things,” in the CINAHL database. A total of 45 articles were retrieved. From these articles and abstracts, 45 articles were excluded as they did not meet the inclusion criteria. Fifteen articles were greater than 10 years old, 17 were not of the occupational therapy domain, 10 were not an ADHD intervention, and 3 were excluded due to replication from a previous search. This resulted in no articles being reviewed.

The seventh search was carried out using the terms “Attention Deficit Hyperactivity Disorder and Sensory Motor Integration,” in the CINAHL database. A total of 21 articles were retrieved. From these articles and abstracts, 21 articles were excluded as they did not meet the inclusion criteria. Nine were greater than ten years old, 7 were not of the occupational therapy domain, 4 were not ADHD intervention, and 1 article was a level IV or V. As a result, no articles were reviewed.

The eighth search was carried out using the terms “Attention Deficit Hyperactivity Disorder and Motor Skills,” in the CINAHL database. A total of 58 articles were retrieved. From these articles and abstracts, 57 were excluded as they did not meet the inclusion criteria. Nineteen were greater than 10 years old, 1 was not of the English language, 32 were not of the occupational therapy domain, and 5 were not an ADHD intervention. After review of a questionable article by our research team, 1 article met the criteria to have their full text reviewed and evaluated for inclusion in the organizational framework.

The ninth search was completed using the terms “Attention Deficit Hyperactivity Disorder” in the OT Search database. A total of 164 articles were retrieved. From these articles and abstracts, 160 articles were excluded as they did not meet the inclusion criteria. One hundred and six articles were greater than 10 years old, 47 articles were not an ADHD intervention, and 6 articles were excluded due to replication from a previous search. After review of 5 questionable articles by our research team, 4 articles met the criteria to have their full text reviewed and evaluated for inclusion in the organizational framework.

The tenth search was completed using the terms “Attention Deficit Hyperactivity Disorder and Cognition,” in the OT Search database. A total of 7 articles were retrieved. From these articles and abstracts, 7 were excluded as they did not meet the inclusion criteria. Three articles were greater than 10 years old and 4 articles were not an ADHD intervention. As a result, no articles were reviewed.

The eleventh search was completed using the terms “Attention Deficit Hyperactivity Disorder and Play,” in the OT Search database. A total of 19 articles were retrieved. From these articles and abstracts, 19 articles were excluded as they did not meet the inclusion criteria. Ten were greater than 10 years old, 5 were not an ADHD intervention, and 4 articles were excluded due to replication from a previous search. This resulted in no articles being reviewed.

The twelfth search was completed using the terms “Attention Deficit Hyperactivity Disorder and Motor,” in the OT Search database. A total of 29 articles were retrieved. From these articles and abstracts, 29 articles were

excluded as they did not meet the inclusion criteria. Fourteen were greater than 10 years old, 12 were not an ADHD intervention and 3 were excluded due to replication from a previous search. As a result, no articles were reviewed.

The thirteenth and final search was completed using the terms “Attention Deficit Hyperactivity Disorder and Sensory,” in the OT Search database. A total of 55 articles were retrieved. From these articles and abstracts, 55 articles were excluded as they did not meet the inclusion criteria. Thirty-six were greater than 10 years old, 18 were not an ADHD intervention, and one was excluded due to replication from a previous search. As a result, no articles were reviewed.

After articles were chosen for inclusion, two articles were determined to not be level I, II, or III; *An Eighteen Month Follow-Up of a Parent Delivered Play Based Intervention to Improve the Social Play Skills of Children with Attention Deficit Hyperactivity Disorder and their Playmates* (Cantrill, Wilkes-Gillan, Bundy, Cordier, & Wilson, 2015), and *Eighteen Month Follow-Up of a Play Based Intervention to Improve the Social Play Skills of Children with Attention Deficit Hyperactivity Disorder* (Wilkes-Gillan, Bundy, Cordier, & Lincoln, 2014b). Both articles were considered follow-up studies to *Evaluation of a Pilot Parent Delivered Play Based Intervention for Children with Attention Deficit Hyperactivity Disorder* (Wilkes-Gillan et al., 2014a) and *A Play Based Intervention for Children with ADHD: A Pilot Study* (Wilkes et al., 2011), respectively. Upon review by our research team, it was decided these articles would not be included in the final product.

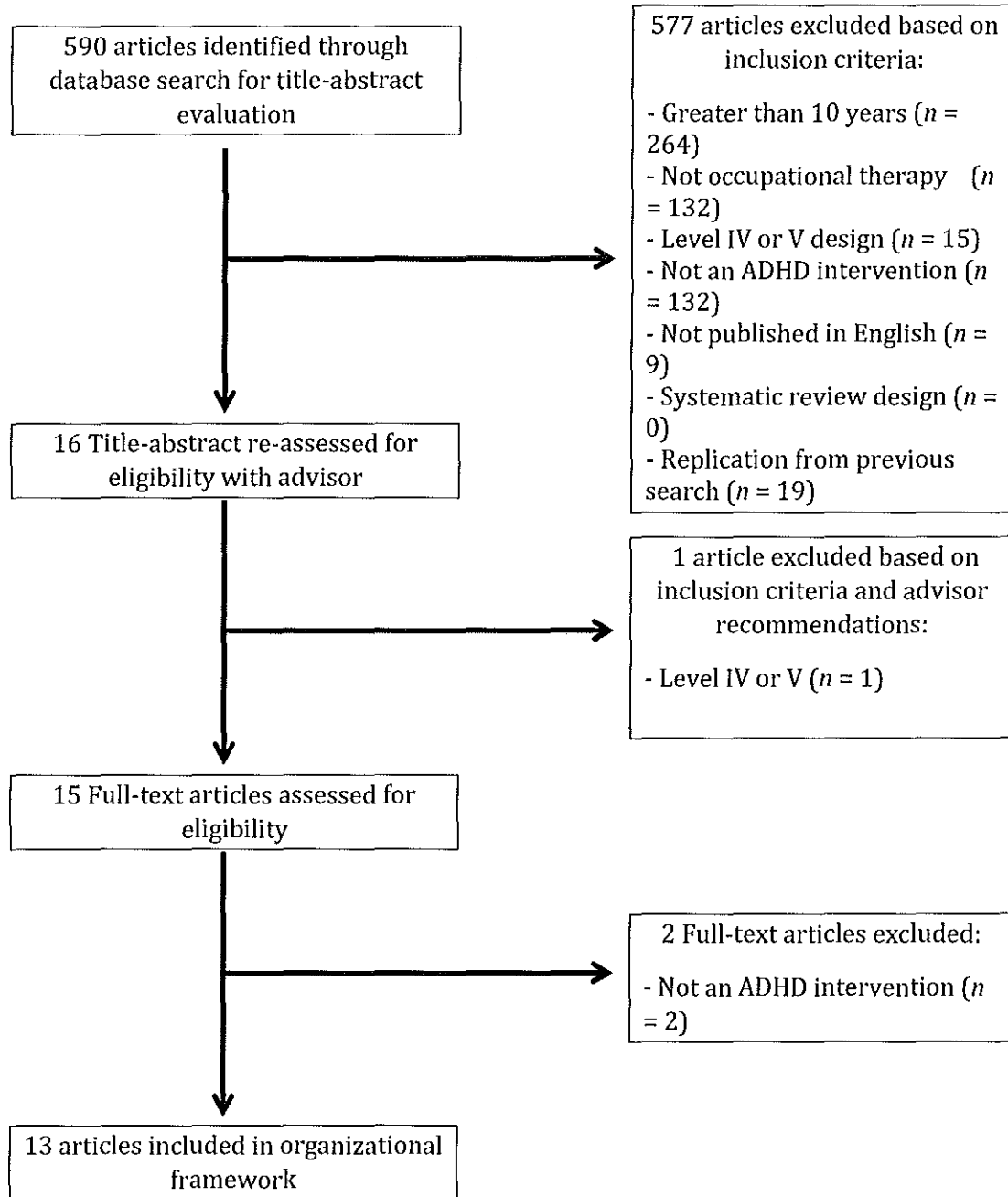
Ethics approval

Due to no involvement of human subjects or protected data in this systematic review, ethics approval was not required.

Theory

Because of the nature of the systematic review, an atheoretical approach was utilized. Rather than a specific theory, *The Occupational Therapy Practice Framework—Domain and Process- 3rd Edition* (AOTA, 2014) was applied. More specifically, we looked at categorizing interventions based on type, whether or not they addressed occupation, performance skills, client factors or patterns. When reviewing the literature the four main topics that stood out were cognition, motor, sensory, and play, which are client factors and performance skills that can be addressed in occupational therapy intervention. However, when completing the organizational framework, levels of evidence were used to categorize the articles due to some crossover of topics.

Figure 1. Article Selection through the Systematic Review Process.



CHAPTER IV

PRESENTATION, ANALYSIS, & INTERPRETATION OF DATA

Chapter IV includes the articles selected for this systematic review, which are presented in an organizational framework, which focuses on the major items of each research study. The factors that were included in the framework include the author/year, the objectives of the research study, the level of evidence, research design, and the number of participants included in each research study. The interventions utilized, the outcome measures, the results of the research study and limitations were also included in the organizational framework. Limitations were significant to note due to the ability to influence the application or generalizability of the findings. Overall, the organizational framework is a guide for readers to examine the research studies that were included in the systematic review.

The articles included in the systematic review are organized by level of evidence, from most rigorous to least rigorous. Level I research articles are randomized control trials, which are considered to be “very strong” and have a high degree of rigor (Lieberman & Scheer, 2002). Level II research articles consist of two groups that are non-randomized and include pre and post test design (Lieberman & Scheer, 2002). This evidence is found to be “less strong” and less degree of rigor than a level I research study (Lieberman & Scheer, 2002). Level III is a one group, pre and posttest intervention and has the least degree of rigor compared to previous levels (Lieberman & Scheer, 2002). Refer to tables 1.1 – 1.2, 2.1 – 2.2, 3.1 – 3.10 to view the results.

Table 1.1

Level I Research Study Synopsis

Author/Year	Study Objectives	Level/Design/Subjects	Interventions	Outcome Measures	Results	Study Limitations
Fourie, van Vuuren, Venter, & Nel (2007)	Investigate the impact of Theraplay on children with ADHD in the classroom, at home, and in individual performance.	Level I (Blind randomized study) N = 17 (Experimental group $n = 9$, M age = 7.86 and Control group $n = 8$, M age = 7.37 15 boys and 5 girls)	Experimental Group: 9 children with ADHD participated in 10 Theraplay sessions. Control Group: 8 children with ADHD did not receive Theraplay interventions until after the study was complete. Theraplay is a therapist lead method that addresses touch and physical contact to form a relationship with others and increase self-control. Concepts of the Theraplay activities include nurture, engagement, challenge and intrusion/playfulness.	Conners' Rating Scales-Revised (CRS-R) Rivermead Behaviour Memory Test (RBMT-C) Developmental Test of Visual Perceptual Skills-2 (DTVPS-2)	Home situation: Significant improvements were found in the experimental group compared to the control group as measured by the CPRS-RL. Classroom situation: Significant improvements were found in the experimental group regarding the category of oppositional behavior. Positive tendency was noted in 10 or 13 CTRS-RL categories, but change was not significant. Individual Performance: The experimental group showed a strong positive tendency in all	Small sample limits generalizability. Only mixed types of ADHD.

general visual perceptual abilities categories and motor reduce visual perception age-equivalent quotient of the experimental group was noted on the DTVP-2 after Theraplay. A significant difference was noted in experimental group for visual motor integration. No significant difference was noted between groups on the RBMT.

Table 1.2

Level I Research Study Synopsis

Author/Year	Study Objectives	Level/Design/Subjects	Interventions	Outcome Measures	Results	Study Limitations
Lin, Lee, Chang, & Hong (2014)	Investigate the impact of wearing weighted vests on attentional, impulse, and on-task behavior in children with ADHD.	Level I (Randomized, two-period cross-over design) N = 110 (Age, <i>M</i> (SD) = 8.6 (1.7), 93 boys, 17 girls)	Group A: Completion of CPT-II task weighted vest (10% of body weight) condition and four weeks later repeated with un-weighted vest condition. Group B: Completion of CPT-II task under the un-weighted vest condition first. The same task was completed under the weighted vest condition 4 weeks later. All participants were told they were wearing the same vest for both conditions Video recording was utilized to measure on-task behavior.	Conners' Continuous Performance Test (CPT-II)	Attentional performance: Attentional performance improved for all three attentional variables measured by the CPT-II task in the weighted vest condition compared to the un-weighted vest condition Impulsivity: A difference was not found in impulsivity measured by the CPT-II task in the weighted vest condition compared to the un-weighted vest condition. On-task behavior: On-task behavior improved for off task behavior, out of seat and fidgets in the weighted vest	Measured immediate effects only. One variable measured impulsivity. Lack of a no-vest condition. No subtypes of ADHD considered. Small sample size limits generalizability. Auditory attention is not measured by CPT-II.

condition compared to the un-weighted vest condition. No significant difference was found in one of the on-task behaviors (Automatic vocalizations).

Table 2.1

Level II Research Study Synopsis

Author/Year	Study Objectives	Level/Design/Subjects	Interventions	Outcome Measures	Results	Study Limitations
Gol & Jarus (2005)	Compare the daily living skills of children with and without ADHD at baseline and to investigate the impact of a social skills training group on daily living skills of the children with ADHD in the study.	Level II (Nonrandomized controlled design) N = 51 (ages 5-8, 41 boys, 10 girls; ADHD, n = 9, No ADHD, n = 10)	Group 1: 9 randomly selected children from the ADHD sample engaged in 15 1-hour weekly sessions of OT social skills training group with one month break after the 10 th session. Group 2: 10 typically developing children were randomly selected and evaluated after 10 weeks, but did not participate in social skills training. The OT social skills training group focusing on relaxation, listening, taking turns, and how to respond during conflict.	Assessment of Motor and Process Skills (AMPS)	Comparison of process and motor skills of children with and without ADHD: Significant difference for process skill as indicated by the AMPS. No difference for motor skills as indicated by the AMPS. Comparison of process and motor skills of children who participated in the OT social skills training group: Significant difference was found between the first and second assessments. No significant difference between the second and third assessments. Comparison of process and motor skills of	Small sample size limits generalizability. Non-blinded assessments.

children with and without ADHD: Children with ADHD improved following OT social skills group where children without ADHD had no difference in performance. Process skills assessment revealed a significant difference between children with and without ADHD on only first assessment. No significant difference noted for motor scale between groups.

Table 2.2

Level II Research Study Synopsis

Author/Year	Study Objectives	Level/Design/Subjects	Interventions	Outcome Measures	Results	Study Limitations
Maeir, Fisher, Bar-Ilan, Boas, Berger, & Landau (2014)	Investigate the impact of the Cognitive-Functional (Cog-Fun) intervention on occupational goals and executive functioning for young children with ADHD.	Level II (Controlled experimental study with a crossover design) N = 19 (ages 7-9, 10 boys, 9 girls)	Group 1: Children with ADHD participated in 10 1-hour weekly sessions in addition to an initial and post-evaluation. Group 2: Following wait list control group status of 12 weeks, group 2 participated in 10 1-hour weekly sessions in addition to an initial and post-evaluation. Both groups were evaluated 3 months post-intervention. Cog-Fun manualized intervention uses metacognitive learning of executive strategies to support performance.	Behavior Rating Inventory of Executive Function-Preschool (BRIEF-P) Canadian Occupational Performance Measure (COPM)	Occupational Goals: Significant improvements were found in group 1 on all COPM outcome measures before crossover. Significant improvements were found in 89% of occupational goals after crossover as measured by the COPM. No significant difference was found in the COPM scores at follow-up compared to post-treatment. Executive Functioning: No significant difference on the BRIEF plan scale and no significant difference was found in group 2 on BRIEF scores before crossover. Significant	Small sample size limits generalizability. Lack of randomization. Child's educational context not included. Child's perspective not evaluated.

improvements were found in group 2 and no significant differences were found between groups 1 and 2 as measured by the BRIEF after crossover.

Table 3.1

Level III Research Study Synopsis

Author/Year	Study Objectives	Level/Design/Subjects	Interventions	Outcome Measures	Results	Study Limitations
Chu & Reynolds (2007)	Investigate the adequacy of a family-centered occupational therapy intervention for children with ADHD and specifically its impact on behavioral patterns of the child and the parental perceptions of the intervention.	Level III (Single group, pretest-posttest design) N = 20 (ages 5-10, 18 boys, 2 girls)	Children engaged in a 3 month long family-centered assessment and treatment package. The occupational therapist had a total of 12 weekly contacts with the child, parents and teachers. The intervention focuses on impairments regarding the neurological, psychological, and behavioral domains and is based around the family's needs and goals.	Reliable Change Index (RCI) Measure of Processes of Care – 20 item version (MPOC-20) ADHD Rating Scale	Behavioral improvements: Outcomes of the ADHD rating scales: 17 children showed an improvement in scores after treatment and 3 children's scores deteriorated. Significant improvements were found in one subscale for 13 of the children and one or both of the scales for 11 children. Parental perceptions: Outcomes of the MPOC-20: Parents' reported experiencing family-centered care.	Small sample size limits generalizability. Lack of randomization. Lack of control group. Possible experimenter effects. No formal procedure. Measured immediate effects only.

Table 3.2

Level III Research Study Synopsis

Author/Year	Study Objectives	Level/Design/Subjects	Interventions	Outcome Measures	Results	Study Limitations
Cosper, Lee, Peters, & Bishop (2009)	Investigate the impact of Interactive Metronome training on attention and coordination in children with neurodevelopmental disorders.	Level III (Pre-test Post-Test within subject design) N=12 (ages 6-13, 10 boys, 2 girls; ADHD + PDD, <i>n</i> = 2, ADHD + DCD, <i>n</i> =10)	Intervention: Children participated in 15 1-hour sessions using the Interactive Metronome over a 15-week period. Interactive Metronome training involves the child using different hand and feet movements in response to of auditory cues allowing the child to develop timing and rhythmicity.	Bruininks-Oseretsky Test of Motor Proficiency-Short Form (BOTMP Short Form) Gordon Diagnostic System (GDS)	Attention: Interactive metronome training had no significant improvement on sustained attention, focused attention, or impulsivity as measured by the GDS. Coordination: Interactive metronome training had a significant improvement on visuomotor control as measured by the BOTMP Short Form.	Lack of control group. Small sample size limits generalizability. Comorbid diagnoses.

Table 3.3

Level III Research Study Synopsis

Author/Year	Study Objectives	Level/Design/Subjects	Interventions	Outcome Measures	Results	Study Limitations
Fedewa & Erwin (2011)	Investigate the impact of utilizing a stability ball to address in-seat and on-task behavior of students with attention and hyperactivity concerns and student and teacher perceptions.	Level III (Single-subject A-B continuous time series design) N = 8 (age $M = 9$ yr, 11 mo., 6 boys, 2 girls; ADHD $n = 5$, Elevated ADHDT score $n = 3$)	All children in the school received stability balls, but 8 children who were identified as having the most severe attention and hyperactivity levels on the ADHDT were observed using Momentary Time Sampling (MTS). Students were fitted with stability balls and used the balls 2 weeks prior to baseline data being collected. MTS was completed at baseline for 2 weeks and during the 12 week intervention (3 days per week, 30 minutes per student observation).	Attention-Deficit/Hyperactivity Disorder Test (ADHDT) Teacher Social Validity Scale	In-Seat and on-task behavior: Significant improvement was found over the course of intervention. Student and teacher perceptions: Teachers rated improvement in children regarding levels of attention, in-seat behavior and work completion. Per qualitative report, a decrease in noise level and moving/fidgeting was noted.	Small sample size limits generalizability. Short-term intervention makes it difficult to know novelty was not a factor. Data was not collected regarding social acceptability of using stability balls.

Table 3.4

Level III Research Study Synopsis

Author/Year	Study Objectives	Level/Design/Subjects	Interventions	Outcome Measures	Results	Study Limitations
Gharebaghy, Rassafiani, & Cameron (2015)	Investigate the effectiveness of Cognitive Orientation to daily Occupational Performance (CO-OP) approach for addressing motor-based performance issues in children 7-12 years of age with attention deficit hyperactivity disorder (ADHD).	Level III (Single case experimental study, multiple baseline design) N = 6 (ages 7-12, 5 boys, 1 girl)	Group 1: Baseline 2 week no intervention Group 2: Baseline 3 weeks no intervention Group 3: Baseline 4 weeks no intervention Intervention: Following baseline no intervention, each group received 12 CO-OP sessions (45-60 minutes each). CO-OP uses the global strategy of goal, plan, do, check to help children use cognitive strategies to improve motor performance.	Raven Colored Progressive Matrices Test (RCPMT) Canadian Occupational Performance Measure (COPM) Bruninks Oseretsky Test of Motor Proficiency Measure (BOTMP) Goal Attainment Scaling (GAS)	All 3 groups demonstrated improvement in motor-based goals upon parent and child report. All 3 groups demonstrated improvement in motor performance based on the results of the BOTMP.	Small sample size limits generalizability. CO-OP relies on verbal skills and the RCPMT does not provide actual verbal ability of client. Potential memory bias for the BOTMP. Evaluator not blinded to treatment status.

Table 3.5

Level III Research Study Synopsis

Author/Year	Study Objectives	Level/Design/Subjects	Interventions	Outcome Measures	Results	Study Limitations
Hahn-Markowitz, Manor, & Maeir (2011)	Investigate the impact of the Cognitive-Functional (Cog-Fun) intervention on occupational performance, executive function, and self-efficacy in children with ADHD.	Level III (Pretest-posttest) N = 14 (ages 7-8, 9 boys, 5 girls)	Children with ADHD participated in 1-hour weekly sessions for 10 weeks with additional interventions provided in the home environments by the parents. Cog-Fun focuses on strategies addressing executive functioning related to self-regulation, working memory, and planning.	Behavioral Rating Inventory of Executive Function (BRIEF) Tower of London-Drexel University (TOL-DX) Canadian Occupational Performance Measure (COPM)	Executive functioning (BRIEF & TOL-DX): Executive functioning improved as noted by statistically significant improvement on the Global Executive Composite indices and 4 of 8 scales. Planning improved as noted by statistically significant improvements on the TOL-DX. Occupational Performance/self-efficacy (COPM): Statistically significant improvement was noted by parents and children regarding occupational performance measured by the COPM.	Lack of control group. Small sample limits generalizability. Possible bias from OT.

Table 3.6

Level III Research Study Synopsis

Author/Year	Study Objectives	Level/Design/Subjects	Interventions	Outcome Measures	Results	Study Limitations
Palsbo & Hood-Szivek (2012)	Investigate the impact of delivering three-dimensional fine motor training to children with poor functional handwriting.	Level III (Uncontrolled pretest-posttest design) N = 18 (ages 5-11, 14 boys, 4 girls)	Intervention occurred 3-5 times per week for a duration of 4-6 weeks. Each child had 15-20 sessions total. Children received three-dimensional repetitive fine motor training which was customized for the child in regards to speed, glyph size, height of pen lift off the paper, number of repetitions, amount of haptic force, and left- or right-handed stroke patterns.	Beery-Buktenica Developmental Test of Visual-Motor Integration (VMI) Test of Handwriting Skills-Revised (THS-R) Evaluation Tool of Children's Handwriting (ETCH)	A significant improvement was found regarding increased speed and consistent letter shapes in children with ADHD after receiving 8-10 hours of repetitive motion training as measured by ETCH and THS-R.	Small sample size limits generalizability. Lack of valid fine-motor control instrument and writing fluidity. VMI unable to identify all noted improvements. Self-esteem and family inclusion not measured.

Table 3.7

Level III Research Study Synopsis

Author/Year	Study Objectives	Level/Design/Subjects	Interventions	Outcome Measures	Results	Study Limitations
Rosenberg, Maeir, Yochman, Dahan, & Hirsch (2015)	Investigate the impact of cognitive-functional (Cog-Fun) group intervention on functional goals of preschoolers who have ADHD.	Level III (Pilot pretest-posttest design) N = 17 (ages 4-6, 12 boys, 5 girls)	Child-parent dyads participated in 11 weeks of intervention and 2 assessment (pre and post) sessions. Child: 11 sessions and Cog-Fun group intervention which addresses executive functioning in the areas of play, self-care and social participation. Parent: Alternated weekly between participating with child and social work group.	Canadian Occupational Performance Measure (COPM) Goal Attainment Scaling (GAS) Social Participation scale of Sensory Processing Measure (SPM) Behavior Rating Inventory of Executive Function-Pediatric (BRIEF-P) Conners' Rating Scales-Revised (CPRS-R)	Occupational Performance: There were significant changes in occupational performance as measured by the COPM. Executive Functioning: No significant changes were found in improving executive functioning in children with ADHD as measured by BRIEF-P. ADHD Symptomology: No significant improvements were found in improving ADHD symptomology as measured by the CPRS-R. Social Functioning: No significant change was	Small sample size limits generalizability. Only recruited from one setting. Lack of objective measures.

found regarding
improving social
functioning as measured
by the SPM.

Table 3.8

Level III Research Study Synopsis

Author/Year	Study Objectives	Level/Design/Subjects	Interventions	Outcome Measures	Results	Study Limitations
Wilkes, Cordier, Bundy, Docking & Munro (2011)	Investigate the impact of a play-based intervention designed to improve play and social skills in children with ADHD.	Level III (Nonrandomized) N = 28 (ages 5-11, 18 boys, 10 girls)	Group 1: Children with ADHD. Group 2: Typically developing playmates of children with ADHD. Intervention: Each pair received 7 weekly 40 minute sessions. Interventions techniques included video feedback, video feedforward, therapist modeling, and peer modeling.	Test of Playfulness (ToP) Conners' Parent Rating Scales-3 (CPRS-3) Child Behavior Checklist (CBCL)	Playfulness: Intervention resulted in significant improvement for groups 1 and 2 as measured by ToP. Interpersonal empathy: Group 1 showed significant improvement in four of seven interpersonal empathy constructs as measured by the ToP.	Lack of generalizability due to non-randomized sample. Evaluator not blinded to treatment status.

Table 3.9

Level III Research Study Synopsis

Author/Year	Study Objectives	Level/Design/Subjects	Interventions	Outcome Measures	Results	Study Limitations
Wilkes-Gillan, Bundy, Cordier, & Lincoln (2014)	Investigate the effectiveness, feasibility, and appropriateness of a parent-delivered social skills intervention for children with ADHD.	Level III (Pretest-posttest design) N = 5 (ages 6-11, 5 boys)	Children with ADHD engaged in a 7-week intervention of weekly home modules, 3 clinic-based play sessions and a follow-up visit. Home modules: Parents and child completed home module followed by parent providing child feedback before, during and after playdate. Clinic-based play sessions: Children engaged in 20 minute play sessions which supported child-initiated free-play.	Test of Playfulness (ToP) Parenting Relationship Questionnaire (PRQ) Conners Comprehensive Behavior Rating Scales (CCBRS)	Effectiveness: A significant improvement was found in social play skills as measured by the ToP, at the one-month follow-up. Feasibility: Parent-delivered intervention is less costly per comparative cost analysis of therapist versus parent intervention. Appropriateness: Parents preferred therapist-delivered interventions as measured by the PRQ.	Small sample limits generalizability. Possible carry-over effect from previous study. Short-term intervention.

Chapter IV consisted of summaries of research studies meeting the inclusion criteria of this systematic review. The studies were organized by rigor, from most rigorous to least rigorous. The final selection of articles presented in the organizational framework included two level I research studies, two level II research studies, and nine level III research studies. The summaries provided in this organizational framework will be further discussed in chapter V. Chapter V will focus on a discussion of findings and recommendations for further research, as well as for practitioners and educators.

CHAPTER V

SUMMARY, CONCLUSIONS, & RECOMMENDATIONS

Attention Deficit Hyperactivity Disorder (ADHD) is a disorder affecting children's daily occupations including activities of daily living (ADLs), instrumental activities of daily living (IADLs), education, rest and sleep, leisure, play and social participation (Kaneko & Okamura, 2005; Poulsen, 2011). At the time of this study, it was unclear which occupational therapy interventions were being utilized for children with ADHD and considered best practice. Therefore, the purpose of this systematic review was to determine occupational therapy interventions that are effective and evidence based for school aged children with ADHD. Additionally, this research study is a contribution to guiding occupational therapists in care and intervention for children with ADHD. In conclusion the findings of this systematic review aid the profession in determining best practices and where future research needs to be directed.

Discussion

Although the articles were presented in the organizational framework by level of evidence, they can also be broken down by focus of the intervention. Using the *Occupational Therapy Practice Framework* (AOTA, 2014), we broke down the studies in to interventions addressing client factors, for example cognition, motor, sensory and interventions addressing areas of the occupation of play. The following paragraphs will address each intervention based on its focus.

Cognition

The main findings from the literature review indicated children with ADHD may experience impairment in executive functioning (Barkley, 2004). Specific components of ADHD that are of concern include working memory, planning, and emotional regulation (Barkley, 2004). When completing the organizational framework, the highest level of evidence was a Level II study by Maeir, Fisher, Bar-Ilan, Boas, Berger, and Landau (2014). This study utilized the Cognitive-Functional (Cog-Fun) (Hahn-Markowitz et al., 2011) intervention program and found a significant difference regarding executive functioning after receiving the intervention. Hahn-Markowitz, Manor, and Maeir (2011) and Rosenberg, Maeir, Yochman, Dahan, and Hirsch (2015) also utilized the Cog-Fun (Hahn-Markowitz et al., 2011) intervention with children with ADHD in Level III design studies. According to the study completed by Hahn-Markowitz et al. (2011), there was a significant difference in executive functioning in children age's seven to eight. The study done by Rosenberg et al. (2015) did not find a significant difference in executive functioning; however, the participants were preschool aged children.

Chu and Reynolds (2007) completed a study focusing on reducing ADHD symptomology in hopes to decrease or replace the use of medication. There were no standard procedures; rather intervention was focused on the child and the family's needs and wants. Interventions focused on improving neurological, psychological, and behavioral domains of the child. Results of the study indicated over half of the participants had significant changes in ADHD symptomology.

One article in the organizational framework focused on more than one aspect of the child; however, the authors did not find any improvements in cognition. Cospers, Lee, Peters, and Bishop (2009) utilized a motor intervention, but assessed differences in attention along with motor improvements. In the results, Cospers et al. (2009) found no significant improvements on sustained attention with Interactive Metronome Training. Another research study utilized a cognitive intervention, but did not assess the children on cognitive functions. Gharebaghy, Rassafiani, and Cameron (2015) focused their study on the Cognitive Orientation to daily Occupational Performance (CO-OP) (Polatajko & Mandich, 2004) intervention; however, rather than assessing cognition, the authors chose to assess motor performance.

Motor

ADHD symptomology can have an effect on a child's motor performance. According to the literature reviewed, problems in balance and fine motor coordination are typically found in children with ADHD (Kaneko & Okamura, 2005; Racine et al., 2008). Palsbo and Hood-Szivek (2012) completed a study focusing on fine motor intervention with the use of a three-dimensional fine motor training. This training found a significant improvement in increased speed and consistent letter shapes with handwriting in children with ADHD. Another study focusing on fine motor coordination utilized the Interactive Metronome Training (Cospers et al., 2009). The results of this study indicate a significant improvement in visual motor control. A Level II study by Gol and Jarus (2005), examined the effectiveness of a social skills training group. In this study, the result relating to

motor performance had no significant improvements. Regarding gross motor performance, the CO-OP (Polatajko & Mandich, 2004) produced significant improvement in children with ADHD's motor performance (Gharebaghy et al., 2015).

Sensory

Sensory processing has been found to be a deficit in children with ADHD (Yochman, Parush, and Ornoy, 2004). In these children, the deficit can cause higher anxiety due to their inability to properly regulate incoming sensory stimulation (Reynolds & Lane, 2009). Common interventions utilized to address these deficits include weighted vests and stability balls. These interventions are considered sensory due to providing additional sensory input while participating in other tasks (Lin et al., 2014). In a Level I study completed by Lin, Lee, Chang, and Hong (2014), weighted vests improved attention and on-task behavior; however, had no impact on impulsivity. A study focusing on stability balls by Fedewa and Erwin (2011) found a significant improvement in in-seat and on-task behavior while utilizing stability balls.

Play

Regarding the play of children with ADHD, research has found that children with ADHD lack empathy (Cordier et al., 2009) and tend to dominate play interactions (Cordier, Bundy, Hocking, & Einfeld, 2010b). The intervention of Theraplay was utilized in a Level I study by Fourie, van Vuuren, Venter, and Nel (2007) and addressed a variety of these aspects. Theraplay was found to be effective in reducing ADHD symptoms and building relationships with others

within the home, in the classroom, and in the child's individual performance. Two interventions which improved the child's play were a play-based intervention and parent-delivered intervention approach. In a Level III study of a play-based intervention, the researchers Wilkes et al. (2011) utilized the techniques of video feedback, video feed forward, therapist modeling, and peer modeling and showed improvements in playfulness and interpersonal empathy. Wilkes-Gillan, Bundy, Cordier, and Lincoln (2014a) completed a study based off of a parent-delivered intervention approach, which was Level III design. The results of this study supported incorporating parents into the intervention process in order to increase the play skills of the children. In addition, the studies completed by Wilkes et al. (2011) and Wilkes-Gillan et al. (2014a) each had a follow-up study completed by Cantrill, Wilkes-Gillan, Bundy, Cordier, and Wilson (2015) and Wilkes-Gillan, Bundy, Cordier, and Lincoln (2014b), respectively. These studies were not included, as they were determined to not be a level I, II, or III.

Strengths & Limitations

A variety of strengths were noted during the systematic review process. First, we consulted with the librarian to create appropriate subject headings and key words for the systematic review. The librarian also assisted in the selection of appropriate databases. Next we limited our database search to include only articles published in the last ten years. In consultation with our advisor, an established process was determined and followed, which included a method of

record keeping. Record keeping allowed us to review previous searches and articles, which increased our reliability.

Limitations in regards to the systematic review include: (a) researchers lack of experience completing a systematic review, (b) locating sufficient evidence, (c) research databases, (d) and focusing on occupational therapy interventions. The first limitation reflects our lack of familiarity and knowledge with systematic reviews, which may have hindered the research process. Throughout the research process we reviewed published systematic reviews, documented each process of the systematic review, and conferred with our advisor in attempts to compensate for our inexperience.

In regards to locating sufficient evidence, there is an abundance of literature relating to the impact of ADHD symptomology on occupational performance. However, there is a lack of research concerning occupation-based interventions. As a result of this limitation, there were only 13 articles presented in the organizational framework. The research databases also came into effect when locating sufficient evidence. We chose to utilize the research databases OT Search and CINAHL for the systematic review, due to their focus on allied health. There were additional databases that could have been incorporated, such as PubMed, which may have produced more results. Additionally, only focusing on occupational therapy interventions limits the applicability to occupational therapists; therefore, the results are not informative to other disciplines.

The main strength of articles included in this systematic review is the psychometric properties of the assessments utilized in the studies. Common

assessments applied throughout the studies include, Canadian Occupational Performance Measure (COPM) (Law, Baptiste, Carswell, McColl, & Polatajko, 2005), Behavioral Rating Inventory of Executive Functioning (BRIEF) (Gioia, Isquith, Guy, & Kenworthy, 2000), Test of Playfulness (ToP) (Bundy, 2004), Bruninks Oseretsky Test of Motor Proficiency Measure (BOTMP) (Bruninks, 1978), Conners' Continuous Performance Test II (CPT-II) (Conners, 2004) and the Assessment of Motor and Process Skills (AMPS) (Fisher, 1997). Each assessment demonstrates good reliability and, or validity (Gharebagy et al., 2015; Lin et al., 2014; Wilkes et al., 2011; Cospers et al., 2009; Gol & Jarus, 2005; Rosenberg et al., 2015; Wilkes-Gillan et al., 2014a; Hahn-Markowitz et al., 2011; Maeir et al., 2014).

The main limitations found when reviewing the articles in the systematic review are small sample, lack of randomization, and lack of a control group. The small sample size of the studies, which 11 of the 13 reported, results in a lack of generalizability (Gharebaghy et al., 2015; Cospers et al., 2009; Gol & Jarus, 2005; Palsbo & Hood-Szivek, 2012; Rosenberg et al., 2015; Wilkes-Gillan et al., 2014; Fourie et al., 2007; Hahn-Markowitz et al., 2011; Fedewa & Erwin, 2011; Maeir et al., 2014; Chu & Reynolds, 2007). Therefore, the results may not be applicable to a large population. Lack of randomization, which occurred in 11 of the 13 studies, and lack of a control group, which occurred in 9 of the 13 studies, decrease the rigor of the studies (Gharebaghy et al., 2015; Wilkes et al., 2011; Cospers et al., 2009; Gol & Jarus, 2005; Palsbo & Hood-Szivek, 2012; Rosenberg

et al., 2015; Wilkes-Gillan et al., 2014a; Hahn-Markowitz et al., 2011; Fedewa & Erwin, 2011; Maeir et al., 2014; Chu & Reynolds, 2007).

Recommendations for occupational therapy

As a result of the systematic review, recommendations can be made for practitioners, future research, and educational curriculum. In regards to practitioners, the interventions presented in the systematic review can carry over into practice. The information provides evidence-based interventions that have been shown to improve cognition, motor, sensory, and play of children with ADHD. Articles that presented interventions incorporating parents into the process has shown to increase carry-over of interventions from the clinic to the home. This information could be beneficial to American practitioners specifically, as the studies that showed results were from various countries. One limitation to practitioners is the Cog-Fun (Hahn-Markowitz et al., 2011) is not yet published in the English language, but the CO-OP (Polatajko & Mandich, 2004) is currently available to occupational therapists. All the interventions presented in the organizational framework will also be beneficial to educational curriculum, as again, they are evidence based and shown to be effective. It is our hopes that this systematic review be published in a scholarly journal in order to be accessible to practitioners and educators. At this time, it is assumed practitioners and educators are not practicing and teaching current evidence based interventions for children with ADHD. Therefore, this provides a guide for best practice regarding this topic.

Recommendations for future research can be based off of this systematic review. More rigorous research needs to be completed on each of the interventions that were presented. Through our review of articles, there is a lack of research on ADHD interventions, as well a lack of current research regarding sensory interventions. This systematic review focused on school-aged children, and future research could be completed regarding interventions for ADHD into adulthood. Additional future research could be cognition and sensory interventions that are occupation-based.

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