SJOT

Student Journal of Occupational Therapy

Volume 1
Issue 1 *Inaugural Issue*

Article 3

2020

Innovative Movement Strategies for Adolescents with Autism Spectrum Disorder: A Review of Dance and Exergaming Interventions

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Innovative Movement Strategies for Adolescents with Autism Spectrum Disorder: A Review of Dance and Exergaming Interventions

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DOI: https://doi.org/10.46409/001.ZCIE4403

To cite this article:
Garcia, A., Bode, A., Camillone, S., & Rao, A. (2020). Innovative movement strategies for adolescents with autism spectrum disorder: A review of dance and exergaming interventions. *Student Journal of Occupational Therapy, 1*(1), 1-16. https://doi.org/10.46409/001.ZCIE4403

Abstract

Background: *Given the types of symptoms present in individuals with autism spectrum disorder (ASD), interventions should address deficits in motor control, social interactions, and emotional intelligence. Alternative interventions, such as exercise video gaming (exergaming) and dance movement therapy, may address these deficits in an engaging, age-appropriate manner, thus meeting the unique needs of adolescents with ASD.*

Objectives: *The purpose of this paper was first, to review the current literature on ASD for innovative movement strategies feasible to address emotional, social, cognitive, and physical outcomes for adolescents ages 11-18; and second, to determine the effectiveness of these interventions.*

Methods: *The databases used were: Pubmed, Cochrane Library, Web of Science, EMBASE, CINAHL, Psycinfo, REHABDATA, Human Kinetics Journal, and PEDro. Search terms included: autism or autism spectrum disorder; and dance, dancing or dance therapy, or exergaming, exergame, video gaming or video*

game. Selected articles were published in the last 10 years, written in English, and included subjects with ASD who participated in dance or exergaming interventions. After the initial screening of articles with relevant titles and abstracts, we included studies with evidence levels of 1-4.

Main results: *Five dance therapy intervention studies showed moderate effectiveness for social and emotional outcomes such as empathy skills, emotional regulation, and negative symptoms of ASD. Four exergaming studies had moderate effectiveness for motor and physical outcomes, such as energy expenditure and perceived object control.*

Implications: *Based on the review of dance and exergaming intervention studies, the authors recommend providing the interventions to selected clients depending on individual circumstances. Both dance and exergaming may be cost-effective and feasible in school settings. Future studies should include larger and more diverse samples with rigorous randomization procedures.*

Keywords: autism spectrum disorder, dance therapy, video gaming, motor skills, social skills.

Introduction

In the United States, approximately 1 in 54 children are diagnosed with autism spectrum disorder (ASD) (Centers for Disease Control and Prevention, 2020). Children with ASD often experience difficulties with social skills, prosocial behaviors (i.e. behaviors intended to support other individuals), motor planning, coordination, core strength, executive functioning, and fine motor skills (American Psychiatric Association [APA], 2013; Maenner et al., 2020; Oerlemans et al., 2018). Many students who receive long-term therapy services may tire of traditional therapy techniques, resulting in disengagement during sessions, due to loss of interest or motivation.

Since occupational therapists (OTs) must often work with this population in school settings, it is important for them to have an accurate understanding of the evidence for any treatment method. This paper evaluated the evidence in recent published literature on the use of innovative movement techniques to obtain positive effects in adolescents with ASD for a variety of outcomes, ranging from social skills to motor functioning. This literature review was conducted in the context of treatment of adolescent students with high-functioning ASD at the Sonia Shankman Orthogenic School in Chicago, Illinois.

An initial review of the literature indicated movement therapies can provide engaging stimulation for adolescents with ASD (Healy et al., 2018). Physical activity interventions have moderate to large positive effects on the development of specific skills, including manipulative skills, locomotor skills, muscular strength, and endurance (Healy et al., 2018). Through this initial review, dance therapy and exercise video gaming, referred to as exergaming, were identified as two interventions with potential to create positive outcomes for adolescents with high-functioning ASD. For the purpose of this review, high-functioning ASD is regarded as individuals with an ASD diagnosis who can communicate verbally, follow verbal and visual instructions, and who demonstrate minimal to moderate deficits in the previously outlined symptoms of ASD. Exergaming and dance

interventions addressed motor, social, and emotional outcomes.

This paper aims to answer the following question: According to the published literature, what evidence is available to support the use of exergaming and dance therapies for children with ASD aged 11 to 18 who demonstrate strong social skills, communication, and self-sufficiency?

Methods

Summary of Search

Twelve electronic databases were reviewed: Pubmed, Cochrane Library, Web of Science, EMBASE, CINAHL Plus, PsychoINFO, REHABDATA, OTseeker, American Journal of Physical Medicine and Rehabilitation, Rehabilitation Reference Center, Human Kinetics Journal, PEDro and Science Direct. The entire search of databases for relevant literature was conducted between September and October of 2019.

Selected databases were searched twice, combining search terms related to the population and intervention. A combination of the following search terms for population and intervention were used across all databases: [(autism, autism spectrum disorder) AND (dance, dancing or dance therapy)] OR [(autism, autism spectrum disorder) AND (exergaming, exergame, video gaming or video game)]. During the initial search, the authors excluded articles not written in the past 10 years or that did not have full text available online.

The combined searches produced 1,899 results. An additional two articles identified through a manual search, conducted by looking through the references of relevant articles discovered in the database search, were also included. In total, this resulted in 1,901 articles. To identify relevant articles from the 1,901 results, articles were then filtered based on the following search criteria: be written in English, include participants with an ASD diagnosis, and examine exergaming or dance interventions with various outcomes. Articles not meeting the search criteria or which met the search criteria but lacked relevance based on the title and abstract were excluded.

Of the 1,901 initially identified articles, 155 were determined to be relevant based on title, abstract and previously stated search criteria.

From the 155 articles, 48 were determined to be duplicates and removed, leaving 107 articles. From the remaining articles, 11 were selected to include in the review based on study design. Study designs prioritized were based on the Oxford Center for Evidence based medicine (Oxford Centre for Evidence-Based Medicine, 2009). In choosing articles, the authors prioritized articles with evidence levels 1-4 which includes randomized control trials, meta analyses and systematic reviews over case reports.

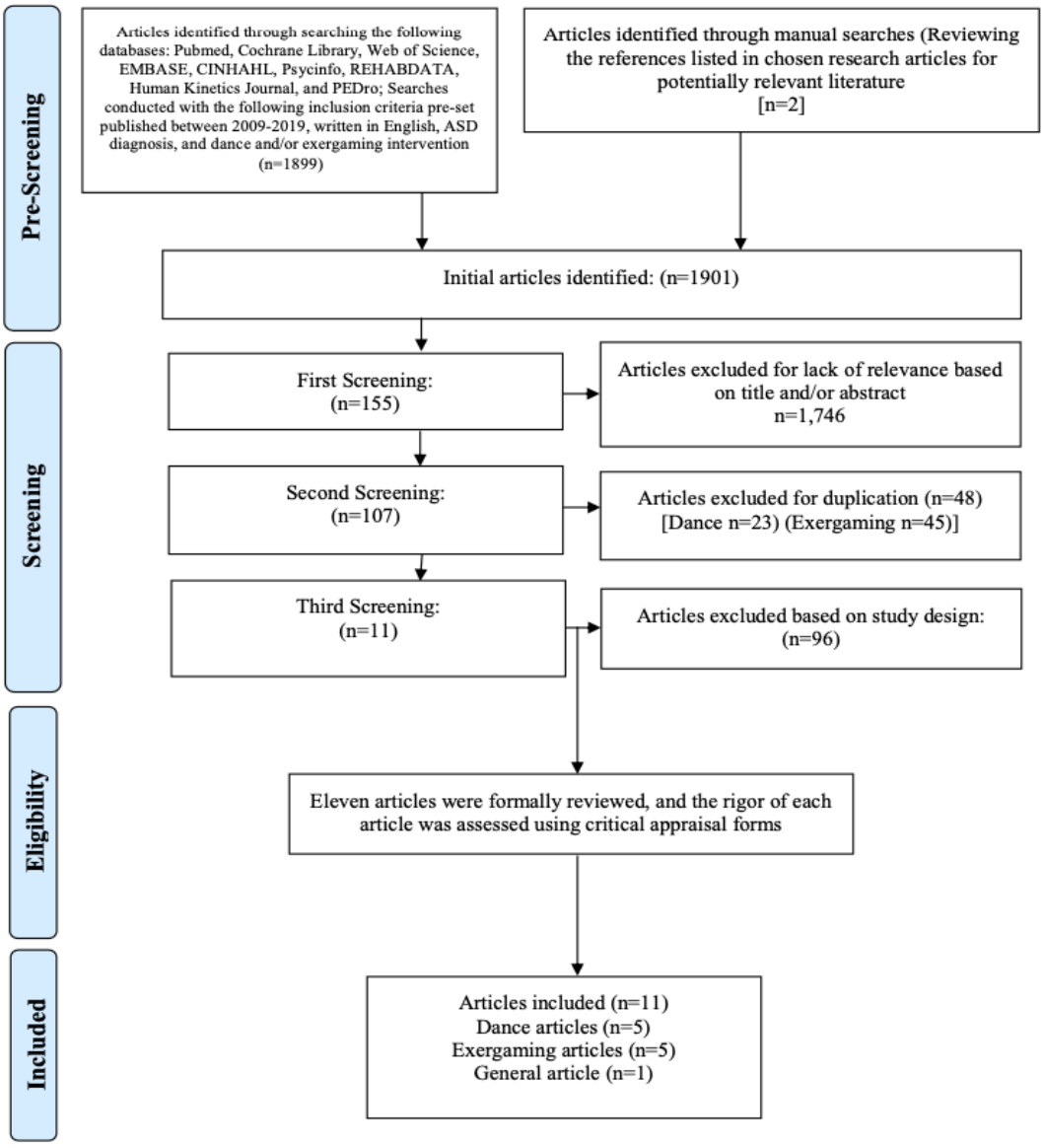
Of the accepted articles, rigor was analyzed according to critical appraisal forms created by faculty at the University of Illinois at Chicago (UIC), Occupational Therapy Department (University of Illinois at Chicago, 2017). The forms were created to assist in dissecting research designs into critical components and assessing information to support analysis and critical thinking (University of Illinois at Chicago, 2017).

With permission from Dr. Mansha Mirza, PhD and Dr Susan Magasi, PhD, these critical appraisal forms were used by the authors to summarize the rigor and results of the 11 chosen articles, including each study's objectives, methods, outcomes, findings from these critical appraisals allowed the

strengths/limitations, and clinical bottom line. The authors to determine the rigor of each of the 11 chosen articles, including internal and external validity, and to synthesize the results of each article for this review.

To represent the search strategies utilized to formulate this review, the authors created a PRISMA flow diagram (Moher et al., 2009) to demonstrate the outcomes of the search criteria, as well as the reasoning behind these criteria. See Table 1 for a summary of the search.

Table 1. *PRISMA Diagram: Summary of Article Search*



Review of Rigor

Neutrality

Neutrality refers to any potential sources of bias (Guba, 1981). Articles with more procedures in place to reduce bias were regarded as having higher neutrality. In meta-analyses, neutrality was based on factors such as whether or not there were comprehensive search strategies and independent reviews of coding by two different raters, as seen in Healy et al. (2018). In experimental studies, neutrality was determined based on strategies implemented to reduce bias through rigorous randomization procedures and methods to promote distance between the researcher and participants (DePoy & Gitlin, 2011).

Consistency

Consistency measures how dependably the intervention was implemented and data was collected, in order to ensure findings would be the same in replication (Morse et al., 2002). When reviewing the consistency of each study, consistency was determined based on the use of reliable measures and consistent procedures, both in implementing the intervention and collection of data, such as training of interventionists, manualization of intervention, fidelity checks, and consistent data collection protocols (DePoy & Gitlin, 2011).

Applicability

Applicability measures the extent to which the results of a study can be generalized to a larger population (Guba, 1981). Applicability was determined based on an assessment of whether the findings could be generalized to other samples, settings, and times. This was, in part, based on how clearly researchers described study populations, how closely study populations matched the target adolescent population as well as feasibility of implementation in a school-based setting (DePoy & Gitlin, 2011).

Truth Value

Truth value, or internal validity, refers to the accuracy of a study's findings (Morse et al., 2002). Truth value ratings were determined based on the strategies that were used or not used to reduce bias and ensure the outcomes of each study were reliable and valid. All included studies gathered baseline data using outcome measures before allocating participants to treatment and control groups.

Review of Rating

Individual articles were assessed for overall study design, applicability, and truth value through the use of the critical appraisal forms (see Table 2). Studies considered to have less rigorous designs, were those that did not have samples with diverse demographics, did not use assessment tools with moderate to high ratings of validity and/or reliability, and did not demonstrate that the study could be replicated with the same results (DePoy & Gitlin, 2011).

To assess the levels of evidence, study design and rigor were considered, and articles were graded from I to V using the levels of evidence chart developed by the Oxford Centre for Evidence-based Medicine (2009). I being the highest level, reserved for well-designed and documented systematic reviews and RCTs; and V being the lowest level, reserved for low-rigor research, pre-experimental designs, and case studies (Oxford Centre for Evidence-based Medicine, 2009). The majority of articles fell between II and III.

Table 2. *Assessment of Study Design*

Intervention Type	Study Design of Appraised Article	Author (Year)	Rating
General	Meta-analysis	Healy et al. (2018)	I2b
Dance	Randomized Control Trial	El Shemy & El-Sayed (2018)	II2b
		Hildebrandt et al. (2016)	II2c
	Quasi-experimental	Koch et al. (2015)	III1c
		Koehne et al. (2015)	III2c
		Mateos-Moreno & Atencia-Dona (2013)	III2b
Exergaming	Systematic Review	Fang et al. (2019)	II2b
	Quasi-experimental	Getchell et al. (2012)	III2c
		Edwards et al. (2017)	V2b
	Pre-post design; no comparison group; pilot study	Travers et al. (2018)	III2b
		Hilton et al. (2015)	V2c

Applicability and truth value were included within the assigned rating, and the previously mentioned strategies and considerations were utilized to determine their respective ratings. Applicability was rated 1 for high, 2 for moderate, and 3 for low. Truth value was graded as 'a' for high truth value, 'b' moderate and 'c' low.

Results

Study Designs

The authors appraised 11 quantitative studies. The first study was a meta-analysis, which examined various movement therapies for ASD (Healy et al., 2018). Articles examining dance therapy interventions included two randomized control trials (RCT) (El Shemy & El-Sayed, 2018; Hildebrandt et al., 2016) and three quasi-experimental studies (Koch et al., 2015; Koehne et al., 2015; Mateos-Moreno & Atencia-Dona, 2013). Within the dance intervention studies, intervention length ranged from a one-hour session once a week for seven weeks (Koch et al., 2015), to a one-hour session twice a week for 36 weeks (Mateos-Moreno & Atencia-Dona, 2013).

Articles examining exergaming interventions included two quasi-experimental studies (Hilton et al., 2015; Travers et al., 2018), two pre-post designs (Edwards et al., 2017; Getchell et al., 2012) and one systematic review (Fang et al., 2019). The exergaming interventions ranged from three two-minute sessions each day with up to six sessions per week for six to ten weeks (Hilton et al., 2015), to three 60-minute sessions per week for six weeks (Travers et al., 2018).

Study Samples

Across all experimental studies, sample sizes ranged from 16 to 78 participants, with ages ranging from 6 to 55. Of the dance intervention studies, overall sample size ranged from 16 (Mateos-Moreno & Atencia-Dona, 2013) to 78 participants (Hildebrandt et al., 2016), and participants' age ranged from 8 (El Shemy & El-Sayed, 2018) to 55 (Koehne et al., 2015). Mateos-Moreno & Atencia-Dona (2013) did not report an age range for their dance intervention participants.

Within the exergaming intervention studies, overall sample size ranged from 17 (Hilton et al., 2015) to 30 participants (Getchell et al., 2012) and age spanned from 6 (Edwards et al., 2017) to 18 years old (Hilton et al., 2015). Some exergaming studies did not report an age range for their participants (Getchell et al., 2012; Travers et al., 2018). In addition, as Fang et al. (2019) was a meta-analysis, participant data of the individual studies within that review were not included in these exergaming participant and age ranges. The majority of participants across all studies were male, and there was an average female representation of 21%.

Intervention Types

Dance interventions included gait training with auditory rhythmic stimulation (El Shemy & El-Sayed, 2018), parts of a dance movement therapy modality (Hildebrandt et al., 2016; Koch et al., 2015; Mateos-Moreno & Atencia-Dona, 2013), and an author-developed, imitation/synchronization-based dance movement intervention (Koehne et al., 2015).

Exergaming interventions included bio-feedback balance training with a Nintendo® Wii balance board (Travers et al., 2018), Nintendo® Wii fitness games (Getchell et al., 2012), Makoto arena exergame (Hilton et al., 2015), and Xbox Kinect (Edwards et al., 2017). Some interventions used different activities, which varied from session to session (Mateos-Moreno & Atencia-Dona, 2013).

Assessment of Outcomes

Common symptoms of ASD were addressed across multiple articles (Hildebrandt et al., 2016; Hilton et al., 2015; Travers et al., 2018). Mateos-Moreno & Atencia-Dona (2013) measured frequently associated symptoms of ASD using The Revised Clinical Scale for the Evaluation of Autistic Behavior (ECA-R). Self-reported scales or observational assessments of outcomes varied across studies.

Physical or motor outcomes were most frequently measured using the Bruininks-Oseretsky Test of Motor Proficiency, 2nd Edition, Short Form (BOT-2 SF) (El Shemy & El-Sayed, 2018; Hilton et al., 2015; Travers et al., 2018). In El Shemy & El-Sayed (2018) the BOT-2 SF was used to measure bilateral coordination, balance, running, speed & agility, and strength.

Emotional and social functioning were also addressed in dance therapy interventions (Hildebrandt et al., 2016; Koch et al., 2015; Koehne et al., 2015; Mateos-Moreno & Atencia-Dona, 2013). Koehne et al. (2015) used the Multifaceted Empathy Test (MET) to measure emotional inference and empathy skills, and the Interpersonal Reactivity Index (IR) to measure perspective-taking and empathic concern.

Review of Outcomes

An initial review of the meta-analysis by Healy et al. (2018) showed that physical activity in dance and exergaming was supported as a valid intervention for individuals with ASD. The study examined the effects of various interventions on

motor skills, social skills, and behaviors related to ASD. Participants with ASD aged 2 to 22 participated in dancing, Nintendo® Wii, and trampolining, among other physical activity interventions. The study reported development of motor, social and process skills when compared to the control group (Healy et al., 2018). Based on this evidence, the current study sought to perform a wider assessment of current evidence on dance and exergaming therapy.Dance-based interventions were found to be effective in developing emotional and social skills (El Shemy & El-Sayed, 2018; Hildebrandt et al., 2016; Koch et al., 2015; Koehne et al., 2015; Mateos-Moreno & Atencia-Dona, 2013). Empathy and emotional inference developed significantly in Koehne et al. (2015) and Koch et al. (2015) found improved psychological factors and social skills in the dance-movement therapy (DMT) intervention group. Mateos-Moreno & Atencia-Dona (2013) found dance therapy and music therapy improved social interaction and emotional regulation in adults with severe ASD. El Shemy & El-Sayed (2018) saw significant improvements from the pretest to post-test (p=.001) in bilateral coordination, balance, running, and speed, compared to the control group after delivering rhythmic auditory cueing. Hildebrandt et al. (2016) reported a 15.27% decrease in negative symptoms, and an improvement of emotional expression and empathy after receiving weekly one-hour DMT intervention for ten weeks.

Exergaming interventions were found to be effective in addressing gross motor and physical outcomes (Edwards et al., 2017; Fang. et al., 2019; Getchell et al., 2012; Hilton et al., 2015; Travers et al., 2015). Studies found an increase in perceived object control (Edwards et al., 2017) and higher energy expenditure in the treatment group with ASD. (Getchell et al., 2012). Hilton et al. (2015) reported improved motor control, strength, and agility using a speed-based game intervention. Travers et al. (2018) found improved balance and postural sway after using a balance-based intervention delivered through a Nintendo® Wii balance board and Xbox Kinect. The systematic review by Fang et al. (2019) reviewed the effects of exergaming on physical and cognitive outcomes, including dance video games. Their results supported exergaming in addressing cognitive performance, social-emotional, and physical behaviors associated with ASD (Fang et al., 2019).

Overall, the literature of dance movement therapy and exergaming indicates positive effects on physical, cognitive, social, and emotional outcomes.

Levels of Evidence

Neutrality

Most dance intervention studies showed moderate levels of neutrality (El Shemy & El-Sayed, 2018; Hildebrandt et al., 2016; Koehne et al., 2015; Mateos-Moreno & Atencia-Dona, 2013), with the exception of Koch et al. (2015) displaying low neutrality. Studies using RCT designs (El Shemy & El-Sayed, 2018; Hildebrandt et al., 2016) promoted objectivity through randomization or blinding. Quasi-experimental designs were less objective due to lack of randomization (Koch et al., 2015) and the absence of a control group (Koehne et al., 2015).

Much of the exergaming intervention literature, represented in Table 3, displayed a moderate level of neutrality (Fang et al., 2019; Hilton et al., 2015; Travers et al., 2018), while some studies presented low levels of neutrality (Edwards et al., 2017; Getchell et al., 2012). Similar to the dance intervention literature, several exergaming studies did not include control groups, which made it impossible to implement certain strategies that

promote objectivity such as randomization (Hilton et al., 2015; Travers et al., 2018). Both the meta-analysis and systematic review were rated as moderate, as these reviews included a wide variety of studies with varying levels of neutrality (Fang et al., 2019; Healy et al., 2018). Across studies, lower levels of neutrality limit our certainty the results are due to true phenomenon and not the bias of the researchers (Guba, 1981).

Consistency

Most studies included in this review were evaluated as having high or moderate consistency, with one study having low consistency (Mateos-Moreno & Atencia-Dona, 2013). Limitations of consistency across included studies affect the ability of future research to replicate procedures and findings, increasing the likelihood of unreliable results (Guba, 1981). In addition, such lack of consistency may make it difficult to utilize these studies to create knowledge translation tools or assessments that improve current ASD-related interventions (Mallidou, 2018). The meta-analysis by Healy et al. (2018) was rated high in consistency due to the reported study protocol, adherence to PRISMA guidelines, description of search process, reliable selection of studies, and clear explanation of inclusion and exclusion criteria.

In dance intervention studies, overall consistency was moderate, with two studies rated as having high consistency (Hildebrandt et al., 2016; Koehne et al., 2015), two moderate (El Shemy & El-Sayed, 2018; Koch et al., 2015), and one low (Mateos-Moreno & Atencia-Dona, 2013). These evaluations are also represented in Table 3.

The majority of these dance intervention studies had reliable and valid instruments or measures (El Shemy & El Sayed, 2018; Hildebrandt et al., 2016; Koehne et al., 2015; Mateos-Moreno & Atencia-Dona, 2013), provided comprehensive documentation about the intervention (El Shemy & El-Sayed, 2018), or trained raters or interventionists (Hildebrandt et al., 2016; Koch et al., 2015). Comparatively, dance intervention articles did not report the fidelity of interventions, with only one article doing so (Koch et al., 2015), and one article also lacked information on the interventionists (El Shemy & El-Sayed, 2018).

Of the exergaming intervention studies, overall consistency was moderate, with three articles rated as moderate (Edwards et al., 2017; Getchell et al., 2012; Hilton et al., 2015), and two high (Fang et al., 2019; Travers et al., 2018). The articles rated as moderate lacked consistency in procedures and study measures with established reliability (Getchell et al., 2012), as well as adequate information on the training of researchers and interventionists (Travers et al., 2018). However, many of the exergaming studies showed valid and reliable instrument and assessment use (Edwards et al., 2017; Fang et al., 2019; Hilton et al., 2015), comprehensive data collection and analysis (Getchell et al., 2012; Travers et al., 2018), or trained interventionists (Hilton et al., 2015).

Applicability

All studies included in this review were rated as having low or moderate applicability. Due to the variance of symptoms and level of functioning in individuals with ASD (APA, 2013), having strong applicability in the chosen articles can be challenging. Studies examining individuals with ASD should include more detailed descriptions of participants in order to facilitate evaluation of applicability in a given setting.

Table 3. *Rigor Assessment*

Author (year)	Neutrality	Consistency	Applicability	Truth Value
Edwards et al. (2017)	Low	Moderate	Moderate	Moderate
El Shemy & El-Sayed (2018)	Moderate	Moderate	Moderate	Moderate
Fang et al. (2019)	Moderate	High	Moderate	Moderate
Getchell et al. (2012)	Low	Moderate	Low	Moderate
Healy et al. (2018)	Moderate	High	Moderate	Moderate
Hildebrandt et al. (2016)	Moderate	High	Low	Moderate
Koch et al. (2015)	Low	Moderate	Low	High
Koehne et al. (2015)	Moderate	High	Low	Moderate
Mateos-Moreno & Atencia-Dona (2013)	Moderate	Low	Moderate	Moderate
Travers et al. (2018)	Moderate	High	Moderate	Moderate
Hilton et al. (2015)	Moderate	Moderate	Low	Moderate

Overall population validity across studies using dance interventions was low to moderate, due to lack of sufficient descriptors of participants. Despite race, ethnicity, and socioeconomic status being factors contributing to an ASD diagnosis (APA, 2013), across all studies no description was provided. Gender was addressed in all dance intervention studies (El Shemy & El-Sayed, 2018; Hildebrandt et al., 2016; Koch et al., 2015; Koehne et al., 2015; Mateos-Moreno & Atencia-Dona, 2013). According to the American Psychiatric Association (2013), "[a]utism spectrum disorder is diagnosed four times more often in males than in females." While some studies slightly over-represented the population of males diagnosed with ASD (Koehne et al., 2015; Mateos-Moreno & Atencia-Dona, 2013), others slightly over-represented the population of females (El Shemy & El-Sayed, 2018; Koch et al., 2015). All studies were within 20% of the true population value. Gender aside, one dance intervention study found participants enjoyed the dance intervention, which suggests feasibility for the target population (Koch et al., 2015).

Applicability was assessed to be low to moderate in the exergaming intervention studies. Race, ethnicity, and socioeconomic status were not described in any of the studies (Edwards et al., 2017; Fang et al., 2019; Getchell et al., 2012; Hilton et al., 2015; Travers et al., 2018). However, all studies addressed the gender representation in their

samples. One study over-represented the proportion of males (Travers et al., 2018), three over-represented the proportion of females (Edwards et al., 2017; Getchell et al., 2012; Hilton et al., 2015), and one did not include information about gender (Fang et al., 2019). All studies that reported gender were within 20% of the true population value but leaned toward over-representation of females with ASD.

Truth Value

Truth value ratings were determined as moderate to high for all studies. All studies gathered baseline data using outcome measures before allocating participants to treatment and control groups. The meta-analysis regarding physical interventions had moderate internal validity, using a three-stage screening process and clearly stated inclusion criteria and criteria for interpretation of results (Healy et al., 2018).

Randomization of participants to treatment and control groups occurred in two dance intervention studies (El Shemy & El-Sayed, 2018; Hildebrandt et al., 2016).

Design contamination was likely when participants disclosed possible interventions with family (El Shemy & El-Sayed, 2018). Hildebrandt et al. (2016) displayed attrition effects due to high dropout rates and co-intervention effects, resulting from some participants attending rehabilitative day programs outside the study. Mateos-Moreno & Atencia-Dona (2013) did not randomize, but participant selection occurred using an outside source and specific statistical techniques to compensate for the lack of randomization. Koehne et al. (2015) implemented participant blinding from beginning to end of the study. Koch et al. (2015) was unable to use randomization and instead matched participants using age, sex, and severity of condition for the treatment and control group.

Of the five exergaming interventions, no study used random allocation for participants, but all studies collected baseline data and used unique methods to promote internal validity. Fang et al. (2019) used multiple keywords and searched numerous databases for the systematic review. Researchers in Edwards et al. (2017) implemented the intervention in homes of participants following the pre-assessment to increase rigor. Hilton et al. (2015) collected baseline data using pretests and completed post-testing within one month of completing interventions. Travers et al. (2018) prevented co-intervention effects using effective data collection methods but may have experienced maturation effects due to the six-week period of the study. Getchell et al. (2012) reduced threats to internal validity by using a short time period for the intervention and looking at energy as an outcome, which cannot be affected by outside interventions.

Of the dance intervention studies, four were ranked as having moderate truth value (El Shemy & El-Sayed, 2018; Hildebrandt et al., 2016; Koehne et al., 2015; Mateos-Moreno & Atencia-Dona, 2013) and one was ranked high (Koch et al., 2015). All five exergaming interventions were ranked as having moderate truth value (Edwards et al., 2017; Fang et al., 2019; Getchell et al., 2012; Hilton et al., 2015; Travers et al., 2018). The meta-analysis was also rated moderate (Healy et al., 2018). The overall quality of each article, including neutrality, consistency, applicability, and truth value, can be viewed in Table 2.

Limitations

Although efforts were made to implement a thorough review of the current literature, a main limitation of this review is that it lacks a detailed

record of systematicity. While authors kept record of how many articles were found per combination of keywords, there was no record kept of how many articles were eliminated at each application of initial search criteria. Instead, authors entered all of the search criteria at once and then counted the number of articles that resulted.

The authors only reviewed 11 of the 107 potential articles identified through the literature search. Articles believed to be most appropriate for the population and inclusion criteria were selected; however, individual preferences may have contributed to selection bias. A short-allotted assessment period of 14 weeks was a significant limitation, necessarily constraining the review, and resulted in the exclusion of a significant body of less recent literature

Since the authors chose to investigate specific interventions, rather than given outcomes, drawing definitive conclusions was difficult due to the wide variety of outcomes observed across the included studies.

Conclusions

It is well within the scope of occupational therapy to address motor and social outcomes for children with ASD. According to the Occupational Therapy Practice Framework (American Occupational Therapy Association, 2020), social skills fall under the occupation of social participation, while motor skills fall under the category of performance skills. Both dance and exergaming interventions have the potential to improve such outcomes for adolescents with ASD. In choosing interventions, therapists implementing best practice should consider preferences of the person, limitations of the environment, and importance of given occupations for adolescents with ASD.

The Grading of Recommendations Assessment, Development, and Evaluation (GRADE) is a framework utilized to evaluate the quality of a body of evidence using "a common, sensible, and transparent approach" (The GRADE Working Group, 2020). This framework provides a systematic and organized way to consider the strategies used to increase the quality and efficiency overall of a study. For example, if GRADE was used to review an RCT or systematic review, clearly outlined would be what high quality strategies were used to increase the efficacy of these higher evidence level studies. (Balshem et al., 2011).

Using the GRADE, the overall quality of evidence of dance interventions was rated as "C". A grade of "C" means there is at least moderate certainty that the net benefit is small (Balshem et al., 2011).

It is the recommendation of the authors that clinicians be judicious in their application of dance interventions due to the lack of sufficient information on the demographics of the sample. There was not sufficient evidence to conclude if dance movement was likely to improve motor functioning in adolescents with ASD, because only one study examined gross motor skills (El Shemy & El-Sayed, 2018). Exergaming studies demonstrated examples of decreased reliability due to their failure to include adequate information on who conducted the study and written descriptions on how the study was conducted (Edwards et al., 2017; Getchell et al., 2012; Hilton et al., 2015; Travers et al., 2018).

These studies may be applicable to the students at Sonia Shankman Orthogenic School, given these students are of higher socioeconomic status and have high-functioning autism, which more closely matches the participants described in the

exergaming studies. However, these studies may have less applicability to adolescents with ASD of lower socioeconomic statuses, or who have more complex needs. It may be more difficult or not possible for these individuals to purchase the required gaming systems, or they may find it more challenging to follow the steps required of these interventions.

Using the GRADE, the overall assessment of exergaming intervention studies was rated a "C". Again, clinicians should be judicious in, and consider individual circumstances when implementing exergaming interventions with students. Review of exergaming studies showed moderate results for physical activity and motor skills (Fang et al., 2019; Getchell et al., 2012; Hilton et al., 2015), and enjoyment (Travers et al., 2018).

These interventions are likely to be clinically relevant for occupational therapists, as all studies reported strong interest by participants, supported through reports of qualitative measures or participant engagement.

Implications for Future Research

Based on the 11 identified articles for this review, there is an indicated need for improved research related to dance and exergame interventions. Because of the limited availability of evidence and the fact that much of the literature in this area was in a preliminary stage, there is a need for more studies in this area that are of a higher rigor. Increasing the amount of rigorous studies available would increase the confidence of occupational therapists implementing these interventions. While all aspects of rigor would benefit from more strenuous implementation, external validity was of particular importance and should be an area of increased focus in future work. To increase external validity, researchers should implement randomization of participants between groups in their work where possible. Future research should also collect more detailed participant information and include larger and more diverse samples.

More studies are needed in this area to formulate narrower conclusions specifying a target population, target outcome measures, and assessment measures that capture those outcome measures.

Specific questions to guide this research to be the most beneficial for clinicians are: What is the feasibility of implementing both DMT and exergaming interventions in a school setting where time and resources are more limited than a clinical setting? Which aspects of DMT are most effective in creating positive change for this population of adolescents with ASD? Do exergaming interventions need to be consistently delivered to maintain the motor improvements seen as a result of this intervention.

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