THE IMPACT OF ANTECEDENT PHYSICAL EXERCISES ON INCREASING ON-TASK BEHAVIORS AND DECREASING RESTRICTED AND REPETITIVE BEHAVIORS IN ELEMENTARY STUDENTS WITH HIGH FUNCTIONING AUTISM SPECTRUM DISORDER IN SAUDI ARABIA

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A Dissertation

Submitted to the School of Education

Duquesne University

In partial fulfillment of the requirements for the degree of Doctor of Philosophy

By

Shadi Albadawi

December 2022
THE IMPACT OF ANTECEDENT PHYSICAL EXERCISES ON INCREASING ON-TASK
BEHAVIORS AND DECREASING RESTRICTED AND REPETITIVE BEHAVIORS IN
ELEMENTARY STUDENTS WITH HIGH FUNCTIONING AUTISM SPECTRUM
DISORDER IN SAUDI ARABIA

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ABSTRACT

THE IMPACT OF ANTECEDENT PHYSICAL EXERCISES ON INCREASING ON-TASK BEHAVIORS AND DECREASING RESTRICTED REPETITIVE BEHAVIORS IN ELEMENTARY STUDENTS WITH HIGH FUNCTIONING AUTISM SPECTRUM DISORDER IN SAUDI ARABIA

By
Shadi Albadawi
December 2022

Dissertation supervised by Bridget Green, Ph.D. Assistant Professor

Physical exercises (PEs) is one of the most used approaches by researchers to treat restricted and repetitive behaviors (RRBs) and enhance on-task behaviors in students with high functioning Autism spectrum disorders (ASD). Although PEs is recognized as Evidence based Practices (EBPs) for students with ASD in the United States of America (USA) that are based on moderate evidence, it is important to conduct more empirical studies to explore its effectiveness on individuals with ASD from different populations in the KSA. The current study used a single subject, multiple baseline design across subjects to examine the effect of antecedent structured physical exercises (teaching soccer skills) on increasing on-task behaviors and decreasing RRBs of high functioning students with ASD in the Kingdom of Saudi Arabia (KSA). Results of this study is consistent with earlier findings that, in an elementary school setting, antecedent PEs
decreased RRBs in students with ASD. Even after the intervention had been disconnected for two weeks, the dependent variables' favorable changes remained consistent.

*Keywords:* Restricted Repetitive Behaviors, On-Task Behaviors, Autism Spectrum Disorder, Physical Exercises, Saudi Arabia.
DEDICATION

First and foremost, I would like to take this opportunity to express my gratitude to those who without whose support I could not have completed this academic research. I'd like to start by thanking my Allah for His mercy and grace. I dedicate this dissertation to my parents, whose words of support and encouragement enabled me to intellectualize my childhood dream into an academic pursuit that will eventually lead to a job. They have also significantly contributed to the development of the person I am today. I sincerely appreciate your help. I also dedicate this dissertation to my brothers and sisters in appreciation of their affection and constant support of my educational pursuits.

Additionally, I dedicate this dissertation to my lovely wife, my soulmate. Your words of support and ongoing encouragement have made sure that I put out all of my effort to achieve my final objective. For both of us, studying abroad has been tough. However, I appreciate your patience and never-ending inspiration during my academic journey. This dissertation is also dedicated to my two beautiful children, Qusai, and Yamen who were patience until I got my dissertation done. I appreciate all of your help, tolerance, and confidence in me.
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Chapter One

Introduction

Education is the critical base to develop and grow any nation through different domains, and teachers play an increasingly important role to achieve satisfying outcomes of the learning process. Students present different abilities and skills to recognize academic contents, especially students with autism spectrum disorder (ASD). Students with ASD face challenges in social and communication skills, motor development delays, and RRBs (American Psychological Association: APA, 2013). These difficulties can negatively impact their academic performance and behaviors during academic sessions. In the Kingdom of Saudi Arabia (KSA), the educational system created mainstreaming programs to enable students with high functioning ASD to receive their education within public education schools. Therefore, special and general education teachers should be prepared and well-trained to use effective strategies to facilitate the academic materials and bring the best behaviors of these students in the classroom environment (Al-mousa, 2010).

Restricted and repetitive behaviors (RRBs) have been considered one of three core characteristics of ASD (APA, 2013). They are recognized by teachers and parents as the most complicated behaviors to manage (Welsh, et al., 2019). RRBs refer to a variety of inappropriate behaviors that ranges from lower order behaviors (e.g., repetitive motor behaviors, self-injury), to higher order (e.g., insistence on sameness behaviors, rituals, restricted routine) (Boyd et al., 2009). These behaviors can be recognized by their topographical similarities across settings, unsuitability, and intensity.

Researchers have associated the engagement in RRBs with sensory defensiveness (Boyd et al., 2009). Baker et al. (2008) found the reduction in sensory processing scores may increase
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the occurrence of RRBs. High frequencies of RRBs may impact a variety of functions in individuals with ASD such as self-stimulation and emotional regulation (Boyd et al., 2009). The existence of challenging behaviors in children with ASD can also impact others relevant as parents and caregivers, who pointed out to RRBs as the most challenging behavior to manage. Therefore, parental stress and family functioning can be increased as a result of high frequency and intensity of RRBs (Welsh, et al., 2019). Additionally, scientific studies considered individuals with ASD exhibiting any form RRBs as challenging behaviors and a major barrier to learning when they may limit students’ interactions with their environments and interfere with their academic performances (Bahrami et al., 2012; Cunningham & Schreibman, 2008; Neely et al., 2015; Tiger et al., 2009). For students with ASD, active on-task behavior has been identified as a key component of effective curricula. It is really important for the learning process to be successful (Sparapani et al., 2016). According to the Centers for Disease Control and Prevention ([CDC], 2014), students with ASD should actively engage in learning activities for at least 25 hours per week. As a result, their educational performance would improve, their positive participation would increase, and their problem behaviors would decrease.

Within educational settings, special and general teachers tend to use effective instructions and skillful strategies to manage the classroom and bring the most suitable attendance of students mentally, physically, and behaviorally (Ficarra & Quinn, 2014). In terms of services for students with ASD, special educational EBPs have been designed by behaviorists and educators to enable students with ASD to reach their maximum academically and socially (e.g., positive behavioral interventions and support, positive reinforcement, antecedent based intervention) (Marder & deBettencourt, 2015). These approaches are highly used by behaviorists and educators to control
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challenging behaviors including RRBs, that may negatively impact the learning environment and obstruct on-task behaviors of students with ASD.

In order to determine the appropriateness of these interventions and identify them as EBPs, the validity of these treatments must be based on high quality of research and the measurement of students’ outcome pre-the implementations (Marder & deBettencourt, 2015). These practices are usually documented in an individual educational plan (IEP) by service providers in order to facilitate delivering the educational martials and achieve the final measurable goals of the educational process for students with ASD. According to a review study conducted by Bittner at al. (2018), the National Professional Development Center (NPDC) recently recognized physical exercise as an emerging EBPs for children with ASD.

Multiple studies have confirmed the relationships between academic performance and physical activities (Nakutin & Gutierrez, 2019; Neely et al., 2015; Nicholson et al., 2011; Powers et al., 1992). After participating in PE sessions, children presented faster and higher accuracy responses to different cognitive tasks (Ellemberg & St-Louis-Deschênes, 2010). Also, students showed better on-task behaviors and attention when they engaged in physical activities as a break from the learning session. Scientists found an acceleration between receiving additional physical education, learning academic skills, and psychomotor development (Kohl & Cook, 2013; Shepherd, 1997). The intervention has presented valuable effectiveness on a wide range of social, academic, behavioral skills (e.g., social interaction, on-task behaviors, motor proficiency) (Dillon et al., 2016; National Autism Center, 2015). Therefore, modern general schools provide access for physical activities by holding physical education classes, or organizing sport competition tournaments.
In the KSA, the Ministry of Education requires all public and private educational schools around the nation to hold physical education classes for students with ASD (Ministry of Education, 2020). During elementary education level, first, second and third graders engage in 45 minutes of physical education class three times a week (total of 135 minutes). Students in fourth, fifth and sixth grades receive only two physical education classes per a week (90 minutes) (Ministry of Education, 2020). Although physical education is mandatory for students with ASD, Aljuhani and Sanderrock (2019) found individuals with disabilities have less opportunities to meet the recommended time of physical activities.

Previous studies used specific types of aerobic exercise (e.g., jogging, running, swimming) that aimed to elevate the breath to higher than normal level (Karen et al., 1982; Neely et al., 2015; Powers et al., 1992; Rosenthal-Malek & Mitchell, 1997). Also, other studies aimed to match the form of RRBs with the natural movement of the form of PE (e.g., ball tapping, karate) (Bahrami et al., 2012; Tse et al., 2018). The goal was to provide an equivalent but alternative sensory stimulation in order to decrease RRBs and increase on-task behavior during academic sessions. The finding of these studies indicated that students presented better academic performance and positive behaviors after participating in these models of physical exercises.

The current study will aim to teach soccer skills as a new form of exercise that has never been examined. Soccer is the most popular sport in the KSA, and it is a passion for most Saudis. Soccer is an efficacious contact sport that can have an effect on conditional capacities: running, sprinting, jumping, and kicking are all critical performances that maximize the strength ability of the neuromuscular system and anaerobic capability (Alhaddad et al., 2020). In the KSA, the majority of public schools have all the needed equipment to practice soccer. That is a sign of the importance of physical activities for students. Also, that motivates all students within the general
education schools to participate in physical activities regardless of their different abilities and special needs. It prompts students with ASD to take part in soccer games within the school environment. Enabling students with ASD to practice soccer like their peers without disabilities empowers them to realize their physical potential and rights to enjoy the game (Zhao & Chen, 2018). Students without disabilities would be encouraged to accept students with ASD and understand the equal rights. That plays an increasingly important role in overcoming the social obstacles between students (Zhao & Chen, 2018). As related to IEP designers, it is important to mention the expectations of students with ASD during physical education classes, and what they can add to the class that help students reach their fullest physical potential.

**Significance of the Problem**

In the KSA, the numbers of students with ASD have increased in general public schools in recent decades. In 2015, there were 220 programs available nationwide to support individuals with ASD, with 1,464 students benefiting from these programs (Battal, 2016). In order to provide these students with high efficacy interventions, progressive steps are necessary to raise the awareness about ASD among general and special education teachers, develop high quality of special education services, provide training courses to prepare caregivers, and assess behavioral and educational treatments based on empirical researches to determine their effectiveness (Alnemary et al., 2017; Haimour & Obaidat, 2013; Sulaimani & Gut, 2019). Due to the lack of advanced special education programs in the public schools, parents prefer to enroll their children with ASD in private schools. Unfortunately, these private schools are located in the major cities (e.g., Jeddah, Dammam, Riaydh). Resource limitations in public schools are a serious obstacle that prevents individuals with ASD from participating in high quality of special education programs either in major cities and rural areas (Alnemary et al., 2017; Zain et al., 2014).
Although PEs have been proven to be an effective intervention to reduce RRBs and enhance academic performance in children with ASD (Best & Jones, 1974; Lawson & Little, 2017), students with ASD have limited access to physical activities. Recent studies have found that children and adolescents with ASD have documented delayed performance levels in motor skills and physical fitness (Lang et al., 2010; Pan, 2014; Pan et al., 2017; Tyler et al., 2014). This factor could be a barrier that limits individuals with ASD from participating in physical activities. Pan (2014) implemented an experimental study that compared motor skills and physical fitness between individuals with ASD and individuals without ASD. The researcher assessed 62 adolescent males which included 31 with ASD and 31 without ASD, ages 10-17 years old. Results of the investigation indicated that adolescents with ASD had significantly lower scores on all motor proficiency and fitness measures, except body composition, than adolescents without ASD (Pan, 2014).

Students with ASD who display RRBs may experience lower on-task behaviors and distracted learning situations during academic sessions (Sterling-Turner, et al., 2001). Previous research has shown that interventions aimed at reducing RRBs behaviors can also improve on-task. (Karen et al., 1982; Neely et al., 2015 Powers et al., 1992; Rosenthal-Malek & Mitchell, 1997). The effect of PEs was investigated in RRBs and aggression while limited studies have explored the effects of physical activity on on-task behaviors (Griffin & AFIRM Team, 2015). The current study would raise awareness about the spectacular outcomes of such practices.

The Importance of the Study

In the USA, although adapted physical education programs are regulated and standardized to be available in general public schools, the roles of physical educators in creating IEPs are still too limited. In the KSA, the Ministry of Education compels countrywide schools to
hold physical education classes as a core subject for students with ASD (Salim, 2017), but there is no available data related to the level of physical engagement and their benefits for students’ behaviors, academic performance, well-being. The broad significance of this study will evaluate EBPs for individuals with ASD and attempt to confirm and extend the validity of the previous findings in the USA, by examining antecedent PEs on students with high functioning ASD from the KSA.

To expand the previous studies and fill in the existence gaps as related to PE physical exercise interventions, the long-term effect of PEs would be measured two weeks after disconnecting intervention. The previous findings were inconsistent with long-term effects of the exercise. In some studies, the duration of the intervention effect was unknown (Neely et al., 2015; Schmitz et al., 2017; Tea et al., 2018). It would be useful to gain insight to the potential impact of longer-term PE physical exercise programs over a period of weeks or months to recognize the participants’ responses to these interventions. Most investigation to date has only assessed the effects in the period immediately following exercise from 10 to 25 minutes without measuring the maintenance of the desirable behaviors. For instance, Neely et al., (2015) investigated the duration of the positive effects for only 10 minutes following the intervention and no behavioral data was taken after the session. Also, the distinction between the severity of the ASD affecting the individuals with ASD was absent in previous studies. This disability has various degrees of severity and develops differently from person to another (Filipe et al., 2020). This study could determine the beneficial effects of PE physical exercise on decreasing RRBs and increasing on-task behaviors for participants with high functioning ASD (Schmitz et al., 2017).
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Problem Statement

There is a lack of empirical studies related to the potential benefits of PEs for students with high functioning ASD in the KSA. This research project will add to the field of ASD by examining the effectiveness of antecedent PEs based treatment on students with ASD from different demographics. This research could benefit special and general education teachers in their ability to improve the approaches provided to minimize RRBs and enhance academic outcomes as well as manage the educational environment when students engage in RRBs and disturb the atmosphere of the educational classroom.

Rationale for the Current Study

Physical education is a core subject in the educational system for all students including students with ASD in the KSA. Unfortunately, there is not enough data about the level of engagement in physical exercises during the school day in the KSA for students with ASD. Also, there is a lack of empirical studies about the effects of PEs on Saudi students with ASD. Therefore, the first rationale for selecting physical exercise intervention as a research area is to support existing research results by examining the benefit of PE intervention on students with ASD from another background. As mentioned above, some organizations and professionals requested that more studies be conducted that can provide strong evidence that physical exercise is an EBPs. Therefore, more studies are needed to emphasize the efficacy of physical exercise on decreasing challenging behavior comprising RRBs. This conclusion was based on moderate evidence. Other professionals and organizations indicated that further high-quality research was required in order for exercise to be accepted as an EBPs (Dillon et al., 2016; National Autism Center, 2015).

In the KSA, students with ASD have the right to engage in all sport activities by making
important modifications and accommodations (e.g., reducing time, using specific equipment, lowering the expectations) to facilitate their participation based on their abilities. Unfortunately, studies have shown that children with ASD have less opportunity to engage in physical exercise programs compared to their typical peers. As a result, the second rationale for selecting physical exercise intervention is to raise awareness of the importance of physical exercise among this specific group. Also, their parents or caregivers do not know about the benefits that PE brings to a diversity of skills in children with ASDs. Specialists play a considerably important role in providing access to physical exercise programs for these children and spread the advantages of engaging in such practices among their parents.

The third rationale for selecting physical exercise intervention is to increase the researcher’s knowledge about physical exercise as a treatment for ASDs in order to bring it to students with ASD in the KSA. The strategy has been studied considerably by specialists in the United States. However, little to no research has been done in the KSA. It is critical to bring this knowledge to the KSA to enhance the educational system. Raising this discussion on physical exercise strategy is beneficial and valuable to the field of special education in the KSA.

**Purpose of the Study**

Recent literature reviews have confirmed the feasibility of engaging students with ASD in physical activities prior to academic sessions. The beneficial effects reflect on a wide variety of skills and functions (e.g., on-task behavior, social skills, motor proficiency, and reducing out of seat behaviors) (Bittner et al., 2018; Dillon et al., 2016). Although students with ASD have limited access to participate in physical activities, Tyler et al., (2014) found that the level of flexibility and aerobic fitness of 17 children with ASD was similar compared to 12 typical peers.
The main purpose of this study is to assess the effectiveness of structured physical exercise intervention in decreasing RRBs and increasing on-task behavior in students with high functioning ASD in the KSA. Multiple baseline design across subjects is used by the researcher to introduce the treatment and measure the target behaviors pre-and post. Multiple baseline design across subjects is one type of single subject design, which is helpful to enhance academic services for students within schools (Cooper et al., 2007). The method is essential to recognize the effects of treatments, and the outcomes of interventions across different settings and students (Cooper et al., 2007). The study will include six students with high functioning ASD. The participants will engage in PEs sessions in the gym, and the researcher and special education teachers will observe them pre-and post-intervention during academic classes either in self-contained classrooms or resource rooms. In chapter three, multiple baseline design across subjects will be expanded, more information about how the design will be implemented, and who is eligible will be included in the study (Cooper et al., 2007).

**Research Questions**

The current study aims to answer the below questions:

- Is the antecedent PE intervention effective in decreasing RRBs in students with high functioning ASD in the KSA?
- Is the antecedent PE intervention effective in increasing on-task behaviors in students with high functioning ASD in the KSA?

**Hypothesis:** The PE intervention is effective in decreasing RRBs and enhancing on-task behaviors in students with ASD.
Overview

The purpose of this chapter is to highlight the evolution of special education services for ASD in the KSA, and the potential benefits from international experience in using PEs as treatments to enhance on-ask behaviors and reduce RRBs in students with ASD in educational settings. This chapter consists of two sections. The first part presents an overview of the general education system in the KSA, and the historical development of special education services in the KSA. It addresses the definition, prevalence, causes and etiology of ASD. Also, it presents some facts about RRBs in individuals with ASD, followed by an overview of ABA and the theoretical framework of RRBs. Another goal of this literature review is to provide a concise overview of literature that presents PE as an EBPs, the importance of physical activity, and the level of motor skills in children with ASD. The level of on-ask behaviors and executive function in students with ASD is covered. The second part of this chapter aims to present an overview of previous and recent studies that studied the influence of different types of physical activity on RRBs and on-ask behaviors in students with ASD. The review conducts the type of physical activity, intensity of physical activity sessions for each study, and the tools are used to measure intensity and participants' level of engagement.

Public Schools in the Kingdom of Saudi Arabia

Prior to establishing the KSA by King Abdul-Aziz bin Abdul Rahman Al Saud, education was only available in mosques and religious schools (Alrashidi & Phan, 2015). Reading and writing subjects were taught to students for enhancing their Islamic knowledge and reciting the holy Quran. In 1925, King Abdul-Aziz founded the Directorate of Education before uniting the
whole kingdom, and decreeing the KSA as a kingdom in 1932. This reflected his vision toward the importance of education in building nations. By 1945, the government was mandated by King Abdul-Aziz to establish nationwide schools. Unfortunately, these schools were only accessible by male students of wealthy families. Females were not able to receive education due to people’s opinions that teaching girls is useless, and some social issues (Alrashidi & Phan, 2015; Rabaah et al., 2016). They formally engaged in the educational process in 1960 with only 15 schools around the country. Currently, there are 168,971 Schools for girls exist nationwide to serve girls from different school phases (e.g., pre-schools, elementary schools, high schools, and literacy) (Ministry of Education, 2020). In fact, since the Ministry of Education was officially established in 1952, the general education system has been improving (Aldabas, 2015). The development ranged from creating education regulations to developing educational curriculums, enabling students with disabilities to receive education in inclusive settings, increasing numbers of available schools around the country, designing teachers’ preparation programs, and funding the education system (Ministry of Education, 2020).

Modern Education System in the Kingdom of Saudi Arabia

Education is recognized by the KSA’s government as a significant field to develop the country. Therefore, the government allocates a specific amount of annual budget to enhance the education services (Almannie, 2015; Alrashidi & Phan, 2015). Researchers found that education’s financial support has increased, and it is the only governmental sector that did not complain from huge funding cuts (Alrashidi & Phan, 2015). The government of the KSA invests in education organizations with more than 25% of the total budget expenditure (Almannie, 2015; Alrashidi & Phan, 2015). The sector allocations of 2021 budget has researched to 186 billion riyals (approximately 49 billion US dollars). The amount is specified to establish schools,
colleges, university cities, scholarships. Also, it aims to support innovation, research, establishment of university hospitals, and source of knowledge (Ministry of Finance, 2021).

The Ministry of Education also provides free general and high education for all Saudi citizens through all schooling phases (i.e., pre-school level, elementary school level, middle school level, high school level, and universities and colleges) (Alamery, 2011; Alquraini, 2011). In addition, the government of the KSA is also responsible to provide students with free books to general education schools, health care services, and technological resources. In higher education, Saudi students have the opportunities to enroll in local public universities or to get scholarships to do their high studies overseas. The government of the KSA pays monthly rewards to students who attend public universities as encouragement to obtain their higher education. Also, the KSA’s government highly motivates Saudi students to continue their learning by offering abroad scholarships. During abroad studies, all the expenses (i.e., tuition, health care services, educational materials, and monthly rewards) are covered by the Saudi government (Alamery, 2011; Alrashidi & Phan, 2015). Indeed, police makers in education organizations keep reforming the education system in order to sustain the education’s development.

In 2015, the Ministry of High Education and the Ministry of Education emerged with intent to enhance the learning outcomes, develop the curricula, fill the gaps, and achieve coherence and complementarity between them, the two ministries were merged into one Minister, under the name of the Ministry of Education. The new Ministry of Education is responsible to manage the educational process in five fundamental education levels: pre-school education, elementary school, middle School, high school, and university and college (Ministry of Education, 2020; Rabaah et al., 2016).
Public Education Levels

The public education system obligates students to attend schools five days a week. School days are from Sunday to Thursday for all general schooling phases while Friday and Saturday are weekends. The academic year consists of two terms, each one lasts for 18 weeks.

Preschool Education School. This stage is designed for children from three to five years old. Although the strategic plans to increase the numbers of kindergarten schools around the KSA, the ratio of enrollment in early childhood programs is still low compared to worldwide numbers, approximately 10-12% of Saudi children. In the 2013-2014 academic year, 2,559 early childhood programs served 182,556 kids (Rabaah et al., 2016).

Elementary Education School. During this stage, the educational system requires students to attend six classes a day, each of which lasts for 45 minutes. The duration of this phase is six years from age six to 12 years old. Students study various subjects including Arabic language, Islamic studies, Art education, mathematics, and science from first grade to third grade (Alrashidi & Phan, 2015). They receive additional subjects from 4th to 6th grade that are English, computer, and social studies. Continuous assessments are used to evaluate students’ progress, and students do not take examinations. The continuous assessments are based on specific standards which were created by the Ministry of Education for each subject (Alrashidi & Phan, 2015; Rabaah et al., 2016). According to the Ministry of Education, there were 2,801,881 students who attend 15,780 elementary schools for both genders, students with disabilities, and foreign students (Ministry of Education, 2016).

Middle Education School. The duration of this stage is three years from seventh grade to ninth grade. Students learn advanced levels of the same subjects that were received in elementary schools. In this level, students must pass the final examinations in order to move to
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the next grade. The assessment consists of quizzes, midterms, homework, participation and final examinations. The students are evaluated based on the information that was taught in the class and textbooks (Alrashidi, & Phan, 2015; Rabaah et al., 2016). In 2016, the total enrollment was 1,201,264 students in 9,096 middle schools including typical, with different types of disabilities, and literacy students from both genders (Ministry of Education, 2016).

High Education School. This section lasts for three years from 10th grade to 12th grade. Students have seven classes a week. After completing the first grade of high school level, students have the choice to select between two paths either scientific or art academics. It is the last phase of pre-high education (Alrashidi & Phan, 2015). The total enrollment was 1,150,758 students in 6,349 high schools including typical, with various disabilities, literacy students from both genders (Ministry of Education, 2016). The above number indicated the progress of education services through all public education levels. It also reflected the huge efforts of the government of the KSA to assure that all citizens from different age groups receive academic services.

The History of Special Education in the Kingdom of Saudi Arabia

Historically, the field of special education in the KSA was initially well known in 1958 when special scientific institutes provided education services for some students with blindness. In the KSA, we used the term of special institutes to refer to special education schools, or separate schools. The first special education program only included blind men to learn to use the Braille system (Aldabas, 2015; Battal, 2016). Prior to 1958, families with special needs and care givers were responsible to provide all education and rehabilitation services to their children (Al-Ajmi, 2006; Alquraini, 2011). In 1960, Al-Noor school was founded to deliver education and needed services for individuals with blindness (Battal, 2016). Special education services were
provided to other categories (e.g., deafness and intellectual disability) after establishing the special education program by the Ministry of Education.

The special education system has developed dramatically since it was officially established in 1962 by the Ministry of Education. Initially, there was a lack of public services for individuals with disabilities nationwide until the Ministry of Education officially established the Department of Special Learning in 1962 (Aldabas, 2015). During this time, the Department of Special Learning provided educational services and rehabilitation services for only three main categories of special needs: individuals with blindness, deafness, and intellectual disability (Alquraini, 2011). In 1964, three special institutes, or disabilities focused schools as referred to in the USA, were established to provide educational services for students with blindness in three cities: Mecca, Aneaza, and Alhafouf (Alquraini, 2011). In 1972, the Department of Special Learning took an initiative of establishing the first institutes that served students with deafness and intellectual disability in Riyadh (Battal, 2016).

The government of the KSA established nationwide special education schools that provide special education services to various categories. In 1987, the number of special education schools increased over the nation to reach up to 27 schools. According to Saudi Arabian Cultural Mission, the number went up to 54 schools in 2000. The mission of these schools is to provide necessary services for three different categories. While 28 schools serve individuals with hearing impairments, 16 schools serve individuals with intellectual disability. Only 10 schools serve individuals with blindness (Saudi Arabian Cultural Mission, 2006). During this time, special education services were provided for only these three categories of students with special needs in special schools (Battal, 2016).
In the present, the educational services became available for additional categories of children with special needs. According to the Ministry of Education (2018), there were 1,036 private and public schools providing special education services around the country for students with the following categories: intellectual disabilities, autism, communication disorder, learning disabilities, physical and multiple disabilities, deafness and blindness (Ministry of Education, 2018). In the KSA, children with disabilities can receive their education in two types of schools; special education school and regular schools (Battal, 2016). In fact, the increase of school numbers that serve students with various types of disabilities resulted from focusing the KSA’s government on mainstreaming students with different disabilities into general education settings.

**Mainstreaming Programs**

The government of the KSA provides education for all citizens including students with ASD in the least restrictive environment, which was reflected by creating mainstreaming programs in general public schools in the KSA (Al-mousa, 2010; Battal, 2016). In the KSA, the Ministry of Education defined mainstreaming as “Educating students with disabilities in regular education settings, and providing them special education services.” (The Document of Rules and Regulations for Special Education Institutes and Programs, Ministry of Education, 2002, P.8). In the KSA, the mainstreaming programs can be implemented in two ways: partial and full mainstreaming programs.

**Partial mainstreaming students.** During this form of service delivery, students with special needs attend self-contained classrooms in regular schools to receive special education services. They have the opportunity to interact with their typical peers in some curricula and non-curricular activities (Al-mousa, 2010; Battal, 2016).
**Full mainstreaming students.** To fully mainstream students with disabilities into regular schools, the schools must provide special education support programs that include resource room programs, itinerant teacher programs, and teacher consultant programs. Students with disabilities attend regular classrooms along with their typical peers without disabilities. These students are directed to attend some subjects in the resource rooms if the general education teachers are not able to teach the curriculum for them (Al-mousa, 2010; Battal, 2016).

The mainstreaming programs led to a notable increase in the number of special education services and students who benefited from such services in regular education environments. The number of students with special needs increased to 92% who obtained the education services within general education schools (Battal, 2016). For the academic year 2017-2018, the majority of 11,159 students with a wide variety of categories have the opportunities to receive their educational needs by attending resource rooms or self-contained classrooms in general education schools (Ministry of Education, 2018).

The provision of mainstreaming students with disability into the general education to maximize the accessibility to special education services in general schools. The mainstreaming programs targeted two groups of students with special needs (Battal, 2016). The first group include gifted and talented students, students with physical disability, behavioral and emotional disabilities, learning disability, communication problems, hard of hearing, and low vision. Individuals in these categories already attend regular education schools, but there is a need to provide them special education services by mainstreaming programs (Al-mousa, 2010).

The second group of categories includes students with intellectual disabilities, deaf, blind, and ASD who received their educational services in separate special schools and self-contained classes. These categories have benefited from mainstreaming programs through providing them
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with accessibility to general education schools (Al-mousa, 2010; Battal, 2016). ASD is one of the categories that is supported by mainstreaming projects to engage in general education schools.

The Ministry of Education recognized ASD as one of the disability categories that is entitled to receive special education services in regular public schools. Those who are diagnosed with ASD are eligible to benefit from mainstreaming programs providing necessary modification and accommodation to meet their needs (e.g., resource rooms, self-content classes, and lower the expectations of the curriculums) (Al-mousa, 2010). As stated above, there are 220 programs and institutes available to support individuals with ASD, with 1,464 students using these programs in 2015 (Battal, 2016). Historically, in 1993, the first private program serving individuals with ASD was established (Al-Aoufi, 2011). According to Sulaimani and Gut (2019), the first public program that served individuals with ASD was created in 2004. Individuals with disabilities do not receive the same quality of services including those with ASD regarding the education needs. In contrast, the regulations and laws in the KSA asserted the rights for all individuals with disabilities to receive the same level of appropriate services (Sulaimani & Gut, 2019).

Current Laws and Regulation of Special Education in the KSA

The government of KSA initiated the Disability Law in 2000 to assure each individual with a disability has access to a wide variety of appropriate and free services by public organizations Which includes all public schools (Alquraini, 2011). Under this regulation, all people with ASD have the right to benefit from educational, medical, rehabilitation, and psychological services which are provided through elementary schools. The law indicated the importance of delivering the necessary services in a Least Restrictive Environment, which
enables people with ASD to receive high-quality services as their typical peers, and remove all the barriers to interact in the community (Aldabas, 2015).

In 2001, the Rules and Regulations of Special Education Programs (RRSEP) were initiated by the Department of Special Education under the umbrella of the Ministry of Education. These policies were modeled and formulated based on the laws of the USA (Aldabas, 2015). The RRSEP mandated nationwide public schools to implement mainstreaming programs via providing special education services or designing resource classrooms. RRSEP stated that students with different disabilities (i.e., blindness, deafness, hearing impairment, learning disabilities, intellectual disabilities, and autism) have the right to be provided with special education services (Aldabas, 2015). Students with ASD had various abilities to perform academically like their typical peers without disabilities. Therefore, it was significant to design educational plans that meet their abilities.

The RRSEP highlighted an IEP, and specific components that should be met to achieve the final goals by the student with a disability (Aldabas, 2015; Alquraini, 2011). The RRSEP identified individuals who are eligible to participate in designing an IEP for students with special needs (e.g., school principal, general education teacher, special education teacher, parent, any other specialists who are important for the students). Under these regulations, educational services should be fulfilled based on the student's needs and the nature of their disability. Each person with ASD was qualified to receive early intervention services, transition education, and associated services based on the evaluation of the Ministry of Education. The regulations insisted on providing assessments and evaluations services to determine their needs and eligibility (Aldabas, 2015; Alquraini, 2011). Establishing sophisticated assessment tools is important to
make the right decision about students with ASD academic abilities, and to determine their strengths, weaknesses, and needed services.

Using reliable assessment tools is the key base to design an effective individualized education plan (IEP), and recognize the problem from early ages. Aldabas (2015) noted that there is a real need to design effective assessment tools to diagnose children with ASD accurately, refer them to the right placements, and determine the needed services. Furthermore, governmental sectors must collaborate to enhance the early intervention services, by providing an interdisciplinary team that consists of various specialties in occupational therapy, family training, physiological services, consultations, transportation, behavioral modification therapy, and medication therapy (Aldabas, 2015; Sulaimani & Gut, 2019). In fact, working together will result in identifying the problem from early ages and minimizing the risk of exacerbation.

**Autism Spectrum Disorder (ASD) in the Kingdom of Saudi Arabia**

In the KSA, the Ministry of Health (2015) defined ASD as a group of complex disorders that impair the development of the brain to varying degrees, children with ASD exhibit difficulties in communication, social skills, and RRBs. They are characterized with two important characteristics: delay and deviation in the growth path (Ministry of Health, 2015). Despite the tremendous progress it has made in providing services (e.g., early intervention programs and educational services), and necessary treatments for individuals and families with ASD, researchers still believe that service providers and family members encounter stressful challenges (Alnemary et al., 2017; Sulaimani & Gut, 2019).

Children with ASD in the KSA have difficulties associated with misunderstanding the provision of services for individuals with ASD, understanding causes of ASD, working with inappropriate professionals, having limited access to services and receiving best available
practices that are based on empirical outcomes (Alnemary et al., 2017; Sulaimani & Gut, 2019). Consequently, as a lack of high-quality services in public education schools, stressful parents of individuals with ASD endeavor to seek alternative solutions to meet their children's needs. Some families tend to send their children to local private schools while other families send their children abroad to meet their children's needs either to nearby Arabic countries (e.g., Egypt, Jordan, and Bahrain) or to Western countries (e.g., United States of America, and Canada) (Alnemary et al., 2017; Alquraini, 2013). The government of KSA covers the expenses of travel, educational, and residential services for some families with special needs. In Jordan, 800 Saudi individuals with various categories of disabilities including 80 individuals with ASD receive government funding (Alnemary et al., 2017). Otherwise, families are responsible to pay all the financial commitments on their own expenses.

In the USA, the definition of ASD is similar to the one that used in the KSA, it is defined as a neurodevelopmental disorder that is characterized by deficits in social interaction, social communication, with the presence of repetitive and restricted patterns of behaviors, interests, and activities that limit and impair everyday functioning (APA, 2013). This disorder consists of a large spectrum of variability, from low-functioning autism to high-functioning ASD. While low-functioning autism individuals present profound impairments and less intellectual abilities, high-functioning individuals with autism are distinguished by higher verbal and intellectual functioning (Filipe et al., 2020). The majority of individuals with high-functioning ASD (70%) are documented to have typical intelligence of an IQ of 70 or above (California Department of Developmental Services, 2019; Scheeren et al., 2013).

Children with ASD display a unique group of learning needs, which can hinder their active engagement in the educational settings (Leekam et al., 2011). Individuals with ASD have
difficulties to uphold their physiological arousal and emotions for ideal levels during academic sessions as a result of impairments in emotional regulation (Prizant et al., 2006). They present challenges in focusing on academic content and generating related information (Connor et al., 2010). In agreement, the Ministry of Education in KSA found these challenges disturbing the learning environment and hinder students’ academic progress. Therefore, self-contained classrooms or resource rooms were assigned as the best placement for students with ASD in general public school. Also, they encourage researchers to conduct empirical research to find better treatments to reduce the challenging behaviors in students with ASD during academic classes (Ministry of Education, 2020).

**Prevalence of ASD in the Kingdom of Saudi Arabia (KSA)**

In the KSA, researchers agreed that there are inaccurate figures about the prevalence of ASD among Saudi citizens due to the underdiagnosed children, lack of assessment tools, a lack of awareness about ASD, and lack of scientific studies (Alnemary et al., 2017; Sulaimani & Gut, 2019; Zeina et al., 2014). In fact, the majority of the advanced studies have been conducted in the western countries while little known studies have been done in the KSA (Alnemary et al., 2017; Sulaimani & Gut, 2019; Zeina et al., 2014). Therefore, many cases of ASD have not been identified which limits their access to engage in available special education services. Zeina et al. (2014) reported that practitioners are not able to determine the symptoms of ASD. As a result, a lot of students with high functioning autism are not being diagnosed.

Al-Zahrani (2013) aimed to find the prevalence of ASD among 22,950 students aged from seven to 12 in Taif city. The finding indicated that the overall prevalence of autism in this sample was 0.035%. In the academic year of 2015, special education services were available for 1,464 students with ASD who benefited from those programs (Battal, 2016). Additionally,
according to Salhia et al. (2014), an ASD prevalence ranging from 1.4 to 29 per 10,000 persons in Arab Gulf countries including Oman, Bahrein, UAE, and the KSA. The investigation indicated that approximately 28.6% of Saudi patients presented with developmental delays associated with ASD (Salhia et al., 2014). Since there is a lack of reliable data identifying the prevalence of ASD in the KSA, the USA prevalence of ASD is reviewed.

The World Health Organization (2016) indicated that the number of individuals with ASD has markedly increased in recent decades. According to the latest data and statistics of CDC and Autism and Developmental Disabilities Monitoring (ADDM), approximately 1 in 54 children diagnosed with ASD by 8 years of age (Maenner et al., 2020). In 2000, the number was only 1 in 150 children diagnosed with autism. ASD affected approximately 1 in 68 children in the United States in 2012 for 6-17 years old (CDC, 2014; Guest et al., 2017). The percentage rose to 23% from 2012 (1 in 68) to 2014 (1 in 45) (Özerk, 2016). The National Health Interview Survey (NHIS)-5 echoed the prevalence rate stating that was 2.47% among US children and adolescents between 2014–2016 (Xu et al., 2018).

In the USA, the prevalence estimates of ASD significantly differed by gender, ethnic group, and across network sites in 14 states. Males are diagnosed more frequently with ASD than females, with a ratio of 4:1 respectively (Guest et al., 2017; Maenner et al., 2020). According to CDC (2014), one in 42 males recognized as having ASD compared to one in 189 females (CDC, 2014). Also, one in 54 males were identified as diagnosed with ASDs while one in 252 girls were identified as ASDs. Males presented significantly higher numbers (p < 0.01) of ASD compared to females with ASDs in all 14 ADDM sites across 14 states (Baio, 2012).

The prevalence of ASDs varies by race and ethnicity groups. The figures among non-Hispanic white children (12.0 per 1,000) were significantly higher than that among non-
Hispanic black children (10.2 per 1,000) and Hispanic children (7.9 per 1,000). It was found that the ASD prevalence among Hispanic children was the lowest compared to non-Hispanic black children in five states, and to non-Hispanic white children in nine states. The numbers of ASDs among Hispanic children were the highest in one site (Florida) compared to other racial groups. Only in New Jersey, the estimate of ASD prevalence was approximately the same among non-Hispanic white children, non-Hispanic black children, and Hispanic children (Baio, 2012).

Prevalence rates are associated with the definition and the changes of diagnostic criteria which were created based on scientific research to identify individuals with ASD (Ramsey et al., 2016). Although there is an international agreement about the diagnostic criteria of ASD, some other factors may influence their diagnosis that are related to cultural differences, the age of detecting the problem, parental response to the situation, and available treatments to respond to the problem in early ages (Zeina et al., 2014). The diagnostic criterion for ASD has revised more than five times in the past 55 years (Ramsey et al., 2016). According to the current criteria from the Diagnostic Statistical Manual of Mental Disorders (DSM-V) of the APA (APA, 2013) defines two behavioral domains in individuals with ASD, that are social communication deficits and RRBs (Masi et al., 2017; APA, 2013).

There are three areas of difficulty under social communication deficits to diagnose the disorder including continual deficits in social communication and social interaction across numerous situations (Masi et al., 2017). The individual is considered at risk of having ASD, if he or she shows clear symptoms as related to social communication and social interaction. For example, deficits in social-emotional reciprocity including difficulty of having back-and-forth conversation and inability to interact socially with others. Also, the failure to communicate verbally and nonverbally, inability to understand facial expression and gestures, and
irregularities in eye contact and body language. Another area of difficulty is to present struggles in making friendships, understanding relationships, and adjusting behavior to fit different social circumstances (Masi et al., 2017; APA, 2013).

Within the area of RRBs, which are heterogeneous characteristics that refer to a wide range of stereotyped motor, language, cognitive and behavioral challenges (e.g., body rocking, playing with objects, vocal phrases not related to the situation) (Leekam et al., 2011). DSM-V made a number of changes in classification and organization of the target behaviors in individuals with ASD. The latest version described four principles under the area of RRBs: (1) Stereotyped or repetitive motor movements, use of objects, or speech; (2) Insistence on sameness, inflexible adherence to routines, or ritualized patterns of verbal or nonverbal behavior; (3) Highly restricted, fixated interests that are abnormal in intensity or focus; (4) Hyper- or-hyperactivity to sensory input or unusual interest in sensory aspects of the environment (Masi et al., 2017; APA, 2013). In the previous criteria from the Diagnostic Statistical Manual of Mental Disorders (DSM-IV), presenting only one single example of RRBs is enough for individuals to meet diagnostic criteria of ASD or formally referred to as Asperger's disorders. However, DSM-V requires individuals with ASD to present at least two of the above principles in order to fulfill the diagnosis of ASD. Sensory perception, negative reactions, and sensory seeking (e.g., smelling things, specific sounds) has been included in DSM-V as part of the official criteria. These sensory related behaviors have been found to be highly reported in individuals with ASD and influence individuals’ self-advocacy. Therefore, they are identified as the fourth subarea of RRBs in DSM-V (Lord & Bishop, 2015).
Etiology of ASD

In the KSA, there is a long way to go related to researching the contributing factors in the etiologies of ASD. Almana et al. (2017) pointed out that ASD is not well known among Saudis, they might hear about the concept, but disseminated the facts about its definition, organic causes, and prevalence is one of the Saudi community needs. While some contributing factors are still uninvestigated, researchers studied the possible relationships between some effective factors and ASD such as pregnancy complications, parental age, possible relationships between ASD and engineering training of parents (Sulaimani & Gut, 2019; Zeina et al., 2014).

Although the causes of ASD are still under investigation worldwide, scholars believe that a combination of genetic and environmental factors may cause ASD. Chaste and Leboyer (2012) conducted a meta-analysis that highlighted key findings which indicated that ASD is a complex disorder resulting from genetic and environmental factors. Efforts have been made by geneticists to increase the knowledge about the genetic causes of ASD, which indicate that ASD traits are highly heritable. Research has found that when one sibling has ASD, siblings are 2-8% more likely to have a developmental disability. Further, parents who have one child with ASD, increase the chance of having another child with ASD by 12%-20% (Chaste & Loboyer, 2012).

While there is correlation with genetics and ASD (Chaste & Leboyer, 2012), there is discussion on the impact of environmental factors and ASD. In terms of the environmental risk factors, there is indirect evidence for a contribution of environmental factors such as immune dysfunction, transcriptome. Also, researchers mentioned direct evidence of environmental factors in causing ASD including prenatal risk factors, parental age, maternal physical health, maternal mental health, familial socioeconomic status, natal risk factors (Chaste & Leboyer, 2012; Karimi et al., 2017).
Parental and perinatal factors may increase the risk of ASD. In a meta-analysis, Gardener et al. (2009) found that pregnancy related factors presented with important risk symptoms such as maternal gestational diabetes, maternal bleeding during pregnancy and maternal medication were mentioned as pregnancy related factors. Also, post-term pregnancy (>42 weeks), and preterm pregnancy (<35 weeks), are linked with an increased risk of autism (Karimi et al., 2017). Also, there was association between revelation to intrauterine infections and increased risk of autism (Chaste & Leboyer, 2012; Gardener et al., 2009). Another significant risk factor of autism is advanced paternal age. The study indicated that parents are at high risk to increase risk of autism in their offspring if their maternal and paternal ages are greater or equivalent to 34 years old.

A number of perinatal risk factors were identified as symptoms of an underlying cause the risk of autism such as umbilical-cord complications, fetal distress, birth injury, multiple birth, maternal hemorrhage, low birth weight, meconium aspiration, or neonatal anemia (Chaste & Leboyer, 2012; Karimi et al., 2017). Karimi et al. (2017) studied fetal complications including fetal distress, umbilical-cord complications such as fetal nuchal cord and cesarean delivery increased the risk of autism (26%).

Drug exposure during pregnancy was found to potentially contribute to an important proportion of ASD risk (Chaste & Leboyer, 2012; Gardener et al., 2009). As a result of using a variety of maternal medication during pregnancy, it is difficult to indicate what types of medications are associated with ASD. However, some studies found that the use of psychiatric medication increased the risk of autism at 68%. Also, the use of psychoactive drugs may result in a higher chance of being diagnosed with ASD at 60 % (Gardener et al., 2009).
Comorbidity in ASD

Comorbidities among individualists with ASD are common, which may be chronic and hindering including intellectual disabilities, physical conditions, and cowbird psychopathologies (Matson & Goldin, 2013). Individuals with ASD may display additional complicated characteristics and symptoms when comorbidities associated with medical and mental health (Masi et al., 2017). Medical comorbidities considerably overrepresented in individuals with ASD (i.e., seizures, sleep difficulties, gastrointestinal disorders, mitochondrial dysfunction, and immune system abnormalities). Kohane et al. (2012) found 14,000 individuals with ASD from four hospitals in the Boston area were diagnosed with comorbidities. Researchers measured the prevalence of ASD based on these comorbidities. The numbers indicated that 19.4% of the population have epilepsy, bowel disorders 11.7%, diabetes mellitus 8%, sleep disorders 1.1%, inflammatory bowel disease 0.8%, or autoimmune disorders at 0.7%. The statistic also presented the prevalence of genetic disorders of Fragile X Syndrome, Tuberous Sclerosis and Down Syndrome in individuals with ASD prevalence of 0.5%, 0.8%, 0.9% respectively (Kohane et al., 2012). Also, the number shows a lot of children with ASD who have sleep disturbances (Goldman et al., 2011). The research mentioned that 50% to 80% of children with ASD experience sleep disturbance. Ko et al. (2016) indicated that 11% to 39% of individuals with ASD also present epilepsy, and these individuals are more likely to exhibit social difficulties than children only with ASD (Ko et al., 2016).

Individuals with ASD may present mental health comorbidities (e.g., anxiety, depression, attention deficit/ hyperactivity disorder (ADHD) and intellectual disability (ID) (Masi et al., 2017). Kohane et al. (2012) found that schizophrenia was found to have prevalence of 2.4% with ASD diagnosis. Moreover, 42% of individuals have ASD and a rate of ADHD (Stevens et
Additionally, the population with ASD presented comorbidity of ADHD and ID 17%, hence the total comorbidity rate of ADHD and ASD was 59% (Stevens et al., 2016).

Comorbidities in individuals with ASD occur in varying proportions. They differ from core symptoms of ASD like social and communication impairments and RRBs.

**Restricted and Repetitive Behaviors (RRBs) in Children with ASD**

Researchers found that exhibiting any type of RRBs can negatively influence the quality of life in different aspects such as learning process, social skills, and social communication (Bahrami et al., 2012; Lin & Koegel, 2018). RRBs are major diagnostic criteria of ASD (DSM-V, 2013). They are heterogeneous symptoms that refer to a wide range of stereotyped movements, language, cognitive and behavioral symptoms (Leekam et al., 2011). DSM-V (2013) classified RRBs into four subtypes: restricted interests, nonfunctional routines or rituals, repetitive behaviors, and preoccupation with parts of objects (Leekam et al., 2011). According to the diagnostic of the Autism Diagnostic Interview revised (ADI-R), the main features of RRBs were categorized into at least two classifications that are lower order and higher order behaviors. ADI-R is an evaluation tool that interviews parents to observe the historical and current development of different functions and skills in students with ASD (e.g., social skills, communication, and behavioral skills (Magaña & Vanegas, 2017). Magaña and Vanegas (2017) found it an appropriate tool to identify DSM-V based ASD. Whereas lower order behaviors refer to the occurrence of motor actions, which is featured by movement and repetition such as repetitive forms of self-injuries, stereotyped movements, higher order behaviors refer to ritualistic behaviors affect cognitive functions, which is featured by a rigid adherence such as insistence on sameness, rituals and routine, and compulsion (Kästel et al., 2020; Rutter et al., 2003).

Although higher order RRBs can motivate individuals with ASD to participate in the
learning process and certain contexts effectively, they also can impact different functions of people with ASD. It is considered normal, healthy, and common among typical developing children to prefer specific routines and interests and can shift between preferred activities and interests. However, children with ASD exhibit emotional and behavioral problems when it comes to shifting between restricted activities and interests. Also, exhibiting restricted interests impact children’s interactions with their families and their self-directed learning (Lin & Koegel, 2018). South et al. (2005) indicated that families had challenging times when their children engage in repetitive conversations regarding restricted interests and present challenging behaviors to shift between activities.

One category of RRBs is stereotyped behaviors that are identified by patterns of abnormal repetitive movements, and with no clear functions of their occurrences (Akers et al., 2020). These types of RRBs are identified as lower level repetitive behaviors (Leekam et al., 2011). However, the inappropriate behaviors can occur in different levels of severity from mild to severe. The form of these behaviors differs considerably based on the environmental factors across context, setting, and time. Also, RRBs may be increased by different reinforcement contingencies such as automatic reinforcement or self-stimulation, social reinforcement, and tangible reinforcement (Bahrami et al., 2012; Cunningham & Schreibman, 2008; Lovaas et al., 1987; Rincover, 1978).

Akers et al. (2020) conducted important figures and percentages regarding each form of RRBs among 157 participants. While hand or finger movements recorded the highest topography, which was presented by 57% (n=90) of the sample, sensory stereotypes were exhibited by 31% (n=49) of the participants. Object use stereotype was presented at 33% (n=52), engagement in body racking was displayed by 24% (n=38), mouthed objects or body parts
observed in 15% (n=24) of the participants, jumping was displayed by 13% (n=21), 10% (n=17) showed head nodding. The review also indicated that half of participants presented more than one topography and engaging in motor and vocal stereotypes was exhibited by 36% of the participants (Akers et al., 2020).

A number of studies considered exhibiting any kind of RRBs as challenging behaviors when it interfered with educational activities, hindered a student’s on-task behaviors and progress, and associated with self-injury (Bahrami et al., 2012; Gorman-Smith & Matson, 1985; Neely et al., 2015). Additionally, Tiger et al. (2009) emphasized that the tendency of simple motor movements (e.g., body rocking, facial posturing, hand flapping), repetitive vocalization (repeating sounds), ritualistic behaviors (e.g., shouting all doors, lining up objects) is an issue. These behaviors are often linked with other problems in children with ASD. ASD is often associated with deficits in children’s social skills, self-injurious behavior, occurrence of mood and behavior problems, significant impairments in imaginative activities, substantial impairments in adaptive skills, increased stress in family, delay in response to stimuli, and sleep problems (Bahrami et al., 2012). Goodwin et al. (2011) mentioned that engaging in RRBs can be stigmatized in some communities and result in social isolation. Also, engaging in inappropriate behaviors for long periods of time may limit their repertoire to participate in beneficial activities.

Researchers have associated the engagement in RRBs with sensory defensiveness (Boyd et al., 2009). Baker et al. (2008) found the reduction in sensory processing scores may increase the occurrence of RRBs. High frequencies of RRBs may impact a variety of functions in individuals with ASD such as self-stimulation and emotional regulation (Boyd et al., 2009). This significant impact can also be exposed to relevant others as parents and caregivers, who pointed out to RRBs as the most challenging behavior to manage. Therefore, parental stress and family
functioning can be increased as a result of high frequency and intensity of RRBs (Welsh, et al., 2019). Parents of children with ASD seek any available treatments and services that may result in enhancing their children's behaviors and personality through all life aspects.

*Available Services for Individuals with ASD in KSA*

Although special education services are available in the KSA, huge steps are needed to develop them and make them more accessible in non-major cities. Public and private education agencies offer a variety of special education services for children with ASD and their families (Alnemary et al., 2017; Sulaimani & Gut, 2019). However, providing effective services remains a major challenge for policy makers, service providers, and families. These challenges with the delivery of services were briefed in delayed diagnosis, untrained service providers, limited resources and treatments based on scientific research, limited knowledge of child's disability, family factors, and limited accessibility to public services (Alnemary et al., 2017; Sulaimani & Gut, 2019). In the KSA, ASD is a new research area. Recently, public universities just established graduate programs in the special education field. Also, the first governmental program for students with ASD was established in 2004 (Sulaimani & Gut, 2019). That requires researchers to conduct empirical studies in order to ensure the high validity of educational social interventions for those diagnosed with ASD in the KSA (Alnemary et al., 2017; Sulaimani & Gut, 2019). These studies can also expose existing barristers that limit their accessibility to available services.

Alnemary et al. (2017) highlighted some family factors that obstacle the engagement in services and treatments for their children with ASD (e.g., geographical locations, income, level of education, and family composition). In the 2017 study, Alnemry and others aimed to find out other factors that influenced the use of ASD services. The survey study included a total of 205
parents of children with ASD. The findings indicated that 3.3 years was the mean age of children when they received early intervention services. Authors recommended reform RRSEP to clarify the appropriate age to receive these critical services (Alnemary et al., 2017).

Also, recent studies presented that most children obtained services in private sectors on their family's expenses, although the governmental public schools and health care centers offer free services nationwide. Families referred the reasons to unqualified staff who might not recognize the symptoms of high functioning autism (Zeina et al., 2014). Also, the unavailability of distinguished designed tools that might result in inaccurate placements, which do not meet their abilities and needs. services for children with ASD are not at the same level around the country. Public schools in non-major cities and major cities have limited resources that prevent individuals with ASD from participating in high quality special education programs. Indeed, well-organized private centers are only located in the major cities (e.g., Jeddah, Riyadh, Dammam). As a result, families of children with ASD move to these cities to enroll their children in the private centers, and secure them with the best available treatments (Zeina et al., 2014).

In the KSA, private centers consider using EBPs to meet their students' needs and maximize their academic, social, and behavioral expectations. These approaches facilitate educators’ and students’ tasks in the classroom environments such as treatment and education of autistic and related communication (TEACCH), Early Intensive Behavioral Intervention (EIBI), Hawaii Early Learning Profile (HELP), Psycho educational Profile (PEP-3), Picture exchange communication System (PECS), and Applied Behavior Analysis (ABA). A number of empirical studies have shown the effectiveness of using these strategies on enhancing a wide range of daily life skills (e.g., adaptive behavior, social skills, communication adaptive skills, and intellectual...
ability) (Zeina et al., 2014). In the KSA, individuals with ASD receive special education services in either public or private schools. There is a disparity in the quality of services based on the school type and its location. Also, there is a lack of empirical studies that examined the effectiveness of used approaches on children with ASD from the KSA (Zeina et al., 2014). These practices are considerably used and investigated in USA public schools to ensure better services for those diagnosed with ASD.

**Available Treatments and Services for ASD in USA**

The accurate etiology of ASDs and the efficacy of diverse treatments are still under investigation (Gabriels et al., 2012). Consequently, parents and caregivers of children with ASDs tend to try various types of available treatments in order to relieve the symptoms, even those treatments that do not have a strong evidence base. There is no intensive research about their feasibility in alleviating the symptoms related to ASD. These kinds of interventions may cost families a lot of money without providing any improvements to their child’s performance (Gabriels et al., 2012). Although many complementary alternative medical approaches have no adequate rigorous research conducted to examine their feasibility, approximately 30 to 74% of parents use these approaches with their child with ASD (Fleury et al., 2019). Consequently, some of these pseudoscientific treatment methods may be harmful, and result in preventing or delaying individuals with ASD from receiving more valuable evidence-based interventions, which might enhance different functions in individuals with ASD (Fleury et al., 2019).

Alateeqi and Janjua (2019) mentioned that educational, developmental, and behavioral practices are the ideal primary treatments to decrease core needs in individuals with ASD and enhance their cognitive functions, independence, social skills, daily living skills, and decrease challenging behaviors. However, there is a clear shortage of available interventions to treat the
major symptoms linked with ASDs. Social impairments and RRBs in individuals with ASD still need strong medical and behavioral practices to reduce their existence. Along with these major characteristics, treatments for comorbid mental and medical conditions in individuals with ASD must be found. There are significant efforts to find new medical treatments for autism (Yatawara et al., 2016). Medical interventions were provided to treat children with ASDs while there is insufficient evidence to support the advantage of most treatments (McPheeters et al., 2011).

McPheeters et al. (2011) conducted a systematic review aimed to analyze evidence regarding medical interventions for children with ASD. The review included all experimental studies that examined the effects of medical treatments on at least 30 children with ASDs. Participants were not older than 13 years old. Researchers found 18 articles that investigated medical treatments for challenging behaviors. They found nine studies that focused on antipsychotic medications, five studies that explored serotonin reuptake inhibitor medication, and four studies measured stimulant medications. The finding supported the feasibility of using risperidone and aripiprazole to treat challenging and repetitive behaviors in children with ASDs. They are antipsychotic medications that affect the performance of dopamine and serotonin systems. The researchers recommended conducting more studies to support the strength of existing medical treatments. Although risperidone and aripiprazole have presented benefits for challenging behaviors, they cannot be provided for children with severe impairments (McPheeters et al., 2011).

Yatawara et al., (2016) investigated the effects of Oxytocin nasal spray treatment on social skills in young children with ASDs. The study included 31 children with autism who received 12 international units of Oxytocin and placebo nasal spray twice a day for five weeks.
The children were between three and eight years of age. The finding of the study has shown significant improvement on social interactions in children with autism. The study was the first clinical trial to examine the potential effect of oxytocin on social skills of children with autism in ear ages (Yatawara et al., 2016). Scientists in the medical field have examined the potential effect of other types of medications on ASD challenging behaviors (e.g., risperidone, suramin, valproic acid).

It is important to recognize the achievement regarding what has been done in the medical field for individuals with ASD. Therefore, Thom and McDougle (2020) reviewed the immune modulatory effects of Food and Drug Administration (FDA) approved treatments and other emerging medical interventions for ASD including metabolic disease, infectious disease, gastroenterology, and regenerative medicine. Different types of medications were evaluated in the field of medicine such as pioglitazone as adjunct to risperidone, suramin, valproic acid, N-acetylcysteine, omega-3 fatty acids, vitamin D, and celecoxib to support risperidone. All these medications have potential to be immune modulatory. The review indicated that further investigations are needed to strengthen the evidence, and clear the efficacy and safety of immune modulatory treatments. The treatments are still experimental, and have not been officially recommended to be used (Thom & McDougle, 2020). Since there is a lack of research regarding pharmacological interventions, researchers began to explore alternative treatments including behavioral, educational, and developmental treatments (Alateeqi & Janjua, 2019). It is important to acknowledge that medical treatments are not cure, they can only help with comorbid needs.

In a 2019 review, Alateeqi and Janjua indicated some educational, developmental, and behavioral interventions that are evidence-based practices that are based on empirical outcomes.
Developmental interventions (i.e., early start Denver model, language and communication skills intervention, and pictures exchange communication system) that are systematic methods aimed to improve children’s self-awareness and emotional development. They are recommended to solve the major deficits of ASD based on students’ interests to enhance their cognitive skills and social interaction (Alateeqi & Janjua, 2019).

Additionally, educational interventions that are used in the classrooms to enhance communication, social interaction and academic achievements. For example, TEACCH is a systematic approach that focuses on children’s strength as well as their cognitive abilities. TEACCH is a recommended approach to enhance social skills by encouraging engaging in social activities. Language and communication skills interventions are evidence-based practices that are effective to enhance communication in children with ASD such as alternative augmentative communication, picture exchange communication system, video modeling, and social stories (Alateeqi & Janjua, 2019). Moreover, Behavioral treatments (e.g., Applied Behavior Analysis, Early Intensive Behavioral Intervention, Discrete Trial Training, and Parent-Mediated Intervention) aim to reduce challenging behaviors, support families and teach social skills (Alateeqi & Janjua, 2019). Applied Behavior Analysis (ABA) is one of the most distinguished theoretical and conceptual foundations for the behavioral treatment field (Skinner, 1975).

**Applied Behavior Analysis (ABA)**

ABA is a scientific approach to change particular targeted behaviors, derived by specific procedures based on established principles of behavior and learning (Cooper et al., 2007). The approach applied systemically to develop socially important behaviors and determine the responsible variables of behavior occurrence and nonoccurrence (Cooper et al., 2007; Kearney, 2015). Baer et al. (1968) defined the critical and essential components of ABA in seven key
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dimensions: applied, behavioral, analytical, technological, based on a conceptual system, effective, and addressing generality of behavior. The goal of ABA is to ameliorate the targeted behavior that is significant for someone in his or her daily life. In ABA, specialists use a large number of observations of the intervention programs, and collect data procedures in order to measure the behaviors pre-and post-intervention (Cooper et al., 2007; Kearney, 2015).

Purpose of ABA

Bailey (2000) found the science of ABA as the best available physiological tactic that brings many benefits for our citizens, teachers, parents, and government leaders. Cooper et al., (2007) stated the primary goal of ABA as “a technology for improving socially significant behavior; functional relations between socially significant behavior and controlling variables” (p. 21). The purpose of ABA is to understand and make an improvement in the important behaviors and describe the factors responsible for changing in the behavior (Cooper et al., 2007). The strategy can be applied in a variety of settings and with people with different abilities and for enhancing different aspects of social, learning skills. ABA works to improve social and learning skills of individuals with and without disabilities, gifted students. It is effective for workforce adjustment, physical activity habits, and productivity. It is highly used to enhance the life of people with ASD (Meadan et al., 2016).

According to Kearney (2015), ABA consists of three important characteristics that facilitate the understanding of ABA. First, the applied means that the behaviors that need to be changed must have real-life applications for the participants. The practitioner must choose a behavior that is socially significant for individuals. Second, the behavior part means that the targeted behaviors have to be observable and measurable. Also, the practitioner must select a behavior that needs to be improved as well as using a reliable measurement. The behavior meant
any type of actions that could be measured such as walking, crying, reaching, and pointing. The last critical characteristic of ABA is the clarification of objective data that is collected by using scientific procedures. The researcher must observe the occurrence and nonoccurrence of the behavior. That will help us recognize the effect and the result of the interventions on the targeted behavior. That’s where the analysis part comes in (Cooper et al., 2007; Kearney, 2015).

**ABA and ASD**

There is a historical relationship between the science of ABA and the field of ASD (Matson et al., 2012). According to Ghezzi (2010), the first study of behavior research and treatment aimed to examine the efficacy of operant condition procedures of a child with ASD. Wolf et al. (1963) initially presented the effectiveness of operant strategy and founded the trail treatment that was widely known by the general public. In today’s world, ABA still considers the best available method for treating core symptoms of ASD and other challenging behaviors. The recent studies found that young individuals with ASD respond better to the treatments of ABA when compared to older participants. Therefore, it is highly recommended to provide early intervention services in order to prevent exacerbating the problem for people with ASD (Matson et al., 2012).

The EBPs are considerably associated with the applied behavior analytic concepts (e.g., prompting, reinforcement, response cost procedures, modeling). Also, some practices that have been consistently combined into a package of positive behavior intervention, are associated with EBPs (e.g., functional assessment, antecedent intervention, extinction) (Butler et al., 2020; Cooper et al., 2007; Fleury et al., 2019; Matson et al., 2012). Practitioners and researchers are encouraged and supported by national organizations to conduct systematic reviews on specific techniques to find out their effectiveness on a variety of needs for individuals with ASD (Fleury
et al., 2019). In a recent literature review, Akers et al. (2020) found that antecedent based interventions are the most used behavioral approach to decrease stereotypic behaviors in children with ASD. Researchers reviewed 126 experiments including 157 participants that demonstrated motor stereotypy. The finding indicated 59% (n=93) participants received antecedent interventions which was the highest compared to other EBPs (Akers et al., 2020).

Theory of Antecedent, Behavior, and Consequences (ABC). The three-term of contingency relationship of antecedent, behavior, and consequences theory (ABC) is applied to determine the relation between the environment and behavior (A= antecedent, B= behavior, C= consequences). When we use behavioral approaches, it is very important to pay close attention to the main behavior that we aim to change along with other factors that may affect the occurrence of the behavior (Kearney, 2015). Also, it is essential to recognize the environmental context where the targeted behavior occurs. The benefit of ABC is to highlight the factors that affect the occurrence of the challenging behavior. There are two types of environmental events or stimuli that happen precede and follow the occurrence of the behavior. The events that occur prior to the behavior is called antecedent while the events that happen after the occurrence of the behavior are called consequences (Cooper et al., 2007; Meadan et al., 2016).

Researchers in the field of ABA have examined a variety of antecedent interventions to find their efficacy on decreasing RRBs in individuals with ASD. The main idea of antecedent stimulation is to evaluate the occurrence of the problem behavior after altering the environment. The changing of the precede environment may cause reduction in undesirable behaviors (Cooper et al., 2007; Rapp & Vollmer, 2005). Akers et al. (2020) reviewed 126 experimental studies that aimed to reduce RRBs (motor movements) using antecedent interventions, reinforcement-based interventions, punishment interventions, or a combination of interventions. The finding of the
study indicated that antecedent interventions were commonly evaluated at 48% (n= 60) while punishment interventions was reported the second prevalence with 15% (n= 16). Only 11%( n = 14) of 126 experimental studies evaluated the effects of reinforcement based interventions. a combination of treatments was experimentally evaluated at 23 % (n=29). Altering the environment during session was the most commonly used type of antecedent interventions, whereas a differential reinforcement of other behaviors (DRO) was the most common type of reinforcement-based interventions. Response blocking was the most common type of punishment interventions (Akers et al., 2020).

**Automatic Reinforcement.** Scholars in the field of behavior emphasized the importance of considering the theoretical operant nature of stereotypy when practitioners design behavioral treatments for this undesirable behavior (Bahrami et al., 2012; Tse et al., 2018). According to the theory of operant nature of stereotypy, individuals with ASD exhibit stereotypic motor behavior in order to satisfy internal sensory needs that are learned and supported by reinforcement contingencies (Berkson, 1983; Lovaas et al., 1987). It is essential to provide an equivalent but alternative sensory stimulation according to the functional response class to which behaviors belong and the assumption of automatic reinforcement. The functional response will tell why the behavior is maintained (Berkson 1983; Cunningham & Schreibman, 2008; Lovaas et al.,1987).

Some studies found that there is a relationship between stereotypy motor movements and engaging in physical activities, which have similar movements. These studies agreed that practiced behavior that matched with the biomechanics of stereotypy may result in reducing repetitive behaviors for example, students who present with hand flapping or hand movements can participate in Karate or basketball to satisfy their internal desire (Bahrami et al., 2012; Tse et al., 2018; Watters & Watters,1980).
PEs as a Motivating Operation (MO). In this hypothesis, an antecedent event can alter an individual’s stimulus to present a specific behavior. The antecedent exercise is an intervention, which might affect the desire of individuals to engage in targeted behaviors after disconnecting the intervention. MOs consists of two subcategories; abolishing operations (AOs) and establishing operations (EOs). While the AO is an antecedent event that aims to decrease an individual’s motivation to engage in specific behaviors, the EO is an antecedent event that aims to increase an individual’s motivation to participate in specific behaviors (Cooper et al., 2007; Lang et al., 2010; Laraway et al., 2003).

In concert with the fatigue hypothesis, physical activity may result in fatigue that causes the decrease of self-stimulatory and stereotypic behaviors and increases appropriate behaviors and academic performance. There was an argument that desired behaviors and on-task behaviors should have decreased as well, if the disruptive behaviors went down as a result of fatigue post physical activity. The fatigue hypothesis has been denied because of the conflict results (Nicholson et al., 2011; Rosenthal-Malek & Mitchell, 1997).

Physical activities for children with ASDs

CDC (2014) has established policy, recommendations, initiatives, conducting research in order to emphasize the importance of engaging physical activity in the public health system. For instance, establishing a public health facility for physical activity was highly recommended by CDC that provides training, funding, and nutrition and obesity prevention programs. Later in 2006, CDC organization supported the foundation of a national society of physical activity practitioners in public health. The association of CDC and the prevention research center at the University of Carolina founded research and practice training programs for physical activity that
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is well known globally. The collaboration resulted in creating the standards for physical activities (Brown et al., 2002; Pratt et al., 2009).

According to CDC (2016), it is recommended for typical children and adolescents between 6 and 17 years to participate in moderate to vigorous physical activity for at least 60 minutes per day on at least 3 days a week. Scientists highly recommend engaging children with ASD in aerobic physical activities for 25 minutes a day everyday (CDC, 2016). It is important to consider the intensity of aerobic exercises. Vigorous aerobic exercise lasts for 20 minutes or more (Bittner et al., 2018). In the KSA, although the positive effectiveness of physical activities has been revealed in different aspects of students' daily life especially in school settings. Aljuhani and Sanderrock (2019) found that middle school students do not receive the recommended time of physical activity. The number showed that 111 of inactive and unfit school students spent 22% of physical education class engaging in moderate to vigorous physical activity. The result documented that physical education classes resulted in meeting 40% of their physical activity needs. The percentage went down to 22% during days without physical education classes (Aljuhani & Sanderrock, 2019). Indeed, even individuals with disabilities have less opportunities to meet the recommended time of physical activities.

Previous studies showed varied findings in terms of levels of physical fitness levels in children with ASD (Thomas et al., 2019). Jones et al. (2017) conducted a systematic review of 35 studies of children with ASD between zero and 18 years. The researchers reported that the participants with ASD engaged in approximately 86 minutes of moderate to vigorous physical activity per a day (Jones et al., 2017), while their typical peers participated in approximately 135 minutes of moderate to vigorous intensity physical activity per a day (Strutz et al., 2018).
A number of studies have indicated that individuals with ASD have less opportunities to participate in physical activity programs (Lang et al., 2010; Menear & Neumeier, 2015). Due to this, individuals with ASD are more likely to be overweight, and inactive than their typical peers. Some factors and obstacles such as social deficits, emotional disorders, behavioral problems and motor abilities may prevent students with ASD from engaging in the recommended physical activity levels (Lang et al., 2010; Menear & Neumeier, 2015).

Numerous studies have found possible barriers that might face students with disabilities to engage in physical education classes effectively (Alhumaid et al., 2021; Samalot-Rivera & Lieberman, 2017). These challenges are represented in the lack of service provider preparation, knowledge, experience, and low self-efficacy to include students in general physical education programming. That might cause inability to accommodate and modify the physical education classes to meet individuals with disabilities’ needs (Alhumaid et al., 2021). Samalot-Rivera and Lieberman (2017) indicated that physical educators are not involved in developing IEP considerably. Therefore, the quality of physical education programming will be affected as the plans do not fit students’ abilities. Physical education teacher felt marginalized and left out of the IEP process. The researchers recommended enhancing the roles of physical educators in planning and designing IEP, by conducting better communication, and enhancing their knowledge about adapted physical education (Samalot-Rivera & Lieberman, 2017).

Physical activities bring huge benefits for health and well-being. Engaging in regular physical activities play an increasingly major role in preventing chronic disease and health promotion. Aerobic exercise is the most common kind of PEs examined to prove the beneficial effects of such practices on decreasing stereotypical and self-stimulatory children with ASD. Aerobic exercises are defined as physical activities that increase breathing and heart rate such as
walking, swimming, jogging, running, or cycling (Bittner et al., 2018). In 1974, Best and Jones initially used PEs as a treatment of children with ASD. They founded a movement of using exercise to enhance the quality of life of children with ASD. The results of integrating four children with ASD in swimming sessions presented positive effects on aquatic skills and social interaction learning (Best & Jones, 1974).

Researchers examining aerobic exercise in students with ASD have found that the strategy can treat comorbidity and other challenging behaviors in children with ASD. The findings presented beneficial effects on decreasing aggression (Allison et al., 1991), off task behavior (Powers et al., 1992), sleep problems (Brand et al., 2015), and RRBs in students with ASD (Toscano et al., 2018). The outcomes also conducted improvement in motor skill proficiency (Pan et al., 2017), improvement in emotion regulation and reduction in behavioral problems (Andy, 2020), improvement in attention and cognitive function (Anderson-Hanley et al., 2011), and social impairments and communication (Bittner et al., 2018; Menear & Neumeier, 2015; Zhao & Chen, 2018).

In addition, researchers have elaborated the differential effects of the level of intensity and length of aerobic exercise sessions on this undesirable behavior. Also, these different effects were found depending on both these variables (Kern et al., 1984; Levinson & Reid, 1993; Schmitz et al., 2017). Also, some other studies compared the efficacy of aerobic exercise as a treatment to various treatments in terms of decreasing RRBs (Losinski et al., 2017; Watters & Watters, 1980). In fact, a new research area has emerged that aims to find out the effect of PEs on enhancing various aspects in people with disabilities including on-task behaviors and performance in students with ASD. Previous findings point out to the relation between the
reduction in RRBs and bringing higher levels of academic performance during educational sessions (Nakutin & Gutierrez, 2019).

**On-task behaviors and Students with ASD**

In the USA general education settings, the definition of active engagement is students’ abilities to show their best observable behaviors in order to respond to the tasks and activities in classrooms (Pointz et al., 2009; Sparapani et al., 2016). Students display high active engagements if they can attend, respond, complete tasks, and follow classroom instructions effectively. The researchers consider active engagement as a significant element for academic achievement. They also indicated that there is a relation between presenting greater active engagement and high-quality educator-student interactions (Pointz et al., 2009; Sparapani et al., 2016).

Active on-task behaviors has been recognized as a core factor of effective curriculum for students with ASD. It plays a considerably significant role in the success of the learning process (Sparapani et al., 2016). According to CDC (2014), it is highly recommended for students with ASD to actively engage in learning activities at least 25 hours weekly. That would result in enhancing their educational outcomes, increasing their positive participation, and reducing problem behaviors.

In a 2016 study, Sparapani and other colleges investigated the classroom measure of active engagement (CMAE) for 196 students with ASD within classroom activities. The study included students with ASD from kindergarten through second grade. The CMAE included a 5-factor model: emotional regulation, classroom participation, social connectedness, initiating communication, and flexibility. The researchers developed and implemented the CMAE and used it along with Classroom Secrets Interventions to measure the change in active engagement.
The findings indicated a lack of active engagement among early elementary students in the classroom activities. Also, all 5-factor models were found to have an effect on the level of on-task behaviors (Sparpani et al., 2016). Based on that, it is important to bring out the best in students with ASD by making sure the learning environment is accommodated and appropriate for the students. That would be possible if teachers use appropriate approaches that meet their needs.

Many studies have examined the effects of different interventions to decrease off-task behaviors in classroom settings (Carnett et al., 2014; Kolbenschlag & Wunderlich, 2019; Macdonald et al., 2018). Macdonald et al. (2018) investigated the use of visual schedules and work systems to help students with ASD to stay on-task and work independently in mainstream settings. The study included three students in the 5th grade and one student in the 3rd grade. Researchers implemented a multiple-baseline, single-case design across participants. On-task behavior was measured during writing activities. The result found a positive effect of visual schedules and work systems on increasing on-task behavior. The finding supported previous studies that examined the strategy (Macdonald et al., 2018). However, it was important to conduct studies that measure the feasibility of APA strategies on enhancing on-task behaviors in students with ASD.

Token economy was one reinforcement technique that is highly applied by behaviorists to control students' behaviors in school settings (Cooper et al., 2007). Carnett et al. (2014) used an alternative treatment design to compare between the perseverative interest-based token economy and only tokens without the perseverative interest. A seven-year-old boy with autism was included in the study. The result indicated that the perseverative interest-based tokens had better effects on on-task behaviors (Carnett et al., 2014). Moreover, another strategy that was widely...
used as a behavior intervention to record the presence and the absence of on-task behavior in students with ASD is self-monitoring strategy (Cooper et al., 2007).

Self-monitoring could bring better outcomes when it is combined with programmed reinforcement contingency. Kolbenschlag and Wunderlich (2019) examined the feasibility of self-monitoring including reinforcement contingency for recording occurrences to measure on-task behaviors. The outcomes indicated that two of three presented an increase in on-task behavior during the intervention phase while the third student needed more reinforcement contingency to initiate on-task behaviors (Kolbenschlag & Wunderlich, 2019). Indeed, researchers pay critical attention to the impairment in executive functions that might affect human cognition and achievement. They found that executive functions are associated with controlling important processes for managing thoughts and behaviors (Doebel, 2020).

**Executive Functions in Children with ASD**

Executive function was defined as a set of related component processes responsible for direct thoughts and actions in typical people (Andy, 2020; Doebel, 2020; Zhang et al., 2020). Executive function processes played a pivotal role in the way that the brain communicates with itself that include, shifting, inhibition, updating the working memory by adding or deleting the constant, and switching between tasks at the same time (Andy, 2020; Doebel, 2020; Zhang et al., 2020). Cirino and Willcutt (2017) reviewed seven articles aimed to measure the relation between executive function and word reading, reading comprehension, writing, and math. The measurement of the review was based on a wide sample of participants from childhood to adulthood. Also, participants were different demographically. The findings highlighted executive functions are associated with academic skills (Cirino & Willcutt, 2017). Students with ASD displayed difficulties and impairments in executive functions compared to typical peers.
As related to individuals with high functioning ASD, they presented deficits and impairments in executive function. Some studies considered the deficits in executive function as a clinical mark of ASD (Andy, 2020; Zhang et al., 2020). In a 2020 study, Filipe et al. found that as a result of deficits in executive functions, children with high-functioning ASD have difficulties in cognitive and language skills that affect their literacy and academic performance. The goal of the study was to explore the relation between the executive functions and pragmatic skills and compare the findings with typically developing peers. Researchers indicated that the deficit in pragmatic language is associated with the impairments in executive functions. The finding was based on the score of a programmatic language assessment protocol and comparing the results with their typical peers (Filipe et al., 2020).

In a similar study, Yeung and Chan (2020) aimed to investigate executive cognitive, motivational, and emotional functions and the potential effect of language delay on these variables in ASD. The experimental study included twenty-two adolescents with high functioning ASD and twenty-two typical peers. Researchers indicated that 10 participants with ASD and early language impairment showed deficits in executive cognitive, motivational, and emotion-recognition functioning compared to the control group. Also, the participants with ASD and lower early language impairment had lower functioning than 12 participants with ASD and without language impairments (Yeung & Chan, 2020).

Anderson-Hanley et al. (2011) identified a theory of repetitive behaviors in individuals with ASD as a symptom of executive dysfunction. Researchers studied the link between performance in executive function examination and the presence of RRBs. The outcomes indicated that the occurrence of RRBs is associated with a propensity to perseverate. Some studies supported the theory of repetitive behaviors as an experience of dysfunction in executive
function in children with ASD which prevents students from producing, planning, and managing behaviors in the typical manner (Lopez et al., 2005; Turner, 1999).

Physical activity could enhance cognitive function in students with ASD. Researchers indicated that higher physical activity levels in children linked with increased hippocampal and areas of the brain that are responsible for problem solving, attention, and focus (Menear & Neumeier, 2015). Ellemberg and St-louis-Deschênes (2010) investigated the effect of acute aerobic exercise on cognitive function during development. The study included 36 Children aged seven and 10-year-olds. The participants were divided into two groups, 18 children participated in the experimental group (30 minutes of cycling) and 18 children participated in the control group (40 minutes of watching TV). The cognition was measured by using simple reactions and choice response time tasks. The findings of the study indicated that response time for the simple and choices tasks were improved after aerobic exercise sessions (Ellemberg & St-Louis-Deschênes, 2010).

Andy (2020) examined the impact of physical activity on executive functions in a total of 40 children with ASD. The participants were randomly assigned in two groups that physical activity treatment and a control group to measure inhibition control and working memory. Participants in the intervention group showed a clear improvement in working memory capacity compared to the coronal group. However, no noticeable improvement in working memory capacity was reported for both groups (Andy, 2019). Pan et al., (2017) examined the effects of a 12-week physical activity intervention on executive function of 22 boys with ASD aged between 6 to 12 years participated in the study. The study included 11 children who engaged in physical activity intervention (tennis table), whereas the control group included 11 boys did not. Physical activity sessions last for 70 minutes for 24 sessions. The outcome of the study found
improvements in executive function in children with ASD after 12 weeks of physical activity training (Pan et al., 2017). It is clear that there is a relationship between executive function processes and academic skills. That might be the possible reason behind showing better on-task behaviors after PEs sessions in previous studies. It is important to review previous studies that aimed to use PEs to enhance on-task behaviors and reduce RRBs in students with ASD. Therefore, additional research can be conducted to fill the gaps and enrich the field of ASD.

Methodology

A number of studies investigated the effectiveness of antecedent PEs on decreasing RRBs and increasing on-task behaviors in students with ASD. These studies evaluated the outcomes of different intensity of physical activity and different types of PEs (Bahrami et al., 2012; Elliott et al., 1994; Levinson et al., 1993; Tse et al., 2018). The conclusion of the studies confirmed the efficiency of the anteceding treatment on decreasing stereotypies and other challenging behaviors. However, the findings were not consistent. While the majority of the antecedent aerobic exercise studies found that vagarious PEs physical exercise has better effect on RRBs (Elliott, 1994; Kern et al., 1984; Levinson et al., 1993), another recent study found mild and short aerobic exercise has a better effect (Schmitz et al., 2017). Also, few studies measured the long-term effect of the intervention of reducing the target behaviors (Bahrami et al., 2012). Only specific types of aerobic exercises have been examined to explore students’ behaviors post interventions such as running, walking, swimming, and jumping.

Empirical studies have been conducted in the field of ASD to strengthen the evidence about the effectiveness of PEs to treat RRBs and enhance on-task behaviors in children with ASD. Therefore, this review of the literature concentrated on PEs as an independent variable. Increasing on-task behaviors during class activities and decreasing RRBs were measured as a
dependent variable. The initial search included only English language articles that were published from April 1980 to April 2020. The research conducted an initial search of the literature using the electronic database Educational Resources Information Center (ERIC), APA psycinfo, Gala academic onefile, sportDiscus with fall text, and academic search elite. The search included a combination of relative key words (physical exercise, activity, aerobic exercise, on-task behaviors, on-task, autism, stereotypic behaviors, self-stimulatory behavior, and repetitive and restricted behaviors). The researcher used the truncation facility * to confirm that the review comprised all possible endings to the used terms. The researcher conducted a title and abstract review on the potential articles in order to ensure studies met inclusion criteria. The references of excluded articles were investigated for further potential studies. The initial search of the review identified a total of 67 PE based treatment studies including students with ASD aged 5-16 years. After screening out the titles and abstract, investigators eliminated 55 studies because they failed to meet the inclusion criteria. Only 14 peer reviewed articles met the inclusion criteria. Also, 6 additional articles found in the references of the excluded articles. The review includes 12 peer reviewed studies that investigated the effectiveness of different types of PEs on decreasing RRBs in individuals with ASD. Also, the review found only five articles that studied the feasibility of physical activity on on-task behaviors.

**Inclusion criteria**

The purpose of this review is to analyze the articles that meet the following inclusion criteria: (a) including peer-reviewed articles, (b) using an experimental single subject design, (c) including school-age participants who have been diagnosed with ASD, (d) and written in English, (e) using PEs (aerobic exercise) as the independent variable (IV), (f) including RRBs and on-task behaviors as the dependent variables (DV). The studies were excluded if they did not
meet the specified criteria.

**Empirical Literature Related of the Current Studies**

*The Effects of Physical Exercises on RRBs*

Previous studies have examined the effectiveness of antecedent PEs on decreasing RRBs and increasing on-task behaviors in students with ASD. In those studies, researchers used different forms of aerobic exercises (e.g., walking, jogging, swimming, cycling, ball playing, roller skating, martial arts, jumping, and treadmill). These forms of PEs were evaluated based on different intensity of physical activity (mild, and vigorous) and different measurement tools. Also, previous studies targeted different characteristics of RRBs (e.g., hand flapping, body rocking, and screaming). PEs were compared with other preconditions and therapies for children with ASD (e.g., regular academic work, deep pressure therapies, and TV watching). These studies would be reviewed below to extend our knowledge to what has been done in this area so far.

The majority of the empirical studies investigated the efficacy of walking and jogging form of PEs based on its intensity (Kern et al., 1984; Levinson et al., 1993; Prupas & Reid, 2001) or comparing to other preconditions (Mlek et al., 1997; Watters & Watters, 1980). Watters and Watters (1980) examined three antecedent interventions (e.g., jogging sessions, TV watching, and regular academic work) on five boys with ASD while Mlek et al. (1997) examined the effects of two preconditions: jogging exercise and academic sessions. The overall participants in these studies were 10 who presented RRBs (configuring fingers, hand flapping, biting hands, rocking back, and forth). It was found that PEs treatment was more effective compared to TV watching and regular academic work interventions. Participants in the study showed less self-
stimulatory behavior after periods of PE and a decrease of 32.7% of stereotypical behaviors as well as higher on-task behaviors (Mlek et., 1997; Watters & Watters, 1980).

There was some concern about the fatigue effect on the results of the treatment. Researchers found the amount of time and the level of intensity required in order to have a positive result is an issue (Mlek et al., 1997). These studies did not examine the effect of vigorous exercise. Therefore, there was a concern about the results of vigorous exercise because the level of exercise intensity was mild in the study. An overlap between the exercise and the stereotypical behaviors was observed. The PE of jogging involved leg, arm, and some torso movement which was similar to the repetitive behavior (Mlek et al., 1997; Watters & Watters, 1980).

Moreover, a number of studies investigated the effects of antecedent jogging sessions on reducing RRBs with consideration to measuring the intensity of jogging sessions by engaging students with ASD in mild jogging sessions and intensive jogging sessions (Kern et al., 1984; Levinson et al., 1993; Prupas & Reid, 2001). The goal was to find what form of intensity (mild v. intensity) presents favorable outcomes. Levinson et al. (1993) compared between the mild exercise involved 15 minutes of walking and the vigorous exercise involved 15 minutes of jogging. Participants were presented with various types of challenging behaviors such as gazing at hands, body rocking, finger flexing, biting hands, laughing, and screaming. The study consisted of two males and one female aged 11 years old. The results of the study found that the vigorous exercise treatment was most efficient in decreasing the target behavior immediately after receiving treatment (Levinson et al., 1993). Unfortunately, intervention effects were no longer evident 1-1/2 hours following the jogging treatment, as the participants’ levels of stereotypic behaviors returned to or exceeded their pre-exercise frequencies. The mean reduction
in stereotypic behaviors between pre-jogging and post-jogging was 17.5%. Researchers agreed with Berkson (1983) who indicated that providing alternative activity that has the same sensory input helps to reduce the stereotypic behaviors of an individual (Levinson et al., 1993).

Prupas and Reid (2001) examined the influence of exercise frequency on RRBs (repetitive vocalizations and echolalia, hand flapping, head weaving, body rocking, and finger and hand movements.) by implementing two exercise treatments differentiated by frequency. While the single frequency exercise treatment involved a 10-minute walk/jog per a day, the multiple frequency treatment consisted of three 10-minute walk/jog sessions daily with the participants’ maximum heart rate (HR) of 65 to 70% measured through a pedometer. All the participants were diagnosed with ASD ranging in age from five to nine years old and participated in the study. Researchers used a HR monitor to assess the intensity of exercise.

In agreement with previous findings, Prupas and Reid (2001) found the results indicated that while participants revealed a mean decrease of 51.6% in the single frequency condition, they demonstrated a mean reduction of 58.9 % post multiple frequency condition. Although both treatments showed positive results, multiple frequency condition treatments were more effective because the reduction lasted throughout the day. However, the single frequency condition effect was short-lived (Prupas & Reid, 2001).

Elliot et al. (1994) and Kern et al. (1984) compared the effectiveness of vigorous exercise versus mild exercise on RRBs by examining two different types of antecedent PEs. in the 1984 study, Vigorous jogging and mild ball playing were used as independent variables to measure their efficacy on decreasing the target behaviors. The two experimental conditions were applied (jogging or ball playing) for a total length of 15 minutes and followed by 90 minutes of data recording. (Kern et al., 1984). While Elliott et al. (1994) used mild motor training (choose
between riding a bike and treadmill moving) to elevate heart rates to levels between 90 and 120 beats per minute, antecedent vigorous, aerobic exercise (treadmill moving including jogging and walking) aimed to elevate heart rates to levels above 130 beats per minute. Each condition lasted for 20 minutes. According to the results of the studies, researchers found out that 15 minutes of continuous and vigorous exercise presented more reduction in RRBs compared to engaging in 15 minutes of mild exercise (Kern et al., 1984). The results of the study matched the previous finding that the vigorous exercise treatment was most efficient in decreasing the target behavior immediately after receiving treatment (Kern et al., 1984; Levinson et al., 1993). It indicated that vigorous antecedent aerobic exercise considerably decreased inappropriate behaviors in the controlled setting while general motor training activities did not. Post aerobic exercise, over 57% of the stereotypic behaviors showed improvement (Elliott et al., 1994).

A study conducted by Losinski et al. (2017), compared two forms of Deep Pressure Therapies (DPT) (weighted blanket and compression vest) and antecedent exercise (Ride a bike) on the stereotypical and attending behaviors of students with ASD. Riding a bike was compared with a weighted blanket and the use of compression vests, which were found to be the most used interventions in classrooms for these students. Three students diagnosed with ASD ranging in ages from seven to nine years old were included in the study. All three participants exhibited stereotypic behaviors in the classrooms such as hand flapping, echolalia, yelling, and grunting. Researchers used an alternating treatment design to determine the effect of three different independent variables (weighted blanket, a compression vest, and an antecedent exercise) on the stereotypical behaviors. The participants rode an exercise bike for 10 minutes prior to the academic session. This study was completed over a period of four weeks. The findings of the study supported the findings from previous literature on the lack of effectiveness of Deep
Pressure Therapies (Losinski & Ennis, 2016). As related to the effectiveness of antecedent exercise on stereotypical behaviors, there were mixed results. Two cases showed positive effects on stereotypical behaviors while one showed no effects. During the exercise condition, there was no effort made to determine the exact effort (e.g., heart rate, and corresponding physiological measures) during the exercise condition (Losinski et al., 2017).

In a recent study, Schmitz et al. (2017) determined the acute effect of exercise and examined the influence of duration and intensity on the frequency of stereotypical behaviors in children with ASD. In the study, children with ASD participated in continuous aerobic exercise including cycling and treadmill. Aerobic exercise sessions were accomplished at a low (L) or high (H) intensity for either 10- or 20-minutes. Exact effort was determined by measuring heart rate. Researchers concluded that a reduction in stereotypical behaviors in response to exercise was observed.

Contrary to previous studies, Schmitz et al. (2017) also found that the use of short, low-moderate intensity exercise was more effective in decreasing stereotypical behaviors in this population with ASD. In contrast, previous studies concluded that high PE intensity brings more beneficial effects at decreasing stereotypy than exercise with mild intensity. The authors’ conclusion was based on the shortage of standardized criteria to measure exercise intensity in previous investigations. It was recommended to use acceptable and quantifiable measurement tools. However, the study had some limitations which must be considered. There was a lack of distinction between the severity of the disorder affecting the individual with ASD and the intensity of the exercise provided. The severity of the disorder in the participants was not mentioned. Therefore, it is essential to explore this distinction between the benefits of the exercises and the level of severity of autism in future research. A potential limitation was the
requirement of participants to use multiple forms of exercise. It would be better to allow a degree of self-selection in the specific aerobic modality (Schmitz et al., 2017). Also, it was important to examine the effects of different types of aerobic exercises on students with ASD such as swimming. Pan (2010) and Yilmaz et al. (2004) explored the feasibility of swimming in reducing RRBs in students with ASD.

Yilmaz et al. (2004) examined the effects of water exercises and swimming on motor performance and physical fitness. The study included only one participant who was 9-years-old and diagnosed with ASD. The programs lasted for 10 weeks. Researchers used a 45-minutes video camera recording to measure the duration of stereotypical autistic movements before and after the hydro-therapy sessions. Results of the study indicated that the level of development in physical fitness and water orientation increased considerably following hydro-therapy. Following the 10 weeks swimming training program, the child demonstrated improvement in balance, speed, hand grip, and lower and upper muscle strength. The amount of RRBs (i.e., spinning, rocking, and delayed echolalia) was reduced after swimming for a total of six minutes over 45 minutes of swimming training. The measurements were collected 45 minutes pre-and post-intervention for the three stereotypical movements. For pre-intervention, the participant presented with swinging, spinning, and delayed echolalia for seven, two, and four minutes respectively. In post-intervention, the engagement time reduced to five, zero, and two minutes respectively. It was highly recommended to further investigate the effects of swimming training on physical fitness in children with ASD using more subjects (Yilmaz et al., 2004).

In a similar study, Pan (2010) conducted the effectiveness of a 10-week water exercise swimming program on the aquatic skills and social behaviors of children with ASD. Sixteen boys with ASD ranging in age from six to nine years old participated in a within-participant
repeated-measures design. The results were similar to those of the study conducted by Yilmaz et al. (2004) which related to the duration of RRBs (i.e., spinning, rocking, and delayed echolalia). Following swimming training, undesirable behaviors were reduced significantly as well as the balance, speed, hand grip, and lower and upper muscle strength improved (Pan, 2010).

Additionally, Tse et al. (2018), and Bahrami et al. (2012) conducted studies that explored the underlying mechanism of the theoretical operant nature of RRBs. In their studies, they used various PEs that matched the biomechanics of stereotypy in order to decrease inappropriate behaviors. While Tse et al. (2018) were the first investigators who explored the differential effects of PEs (ball-tapping-exercise intervention) on different stereotypical behaviors (hand-flapping and body-rocking), Bahrami et al. (2012) used Kata techniques which are an integral part of martial arts practices as an exercise.

Tse et al. (2018) applied a crossover design to examine the differential influences of a PE treatment on diverse RRBs in children with ASD. The study included 22 males and 8 females, participants were between 9 and 12 years of age, who exhibited hand-flapping and body-rocking stereotypes to participate in both control (story-time) and experimental (ball-tapping-exercise intervention) conditions. Researchers used the design to test the hypothesis that a ball-tapping exercise that required similar biomechanics as repetitive-hand-flapping behavior would be more effective at decreasing this behavior than decreasing repetitive body-rocking behavior. All participants engaged in both the control and experimental conditions. In the control condition, participants were seated side by side, and the research assistant read a story to them out loud. The findings showed that while the frequency of hand-flapping that matched the movement of exercise (ball-tapping) significantly decreased, body rocking following the ball-tapping-exercise
intervention stayed at the same level. Researchers associated the results to the theoretical operant stereotype that consider stereotyped motor behavior as sensory consequence to satisfy internal sensory needs in individuals with ASD (Lovaas et al., 1987; Tsa et al., 2018).

Bahrami et al. (2012) aimed to determine whether teaching Kata techniques to children with ASD for a longer period of time leads to a substantial improvement in RRBs. The Kata of karate are rational arrangements of blocking, punching, sticking, and kicking skills in an arranged sequence. A total of 30 children with ASD (26 males and 4 females) participated in the research. Their ages ranged from five to 16 years old. An experimental design was employed that assigned participants equally into an exercise group using Kata (n=15) and control group (n=15). Researchers used the Gilliam Autism Rating Scale-Second Edition (GARS-2) to measure changes in participants’ stereotypy severity. Researchers administered a stereotype subscale of GARS-2 pre-intervention and post-intervention. The study included a maintenance phase which included interviewing the children’s parents, caregivers, and teachers and direct observation (Bahrami et al., 2012). According to the results, the participants of the exercise group exhibited a considerable decrease in stereotypic behavior following receiving Kata-based treatment. Stereotypy decreased from baseline levels by a mean of 42.54% across participants. Results also showed that after 30 days of no practice, stereotypy in the exercise group remained significantly decreased compared to pre-intervention time (Bahrami et al., 2012). The findings agreed with a number of studies which revealed that practiced behavior that matched with the biomechanics of stereotypy may result in decreasing inappropriate behaviors (Bahrami et al., 2012; Tse et al., 2018; Watters & Watters, 1980). Obviously, some studies have found that the reduction in RRBs may result in elevating the abilities to stay on-task and bringing appropriate behaviors during educational sessions. The below empirical studies highlighted the effects of PEs on on-task
behaviors.

_The Effect of Physical Exercises on On-task behaviors_

When students with ASD stay focused on the academic materials that can elevate the benefits of the learning session and accelerate the achievement of the academic goals. During academic sessions, decreasing on-task behaviors and distracting learning environments could result of children with ASD who present disruptive or off-task behavior (Sterling-Turner, et al., 2001). Previous studies indicated that treatments prepared to decrease maladaptive behaviors may also result in developments in on-task behaviors (Karen et al., 1982; Neely et al., 2015; Powers et al., 1992; Rosenthal-Malek & Mitchell, 1997). The effect of PEs was investigated in RRBs and aggression while limited studies have explored the effects of physical activity on on-task behaviors (Griffin & AFIRM Team, 2015). Only five studies have examined the feasibility of physical activity on on-task behaviors that met the inclusion criteria for the review (Nakutin & Gutierrez, 2019; Neely et al., 2015; Nicholson et al., 2011; Powers et al., 1992).

Powers et al. (1992) evaluated the effects of engaging in antecedent roller skating on the self-stimulatory and on-task behavior of an 8-year-old male diagnosed with ASD. Researchers used a withdrawal design to validate a functional relationship between antecedent exercise and subsequent decrease in undesirable behaviors and parallel increase in appropriate behavior. During the study, he exhibited self-stimulation that was defined as any nonfunctional object manipulations. For this subject, this self-stimulation involved swinging objects between his thumb and index finger. The researchers concluded that although the treatment resulted in a significant decrease in the undesirable behavior as well as a dramatic increase in on-task performance, future research should consider additional points (Powers et al., 1992).
Nicholson et al. (2011) conducted the first study that aimed to examine the effects of antecedent physical activity on on-task behaviors. The study included four elementary-school children diagnosed with ASD using a single-subject, multiple baseline study across participants was implemented in the study. Physical activity consisted of 12 minutes of jogging. After the jogging sessions were complete, the students were observed during academic sessions in the classroom. The overall result of this study indicated that the percentages of observed on-task behaviors for students increased. Researchers used Behavioral Observation of Students in Schools (BOSS) to measure on-task or active engagement time during academic behavior such as writing, reading aloud, answering questions, raising one’s hand. Also, passive engaged time was measured, which includes different behavior such as reading silently, and looking at the teacher during instruction. The finding also revealed that on-task behaviors correlated with level of participation in physical activity. For instance, the participants who kept jogging for longer periods presented a higher percentage of on-task behaviors in the classroom (Nicholson et al., 2011).

Neely et al. (2015) evaluated the effects of PEs conducted prior to instructional sessions (antecedent physical exercise) on on-task behaviors and motor stereotypy during instructional sessions for two children diagnosed with ASD. The operational definition of on-task behaviors was looking at the task and instructor, verbally responding to questions or appropriately responding to directives. It was the first study to use behavioral indicators of satiation in determining the amount of antecedent PEs to provide for each participant. Researchers used a single subject design to evaluate on-task behaviors and stereotypic behaviors following three sequenced conditions (a) no antecedent exercise, (b) brief durations of antecedent exercise, or (c) antecedent exercise that continued until the subjects determined behavioral indicator of satiation.
The two participants jumped on a trampoline until their individual behavioral indicator of satiation had occurred three times. Results of this study indicated a significant reduction in stereotypic behaviors and improvement in on-task behaviors was observed for both participants following PE sessions. They also supported previous study results about prior PE as a beneficial treatment for this challenging behavior (Neely et al., 2015).

In a recent study conducted by Nakutin and Gutierrez (2019), a multiple-baseline design across participants was used to examine the effects of physical activity as a school-based intervention on academic engaged time. The study included three students who have ASD. Jogging intervention used as the form of physical activity. The jogging duration lasted for 12 minutes. The overall result indicated that the percentage of active engaged time across all participants was increased. BOSS was used to measure on-task behaviors. Also, the online go/no-go in order to measure executive functioning in the participants. Exercise was found to have a large, immediate effect on improvement of on-task behaviors (Nakutin, & Gutierrez, 2019). The above studies have investigated the feasibility of PEs on decreeing challenging behaviors and enhancing on-task behaviors in students with ASD.

**Chapter Summary and Literature Gap**

This chapter has highlighted a comprehensive literature review on antecedent physical exercises as an antecedent based intervention, and their impact on decreeing RRBs and enhancing on-task behaviors in students with ASD. Results from reviewing 14 studies have concluded that antecedent aerobic exercises can decrease RRBs in students with ASD. Other five studies have shown PEs as an effective treatment for enhancing on-task behaviors. However, there is inconsistency regarding other forms of PEs, the duration effect of treatment on the target behaviors, and the severity of ASD in the participants.
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In the current study, the researcher will examine a new form of PEs (teaching soccer skills) to help explore which type of PEs has the most potential to effectively decrease the RRBs associated with ASD and enhance on-task behaviors. The duration of PEs will be 20 minutes for individuals with ASD (Bittner et al., 2018). Only subjects with high functioning ASD will be included in the study. Determining the characteristics of ASD in participants who will respond positively to PEs treatment will bring beneficial results to the field. One approach in this area is to explore whether the level of severity will result in different responses to the treatments. The examination of how long the effects of exercise intervention on the behavioral change will be conducted in the current study. The duration of the treatment effects could result in significant implications for practice as a short duration of effect could restrict the validity and feasibility of this intervention. Also, the duration of the effect of exercise on on-task behaviors has not been determined.

To date, this is the first study that aims to examine the feasibility of PEs on reducing RRBs and increasing on-task behaviors in students with high functioning ASD in the KSA. The Ministry of Education invests in enhancing the available treatments for students with ASD by encouraging research centers and postgraduate students to conduct empirical research. Although PEs is recognized as EBPs for students with ASD, conducting more empirical studies about its effectiveness is still recommended. In fact, there is a paucity of research around ASD, on-task behaviors, and physical exercise specifically in the KSA.
Chapter Three
Methodology

Overview

This chapter aimed to highlight the scientific methodology used in this study. It described the research design, followed by information about the participants and a description of the settings in which the study was conducted. This chapter covered the following important components in order to answer the research questions: independent variables, dependent variables, procedures, materials, preference assessment, inter-observer agreement (IOA), treatment integrity, and the method of analysis of results. Also, social validity of the study was measured by providing a checklist to special education and physical education teachers. To the researcher’s knowledge, this was the first study of its type in the KSA that aimed to examine the effectiveness of antecedent PEs on decreasing RRBs and enhancing AE in students with high functioning ASD. It was also the first study that examines the efficacy of a new type of PEs (soccer skills) on the target behaviors. This study aimed to answer the following research questions:

- Is the antecedent PE intervention effective in decreasing RRBs in students with high functioning ASD in the KSA?
- Is the antecedent PE intervention effective in increasing on-task behaviors in students with high functioning ASD in the KSA?

Participants

The single subject multiple baseline across subjects is an appropriate approach that focuses on 10 participants or fewer involving repeated measurements over time (Graham et al., 2012). All eligible participants met the inclusion criteria. There were several criteria for
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including participants in this study: (1) students were diagnosed with high functioning ASD officially based on DSM-5; (2) Students were able to participate in physical education classes, that means participants have physical and motor abilities to practice sports without any negative health consequences; (3) Students showed cognitive abilities to follow the directions by screening previous assessments (e.g., students’ movements between classes, and recess place, and student’s ability to take turns during lunch time); (4) Student exhibited any form of RRBs (e.g., body rocking, hand flapping, playing with objects), the target behaviors were specified after talking with parents, and special education teachers, and getting the permission to conduct the study. The target behavior for each participant operationally defined down in the dependent variables section. (5) Participants live with their parents or guardians. PE sessions held at the beginning of the school day to prevent interfering with any other factors.

Students were excluded from this study if the students present severe behavior and health issues. This was determined by reviewing their medical history. Health comorbidities were significantly overrepresented in people with ASD such as seizures, sleep difficulties, gastrointestinal disorders, mitochondrial dysfunction (Masi et al., 2017). These health problems might limit their abilities to participate in physical, therapeutic, and academic programs (Bauman, 2010).

The targeted participants were three students with high functioning ASD, whose names are Ahmad (male aged six years old); Khalid (male, aged seven years old); Mohammad (male, aged seven years old). They are attending 1st grade at Manar Altafwaq elementary school in Jeddah city. The researcher selected a different name after receiving parental participation to protect the participants anonymity. All the selected participants involved in the study until the end of study, no participants dropped out prior to completion of the intervention.
The students were selected because they met the inclusion criteria that are explained below.

Ahmad, six years old, has high functioning ASD and ADHD. According to his medical and educational records, he needed support with social skills such as playing with peers, making friendships, and working in groups. He had lack of speech and interrupted sleep. Ahmad showed Hand flapping, and out of seat during academic sessions that disturbing his on-task behavior. They operationally defined as hand flapping (e.g., repetitive arms swinging forward and backward), walking around the classroom (e.g., leaving the seat while working on academic tasks), while he was giving academic assignments to work on. For example, Ahmed starts flap his hands when the teacher asked him to work on matching or coloring letters tasks. Also, he comes out of his seat at the middle of the academic task. These behaviors drugged his teacher and classmates’ attention. Therefore, the teacher faced difficulties to manage the classroom, especially, there were other eight students in the classroom to deal with. When Ahmad engaged in such challenging behaviors, other students got motivated to get off-task as well.

Khalid was seven years old, who was diagnosed with high functioning ASD. His engagement in RRBs during academic session resulted in disturbing the educational environment, and spending extra time to finish the assignment. Khalid’s RRBs was defined as playing with objects while he was supposed to work on his academic task. If the objects were taken away from him, he begun to scream and cry in order to return the objects back.

Mohammad was seven years old, who was diagnosed with high functioning ASD associated with ADHD. Mohammad presented speech delay, and RRBs that affected his on-task behavior during academic sessions. They are operationally defined as making shapes with learning materials while he was supposed to work on his assignment.
Recruitment of the participants

The researcher received permission from Duquesne University prior to the beginning of the study. The permission approved by the University Institutional Review Board (IRB) before recruiting and contacting the potential participants for the empirical study. Also, the researcher got permission from the Ministry of Education in the KSA to implement the study in an elementary school, Manar Altafwaq, that has students with high functioning ASD in Jeddah city. In order to get permission from the Ministry of Education in the KSA, the researcher made a request for a scientific trip through the Safeer website. The request included a copy of the first three chapters of the current dissertation, a copy of IRB that consisted of a parent permission form, and a child's agreement form to participate in the study. Once these essential requirements were met, the Ministry of Education sent an official form to the principal of the elementary school that serves students with high functioning ASD on behalf of the investigator. Then, the principal of the assigned school emailed special education and physical education teachers to inform them about the study. The researcher reached out to the special education personnel who have students with ASD. The special education teacher sent information to the parents about the study. Parents contacted the researcher, discussed the study, and provided necessary information. One objective was to inform parents about the nature and the expectations of the intervention and how it was going to work. The researcher, special education teacher, and parents discussed the forms of the target behaviors that students present in classroom settings, and the possibility of reviewing student’s previous assessments and IEP.

Prior to implementing the study, parent consent and child assent forms were signed by parents and participants. Once the forms were collected by the researcher, the researcher asked special education teachers to identify and define the forms of RRBs that are mostly presented by
students with high functioning ASD during academic classes. That determined target behaviors of RRBs and participants’ eligibility to take part of the study and find out whether they meet inclusion criteria.

The researcher had permission from parents, students, special education teachers to observe the participants’ during academic classes pre-and post PE sessions, and receive clearance from special education teachers to pull out students for one-on-one direct instruction. The physical education teacher was asked about the availability of the gym facility to hold structured soccer skills sessions during the conducting of the intervention phase.

Setting

In the KSA, physical education is required in the educational curriculum as a core subject. It must be offered for all students with and without disability in all levels of public education (i.e., elementary, middle, and high schools). The educational system obligates all nationwide schools to include students in first, second, and third grades to complete 45 minutes of physical education class three times a week (total of 135 minutes). This policy can minimize the opportunities for students to engage in beneficial practices and stay physically active while they are growing up (Salim, 2017).

The current study included subjects from Manar Altafwaq elementary school in Jeddah city, which located in the Western Province of the KSA. The school consisted of general education classrooms, self-contained classrooms, resource room, and gymnasium. The school offered a partial mainstream program that allows students to receive some subjects in general classrooms. However, despite of the legislation to participate in physical activities for all students, the targeted participants with high functioning ASD at Manar Altafwaq elementary school had no access to attend physical education classes based on their weekly schedule.
The participants with ASD attended some classes part of the day in general classrooms where they got the opportunity to engage with their typical peers. The goal was to prepare them for full inclusion in the future. Some participants took all classes in self-contained classrooms or resource rooms. They had access to the same curriculum but they are delivered in one-to-one instruction. Antecedent PE sessions took place in the gym. The subjects received academic lessons in self-contained classroom pre-and post PE intervention. The researcher found eligible participants with high functioning ASD based on the inclusion criteria, and recruitment steps that are mentioned above. Prior to implementing antecedent PE sessions, the gym environment was organized and have all necessary materials that are explained below.

**Materials**

*Stopwatch and sport equipment*

Participants were engaged in PE sessions that were based on duration, so a timer used to track times. According to the CDC (2014) recommendation, the duration of exercise lasts for 25 minutes. Previous studies found vigorous PE which last more than 20 minutes or greeter has better effects on eliminating RRBs (Bittner et al., 2018). Stopwatch was also important to measure the duration the participants on-task behavior pre-and post-intervention. Small plastic cones used to make guideline formats in the gym and three soccer balls.

*Data collecting sheets*

The study included three forms of data collecting sheets. During structured soccer skills sessions, data collecting sheets used to mark if the participants either engaged or disengaged in PE sessions by measuring the percentage of active engaged time. During baseline and intervention phases, data about RRBs and time on-task were collected in two forms of data collecting sheets. For measuring the presence of RRBs, 15-minutes observations using a 30-
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seconds partial interval recording system used to measure the frequency of RRBs (see Appendix B). On-task behavior were measured by using 15 minutes with one minute momentary time sampling interval (see Appendix C). Prior to conducting the study, for an hour, a special education teacher and a physical education teacher were trained about collecting data procedures by introducing a partial interval recording system and duration recording system to measure IOA and data validity. The researcher held a training session in the teacher’s office so that it is a face-to-face meeting. The physical education teacher was trained how to use a duration recording system to observe the participants during physical exercise sessions. The special education teacher was trained on a partial interval recording system to collect data about students’ on-task behaviors and RRBs during reading classes. The special education teacher and the physical education teacher collected data along with the researcher to measure inter-observer agreement and data validity. The finding of reliability will be reported in chapter four.

**An iPod for recording the events**

An iPod camera was used to record the events for reliability purposes. We tended to record the events to measure the treatment integrity and inter-observer agreement. The researcher reviewed recordings with special education teachers and physical education teachers to measure the reliability of data. The review took place in the teachers' office. The implementation of inter-observer agreement was covered in a separate section below.

**Visual support cards, footprint, cones and arrows**

Visual support cards were created to guide students during structured soccer skills sessions. The visual support card numbered each station from one to five. Footprints and arrows directed participants between stations to facilitate their understanding of the structures, and their
movements during the intervention sessions. The distance between one station to another was 10 feet to make the gym environment more organized.

**Research Design**

Multiple-baseline design has been the most commonly used experimental design in the field of ABA (Cooper et al., 2007). It enabled researchers to measure the effectiveness of independent variables on multiple behaviors, settings, or subjects (Cooper et al., 2007). According to Bear et al. (1968), multiple baseline approaches referred to a number of responses observed and measured over time to establish baseline phases. Post-collecting date baseline data as related to a specific behavior, the researcher was able to introduce independent variables to find out what change could be produced. There were possibilities of observing change in other baselines. Instead of mentioning changes in the target behavior that just occurred, the researcher may apply the independent variables to the other participants. If the experimental variable resulted in changes of the target behaviors, the researcher could conclude that the intervention was effective (Bear et al., 1968).

Gast et al. (2014) highlighted advantages of using multiple baseline designs. First, the design resulted in high reliability of data by implementing intra-subject direct replications. Researchers were not required to return to the baseline phase to evaluate the treatments. It was appropriate to teach academic and functional skills that are non-reversible once acquired (Gast et al., 2014).

Scientists commonly used the design in social and behavioral fields (Hedges et al., 2013). In applied research, the design was becoming a favorable and acceptable approach to measure effectiveness of treatments in the educational setting. It was an appropriate experimental design for teachers to conduct the research in their classrooms. The multiple baseline across
subjects design was established to be used for a small sample size such as students with special
needs in the resource or self-contained rooms. The result of including a small sample size
enabled researchers to collect and graph the data individually for each participant (Barger-
Anderson et al., 2004).

The current study used a single-subject, multiple-baseline design across subjects, that
enabled the researcher to evaluate the effectiveness of antecedent PE treatment on participants’
target behavior as well as to measure the target behavior pre-and post-antecedent PE treatment.
This strategy enabled the practitioner to measure the effect of an antecedent PE treatment and
document behavior change by direct and repeat measurement of behavior (Cooper et al., 2007).

Another rational to single subject design method is to build evidence to the antecedent PE
treatment of behavioral problems. In ABA’s world, the EBP movement aims to make practice
more rigorous by integrating scientific research into clinical work, hoping to serve clients better.
Some organizations and professionals are calling for more research to provide strong evidence
that physical activity is a form of EBP (Auerbach et al., 2021). Therefore, more research is
needed to highlight the effectiveness of physical activity in reducing RRBs. This conclusion is
based on moderate evidence. Other professionals and organizations have indicated that more
high-quality research is needed for exercise to be accepted as EBP (Dillon et al., 2016; National
Autism Center, 2015).

One of the benefits of using single subject design across subjects is the ability to evaluate
antecedent PE treatment as they are delivered with actual clients in real-world settings, which is
very different from group intervention designs. In this way, practice-based research can help
bridge the translational research gap between cohort research design and actual practice
(Auerbach et al., 2021).
Moreover, the study enriched the field of ASD in the KSA, especially because ASD has been a new area of research, and it would be the first study that examines the feasibility of antecedent PEs on decreasing RRBs and enhancing on-task behavior (Sulaimani & Gut, 2019). Also, there were few empirical studies that investigated the effects of treatments on students with ASD using a single subject design. Moreover, the study rose awareness about the benefits of participating in physical activities as well as pointed out the important roles of physical education teachers in designing IEP for students with ASD.

**Operational Definition of Variables**

**Independent variable.** Structured PE involved teaching basic soccer skills (e.g., shooting, passing, running with the ball) used as an independent variable. Structured PEs helped subjects to guide and navigate through PEs sessions. The researcher and physical education teacher set up four numbered stations in the gym environment that lasted for 20 minutes total, each station for five minutes. Visual support cards or exercises were provided in each station. Timing devices helped subjects to understand the expectation of how long they were going to perform that exercise for each station. Arrows and footprints used between stations to direct the participants to the following station. The researcher measured the percentage of duration by using stopwatch to ensure that subjects were actively engaged in PEs for 20 minutes. When the student engaged in PEs, the researcher activated the stopwatch again. The stopwatch stopped when a participant stopped doing any activity. The researcher activated the stopwatch again when the subject returned to the practice. The total duration of engaging in PEs was reported as a percentage by \[
\left(\frac{\text{total duration of PE engagement}}{\text{the total duration PE session}}\right) \times 100 = \% \text{ of duration of engagement in one session of PE sessions (Cooper et al., 2007).}
\]
Dependent variables. In this study, two dependent variables measured: RRBs and on-task behavior. The operational definition of RRBs is exhibiting any forms of challenging behaviors that can negatively influence large-group activities and disturbing peers from learning during the academic session (e.g., body racking, hand flapping, and playing with objects, screaming, insistence, restricted interests, and rituals compulsion). The current study included three participants with high functioning ASD who presented different type of RRBs. Ahmad’s RRBs was operationally defined as one or combination of (a) Hand flapping (e.g., repetitive arms swinging forward and backward) out of seat (e.g., leaving the seat while working on academic tasks). Khalid’s RRBs was operationally defined as one or a combination of (a) yelling (e.g., making a loud vocal behavior) (b) playing with objects (e.g., playing with pencils, colors, and a sharper instead of using them to stay on work). Mohammed RRBs was operationally defined as playing with objects (e.g., using learning materials to make shapes).

Table 1

Target behavior and definition

<table>
<thead>
<tr>
<th>Participant</th>
<th>Target behaviors</th>
<th>Definitions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ahmad</td>
<td>Hand flapping, and out of seat</td>
<td>(e.g., repetitive arms swinging forward and backward) out of seat (e.g., leaving the seat while working on academic tasks).</td>
</tr>
<tr>
<td>Khalid</td>
<td>Playing with objects, and screaming.</td>
<td>one or a combination of (a) yelling (e.g., making a loud vocal behavior) (b) playing with objects (e.g., playing with pencils, colors, and a sharper instead of using them to stay on work).</td>
</tr>
<tr>
<td>Mohammad</td>
<td>Playing with objects.</td>
<td>(e.g., using learning materials to make shapes).</td>
</tr>
</tbody>
</table>
The target behaviors were assessed throughout 15-min observations using a 30-seconds partial interval recording system (see Appendix B; Meany-Daboul et al., 2007). If the RRBs occurred at any time during the 30-seconds interval, the observer marked the occurrence of the target behavior on the recording sheet. The frequency and the percentage of occurrence of the RRBs were calculated. The partial-interval data stated in terms of the percentage of total intervals during which the behavior happened (i.e., \[\text{the number of intervals the behavior occurred} \div \text{the overall number of intervals}\] × 100; Cooper et al., 2007).

Participants were considered to exhibit on-task behavior when seated and working on academic tasks (Nicholson et al., 2011). On-task behavior was operationally defined as the student actively (e.g., reading loudly, counting loudly, writing, answering questions, or discussing with peers), and passively (e.g., looking at the teacher during an academic session, or reading silently) engaged in the assigned tasks and absence of off-task behavior during academic sessions (Nicholson et al., 2011). The students presented off-task behaviors if they engage in any verbal or motor behaviors that are not associated with the assigned work (e.g., out of seat, playing with objects, and screaming).

The dependent variable of on-task behavior was measured by using momentary time sampling (Cooper et al., 2007). This form of time sampling records whether active or passive on-task behaviors was occurring at the moment that each time interval ends. The observation period lasted for 15 minutes with a one minute momentary time sampling interval. The investigator looked at the student at the one-minute mark of the observation period to investigate whether on-task behavior is occurring. The goal was to determine the occurrence or nonoccurrence of the target behavior by the end of the interval. The procedure lasted until the end of the observation.
duration (see Appendix C). The percentage of total presence of the on-task behavior was calculated (i.e., [the number of intervals the behavior occurred ÷ the total number of intervals] × 100; Cooper et al., 2007).

**Data Collection Procedures**

This study lasted until data is collected by the researcher, special education teacher, and physical education teacher during all study phases for all subjects. While the special education teachers collected data with the researcher during academic sessions, physical education teachers worked with the researcher during PE intervention sessions. All sessions were conducted one-on-one format and videotaped for data reliability purposes. The study conducted through 25 sessions. The multiple baseline design consisted of three phases: baseline (A), antecedent PEs (B), and maintenance (C) phases. In this design, the transition from a baseline phase (A) to a treatment phase (B) for participants was not at the same time in order to evaluate the effectiveness of the intervention accurately. The researcher and special education teacher collected data until the participant presents stable data related to on-task behavior and RRBs. While one participant received treatment, the other participants remained in the baseline condition. When the intervention presented a change in the participant’s target behavior, the researcher was able to move another participant to the treatment phase. The process continued until all participants engaged in structured soccer skills sessions and are assessed (Cooper et al., 2007).

**Preference assessment**

Preference assessment aimed to determine participants’ preference for certain stimuli. Information collected by implementing direct assessment in the gym before implementing the intervention (Hagopian et al., 2004). The researcher discussed the potential reinforcement for
each student with special education teachers, physical education teachers, and parents. The goal of this procedure was to determine preferred stimuli that could be used as reinforcement for participants in the study. Direct measures of preference used by creating a box of tangible items (e.g., stickers, color books, or puzzles), and enabling participants to identify their preferred reinforcement by choosing from the item menu (Hagopian et al., 2004).

The Baseline Phase

Observation sessions conducted to make sure participants need to enhance their on-task behavior and reduce their RRBs during reading sessions before the initiation of the intervention. Participants were required to not engage in any type of physical activities prior to collecting the data. When dependent variables were stable, the treatments were introduced to the participants. In other words, if one participant engaged in on-task behaviors and RRBs in a stable manner, researchers introduced the intervention for that participant. The researcher took baseline measures on on-task behavior and RRBs that were obtained by students’ actions during the first 15 minutes during an Arabic language class in the classroom. During the baseline condition, new data was collected on five separate occasions over a period of two weeks, by measuring the percentage and frequency of on-task behaviors by using one minute momentary sampling intervals through 15 minutes of observational duration, and the frequency of percentage RRBs by using 30- seconds partial intervals through 15 minutes intervals. This process applied with each subject until the intervention is introduced to all participants.

The Intervention Phase

The treatment sessions occurred three times per week. The researcher held one-on-one direct instruction prior to PEs sessions. One participant at a time added to structured soccer skills sessions which took place in the gymnasium, while other subjects stayed in the baseline phase.
This condition continued for 15 consecutive academic days. The structured soccer skills session lasted for 20 minutes that was split into four stations including warming up and stretching station, jogging station, passing the ball station (forth and back with the researcher), and kicking the ball toward a goal station. Each station lasted for five minutes. The subjects cooled down for three minutes before the session is dismissed. Each station numbered by a visual support card to guide the participant about the expectations of each station. Small plastic cones used to make guideline formatting for each station. The distance between the cones was 15 feet. Arrows and footprints were used between stations to direct the participants to the following station.

Students were able to walk during the session if they need to for their safety. The stopwatch was stopped by the researcher if participants stop doing any activity. The researcher reactivated the stopwatch when the subject returns to the practice. The researchers were available to practice with participants during the soccer skills sessions. Positive reinforcement was provided to motivate participants through verbal praise or receiving a small item after compilation PE sessions. Preference assessment helped the researcher to use the most desirable reinforcement.

Students returned to the classrooms, where data collection occurred regarding RRBs, and increasing on-task behavior. Participants were assessed within 30 minutes after finishing exercise sessions. They were observed during the first 15 minutes of reading classes. If the participants have no reading classes, they can be observed during other academic classes (e.g., mathematics, and social science). The researcher and special education teacher collected data by using time sampling (partial-interval recording) to measure RRBs and calculating the percentage of on-task duration in either resource room or self-contained classroom.
Maintenance phase

Two weeks post-intervention, the researcher collected maintenance data to measure the sustainability of the effectiveness of PE interventions (Cooper et al., 2007). The researcher assessed participants’ behaviors during reading class by using the same procedures as the collection of baseline data for five sessions. During this condition, participants no longer engaged in any PE sessions nor receive any reinforcement. One-minute partial interval recording system used to measure the frequency of RRBs (see Appendix B). On-task behavior were measured by calculating the frequency and percentage of on-task duration (see Appendix C).

Social Validity

Social validity was measured in order to determine the social importance of treatment and the acceptability of treatment effects on consumers (Carr et al., 1999). In this study, in order to ensure that the researcher conducted a satisfying study, a social validity checklist was provided to the special education and physical education teacher. The questionnaire seeks to measure the appropriateness of the current research (e.g., the length of study in all phases, the way that the intervention was presented, the outcome of the intervention, the procedures). Social validity questionnaire aimed to measure teachers’ perspectives as related to students’ benefits, and the ease of implementation. The special education and physical education teachers were asked to check one box from six boxes for each statement with the first box meaning strongly disagrees, and the sixth box meaning strongly agree (see Appendix D; Carr et al., 1999).

Inter-observer agreement (IOA)

A special education teacher collected the target behavior data independently in order to judge the relative credibility of the data. He trained about how to use partial interval recording (Cooper et al., 2007). The inter-observer agreement was determined by having two observers
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(researcher and the special education teacher) who record the figure of occurrences of the target behaviors and comparing these numbers during academic sessions. The primary researcher and special education teacher recorded whether or not participants exhibit RRBs during academic sessions through all phases. After they collected the frequency of the target behavior, they compared the total number of agreements and disagreements. Physical education teacher and the researcher were responsible for collecting data during PE sessions. Inter-observer agreement was determined by using the following formula (i.e., number of agreements ÷ number of agreements + number of disagreements × 100). The acceptance level of IOA is 80% and higher (Cooper et al., 2007). Reliability will be reported in chapter four.

Treatment Integrity

Treatment integrity was assessed to make a valid conclusion about the research outcomes. It was created to ensure the effectiveness of the intervention by implementing it was exactly as intended. Researchers highlighted that higher levels of treatment integrity resulted in more accurate findings (Sanetti & Kratochwill, 2009). In the current study, the premier investigator used a five items checklist including particular steps of study intervention to measure the treatment integrity (see appendix E).

Procedures

Informed consent

Parents of all elected participants required to complete a consent form, before they were included in the study. Parents received a consent form that will be given to their children after school. The consent form contained basic information of the study. They were informed that their participation is voluntary. Therefore, they were able to withdraw at any time for any reason. In addition, they were informed that all data collected would kept confidential and would be
hidden in a secure place. After the research was completed, it has kept for three years. After that, all the information would be destroyed. Parents knew about the advantages of engaging their kids in physical activity programs such as psychological well-being, interaction with others, and healthy bodies. The parents of the participants were notified about the potential occurrence of injury during practice of any kind of sports. The researcher’s contact information was provided on the consent form, so parents were able to communicate with him for any questions or concerns. Parents were informed about the right to withdraw from the study if they feel uncomfortable anytime during the study.

**Child Assent**

The researcher met each participant individually in order to provide them with information about the purpose of the study including pros and cons. Students were informed verbally about the risks and benefits of the study. They were asked to sign a Minor Assent Form. Also, the researcher emphasized that participation was totally voluntary. Subjects and their parents informed about the right to withdraw from the study if they feel uncomfortable anytime during the study. They were also notified that the privacy of their children secured and all information kept confidential.

**Data Analysis**

Graphed data were visually analyzed to assess the effectiveness of intervention, including level, trend, and comparing changes across phases. For each student, visual analyses were completed for each intervention against baseline, as well as the maintenance phase. The visual analysis explained the changes in level, trend and variability of the target behaviors (Ledford et al., 2018). The researcher calculated a standard mean difference in order to support the
determination of the best treatment for the subsequent phase if visual analysis did not provide a clear answer to which intervention was most successful.

Also, within-condition analysis was conducted to evaluate data change within a single condition during the study. We aimed to measure stability and variability of data within-condition. In the baseline phase, it was important to find stable data prior to introducing the intervention (Lane & Gast, 2014). It was recommended to lengthen the condition if the data are still unstable. Between-conditions analysis was conducted in order to compare across adjacent conditions during the study. It was important to record the changes in students’ behaviors after introducing the independent variables. The evaluation was based on the variability, level, and trend between conditions. There was comparison between the occurrence of on-task behaviors (active engaged time, passive engaged time), and RRBs between conditions (Lane & Gast, 2014). The percentage of intervals with on-task behaviors and RRBs were obtained and graphed separately.

**Validity of the Intervention**

In a single subject design method, it was important to consider the validity of the intervention by examining internal and external validity (Cooper et al., 2007). Internal validity referred to the researcher's ability to demonstrate that the occurrences of the changes in the dependent variables only resulted from the independent variable. In the current study, to ensure that any change in RRBs and on-task behaviors were related to physical exercise intervention, participants were required to not engage in any kind of physical activities before coming to school. Also, the physical exercise sessions held during the first period of the school day. During all study phases, data collection was taken at the beginning of the first period of the school day. Post implementing physical exercise intervention, participants returned to the self-contained
room or the resource room within 30 minutes. The researcher and special education teacher observed participants’ behaviors directly after returning to the classroom during academic sessions. The purpose of these guidelines was to prevent other factors that might affect any change in students’ target behaviors. On another hand, the external validity aimed to recognize the potential of generalizing the results of the studies to others in population, behaviors, or settings. Single subject design was weak in external validity as a result of a small sample of participants. Therefore, researchers in the field of single subject design are encouraged to replicate previous studies to include other participants from the same population. The result of the current study was recommended to be replicated in the future to measure the external validity (Cooper et al., 2007).

Conclusion

This chapter aimed to highlight the experimental procedures of using a single-subject, multiple-baseline design across subjects to examine the effects of physical exercise on On-task behaviors and RRBs in students with high functioning ASD. The chapter defined important terms in the study as related to the dependent variable and independent variable. Also, information about participants who were going to take place in the current study was presented by the researcher. Inclusion criteria and recruitment steps were included to clarify the eligibility of participants and how they will be informed about the current study. The researcher mentioned the setting of study and all needed materials for the implementation. In this chapter, the expectations of baseline, intervention, and maintenance phases were covered. Also, the researcher mentioned how the preferred items will be determined and delivered. For increasing reliability and validity of implementation of the study and its outcome, the researcher talked about measuring social validity, treatment integrity, inter-observer agreement, and internal and
external validities. The chapter mentioned specialists who are going to take part in collecting data including researcher, special education teacher, and physical education teacher. Data collection systems were explained as well as how data will be visually analyzed and graphed to assess the effectiveness of intervention, including level, trend, and comparing changes across phases.
Overview

This study was conducted to examine the effectiveness of antecedent PE intervention on enhancing on-task behaviors and reducing RRBs in students with high functioning ASD during academic classes in Jeddah, KSA. The following research questions were addressed (1) is the antecedent PE intervention effective in decreasing RRBs in students with high functioning ASD in the KSA?; (2) is the antecedent PE intervention effective in increasing on-task behaviors in students with high functioning ASD in the KSA?; (3) to what extant will the effect of antecedent PE intervention will maintain over time? This chapter aims to present the results for these research questions as well as the results for preference assessment, social validity, inter-observer agreement (IOA), and treatment Integrity.

This study was conducted at Manar Altafwaq elementary school in Jeddah, KSA. Participants were recruited at school by collecting parental consent forms, and children consent forms prior to implementing the study. Only three students met the inclusion criteria and qualify to participate in the study. Five out of eight students were excluded from the study as a result of medical issues and family injury concern. All participants were observed during Arabic language classes through all phases. The data collection lasted for five academic weeks including all phases.

Preference assessment

Prior to conducting the study, informal direct assessment was conducted in the gym to determine preferred stimuli for each participant in the study. Students were given to list of items that they might like. The items were delivered to them after participating in PEs sessions. The list
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consisted of stickers, color books, and puzzles. While Ahmad and Khalid chose to receive color books right after PE sessions, Mohammad preferred to receive stickers.

Data Analysis

The observations of the two DVs (e.g., RRBs, and On-task behaviors) for all participants were collected at the same time through all phases with using two different data collection sheets. Data for all participants were analyzed through visual analysis. The Percentage of Non-Overlapping Data (PND) was commonly used to measure the effectiveness of single case design through baseline and treatment phases. The PND was computed by counting every treatment phase favorable numbers and dividing by the total number of measures in the treatment phase (Ralf et al., 2008). In term of the interpretation of PND results, Scruggs et al. (1987) originated the following benchmarks 90% highly effective, (70%-90%) moderately effective, and (50%-70%) questionable effects. This method was used by the researcher for interpreting the PND.

The Effect of Antecedent PE on RRBs Through all Phases

Ahmad. Based on the chart graph, it is very clear visually that the level of Ahmad’s RRBs decreased post-treatment with a positive trend (see Figure 1). There was a variable baseline data. Ahmad was observed for five consecutive sessions prior to introduced the treatment. The treatment phase lasted for 15 sessions. While the mean of the target behavior during the baseline phase was ($M=80.03$), there was a sharp drop ($M =31.09$) over the course of participation in antecedent PE intervention. Two weeks after disconnected the treatment, the maintenance was measured by observing the target behaviors for five sessions. The visual analysis of maintenance data indicated that the level of the target behavior increased, but it did not return back to level of the baseline phase. After the removal of the treatment, the average of the occurrence of RRBs went up ($M= 55.99$) (see Table 1).
**Khalid.** The observation during the baseline phase lasted for eight sessions prior to the move to the treatment phase. The antecedent PE sessions were introduced to him for 12 consecutive sessions. The visual analysis of the total engagement RRBs for Khalid presented a variable baseline data. He presented a great change in observed target behaviors from baseline to intervention, and maintenance phases. Comparing the baseline phase, the level of the observed target behaviors declined post-treatment and after the removal of the treatment with a positive trend (see Figure 1). The mean percentage of the total engagement in RRBs was high during the baseline phase ($M= 76.24$). In contrast, that went down through treatment ($M= 41.94$) and maintenance phases ($M= 59.9$).

**Mohammed.** The result of collected data as related RRBs presented unstable and variable changes through all phases. He was observed 12 times during the baseline phase, eight times during the treatment phase, and five times during the maintenance phase. The chart graph suggested a decrease in the level of the target behaviors after engaging in PE sessions with a positive trend (see Figure 1). The mean percentage of the observed behavior decreased post-treatment ($M= 29.15$), and during the maintenance phase ($M=53.99$) compared to the mean percentage of the observed behavior during the baseline phase ($M= 83.91$) (see Table 1).
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Figure 1

Participants’ percentage of RRBs during academic sessions

[Graph showing baseline, treatment, and maintenance periods for participants named Ahmad, Khalid, and Mohammad.]
The Effects of Antecedent PE on On-Task Behaviors Through All Phases

Ahmad. The visual analysis of the pattern results for Ahmad’s on-task behaviors suggested an improvement after engaging in PE sessions. There was a change in the level of data through all phases (see Figure 2). His on-task data was unstable with clear variability and a negative trend during baseline phase. After participating in PE sessions, Ahmad’s average percentage of on-task behaviors increased with a positive trend. The mean percentage of on-task behaviors increased through treatment ($M=77.33$) and maintenance phases and ($M=47.99$) compared with the mean percentage during baseline phase ($M=23.99$).

Khalid. On-task behaviors improved after engaging in the treatment sessions. We can clearly see that the directions of data were unstable with a lot of variabilities through all phases. The level of on-task behavior data increased post-treatment with a positive trend. During the maintenance phase, on-task behaviors’ level went down slightly compared to the level during treatment phase. However, it did not return back to the baseline’s level. The mean percentage of the result of observed on-task behaviors was law during the baseline phase ($M=26.66$) while they increased significantly during treatment ($M= 62.77$) and maintenance phases, and ($M= 39.99$).

Mohammed. The visual data analysis of Mohammed’s on task behavior during Arabic language classes suggested that he presented lower on-task behaviors pre-treatment compared to post-treatment. The result of collected data were not stable with variability through all phases. The level of on-task data increased considerably after engaging in PE sessions with a positive trend. The mean percentage of the observed behavior were higher during the treatment ($M=83.32$) and maintenance ($M=51.99$) phases compared to the mean percentage during the baseline phase ($M=27.21$).
Figure 2

Participants’ percentage of On-task Behaviors during academic sessions
Table 2

*Participants’ Mean Percentage of RRBs and On-task behavior across phases*

<table>
<thead>
<tr>
<th>Participants</th>
<th>Baseline RRBs</th>
<th>Baseline On-task behavior</th>
<th>Intervention RRBs</th>
<th>Intervention On-task behavior</th>
<th>Maintenance RRBs</th>
<th>Maintenance On-task behavior</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ahmad</td>
<td>80.03</td>
<td>23.99</td>
<td>31.09</td>
<td>77.33</td>
<td>55.99</td>
<td>47.99</td>
</tr>
<tr>
<td>Khalid</td>
<td>76.24</td>
<td>26.66</td>
<td>41.94</td>
<td>62.77</td>
<td>59.9</td>
<td>39.99</td>
</tr>
<tr>
<td>Mohammad</td>
<td>83.91</td>
<td>27.21</td>
<td>29.15</td>
<td>83.32</td>
<td>53.99</td>
<td>51.99</td>
</tr>
</tbody>
</table>

Overall, all participants’ RRBs decreased after antecedent PE sessions were introduced. Their on-task behaviors showed improvement after participating in the treatment sessions. Therefore, the finding matched the hypothesis that the antecedent PE intervention is effective in decreasing RRBs and enhancing on-task behaviors in students with ASD. Additionally, we concluded that there was inverse relationship between the two variables as a result of participating in PE treatment. The result of the maintenance phases for all participants with ASD presented an increase in the level of RRBs compared to the treatment phase, but it did not return to the baseline level. The level of on-task behavior decreased slightly after disconnecting the intervention, but did not return to the baseline level. In the current study, PND measure was used to determine if either or not there are overlap between baseline and treatment phases. No overlap between phases were found for all participants. The magnitude of the PND = 100% that is clear evidence the treatment phase success and highly effective.

**Social Validity**
Two social validity questionnaires were answered by a special education teacher and a physical education teacher. The Likert Scale consisted of six statements that aimed to measure teachers’ perspective as related to the use of physical exercise intervention with students with ASD, the acceptability of treatment effects on the students. Both teachers completed the questionnaires with a mean score 6 out of 6. See Table 3 for questions and averages for each answer. Two checks were marked that represented the answers of two teachers. Based on the results of the questionnaire, the teachers reported being strongly satisfied about the outcomes and the appropriateness of the current research (e.g., the length of study in all phases, the way that the intervention was presented, the outcome of the intervention, the procedures). Also, teachers strongly agree that physical activity sessions must be held within schools based on the positive effects of the intervention on students RRBs and on–task behaviors.
Table 3
*Social Validity Questionnaire*

Consider the use of antecedent PE intervention with your students with ASD. How much do you agree with the following statements?

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Slightly Disagree</th>
<th>Slightly Agree</th>
<th>Agree</th>
<th>Strongly Agree</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I understood all of the elements of the physical activity intervention.</td>
<td>√</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>2. Restricted and Repetitive behaviors have decreased since the implementation of the physical activity intervention.</td>
<td>√</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>3. Appropriate on-task behaviors have increased as a result of the implementation of the physical activity intervention.</td>
<td>√</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>4. My participation in the implementation of the physical activity intervention was relatively easy (e.g. amount of time/effort) to implement.</td>
<td>√</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>5. Participation in implementing the Physical activity intervention for this student was worth the time and effort.</td>
<td>√</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>6. The Physical activity intervention fits within my current school climate.</td>
<td>√</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>6</td>
</tr>
</tbody>
</table>

Inter-observer agreement (IOA)

The IOA was found by having two observers (researcher and the special education teacher) who recorded student’s RRBs and on-task behaviors through all the study phases. Special education teacher was trained to use partial interval and time sampling recording. The
goal was to ensure the relative credibility and reliability of the data collection. The primary researcher and special education teacher reported whether or not participants exhibit RRBs and on-task behaviors during academic sessions through all phases. The data collected by both observers met the acceptance level of IOA which is 80% and higher. All the IOAs for Ahmad, Khalid, and Mohammad were higher than that acceptance level at 82%, 86%, and 92% respectively.

**Treatment Integrity**

Treatment integrity checklist consisted of 10 steps that ensured the accuracy of implementing the intervention as intended. The researcher followed the steps that were written in the checklist when organizing the gym environment. He wrote yes in front of each implemented step before the PE sessions ended. The percentage of implementing all PE sessions as planned were 100%.

**Summary of the Results**

The implementation of the current study went as intended as mentioned in treatment integrity section. The reliability and credibility of the results were measured by conducting social validity, IOA and. During social validity assessment, special education teacher and physical education teacher showed their satisfaction about the antecedent PE treatment and the beneficial impact of it. The IOA resulted in accepted levels of agreement of the observed behaviors for all participants. As related to the research question, the finding of the study indicated that the PEs has a significant effect in decreasing RRBs and increasing on-task behaviors during academic sessions.
Chapter Five

Discussion

The present study examined the effects of antecedent physical activities on enhancing on-task behaviors and minimizing RRBs of students with high functioning ASD in during academic classes. The current research aimed to answer the following research questions: (1) Is the antecedent PE intervention effective in decreasing RRBs in students with high functioning ASD in the KSA?; (2) Is the antecedent PE intervention effective in increasing on-task behaviors in students with high functioning ASD in the KSA?; (3) To what extent will the effect of antecedent PE intervention will maintain over time? This chapter presents (a) a discussion of the outcomes of the above research questions, (b) the implications for practices, (c) the limitations of the study, the mechanism of the change, and the recommendation for future researcher.

Review of the Results

The study included three male elementary students with high functioning ASD who were exposed to the treatment ages six (Ahmad), seven (Khalid), and seven (Mohammad) in the first grade. According to the Ministry of Education, the educational system requires all elementary schools nationwide to hold physical education classes. Students in first, second, and third grades are supposed to complete 45 minutes of physical education class three times a week (total of 135 minutes).

Unfortunately, students with ASD in Manar Altafwaq elementary school were found left behind. They did not have an access for the sport court and physical education classes based on their weekly schedule and researcher observations. Prior to the implementation of the study, students did not attend any physical education classes at all. That opposed the governmental regulations that ensured their rights to engage in sports and leisure activities like their typical
peers. It entered into marginalization and inequality among students. In the present study, the participants were observed during pre-and post- antecedent PE treatment sessions, and two weeks after the treatment was disconnected.

**The Effectiveness of Antecedent PE**

The current study investigated the effectiveness of antecedent PE as a school-based intervention to decrease RRBs and increase on-task behavior in students with ASD. Generally, the findings presented a significant decrease in percentage of RRBs across three participants. The antecedent PE had a considerable increase in percentage of on-task behaviors during academic sessions in a self-contained classroom across three participants. In the study, the exercise intervention demonstrated social validity and was regarded as efficient, secure, and suitable for use in educational settings.

The study's findings are consistent with earlier research on antecedent physical activity interventions for people with ASD, showing a functional relationship between physical activity and improvements in desirable classroom behaviors (Bahrami et al., 2012; Nicholson et al., 2011; Rosenthal-Malek & Mitchell, 1997; Tse et al., 2018; Watters & Watters, 1980). The current study supports antecedent PE as an intervention to improve desirable behaviors, such as on-task behaviors, and minimize challenging behaviors such as RRBs, despite the fact that earlier researches have primarily focused on either reducing maladaptive behaviors or increasing on-task behaviors separately (Neely et al., 2015).

Results of this study replicated previous finding that antecedent PEs decreased RRBs in students with ASD in an elementary school setting (Kern et al., 1984; Levinson et al., 1993; Losinski et al., 2017; Mlek et al., 1997; Prupas & Reid, 2001; Schmitz et al. 2017; Watters & Watters, 1980). The current findings show that physical activities may result in improved
academic outcomes for kids with ASD because the quantity of on-task behaviors has been recognized as a major predictor for academic achievement.

Most investigations to date have only assessed the effects in the period immediately following exercise (Losinski et al., 2017; Rosenthal-Malek & Mitchell, 1997; Tse et al., 2018; Watters & Watters, 1980). For instance, Neely et al. (2015), investigated the duration of the positive effects for only 10 minutes following the intervention and no behavioral data was taken after the session. In the current study, the positive change of the target behaviors kept sustained even after two weeks of disconnect the intervention. All subjects with ASD showed an increase in RRBs levels throughout the follow-up phases compared to the treatment phase, but there was no return to the baseline level. After the intervention was disconnected, the level of on-task behavior somewhat declined but did not reach the baseline level. The results were consistent with previous findings conducted by Bahrami et al. (2012) who followed up on the effect of physical exercise on decreasing RRBs after a long period of time. After 30 days of no practice, the study's follow-up phase was conducted, the researchers discovered that RRBs in the exercise group had stayed significantly lower than they had been before the intervention.

Finally, PND was measured based on Scruggs et al. (1987) measurement in order to ascertain whether or not the baseline and treatment phases overlap. For all participants, there was no overlap between the phases. The severity of the PND is 100%, which is proof that the therapy phase was successful and efficient.

The Mechanism of the Change

Although these promising results, there is still a need for theoretical explanations to explain the positive benefits of exercise-based therapies on reducing RRBs and enhancing on-task behaviors in students with challenging behaviors. The explanations of the beneficial effects
of antecedent PEs are based on a behavioral and psychological mechanisms. One such mechanism is the change of the preceding environment may cause reduction in undesirable behaviors (Cooper et al., 2007; Rapp & Vollmer, 2005). Researchers in the field of ABA have investigated a variety of antecedent treatments to find their value on decreasing RRBs in individuals with ASD. The main idea of antecedent stimulation is to evaluate the occurrence of the problem behavior after altering the environment (Akers et al., 2020). The hypothesis for the current study is an antecedent event can alter an individual’s stimulus to present a specific behavior. The antecedent exercise is an intervention, which might affect the desire of individuals to engage in targeted behaviors after disconnecting the intervention.

Another mechanism is to consider the theoretical operant nature of RRBs. According to the theory of operant nature of stereotypy, individuals with ASD exhibit RRBs in order to satisfy internal sensory needs that are learned and supported by reinforcement contingencies (Berkson, 1983; Lovaas et al., 1987). According to the functional response class to which behaviors belong and the presumption of automatic reinforcement, it is crucial to supply a similar but alternative sensory stimulation. The purpose of the reaction will reveal why the behavior is being sustained (Berkson 1983; Cunningham & Schreibman, 2008; Lovaas et al.,1987). Therefore, one explanation of engaging participants in RRBs is to satisfy inner sensory desires that are learned and supported by reinforcement contingencies. The present study is in agreement with previous findings that there is a relationship between RRBs and engaging in physical activities, which have similar movements. These studies agreed that practiced behavior that matched with the biomechanics of stereotypy may result in reducing repetitive behaviors for example, students who present with hand flapping or hand movements can participate in karate or basketball to satisfy their internal desire (Bahrami et al., 2012; Tse et al., 2018; Watters & Watters,1980).
In line with the fatigue hypothesis, exercise may lead to weariness, which in turn reduces RRBs and boosts appropriate behavior and academic achievement. There was a controversy that if the disruptive behaviors decreased as a result of fatigue following physical activity, then the desired and on-task behaviors should have decreased as well. Due to the conflicting findings, the exhaustion theory has been refuted (Nicholson et al., 2011; Rosenthal-Malek & Mitchell, 1997).

**Implications for Practitioners**

The findings of this study provided the field of ABA, ASD, and physical activity with beneficial information for future researches and practitioners. The majority of the previous studies that examined the effects of antecedent PE were conducted in western countries. In this study, the treatment was examined on subjects from different backgrounds and cultural in KSA. This the first study of its type to be conducted in the Arabic region. Therefore, it established a ground to replicate the study for practitioners and strength the findings. The study contributed to the field of ASD in the KSA, especially since it is the first to examine the effectiveness of PEs in reducing RRBs and improving on-task behavior. Since ASD is a relatively new area of research in KSA (Sulaimani & Gut, 2019), this study can inform practitioners of the use interventions to improve student performance. Furthermore, based on the results of the current study, special education teachers and physical education teachers should ensure students have time to move and practice any type of favorable physical activities prior to attending academic classes.

The present study has shown the positive impact of physical activity intervention. This conclusion was based on both a special education teacher and a physical education teacher responded to the social validity questionnaire. Six statements made up the questionnaire, which was designed to gauge teachers’ opinions on the use of physical activity interventions with students who have ASD and the acceptability of those interventions’ impact on the students.
According to survey data, teachers are quite satisfied with the results and the relevance of the current research (e.g., the length of study in all phases, the way that the intervention was presented, the outcome of the intervention, the procedures). Teachers are also in agreement that physical education classes should be offered in schools due to the intervention’s beneficial impacts on kids’ RRBs and on-task behaviors.

**Implications for Future Research**

The majority of previous studies engaged participants in aerobic exercises without consider to participants’ passion, enjoyment and the type of sport they love (e.g., jogging, running, jumping) (Nicholson et al., 2011; Tse et al., 2018; Watters & Watters, 1980). The current study held structured soccer teaching sessions that aimed to expose them to the sport that they like with achieving the target of participating in antecedent PE. This study showed that physical activity can be meaningful for students with ASD.

The examination of how long the effects of exercise intervention on the behavioral change was met in the current study. The duration of the treatment effects resulted in significant implications for practice as a short duration of effect could restrict the validity and feasibility of this intervention. In some previous studies, the duration of the intervention effect was unknown (Neely et al., 2015; Schmitz et al., 2017; Tea et al., 2018). In the current study, the maintenance was measured by observing the target behaviors for five sessions, two weeks after disconnected the treatment.

This study extended previous studies that examined the impact of antecedent physical activities on decreasing and increasing target behaviors based on motivating operations theory (MOs). MOs consists of two subcategories; abolishing operations (AOs) and establishing operations (EOs). While the AO is an antecedent event that aims to decrease an individual’s
motivation to engage in specific behaviors, the EO is an antecedent event that aims to increase an individual’s motivation to participate in specific behaviors (Cooper et al., 2007; Lang et al., 2010; Laraway et al., 2003). The increase in on-task behaviors and the decrease in RRBs were a result of an antecedent event. Although antecedent PE based intervention were studied previously, there is need to replicate the findings in order to minimize the limitations in these studies.

The present study established a good ground for researchers in the field of ABA who are interested in practices based evidence in KSA. In future studies, the researchers could examine the possible positive effect of the treatment on other challenging behaviors or different age group of people with ASD. The available treatment based practices in KSA for students with high functioning ASD were mentioned, and there is need to conduct more studies to strength the findings of the present study. Researchers play an increasingly important role in term of examining the practices to proof their validity and reliability.

Limitation of the Study

This study was governed with some limitations although the current findings have strong suggestions on school-based treatments for students with ASD. A first limitation was the lack of quantitative measurement of effort or exercise intensity. That has been associated with the amount of effect on the outcome behaviors. For instance, all subjects participating in the antecedent PE intervention for a whole 20 minutes, it was likely that some subjects utilized greater effort than others (e.g., more vigorous steps). As a result, these varying degrees of effort could have affected the positive level of behavioral or cognitive outcomes.

A second limitation was related to the treatment validity. Social validity questioners were answered only by physical and special education teachers. Parents and participants’ perspectives
about the current treatment feasibility were not measured. Such measurements will strength the
treatment reliability and validity. In future research, it is highly recommended to involve the
participants and their parents in treatment validity measurement.

A third limitation was linked to a poor external validity that the single subject design has
due to the tiny sample size (Cooper et al., 2007). Therefore, single subject design researchers are
encouraged to replicate this study and incorporate additional subjects drawn from the same
community. It was advised that the findings of the present study be reproduced in the future to
assess the external validity.

A fourth limitation was related to the generalization of the effectiveness of antecedent
PE. It is still unknown if the effect will be generalized to other environments. It is highly
recommended to measure the occurrences of challenging behaviors, and on-task behaviors in
other environments rather than the self-contained classroom.

A fifth limitation was related to the internal validity. Students were observed the self-
contained that includes other students. Although it is an ideal environment to have other
classmates in the classroom, it is possible that other students’ behaviors might affect the
occurrences of the changes in the dependent variables. Therefore, the changes did not only result
from the independent variable.

A sixth limitation was related to the use of one-minute partial interval recording system
to measure the frequency of RRBs. This measurement allowed the observer to record the
occurrence or nonoccurrence of the target behavior at the end of each interval. Therefore, there is
a concern that RRBs might occur anytime within a minute, but they were not recoded on the data
collection sheets.
Students have different interests specially in sports area. The researcher did not consider participants favorable physical activity prior to determine the type of sports that they would engage in. The researcher chose soccer based on the popularity of the game in Saudi Arabia. Also, the majority of schools have access to practice soccer.

**Recommendations for Practitioners**

Physical education intervention was recognized as an evidence-based practices for students with ASD (Bittner at al., 2018). Based on the results of the current study, it is highly recommended for practitioner to use PEs based treatment in order to get the best out of students with ASD during academic classes. Teachers should make sure that students with ASD engage in physical activities at the beginning of the academic day that might affect their behavioral, and academic attendance positively.

A second recommendation, applied behavior analysts are highly encouraged to use antecedent PE intervention in the clinic as a service for their clients. The present study supports the previous finding that physical activity based interventions have effective and beneficial effects on people with ASD. The positive impacts are seen across a wide range of abilities and capacities (e.g., reduced out-of-seat behaviors, improved social skills, and motor proficiency) (Bittner et al., 2018; Dillonet al., 2016).

The third recommendation is to motivate students participating in physical activities by exposing them to their preferred types of sports. This can play an important role in encouraging students to engage in physical activity sessions frequently with passion and enjoyment. The result of the study encourages practitioners to hold after school physical activity programs which could bring many benefits to the students and their families. The advantages will not only include enhancing in a variety of challenging behaviors in different settings, the effects of
physical activity will be extended to enhance social skills, communication, and daily life skills (Bittner et al., 2018; Dillon et al., 2016).

**Recommendations for Future Research**

Some recommendations should be highlighted for future investigation. First, it is recommended to replicate the previous findings with consideration to assessing the motor ability for participants during baseline phase which may be linked with the treatment effects on the outcome of participants. Second, measuring participants’ effort during physical exercise sessions that associated with the outcomes of the treatment. While some studies just measured the participation time in the assigned physical exercise, it was likely that some participants used more exertion than others. For example, a measurement of the children who jogged for 20 minutes may show they took various numbers of steps during that time. Therefore, it will be appropriate to make children wear a pedometer to count their steps.

Researchers examining PE based treatment in students with ASD have explored that the strategy is effective in treating comorbidity and other challenging behaviors in children with ASD. The findings showed beneficial effects on decreasing aggression (Allison et al., 1991), off task behavior (Powers et al., 1992), sleep problems (Brand et al., 2015), motor skill proficiency (Pan et al., 2017), improvement in emotion regulation and reduction in behavioral problems (Andy, 2020), improvement in attention and cognitive function (Anderson-Hanley et al., 2011), and social impairments and communication (Bittner et al., 2018; Menear & Neumeier, 2015; Zhao & Chen, 2018). As long as ASD is a relatively undeveloped area of research in KSA (Sulaimani & Gut, 2019), researchers in KSA are highly encouraged to replicate the effect of PEs based treatment on comorbidity and other challenging behaviors in children with ASD from KSA.
Few studies investigated the maintenance of the effects of physical activities based intervention in elementary school settings. In future research, it would be invaluable to gain insight to the potential impact of longer-term physical exercise programs over a period of weeks or months to recognize the participants’ responses to these interventions. This could enhance the information of the treatment in term of intensity, and possible generalizing the results into different settings.

The most effective form of exercise on enhancing on-task behaviors and RRBs is still unknown. In future research, scholars are advised to explore which type of exercise has the most potential to effectively decrease the inappropriate behaviors associated with ASD. By using alternating treatment designs, researchers will be able to make a comparison of the effectiveness of three different treatments on RRBs and on-task behaviors. This research will help determine the level of potential influence for each variable as well as highlight the contributing elements behind behavioral and cognitive effects.

In future research, it is highly recommended to hear the participants’ voices and involve them in treatment validity measurement. Allowing participants’ feedback will strengthen the treatment reliability and validity. In the current research, social validity questioners were answered only by physical and special education teachers. It is important to measure participants’ perspectives in order to determine their satisfaction about the current treatment and its outcomes. Their opinions on the use of physical activity as an intervention will help to determine if the treatment’s change in behavior is efficient and acceptable.

Another recommendation is that it is important to pay close attention to the ethical matters by teachers, and behavior analysts as related to treating with RRBs. They should only aim to reduce, not extinct, RRBs in people with ASD in order to build beneficial skills. No one
should attempt to remove ASD from the person. RRBs are a part of their identity and potential self-soothing behaviors, and it could lead to a potentially unethical practice to focus on eliminating behaviors instead of helping kids to strengthen their academic and social skills.

**Recommendations for Policy**

This study yielded three recommendations for policy. First, it is important that all students have access to physical activity required by law. This means the Ministry of Education should advocate all students’ rights to practice sport and leisure activities, no matter what their abilities and disabilities. That could be done by alerting students and their parents about the right of engage in such practices, and explaining the benefits that will bring to them physically, mentally, and socially. Schools’ managements should provide IEP teams and schools members with the advantages of physical education based on scientific researchers.

A second recommendation is that policy makers hold schools accountable when they do not follow policy. Schools should send schedules demonstrating how students with and without disabilities are participating in physical education. The objective is to make sure all the IEPs include accommodation and modification of physical education based on students’ special needs and abilities. If the schools failed to meet this requirement, the Ministry of Education should obligate school to hold a sport competition within the school or the community with consideration to students’ differences.

A third recommendation is to obligate all nationwide schools to require physical education teachers to participate in IEPs. In this study, teachers strongly agree that physical activity sessions must be held within schools based on the positive effects of the intervention on students RRBs and on–task behaviors. Although the ministry of educational system requires schools’ administrations to build IEPs for students based on meaningful collaboration between
specialists, physical education teachers must take part in creating IEPs for students. Therefore, students with ASD will be able to find access to physical education classes based on their abilities and needs. When physical education teacher recognizes students’ abilities and physical limits, they will accommodate and modify the curriculum with consideration to individual abilities. IEP development does not engage physical educators very much, their roles are still marginalized (Samalot-Rivera & Lieberman, 2017). As a result of the marginalization and exclusion of the physical education teachers in creating the IEPs, the physical education plans do not match the skills and abilities of all students. Therefore, the quality of physical education programming will be impacted. This problem can be tackled by enabling physical education teachers to provide the services based on their assessment with consideration to students’ different abilities. The present study is in agreement with previous study that by conducting better communication and increasing their knowledge of adaptive physical education, physical educators’ responsibilities in IEP planning and design might be enhanced (Samalot-Rivera & Lieberman, 2017). Students with ASD face difficulties to access physical education classes. The study increased awareness of the advantages of engaging in physical activity and highlighted the critical responsibilities that physical education teachers play in developing IEP for kids with ASD.

Conclusion

In conclusion, results of this study confirmed earlier findings that, in an elementary school setting, antecedent PEs reduced RRBs in students with ASD. Additionally, these results supported past research that indicated antecedent PEs improved on-task behavior in adolescents with ASD in an elementary school setting. The number of on-task behaviors has been identified as a primary predictor of academic achievement, and the current findings suggest that physical
activities may improve academic outcomes for children with ASD (Bittner et al., 2018). The exercise intervention was deemed effective, safe, and appropriate for use in educational settings. It also demonstrated social validity. Finally, this study made a contribution to the area of ASD in the KSA, particularly because it is the first to look at how well PEs work to lower RRBs and improve on-task behavior. Therefore, it is recommended to replicate further research to support the findings.
References


PHYSICAL EXERCISE FOR STUDENTS WITH AUTISM


PHYSICAL EXERCISE FOR STUDENTS WITH AUTISM


PHYSICAL EXERCISE FOR STUDENTS WITH AUTISM


Riyadh, Saudi Arabia: Ministry of Education, General Secretariat for Special Education.


PHYSICAL EXERCISE FOR STUDENTS WITH AUTISM


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Ralf W. Schlosser PhD, David L. Lee & Oliver Wendt (2008) Application of the percentage of non-overlapping data (PND) in systematic reviews and meta-analyses: A systematic review of reporting characteristics, Evidence-Based Communication Assessment and Intervention, 2:3, 163-187, DOI: 10.1080/17489530802505412


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PHYSICAL EXERCISE FOR STUDENTS WITH AUTISM


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## Appendices A

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<tr>
<td>Watters &amp; Watters (1980)</td>
<td>N=5</td>
<td>9 to 11 years old</td>
<td>Comparison designs</td>
<td>8 to 10 min jogging precondition compared to watching TV and academic preconditions.</td>
<td>stereotypical behaviors, On-task behaviors.</td>
<td>A 5-second observe/5-second record sampling scheme.</td>
<td>stereotypical behaviors decrease at 32%. On-task behaviors was higher after physical exercise sessions. That presented better result than other preconditions.</td>
<td>N/A</td>
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<tr>
<td>Kern et al. (1984)</td>
<td>3 children with ASD one age 7 and 2 ages 11 respectively</td>
<td>A simultaneous-treatments design.</td>
<td>(jogging or ball playing). Two experimental conditions (15 min of vigorous jogging) and (15 min of mild ball playing)</td>
<td>arm and hand flapping, repetitive jerking of body, and loud, high-pitched, repetitive nasal vocalization</td>
<td>A time-sampling recording procedure used. 15-second intervals were divided into 5 seconds of observation and 10 seconds of data recording.</td>
<td>15 minutes of continuous and vigorous exercise presented more reduction in stereotyped behavior.</td>
<td>N/A</td>
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<tr>
<td>Powers et al., 1992</td>
<td>N=1</td>
<td>8 years old</td>
<td>an ABAB design</td>
<td>antecedent roller skating</td>
<td>self-stimulatory (swinging objects between his thumb and index) and on-task behavior</td>
<td>A partial-interval time-sample to measure self-stimulation. A momentary time-sample to measure on-task behavior.</td>
<td>The inappropriate behavior was decreased to a mean of 22%. On-task performance increased with a mean of 84%.</td>
<td>N/A</td>
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<tr>
<td>Levinson et al. (1993)</td>
<td>2 males and a female age 11 years old</td>
<td>single subject design</td>
<td>15 minutes of walking and 15</td>
<td>gazing at hands, body rocking, finger flexing, biting hands,</td>
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<td>Children exhibited less inappropriate response post-vigorous exercise</td>
<td>90 min</td>
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<tr>
<td>Study</td>
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<tr>
<td>Mlek, and Mitchell (1997)</td>
<td>N=5 14 to 15 years old Cohort</td>
<td>Jogging lasted 20 min per session/ 10 sessions. The result was compared with academic preconditions.</td>
<td>Self-stimulatory behaviors. Number of correct academic responding.</td>
<td>Self-stimulatory behaviors decreased following aerobic exercise</td>
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<tr>
<td>Prupas and Reid (2001)</td>
<td>Four children with ASD ranging in age from 5-9 years old</td>
<td>A single and multiple exercise frequency single frequency exercise treatment involved a 10-minute walk/jog per day, the multiple frequency treatment consisted of three 10-minute walk/jog sessions daily</td>
<td>Stereotypic behaviors (repetitive vocalizations and echolalia, hand flapping, head touching, body rocking while standing, and finger and hand movements).</td>
<td>Multiple frequency condition treatments were more effective because the reduction lasted throughout the day.</td>
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<tr>
<td>Nichols on et al., (2011)</td>
<td>4 males 9 old year Cohort (multiple baseline design)</td>
<td>Jogging (n=4): 15 min jogging followed by 5-min cool down, 3 times/ week for 2 to 5 weeks.</td>
<td>On-task behaviors</td>
<td>The percentage of On-task behaviors increased. Some students presented increased level of on-task behaviors after the treatment was disconnected and others displaying decreased.</td>
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<td>Bahrami et al., 2012</td>
<td>N=15 5-16 Controlled trail</td>
<td>Martial arts (karate) 1 session (60 min) 4 days/ week and 14 weeks.</td>
<td>Stereotypic behaviors</td>
<td>Gilliam Autism Rating Scale-Second Edition (GARS-2) to measure stereotypy severity decreasing in stereotypic behavior</td>
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<td>Study</td>
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<tr>
<td>Neely et al., (2015)</td>
<td>N=2</td>
<td>Alternating treatment design (comparing three conditions: no antecedent exercise condition, brief duration of antecedent exercise, and the exercise until behavioral indicator of satiation)</td>
<td>Jumping on the trampoline</td>
<td>On-task behaviors and stereotypic behavior</td>
<td>10 s partial interval recording procedure for measuring stereotypic behaviors. 10 s who interval recording procedure for measuring on-task behaviors. On-task behaviors was highest in the exercise until behavioral indicator of satiation condition, followed by the brief duration of antecedent exercise, and lowest in the no antecedent exercise condition.</td>
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<td>Lee and Porretta (2016)</td>
<td>N=2</td>
<td>An A-B single-subject research design</td>
<td>Jumping and swimming</td>
<td>Stereotypic behaviors (tapping an object with hands, bouncing up and down, stomping foot, and spinning, liking, and rubbing objects). Date were coded using a momentary time sampling procedure with 10-s intervals.</td>
<td>Individualized and structured environment reduced Stereotypic behaviors. The target behavior was fewer in pool than gymnasium.</td>
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<tr>
<td>Losinski et al. (2017),</td>
<td>N=3</td>
<td>An alternating treatment design across participants (compared two forms of deep pressure therapy and antecedent exercise).</td>
<td>Participants rode the exercise bike for 10 min.</td>
<td>stereotypic behaviors and attention to task as a secondary target behavior. Using the 5-s partial interval recording system to measure stereotypic behaviors. Measuring heart rating to make sure the heart rate above 100 per min.</td>
<td>After exercise sessions, two cases showed positive effects on stereotypical behaviors while one showed no effects.</td>
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<tr>
<td>Schmitz et al., (2017)</td>
<td>N=7</td>
<td>Pre-exercise and post-exercise behavior measurements</td>
<td>aerobic exercise (cycling and treadmill). low (L) or high (H) intensity for either 10- or 20-minutes</td>
<td>Autism traits, metabolic profile, and perceived quality of life. A Polar HR monitors. Video recording for the frequency of SSB.</td>
<td>short, low-moderate intensity exercise was more effective in decreasing stereotypical behaviors.</td>
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<tr>
<td>Tse et al., (2018)</td>
<td>22 males and 8 females, all</td>
<td>Experimental/ control groups. a crossover design</td>
<td>Ball taping lasted for 15 minutes + 5</td>
<td>Body rocking, and hand flapping. GARS-3</td>
<td>flapping stereotypy was significantly decreased, body rocking stereotypy was not.</td>
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GARS-3: Gilliam Autism Rating Scale-3
<table>
<thead>
<tr>
<th>Nakutin, and Gutierrez (2019)</th>
<th>between 9 and 12 years of age</th>
<th>min of seated stretching.</th>
<th>Physical activity has no effect on executive functioning.</th>
<th>Total on-task behaviors increased across three participants.</th>
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<tr>
<td>N=3 (two male and one female, 6-7 years old)</td>
<td>a multiple-baseline design across participants</td>
<td>12 minutes jogging followed by 5 minutes of cooling down.</td>
<td>The behavioral observation of students in schools (BOSS) used to measure on-task behaviors. The online go/no-go to measure executive functioning.</td>
<td>N/A</td>
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</table>
### Appendix B

#### 30 Seconds Partial Interval Data Collection Sheet

**Observer:** __________________________  **Environment:** __________________________

**Student Name** __________________________  **Target behavior** __________________________

**Observation Period:** ___________  **Minute Intervals** ______________

**Activity:** _______  **Start Time** _______  **End Time** _______

+ = behavior occurs even once during the interval

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PHYSICAL EXERCISE FOR STUDENTS WITH AUTISM

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Total intervals observed

Number of +s: _______ out of _______ intervals = ___________% of intervals
Appendix C

Momentary Time Sampling Data Collection Sheet

Observer: __________________________  Environment: __________________________

Student 1 Name ____________________  Target behavior __________________________

Observation Period: _______________  Minute Intervals ________________

Activity: _______  Start Time _______  End Time _______

+ = Record if behavior occurs at the end of the interval

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Appendix D

Social Validity Questionnaire

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<tr>
<th>Teacher:</th>
<th>Date:</th>
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</table>

Consider the use of physical exercise intervention with your students with ASD. How much do you agree with the following statements?

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Slightly Disagree</th>
<th>Slightly Agree</th>
<th>Agree</th>
<th>Strongly Agree</th>
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<tbody>
<tr>
<td>I understood all of the elements of the physical activity intervention.</td>
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<td>Restricted and Repetitive behaviors have decreased since the implementation of the physical activity intervention.</td>
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<td>Appropriate on-task behaviors have increased as a result of the implementation of the physical activity intervention.</td>
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<td>My participation in the implementation of the physical activity intervention was relatively easy (e.g. amount of time/effort) to implement.</td>
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<td>Participation in implementing the Physical activity intervention for this student was worth the time and effort.</td>
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<td>The Physical activity intervention fits within my current school climate.</td>
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## Appendix E
### Treatment Integrity Checklist

<table>
<thead>
<tr>
<th>Intervention Steps</th>
<th>Rating</th>
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<tbody>
<tr>
<td>Organize the Gym with all needed materials and print all data collecting sheets.</td>
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<tr>
<td>Keep the cones and visual cards 15 feet away from each other (making five stations)</td>
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<td>One-on-one direct instruction to state the goal and the expectations of physical exercise sessions.</td>
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<td>Performance assessment completed at the beginning of the PE session</td>
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<tr>
<td>Participants warm up and stretch prior to the first PE station</td>
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<tr>
<td>Switching students from a station to another after five minutes.</td>
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<tr>
<td>Track the time of engagement in PE by activating the stopwatch.</td>
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<tr>
<td>Deliver tangible reinforcement with verbal praise.</td>
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<tr>
<td>Date taken after completion of 20 minutes of PE sessions.</td>
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<td>Cooling down before dismissing students from the Gym.</td>
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<tr>
<td>Number of “Yeses”</td>
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<tr>
<td>Percentage: (&quot;Number of &quot;Yeses&quot;/10) 100</td>
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Appendix F

Child’s Assent Form- English Version

Duquesne University
Institutional Review Board
Protocol #: 2021/12/11
Verified On: 01/30/2022
Expires: No Expiration Date

DUQUESNE UNIVERSITY
600 FORBES AVENUE • PITTSBURGH, PA 15282

CHILD’S AGREEMENT TO PARTICIPATE IN A RESEARCH STUDY

TITLE:
The Impact of Physical Exercises on Increasing On-Task Behaviors and decreasing inappropriate behaviors in Elementary Students with High Functioning Autism Spectrum Disorder in Saudi Arabia.

WHO IS DOING THE STUDY?
Shadi Ahmad Albadawi, Ph.D. Student, Special Education, School of Education
albadawis@duq.edu, (646)830-3546

ADVISOR:
Dr. Bridget Green, Assistant Professor of Special Education, School of Education
Department of Counseling, Psychology, and Special Education
greenb@duq.edu 412-396-1852

WHAT IS A STUDY?
Research studies help us understand new things. We can examine new thoughts and ways of doing things. This paper talks about the topic of our research that you may take part in. We will be happy to answer your questions anytime, if you have any questions about the study. Everything is up to you, if you want to take part in the study or not.

WHY IS THIS STUDY BEING DONE?
We are conducting this study because we are trying to find out more about the benefits of physical activities and its effectiveness on increasing the level of on-task behaviors and decreasing inappropriate behaviors during academic sessions. In order to take part in the study, you must be:

- between the ages of 6 and 11 years old,
- diagnosed with ASD,
- Able to participate in physical activities.

WHAT DO YOU HAVE TO DO?
- You will be asked to attend academic classes and participate in school activities normally.
- In the gymnasium, you will participate in structured physical activity sessions that include teaching soccer skills (e.g., passing, kicking, running with the ball). The physical activity sessions precede with stretching and warming up, and follow up with stretching and cooling down for 25 minutes.
- A physical education teacher and the researcher will collect data about your physical performance.
- The researcher will observe your academic participation and the presence of restricted and repetitive behaviors before and after engaging in physical exercise sessions.
- Video recording will be taken during observing academic sessions and physical activities.
PHYSICAL EXERCISE FOR STUDENTS WITH AUTISM

HOW LONG WILL YOU BE IN THE STUDY?

- The study will be over in approximately one to two months.
- Doing this study will take about 2.5 hours.
- Participants will go to the gymnasium three times a week.

IS THIS STUDY HARMFUL? HOW IS IT HELPFUL?

Doing this study is not any more unsafe than other things you do each day. If you are uncomfortable with anything, please let us know and we will stop and do whatever we can to make you feel better. It is important to remember that you are in charge of your body. We do not know if you will be helped by being in this study. We may learn something that will help other children.

There are many advantages of engaging in physical activity programs such as, feeling healthy, interaction with others, and healthy buddies. There is a likelihood of injury during practice in any kind of sport. If anything hurts or you are uncomfortable with some of the questions, please let us know and we will stop or do whatever we can to make you feel better.

WILL YOU GET PAID TO DO THIS STUDY?

There will be no money given to you for doing this study, but doing the study will also not cost you anything.

ARE OTHER PEOPLE GOING TO KNOW WHAT YOU DID OR SAID?

The researcher will keep everything you say and do secret. If we find useful information in our research we will want to share it with others, either by writing a paper about it, or talking about it with other people. If we do this, we will never give out your name or talk about you in a way that someone could figure out who you are or what you said in the research. If there are other things during the research that have your name on them, we will keep them locked in a password.

CAN YOU QUIT IF YOU WANT?

Yes. You don’t have to start if you don’t want to. If you do start, and decide to not continue doing it anymore, just tell one of the researchers, or tell one of your legal guardians/caregivers so they can tell us. Don’t worry; no one will be mad at you if you decide to stop. If you decide to stop participating, you can tell us if we can use any information we already got from you, or you can have us delete it all. It’s up to you.

CAN YOU HEAR ABOUT WHAT HAPPENED?

After the study is completely over, the researchers have to get all of the information together and look at it. Once we do, we can tell you about what we found out, and you can have a copy of paper if you want. Just let us know that you would like to have a copy of it and we will provide it to you for free.

OK, WOULD YOU LIKE TO DO IT?

If you read and understand everything on this paper, and you understand that you don’t have to participate if you don’t want to, and you can quit anytime you want, then sign your name below.

If you still have questions, you can ask them by calling Shadi Ahmad Albadawi at 4129325083. You may contact Dr. Bridget Green, Assistant Professor of Special Education, and Chair of the investigator committee on greenb@duq.edu or at 412-396-1852. If you have questions about protecting you in the study, then the best person to contact would be Dr. David Delmonico, Chair of the Duquesne University IRB, at 412.396.1886.
Would like to get started?
If you do not want to get started, then that is all. Thanks for listening.
If you do want to get started and do the study, please circle the green traffic light and write your name below.

Child’s Signature

Date

Researcher’s Signature

Date
Appendix G

Child’s Assent form- Arabic Version
Appendix H

Parental Consent form- English Version

DUQUESNE UNIVERSITY
600 FORBES AVENUE □ PITTSBURGH, PA 15282

PARENTAL PERMISSION FORM TO PARTICIPATE IN A STUDY

TITLE:
The Impact of Physical Exercise on Increasing On-Task Behaviors and Decreasing Restricted and Repetitive Behaviors in Elementary Students with High Functioning Autism Spectrum Disorder in Saudi Arabia.

INVESTIGATOR:
Shadi Ahmad Albadawi, Ph.D. Student, Special Education, School of Education
albadawis@duq.edu, (646)830-3946

ADVISOR:
Dr. Bridget Green, Assistant Professor of Special Education, School of Education
Department of Counseling, Psychology, and Special Education
greenb@duc.edu 412-396-1852

SOURCE OF SUPPORT:
This study is being performed as partial fulfillment of the requirements for the doctoral degree in School of Education at Duquesne University.

WHAT IS THE PURPOSE OF THE STUDY?
This letter explains information to help you to make a decision whether to allow your child to participate in this research study. This study aims to investigate the effectiveness of physical exercise on increasing on-task behaviors and decreasing restricted repetitive Behaviors in elementary students with high functioning autism spectrum disorder. In order for your child to participate in this study, your child must be: between the ages of 6-11, diagnosed with ASD, and included in general education settings. The agreement of this form gives the permission for your child to be part of the research study. Please read the below information and contact the research for any additional information.

WHY IS THIS RESEARCH STUDY BEING DONE?
This research study requires your child to participate in Structured physical exercise sessions before being observed during academic class. The goal is to investigate the effects of physical activities on enhancing your child's academic performance and reducing restricted and repetitive behavior during academic classes. Therefore, the outcome of the study could benefit other students with ASD in general education schools to learn and behave appropriately.

**Where will the study take place and how long will it last?**

The study will be conducted during academic classes (e.g., reading, or social studies), and in the gymnasium where the physical exercise sessions will be held. The study will be done in one to two months.

**WHAT WILL MY CHILD BE ASKED TO DO?**

The things your child will be asked to do are that:

- Read and sign the child consent form.
- Attend his academic classes and participate in school activities normally.
- Participate in structured physical exercise sessions that last for 25 minutes including teaching basic soccer skills (e.g., kicking, passing, running with the ball).
- Return to the classroom post physical exercise sessions to observe his academic performance and restricted and repetitive behaviors by the researcher and special education teacher.

**HOW STRUCTURED PHYSICAL EXERCISE WILL WORK?**

- Structured physical exercise sessions will be held three times per a week; each session lasts for 25 minutes.
- In the gymnasium environment, five numbered stations will be designed with visual support cards and cones. Children will engage in five different exercises for five minutes per each station.
- Arrows and footprint will be used between stations to direct your children to the following station.
- Timing devices will help children to understand the expectation of how long they are going to perform that exercise for each station.
- After attending physical activity sessions, the researcher will observe his academic performance and restricted and repetitive behaviors during reading class.
- The researcher will collect data about your children's behavior and On-task behaviors level pre-and post-structured physical sessions.

**WHAT ARE THE RISKS AND BENEFITS?**

There are many advantages of engaging your child in physical activity programs such as, well psychological being, interaction with others, and healthy buddies. On another hand, the risks are no more than participating in other physical activities.
COMPENSATION:
There will be no compensation for the child's participation in this study. Participation in the project will require no monetary cost to you or your child.

CONFIDENTIALITY:
Your child’s participation in this study and any personal information that you provide will be kept confidential at all times and to every extent possible. All written and electronic forms and study materials will be kept secure. Any study materials with personal identifying information will be maintained for three years.

RIGHT TO WITHDRAW:
You are under no obligation to give your permission for your child to participate in this study, and you may withdraw your permission at any time by notifying a member of the research team. You are free to withdraw your child at any time for any reason without penalty.

SUMMARY OF RESULTS:
A summary of the results of this research will be supplied to you, at no cost, upon request.

VOLUNTARY CONSENT:
I have read the above statements and understand what is being requested of me and my child. I also understand that my child’s participation is voluntary and that I am free to withdraw my permission for my child at any time, for any reason. On these terms, I agree that I am willing to allow my child to participate in this research project.

I understand that should I have any further questions about my child’s participation in this study, I may call the primary investigator, Shadi Ahmad Albadawi at 6468309346 or send an email to albadawis@duquesne.edu. I also may contact Dr. Bridget Green, Assistant Professor of Special Education, and chair of the investigator committee on greenb@duq.edu or at 412-396-1852. I may contact Dr. David Delmonico, Chair of the Duquesne University Institutional Review Board, at 412.396.1886 if I have questions regarding protection of human subject issues.

______________________________            __________________________
Parent / Legal Guardian’s Signature            Date

______________________________            __________________________
Researcher's Signature            Date
Appendix I

Parental Consent Form- Arabic Version

جامعه دوکین
١٥٢٨٢
٦٠٠ شارع فورس ، بيسغ ، بلجيكا

نموذج تصريح الوالدين للمشاركة في دراسة

تأتي الأنشطة الرياضية على تخزين الأداء الأكاديمي ونقل السلوك المعرفي والمفيد لدى طلاب المرحلة الابتدائية من هم الذين يشاركون في هذه الدراسة

من يقوم بالدراسة: شادي أحمد البديهي، مشرّع درجة الدكتوراه في التربية الخاصة، كلية التربية

albadawis@duq.edu
412-932-5083

الشرف الدراسي: الدكتور رجوي جريج، أساتذة مساعدة في التربية الخاصة، كلية التربية

greenbh@duq.edu
412-396-1852

مصادر الدعم:

أتم إجراء هذه الدراسة لتحقيق حجتي لتمثّل درجة الدكتوراه في كلية التربية بجامعة دوکین.

ما هو الغرض من هذه الدراسة؟

تشرح هذه الرسالة الفنية التي تشير إلى الخلاصات، باستثناء للفيلم بالمشاركة في هذه الدراسة البحتية. تهدف هذه الدراسة إلى تحقيق في معايير المدارس في زيادة المشاركة الأكاديمية ونقل السلوك المعرفي والمفيد لدى طلاب المرحلة الابتدائية الذين يعانون من اضطراب مزاجي التوحد على الأداء. لذا، يشارك فريق في هذه الدراسة، يجب أن يكون فريقًا بين 6-11 سنة، وأن يكون موضعمًا بالاضطراب مزاجي التوحد، وأن يكون متعاونًا في الإعدادات التعليمية العام. للتحقيق الفعلي من هذا النموذج، يحق للفيلم تكوين جزءًا من الدراسة البدنية. يجب قراءة المعلومات أدناه للالتزام بالبحث لأي معلومات إضافية.

لماذا يتم إجراء هذه الدراسة البدنية؟

تتعلق هذه الدراسة الحالية أن يشارك فوقما في جلسات التمرينات المدرسية المشتقة من ملاحظة أثناء الدراسة البدنية. يُعرف النتائج الطارئة الأكاديمية ونقل السلوك المعرفي والمفيد خلال التدريبية. ذلك، يمكن أن ينجم نتائج الدراسة الطلاب الآخرين المتساويون بالانجذاب في مدارس التعليم العام للتعلم وإظهار مزايا مجزية.

أين تتم الدراسة وكيف ستمطر؟

سجّر الدراسة خلال مدارس الدراسة البدنية والدراسات المرامية البينية. ستم الدراسة في غضون شهر إلى ثلاثة أشهر.

ماذا سيفعل من الفيلم أن يفعل؟

• قراءة وتوقيع استمارة موافقة الطفل.
• حضور الممارسة الأكاديمية بشكل طبيعي للاختبارات الأداء الأكاديمي وسلوكية قبل المشاركة في الأنشطة البدنية.
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Duquesne University
Institutional Review Board
Protocol #: 2021/12/11
Verified On: 1/30/2022

PUBLIC DETAILS RECEIVED
PUBLIC DETAILS REVIEWED
PUBLIC DETAILS APPROVED
PUBLIC DETAILS DRAFTED
PUBLIC DETAILS DISTRIBUTED
PUBLIC DETAILS ARCHIVED

PHYSICAL EXERCISE FOR STUDENTS WITH AUTISM
Appendix J

Approval Letter from the Ministry of Education to Conduct Research Study
Appendix K

Approval Letter from the School