

The Effect of Physical Fitness Activities on High School Autistic Students' Cardiovascular
Endurance Fitness Levels

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Table of Contents

List of Tables	i
Abstract	ii
I. Introduction	1
Overview	1
Statement of Problem	3
Operational Definition	3
II. Literature Review	4
Autism and Intellectual Disabilities	4
Fitness	5
Measuring Fitness	6
Key Studies	7
Summary	10
III. Methods	12
Design	12
Participants	12
Instrument	12
Procedure	12
IV. Results	15
V. Discussion	17
Implications of Results	17
Theoretical Consequences	17
Threats to Validity	19
Connections to Existing Literature	19
Suggestions for Future Research	21
Summary	21
References	22

List of Tables

1. Figure 1: Percent of Increase in P.A.C.E.R. Scores	15
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Abstract

The purpose of this study was to observe whether the implementation of extra physical fitness activities during a general education physical education class would help to increase the cardiovascular endurance fitness levels of high school autistic students. The study consisted of a descriptive design with the inclusion of testing the participants prior to and after the intervention of physical activity exercises were implemented. Participants completed the Progressive Aerobic Cardiovascular Endurance Run, or P.A.C.E.R. test, in order to determine if their cardiovascular endurance level would increase after the 5 week implementation of the extra physical fitness activities done during their general education physical education class. It was determined that the implementation of the activities did increase the students' cardiovascular endurance fitness level. More research needs to be conducted in order to study whether the implementation of physical fitness activities in the beginning of a general education physical education class is effective in increasing the cardiovascular endurance fitness level of high school autistic students.

CHAPTER I

INTRODUCTION

Overview

Intellectual disabilities are disabilities that may be characterized by someone having significant limitations in both intellectual functioning and behavior. The term intellectual disability allows researchers to cover and pool from a wide range of students who have difficulties in everyday social and practical skills. However, with autism becoming more common some researchers chose to focus their studies specifically on that disability. “Children with autism spectrum disorder (ASD) present with difficulties in social interaction and communication, often accompanied by repetitive, restricted interests, and behaviors (American Psychiatric Association, 1994). Although difficulties in motor development are not considered primary diagnostic categories for ASD, various researchers have noted that some children with ASD experience considerable difficulties in gross motor development” (Pan 2011, p. 657). Due to the impairments of their social communication interactions, they will interfere or impair the child’s development in gross motor development skills causing a limited rate of participation in physical activity and recreational programs (Memari, et al. 2017).

There are two types of fitness that studies have looked at: skill related fitness and health related fitness. Health related fitness looks at a person’s cardiovascular endurance, muscular strength, muscular endurance, flexibility, and body composition. Health related fitness is the more common type of fitness on which most researchers focus. “Skill-related fitness consists of agility, balance, coordination, power, speed, and reaction time. Health related fitness is primarily focused on improving one’s health whereas skill related fitness is critical for improving health, wellness and focuses on improving someone’s sports related fitness goals” (Jeng, Chang, Liu, & Hou, 2017, p. 198).

Being fit and healthy tends to mean being able to perform daily activities without getting winded or needing to take many breaks. Fit and healthy people generally achieve this through good nutrition, moderate to vigorous physical exercise multiple times a week for a period of 30-60 minutes, and getting enough rest in between. They tend to live a more physically active lifestyle in their spare time.

Being overweight or obese means that your body has 20 percent more body fat than what is recommended by the Body Mass Index (BMI) for someone of your weight and height. Obese individuals tend to have poor nutrition and live a more sedentary lifestyle. Multiple studies discussed the prevalence of overweight and obesity among those with autism spectrum disorder and other intellectual disabilities. “The prevalence of overweight and obesity among youths has become a major health concern worldwide, and youths with autism spectrum disorder are particularly vulnerable to development of obesity due to the complex behavioral, physical, and psychological difficulties” (Pan, Hsu, Chung, Hung, Liu, & Lo, 2015, p. 21).

There are many ways to measure someone’s level of physical fitness and many countries have their own assessment tools that they utilize. The Progressive Aerobic Cardiovascular Endurance Run, or P.A.C.E.R. test, was the tool used in the present study to measure the students’ cardiovascular endurance fitness level. This research is necessary in order to determine if students with an intellectual disability like autism are able to participate and improve their cardiovascular endurance fitness levels inside a general education physical education class. Being inside a general education physical education class is in most cases the only opportunity for students with intellectual disabilities like autism to get any kind of cardiovascular endurance fitness exercise.

Statement of Problem

The purpose of this study was to examine the impact of physical exercise on the cardiovascular endurance fitness level of high school autistic students who participate in a general education physical education class.

Operational Definitions

The variables in this study were endurance and the physical regiment of fitness activities being added to the beginning of class. Endurance was measured via the P.A.C.E.R. test. An additional physical fitness regimen was implemented during the students' general education physical education class.

CHAPTER II

LITERATURE REVIEW

This literature review looks at the effects of physical activity and physical fitness on students with autism and other intellectual disabilities. It will briefly discuss what autism and intellectual disabilities are, the challenges those students face with their fitness and physical activity levels, methods used to evaluate fitness levels, and it will look at different articles and studies that discuss these challenges and if or how these students may be able to overcome those challenges they face due to their disability.

Autism and Intellectual Disabilities

Intellectual disabilities are disabilities that may be characterized by someone having significant limitations in both intellectual functioning and behavior. The term intellectual disability allows researchers to cover and pool from a wide range of students who have difficulties in everyday social and practical skills. Many studies use the term intellectual disability to include students with a variety of disabilities such as Down Syndrome, Executive Functioning Disability, Fetal Alcohol Syndrome, and Autism Spectrum Disorder, to name a few. However, with Autism becoming more common, some researchers chose to focus specifically on that disability. “Children with autism spectrum disorder (ASD) present with difficulties in social interaction and communication, often accompanied by repetitive, restricted interests, and behaviors (American Psychiatric Association, 1994). Although difficulties in motor development are not considered primary diagnostic categories for ASD, various researchers have noted that some children with ASD experience considerable difficulties in gross motor development” (Pan 2011, p. 657). Due to the impairments of their social communication interactions, the disability

will interfere or impair the child's development in gross motor development skills causing a limited rate of participation in physical activity and recreational programs (Memari, et al. 2017).

Fitness

There are two types of fitness that these studies looked at, skill related fitness and health related fitness. Health related fitness looks at a person's cardiovascular endurance, muscular strength, muscular endurance, flexibility, and body composition. Health related fitness is the more common type of fitness that most people focus on. "Skill-related fitness consists of agility, balance, coordination, power, speed, and reaction time. Health related fitness is primarily focused on health whereas skill related fitness is critical for improving health and wellness" (Jeng, et al., 2017, p. 198). While skill related fitness does have benefits to a person's health, it is more common to work on that type of fitness for more serious athlete and plan to participate in individual or team sports.

Being fit and healthy tends to mean being able to perform daily activities without getting winded or needing to take many breaks. Fit and healthy people generally achieve this through good nutrition, moderate to vigorous physical exercise multiple times a week for a period of 30-60 minutes, and getting enough rest in between. They tend to live a more physically active lifestyle in their spare time.

Being overweight or obese means that a person's body has 20 percent more body fat on it than what is recommended by the Body Mass Index (BMI) for someone of your weight and height. They tend to have poor nutrition and live a more sedentary lifestyle. Multiple studies talked about the prevalence of overweight and obesity amongst those with autism spectrum disorder and other intellectual disabilities. "The prevalence of overweight and obesity among

youths has become a major health concern worldwide, and youths with autism spectrum disorder are particularly vulnerable to development of obesity due to the complex behavioral, physical, and psychological difficulties” (Pan, et al., 2015, p. 21). In another study they talked about “In children and youth with disability, the risk of obesity is higher and is associated with lower levels of physical activity, inappropriate eating behaviors, and chronic health conditions” (Hinckson, Dickson, Water, Sands, & Penman, 2013, p.1170).

Measuring Levels of Fitness

There are many ways to measure someone’s level of physical fitness, many countries around the world have their own assessment tools with. While these tools have different names most of them measure fitness levels in very similar ways. The Eruofit test is similar to the American Fitnessgram test. They both measure muscular endurance, strength, cardiovascular endurance, flexibility, and BMI; but the Eurofit test looks at a few more sports related skills and has 4 more components to the assessment tool than the Fitnessgram. In one of the studies done for skill related physical fitness versus aerobic fitness, Hartman, et al. (2017) used parts of the Eurofit test battery to measure aerobic fitness and skill-related fitness levels of their test subjects. “For measuring aerobic fitness the 20-m endurance shuttle run was used. The 20-m shuttle run is a health related item of the test battery. In the 20-m shuttle run test children run back and forth between two lines 20 meters apart, pacing their run to audio signals that are progressively increasing in difficulty” (Hartman, Smith, Houwen, & Visscher 2017, p. 3). This 20-m shuttle run is exactly like the 20-m PACER test that the Fitnessgram uses to measure aerobic endurance. Hartman and colleagues (2017) used parts from the Eurofit test battery to measure skill related fitness levels as well. They used the Plate tapping task to measure upper limb coordination; where children move their preferred hand between two discs while holding their other hand on a

rectangle midway between the two discs. The children tap the discs until 25 cycles are completed. They also used the 10 x 5m run test to measure lower limb coordination and agility. The children run 5m back and forth 10 times, both tests are expressed in measurements of time in seconds.

Another form of measuring levels of fitness is the Brockport test. This is a similar test to the Fitnessgram and Eurofit test, but it is specifically geared towards children with disabilities. "...the Brockport fitness test manual, which was developed for use with female and male youth ages 10-17 with intellectual disabilities, visual impairments, and orthopedic impairments, but may also be used with youth without disabilities" (Baran, Aktop, Ozer, Nalbant, Aglamis, Barak, & Hutzler, 2013, p. 697). Unlike the Fitnessgram which only has 6 testing items, the Brockport test has 27 items. This amount is due to the fact that it can be used with children of various disabilities, so some of the items do not apply to every child and their ability or disability. Some of the items are specifically geared towards children with visual or orthopedic impairment, so if the child being tested does not have those limitations, those items are generally not used to assess their fitness level.

Key Studies

Physical activity interventions are often overlooked in individuals with autism spectrum disorder, however recent studies have shown that participating in therapeutic horseback riding for example can improve the social functioning, motor proficiency, and sensory integrative functions in children with autism spectrum disorder. It has also been shown that engaging in treadmill walking programs can result in significant increases in mean monthly treadmill walking frequency, speed, elevation, and calories expended as well as a reduction in body mass index (BMI) for adolescents with severe autism (Pan, 2011). Pan's (2011) study looked at the effects

of aquatic interventions on aquatic skills and physical fitness components of children with autism and their siblings. The study consisted of 28 sessions, twice a week for 60-minutes and was broken down into four parts. The first part was a 10-minute warm-up devoted to structured social and floor warm-up activities. The second part was a 35-minute period where the children practiced individually or in pairs with their family according to treatment and goals. The third part was devoted to 15-minute games and group activities, and the final part consisted of 10-minute cool-down activities. Each family was assigned a trained instructor for specific instructional needs and safety needs. Pan's (2011) study also tested for physical fitness and used the 16m PACER test (it was more age appropriate than the 20m PACER test) as well as muscular strength and endurance, which used the curl-up test, flexibility, which used the sit and reach test, and the children's body composition was measured using the bioelectrical impedance analysis, which uses alternating currents and measures fat free mass, fat mass, and percent body fat. Improvements were seen in aquatic skills and physical fitness components except in the body composition area. These results show that interventions can be developed to promote motor skills and physical fitness components for children with autism spectrum disorder.

Another study done by Hinckson et al. (2013) looked not just at physical activity in youth with intellectual disabilities and autism but looked at dietary habits and overall health in overweight and obese children within this population. This program was a 10-week program made up of 18 sessions of physical activity, healthy eating, and motivational skills. The parents of the children were also very involved with this program, participating in a one hour family physical activity component and a one hour segment on nutrition and motivational skills. The parents filled out questionnaires before and after the study was completed, and the parents reported that during the program there were fewer hospital visits and absences from school due

to illness. There was also an increase in parental confidence in the child's ability and a decrease consumption in confectionary and chocolates (Hinckson et al. 2013, p 1175-1176).

LaLonde, MacNeill, Eversole, Ragotzy, & Poling, (2014) did a study focusing on increasing physical activity in young adults with autism spectrum disorder. The study used a multiple-baseline-across-participants design with a reversal to demonstrate that a treatment package comprising of goal-setting and reinforcement substantially increased walking by young adults with autism spectrum disorders while at school. A variety of exercise activities were employed and following the exercise interventions, there was a decrease in stereotype, aggression, off-task behavior, and elopement. It was also found that fatigue was not the cause of the decrease in these behaviors because on-task behavior, academic responding, and appropriate motor behavior had increased. The study used pedometers and Fitbits to track the physical activity during the study and goal setting was taught to the young adults as well. On the days they returned to baseline, the participants would ask the researchers to assist them in setting goals; the young adults were reminded that this was not a "goal-setting" day but that they would set goals again in the future. LaLonde et al. (2014) reported that during the treatment portion of the study the young adults were meeting their goals and physical activity had increased, but during the return to baseline portion their physical activity and walking had decreased again.

Collins and Staples (2017) looked at the role physical activity plays in improving physical fitness in children with intellectual and developmental disabilities. They discussed that physical literacy places an emphasis on the variety of components that are integral to being physically active throughout life. The study also looked at how children are not achieving the recommended 60 minutes of daily moderate to vigorous physical activity, how it is a large contributor to children being overweight or obese, and how typically children with intellectual or

developmental disabilities are at a much higher risk of being overweight or obese due to a more sedentary lifestyle. Targeting physical activity and the development of fundamental movement skills did show similar results to programs that targeted physical fitness specifically. While high intensity interval and treadmill training does increase physical fitness it is found to be unsustainable in children with intellectual or developmental disabilities. This study found that group programming with social aspects were more enjoyable for many of the children and is more realistic in order for them to be successful (Collins & Staples, 2017, p. 57).

There are many ways to incorporate fitness into a variety of activities for this population, one study saw a decrease in body mass index, a decrease in body fat and increases in muscular endurance, max heart rate, and the ability to workout longer (Wu et al., 2017) . These results were seen in a study that looked at the effects of a cross-circuit exercise training program for overweight and obese adolescents with intellectual disabilities enrolled in a special education school. The 12 week cross-circuit training program improved the adolescent's cardiopulmonary fitness, balance ability, and muscular endurance (Wu et al., 2017, p. 94).

Summary

The review of the literature suggests that fitness levels among children and young adults with autism spectrum disorder and intellectual disabilities are important. Many of these studies were successful due to routine, knowledge of the practitioner, location and environment, and the available resources. Many of these studies looked at working with children and young adults with intellectual disabilities and autism in an isolated setting among their peers. It would be interesting to see how this population of children and young adults would do in a general physical education class working with their able-bodied peers. Would their fitness improve more because their able-bodied peers would offer extra support and motivation? Would their social

skills improve as well? It was concluded throughout the majority of the studies that physical activities are needed and would help improve fitness levels in students with autism spectrum disorder and other intellectual disabilities.

CHAPTER III

METHODS

Design

The study utilized a descriptive design to examine the impact of physical activity on cardiovascular endurance in high school autistic students inside a general education physical education class. The Progressive Aerobic Cardiovascular Endurance Run, or P.A.C.E.R test, performance times were measured at the start and end of the study measuring out 20 meters for the distance in the gymnasium. This study was conducted over a five-week period.

Participants

Participants were selected as a result of convenience sampling; there were 3 participants in total. Participants were African American males, 14 years of age, and are all on the autistic spectrum. Participants all lived in the Baltimore City area and attended a local high school.

Instrument

Cardiovascular endurance was measured with the Progressive Aerobic Cardiovascular Endurance Run, or P.A.C.E.R test, which is part of the national Fitness Gram, which is used throughout the United States. The tests were performed in the gymnasium with the general education physical education class. The use of the P.A.C.E.R test was selected because it is a standard test used in general education physical education classes across the country. It has very simple directions which are easy to follow, making it a reliable test source to look at students' cardiovascular endurance fitness.

Procedure

Participants were scheduled for a general education physical education class Monday

through Friday from 8:15 a.m. to 9:30 a.m. Their class would show up closer to 8:30 a.m. and go straight to the locker room to change into their uniforms. After the participants changed into their uniforms, they would begin the warm-up which consisted of running or jogging laps around the gymnasium to music for 4-5 minutes; after the class would come together to do some stretching. After the warm-up the students would participate in additional cardiovascular endurance fitness exercises.

The P.A.C.E.R. test is a cardiovascular endurance test used in most middle and high schools throughout the country. Cones are placed 20 meters apart and a recording of beeps is used to guide the students pace to let them know when to run from one set of cones to the other set of cones. If the students make it to the cones before the next beep, they have some time to catch their breath before they have to run again. If they fail to make it to the cones before the next beep two times, then they are finished with the test. While they are running, it is their job to count how many times they completed each “lap”. The researcher recorded each participant’s score after they failed to complete two rounds of the exercise. Participants took part in the pre and posttest during their regularly scheduled general education physical education class for convenience purposes.

Throughout the study, participants completed a variety of fitness activities after their warm-up. The activities would range from running laps for 3 minutes, 1 minute line hops 3 times, 1 minute high knees 3 times, and 1 minute karaoke 3 times. The researcher would record how many laps the participants completed during their warm-up, if they changed into their physical education uniform for class, and whether or not they participated in the fitness activity for that day.

Post-study testing was conducted the same way as the pretesting. The participants came

to their general education physical education class, changed into their gym uniforms, participated in the warm-up and stretches, then began the posttest P.A.C.E.R. test.

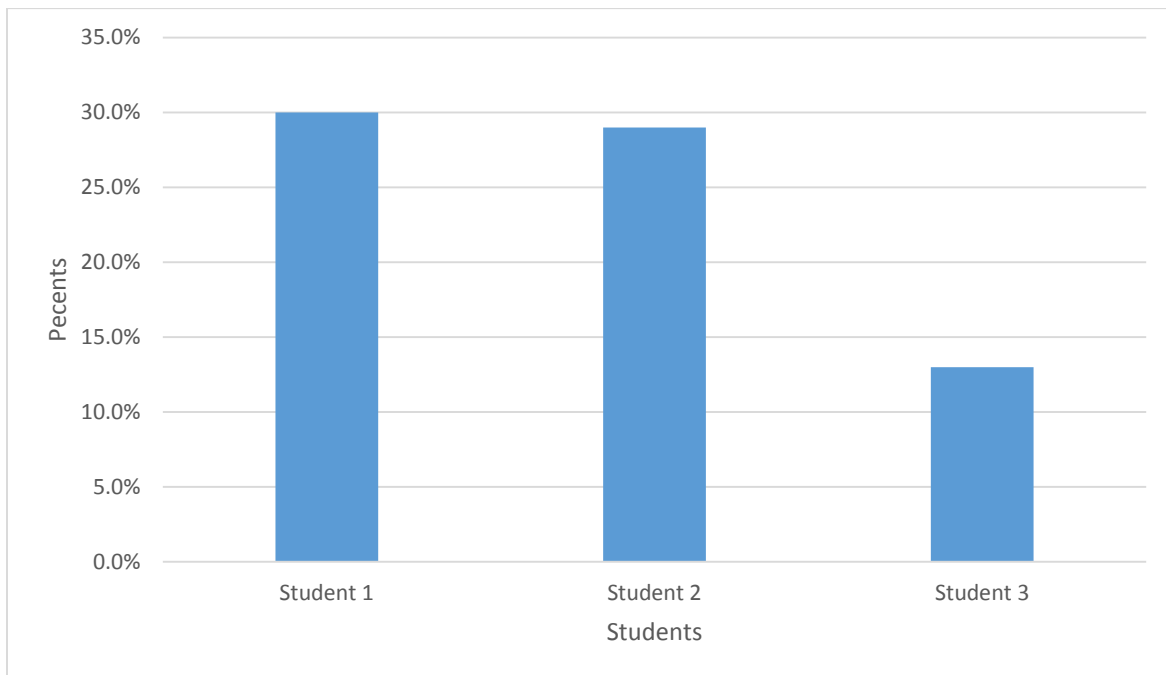
CHAPTER IV

RESULTS

This was a descriptive study consisting of a small sample group of three individual high school autistic student's cardiovascular endurance fitness levels. Although this was a descriptive study, the changes were dramatic and statistical analyses were done. There was pre and posttest data collected and the results showed that there was a significant increase in all three student's scores during the posttest. The mean score for the pre-test was 10.67, which significantly increased to a mean score of 13.00 in the post-test, $t(2)=-7.00, p<.05$. Figure 1 shows the percent increase after the P.A.C.E.R. post-test was performed by the students.

Figure 1

Percent Increase of P.A.C.E.R. Test Scores



Student one showed a 30% increase in his post test score, student two showed a 29% increase and student three showed a 13% increase in his score. The average increase between all three students was 24%.

CHAPTER V

DISCUSSION

This was a descriptive study that looked at three high school autistic students during their general education physical education class, to see if their cardiovascular endurance fitness level would increase. The three students not only participated with their peers in class, but they also participated in extra cardiovascular endurance exercises after the class warm-up. The results showed there was a significant increase to the individual student's cardiovascular endurance fitness level at the end of the study. The results also showed that there was a significant increase to the group's average score as well.

Implications of Results

Although this was a descriptive study, this researcher conducted an analysis to determine if the scores of the three students changed from pre to post. The results showed there was a significant increase to all three student's individual cardiovascular endurance fitness level at the end of the study. The results also showed that there was a significant increase to the group's average score. With only three students, it is difficult to draw overarching conclusions. However, the results indicate it is likely that high school autistic students who participate in a general education physical education class along with the implementation of a few extra cardiovascular endurance physical fitness activities in the beginning of class can increase their cardiovascular endurance fitness level in a short period of time.

Theoretical Consequences

The results of this study provided support for several of the theories on the importance of physical activity. The results in this study showed a significant increase in cardiovascular endurance fitness levels in the three participants which supports the results in other studies that

were done on this topic. In other studies results not only showed the physical benefits to physical fitness activities in this population but also social and behavioral benefits as well. LaLonde et al. (2014) did a study focusing on increasing physical activity in young adults with autism spectrum disorder. A variety of exercise activities were employed and following the exercise interventions, there was a decrease in stereotype, aggression, off-task behavior, and elopement. It was also found that fatigue was not the cause of the decrease in these behaviors because on-task behavior, academic responding, and appropriate motor behavior had increased. The study used pedometers and Fitbits to track the physical activity during the study and goal setting was taught to the young adults as well. In this study not only did the students meet their exercise goals, but their social skills and behaviors improved with the added benefits of physical fitness activities.

Another study done by Collins and Staples (2017) looked at the role physical activity plays in improving physical fitness in children with intellectual and developmental disabilities. The study looked at how children are not achieving the recommended 60 minutes of daily moderate to vigorous physical activity, and how it is a large contributor to children being overweight or obese; and how typically children with intellectual or developmental disabilities are at a much higher risk of being overweight or obese due to a more sedentary lifestyle. This study targeted physical activity and the development of fundamental movement skills, while the study did show similar results to programs that targeted physical fitness specifically, it also showed that high intensity interval and treadmill training does increase physical fitness but is found to be unsustainable in children with intellectual or developmental disabilities. This study found that group programming with social aspects were more enjoyable for many of the children and is more realistic in order for them to be successful (Collins & Staples, 2017).

Threats to Validity

The primary threat to this study was differential selection. The study was based on three students and it was not subjected to randomization. Ideally the study would have used randomization when picking participants and a larger sample group would have likely yielded different results. Because only three students were used for this study, the scores cannot be generalized for all high school autistic students who are participating inside their general education physical education class.

Another threat to the validity of this study is the length of time given for the implementation of the physical activities and amount of time for the data collection. Given more time for data collection and more time spent doing the physical activities would have yielded different results.

Connecting to Existing Literature

Physical activity interventions are often overlooked in individuals with Autism Spectrum Disorder. This study is a much smaller version of the studies that have looked at how students with Autism Spectrum Disorder are affected by physical fitness activities, specifically to determine if their fitness levels have and can improve with the implementation of physical fitness activities. Pan's (2011) aquatics fitness study tested for physical fitness and used the 16m PACER test (it was more age appropriate than the 20m PACER test) as well as muscular strength and endurance, which used the curl-up test, flexibility, which used the sit and reach test. The children's body composition was measured using the bioelectrical impedance analysis, which uses alternating currents and measures fat free mass, fat mass, and percent body fat. Improvements were seen in aquatic skills and physical fitness components except in the body

composition area. These results show that interventions can be developed to promote motor skills and physical fitness components for children with Autism Spectrum Disorder.

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Many of these studies had a larger number of students participating, longer physical activity times, and a longer duration of the study to collect more data. While this study is smaller in sample size and shorter in length, it is still similar and based on the concept that students with intellectual disabilities like autism need and benefit from physical fitness activities. It also

emphasizes that idea their cardiovascular endurance fitness levels can improve if given the opportunity to participate in a variety of physical fitness activities.

Suggestions for Future Research

An ideal situation for this study would have been an increase in the time given for the implementation of the exercises and the collection of the data. Due to the length of time of the class, as well as the fact that the special needs students would show up late to class every day, the length of time given to implement the physical fitness activities was cut to only 3 minutes a day instead of a more beneficial length of time like 5 to 7 minutes a day. Also due to snow days and 2 hour delays the length of time for data collection was affected. Given more time to collect data would have given more accurate results.

Another factor that would benefit future research in the area would be to increase the number of students participating in the study. Because only three students participated, the data cannot be generalized for all high school students who have been diagnosed with Autism. With more students participating the data collected would have possibly provided more accurate and possibly different results.

Summary

In summary, this study probed whether high school autistic students could increase their cardiovascular endurance fitness level during their general education physical education class, with the implementation of extra physical fitness activities at the beginning of class. A few threats to the validity of the study were noted to have implications on future research in this field.

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