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Daniel L. Wheeler

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# MOTOR PROFICIENCY IN AUTISM SPECTRUM DISORDER

## **NORTHERN ILLINOIS UNIVERSITY**

Autism Moves: A Review of Motor Proficiency in Adolescents with  
Autism Spectrum Disorder

**A Thesis Submitted to the  
University Honors Program  
In Partial Fulfillment of the  
Requirements of the Baccalaureate Degree  
With Upper Division Honors  
Department Of  
Health and Human Sciences**

**By**

Daniel Wheeler

**DeKalb, Illinois**

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# MOTOR PROFICIENCY IN AUTISM SPECTRUM DISORDER

## Abstract

As the rate of obesity continues to plague the United States, the disease shows no restraint on its effects in the younger generation of adolescents diagnosed with autism spectrum disorder (ASD). While diagnoses of ASD are based on social and behavioral delays, physical delays continue to be overlooked. Rises in obesity have increased the necessity for support linking motor proficiency to individuals with ASD. Prior literature on the topic has been overall inconsistent with conclusions. This literature review examines positive consistencies between several studies linking motor proficiency to adolescents with ASD; further concluding that there is substantial research supporting the link between adolescents with ASD and a decrease in motor proficiency.

## Introduction

Sedentary living continues to be an issue throughout the United States. By definition, a sedentary lifestyle leads to a decrease in an individual's physical activity. Accompanied by poor nutritional intake, a lack of physical activity is driving the high rates of obesity plaguing today's society. In a study done by Ogden et al. 34.9% of American adults were reported as being obese in the year 2012 (equal or greater than 30.0 Body Mass Index) [1]. Studies have shown individuals with obesity have increased risk of conditions such as diabetes, high blood pressure, and coronary heart disease. According to the U.S. Department of Health and Human Services [2], heart disease is the leading cause of death in the United States attributing to 611,105 people in 2013. Any potential solution in decreasing the prevalence of this condition should not go overlooked. As a major contributor to obesity, a lack of physical activity, and in turn sedentary living, directly correlated to the death of 34.9% of Americans in the year 2012.

According to the authors of the government organization *Choose MyPlate*, Adults age 18-64 years are recommended to engage in at least 2 hours and 30 minutes of moderate physical activity each week (approximately 20-25 minutes each day). Furthermore it is recommended that children, age 6-17 years, are to be engaged in at least 7 hours of physical activity each week (60 minutes each day) [3].

Autism Spectrum Disorder can be defined as a "term for a group of neurodevelopmental disorders sharing similar impairments in communication, reciprocal social interaction, and restricted, repetitive behavior" [4]. ASD is inclusive of Autism, Asperger's Syndrome, as well as several other disorders associated with a developmental delay. Using the criteria of the Diagnostic and Statistical manual of Mental Disorders (DSM-V), children are typically diagnosed with ASD by the age of three.

Motor proficiency of the lower extremities can be observed in an individual's gait. Gait can be defined as the method in which one uses the lower extremities to move from point A to point B [5]. In layman's terms, gait is the pattern of how an individual walks. Atypical gait is found in

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individuals with delayed motor proficiency. Such observational differences may include wider stances, varying cadences, as well as exaggerated lateral motion while walking in the sagittal plane [9].

The cerebellum is a section of the brain located inferior and posterior to the cerebrum. Cerebellar functions include sending neurological impulses to various skeletal muscles throughout the body. These impulses are sent in response to environmental stimulations causing sensory processing in the brain. Cerebellar ataxia can be defined as a lack of control of cerebellar motor coordination [9].

The purpose of this article is to review prior literature regarding motor function and its links to ASD. Overall research has been controversial; however studies support the claim that a delayed motor proficiency (i.e. atypical gait, balance, coordination) is significant throughout the spectrum. Regardless, such physical traits remain absent from the defining symptoms of an individual's diagnosis of ASD. This article provides links between neurological roots of ASD, motor proficiency, and the effects on an individual's physical activity.

### Search Methods

Several articles discussed in this review were provided by Northern Illinois University Assistant Professor, Dr. Christina Odeh, DPT. The remaining articles were searched and found using the PubMed, an online database. Six key terms were used in the search: autism, autism spectrum disorder, motor proficiency, motor coordination, gait, adolescents.

### Results

#### *Identifying Physical Activity Determinants in Youth with Autistic Spectrum Disorder*

Chien-Yu Pan and Georgia C. Frey [6] conducted a study in search determinants of physical activity in adolescents with ASD. The study was designed with thirty children with ASD and a mean age of 13.2 years. With the use of accelerometer technology as well as participant self-evaluation surveys, the authors obtained physical activity data. They found two significant results. The most significant determinant to an individual's physical activity was age. Pan reports that the older the individual, the less likely he/she is to engage in a sufficient amount of physical activity. Also deemed significant in the effect of one's physical activity is the drive for a sedentary lifestyle. Taking into account data showing children with ASD report less time in sedentary pursuits (107 min/day) than children without ASD (134-234 min/day), the authors of this study consider availability as a factor. Children with ASD are anticipated to be busier with added medical and therapy appointments. This concept of availability supports the findings of

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age playing a significant role in physical activity. As one ages, one's life becomes much busier. As one's life becomes busier, there is less time allotted for physical activity.

### *Motor Proficiency and Physical Fitness in Adolescent Males with and without Autism Spectrum Disorders*

Chien-Yu Pan [7] published a study in 2014 with the purpose of comparing motor proficiency in adolescents with and without ASD. The study consisted of 31 male participants in the experimental group, with a mean age of 14.58 years, and 31 male participants in the control group, with a mean age of 14.70 years. The experimental group consisted of 7 individuals with asperger's syndrome and 24 individuals with high functioning autism. Data was collected by having participants individually complete Bruininks-Oseretsky Test of Motor Proficiency, 2nd ed. (BOT-2), the BROCKPORT Physical Fitness Test (BPFT), and the bioelectrical impedance analysis (BIA) assessments. The BOT-2 examined participant's motor proficiency with four composite scores in: fine manual control, manual coordination, body coordination, and strength & agility. This test was scored based on observation of three researchers. The BPFT examined the participant's physical fitness. This consisted of a series of fitness tests evaluating muscle strength and endurance. Each participant was scored quantitatively based on the number of repetitions completed. BIA is a method to assess the participant's body composition. Participants of the experimental group scored significantly lower in all tests of the BOT-2 exam. The largest discrepancy was the evaluation of participant's manual coordination and strength & agility. Similarly on the BPFT exams, participants of the experimental group scored significantly lower in "the PACER, the isometric push-up, and the sit-and-reach tests" (p.160). Pan went on to connect these scores to "lower levels of cardiovascular endurance, upper-body muscular strength and endurance, and lower-body flexibility, compared with adolescents without ASD" (p. 160). Pan [7] suggested possible reasoning for these scores including a lack of social skills, a decrease of fitness skills and motivation, as well as the possibility of developmental delays in the motor skills of children with ASD.

### *Motor Coordination in Autism Spectrum Disorders: A Synthesis and Meta-Analysis*

Kimberly Fournier and associates [4] published a meta-analysis in 2010 with the goal of seeking clarity in the previously controversial comparisons of motor coordination in individuals with ASD. Data from 41 different studies were compiled and contributed to the results of this study. The content data from each study must have included at least one of the following regarding motor proficiency: "motor coordination, motor impairment, arm movement, gait, or postural stability" (p. 1229). Comparing the results of the studies entered into the meta-analysis, the authors of this study found overall significant deficits in the motor proficiency of individuals with ASD when compared to individuals without ASD. Specifically, results showed significant

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deficits in motor coordination in both upper and lower extremities. The authors concluded that individuals diagnosed with autism having greater motor deficit effects than those diagnosed with asperger's syndrome or a nonspecific ASD diagnosis [8].

### *Gait Function in Newly Diagnosed Children with Autism: Cerebellar and Basal Ganglia Related Motor Disorder*

Nicole Rinehart and associates (2006) [9] conducted a study with the purpose of tracing motor proficiency, specifically gait, of children with autism to dysfunction in the cerebellum. The study consisted of an experimental group of 11 children diagnosed with autism. The mean age of this group was 5 years and 10 months. The control group consisted of 11 match participants without autism. The mean age of the control group was 5 years and 9 months. Both groups consisted of 8 males and 3 females. With the use of GAITRite Walkway technology, data was recorded for each participant's velocity, cadence, stride length, double support, and heel-to-heel base of support. When compared to the control group, the experimental group showed several motor delays: more missteps, greater width range, larger adjusted ataxia ratio (the summation of the standard deviation of step length and the standard deviation of step width; divided by two); greater variation in velocity, stride length, and stride time; as well as significant differences in overall coordination, smoothness, consistency, and head & trunk posture. Rinehart reports that "greater difficulty walking in a straight line, reduced stride regularity with increased variability in velocity, and the coexistence of variable stride length and duration" (p. 822) are implications of cerebellar ataxia in the children with autism.

## **Discussion**

Widely identified as a psychiatric disorder for an extended period of time, autism spectrum disorder is now understood to have neurological roots. Researchers have investigated theories on underlying dysfunction of the basal ganglia and cerebellum in ASD. The neurological theories have been supported by observed motor variation (gait) in children with ASD compared to the gait of children without ASD. Atypical motor proficiency reported by Rinehart [9] is consistent with results from the meta-analysis study conducted by Fournier [4]. These consistencies continue with the 2014 study by Pan[7]; Pan summarized further support from prior studies. There is a lack of motor proficiency in adolescents with ASD when comparing them to participants without ASD [7, 8, 9, 10, 11, 12]. With a lack of physical activity playing a role, a 2014 study [6] reports 31.8% of adolescents diagnosed with autism are obese. This is compared to 13.1% of adolescents without a developmental disability who are obese [13]. Such a significant difference calls for immediate action. Some questions remaining include how much of this discrepancy is related to the decreased motor proficiency? How big of a role do underlying symptoms of ASD such as delays in social ability, communication, and behavior play

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in this discrepancy? As noted by Pan [6], does the availability of physical activity or lack thereof, play a significant role in the discrepancy? Each of these questions calls for continued research.

A lack of generalizability alone is a significant motive for further research. With the exception of Fournier's meta-analysis, all of the reviewed studies consisted of relatively small sample sizes. Moreover, the participants of each individual study lacked diversity. As Fournier reported, motor capabilities tend to decrease when there is an increase in the diagnosis severity [8]. Given the large variety in the symptom severities in individuals with ASD, results are expected to differ based on the symptom severities of the participants in the given study. This may be a reason for the noted inconsistencies on the topic discussed in previously published literature.

Regardless of inconsistent findings comparing motor proficiency and the full spectrum of ASD, it is evident that many individuals with some form of ASD are negatively affected in motor proficiency. Based on these findings and more, this author supports the notion of implementing interventions to address motor coordination, gait, and postural control & balance in clinical therapeutic activities with adolescents with autism spectrum disorder.

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