



Brief Report: The Utility of a Golf Training Program for Individuals with Autism Spectrum Disorder

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Abstract

Autism spectrum disorder (ASD) is a common neurodevelopmental condition characterized by impairments in communication, social interactions, as well as motor functioning. Additionally, individuals with ASD are at a greater risk for health concerns due in part to a more sedentary lifestyle. Therefore, it may be advantageous to introduce more physical activity or sport-based training into autism therapeutic programs. Here, we introduce and evaluate a 6-week, 12 session golf-training program that integrates the teaching of autism-relevant social and communicative skills into each lesson. The results showed that all 46 participants ($M = 11.46$, $SD = 6.21$) improved on at least one outcome measure, and statistically significant increases in all measures (communication skills, social skills, motor skills, and regulatory skills) were detected from pre to post. These preliminary findings highlight the utility of an autism-targeted golf training program for all ages; future studies should seek to replicate this strategy in other settings and using other sports or recreational activities.

Keywords Autism spectrum disorder · Treatment of autism · Sport interventions and autism · Physical activity training · Motor functioning in ASD

Autism spectrum disorder (ASD) is an increasingly prevalent neurodevelopmental condition characterized by impairment in social behaviors and communication as well as the presence of repetitive behaviors (Dawson et al. 2010). Traditionally, finding ideal interventions has been challenging given the heterogenous nature of ASD, alluding to the need for more diverse therapy programs that cater to the needs of the individual (Benger et al. 2018). Treatment programs commonly address cognitive, language, and social development, which are indispensable skills for individuals of all ages with ASD to gain proficiency in. However, an additional domain of concern in autism is motor skills. Here, limited motor coordination, deficiencies in fine and gross motor functioning, and repetitive, stereotypical movements, are all common (Pan et al. 2009; Emck et al. 2011). Therefore, it is likely advantageous for treatment plans to include a form of physical activity or organized sport, not only to address these motor concerns but also to serve as an effective promoter of overall physical and mental health. Participating

in sports may be particularly enjoyable, stress-relieving, and effective in promoting social skills; however, thus far there has been limited empirical investigation regarding the influence of sport training on symptoms of ASD (Hardin et al. 2001; Weiss 2000). Here we extend this research by examining the efficacy and value of a 6-week comprehensive golf training program designed to facilitate further development of social, motor, and communication skills.

Physical Activity and Sport Interventions for Autism

Several researchers and clinicians have argued for the importance of implementing physical health programs into autism intervention plans, such as yoga, aerobic exercise, and organized sport training (Todd and Reid 2006). In addition to improving physical and neurological health, sport-training has shown to have a positive impact on social skills and self-esteem in typically developing samples (Tremblay et al. 2000). It is noteworthy that some individuals with ASD are at particular risk for health concerns due in-part to a more sedentary lifestyle, alluding to the possibility that they would receive even greater

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benefits from sport training than typical samples (Sandt and Frey 2005). Bandini et al. (2013) recently found that parents of 3–11-year-olds with ASD reported significantly less physical activity in their children compared to parents of age-matched typically developing children, highlighting the early presence of disparities in physical activity engagement. Systematic research on the efficacy of physical training in ASD is relatively scarce and has primarily focused on small samples or case studies. Still, numerous positive effects of physical training interventions on social, cognitive, and behavioral symptoms of ASD have been illustrated thus far. Nicholson et al. (2011) found that a brief after-school jogging program resulted in significantly higher academic achievement and engagement in a sample of four elementary-school aged children. Hinckson et al. (2013) found that following a 10-week, 18-session physical activity and nutrition program, children with ASD showed improved fitness and reported fewer absences from school due to illness. Additionally, reductions in stereotypical behavior, hyperactivity, and self-injurious behaviors have been found following swimming, jogging, and roller-skating programs (Yilmaz et al. 2004). It has been reported that, aquatic and equine therapies have similarly resulted in improved peer relationships and reduced aggressive and antisocial behaviors (Pan 2010; Wang et al. 2010), while also stimulating gross-motor functioning (Oriel et al. 2011). Most recently, Pan et al. (2017) found that table-tennis training may be a viable option for improving motor skills and executive functioning in children with ASD.

Together, these studies signify the potential value of sport/physical activity training programs for ASD, yet important strategic and methodological issues allude to the need for additional research and evaluation (Sowa and Meulenbroek 2012). First and foremost, the reviewed studies were primarily case-studies, and none examined samples larger than 10 participants. Although case study designs can be highly informative, the generalizability of results to other individuals with ASD is limited in such designs (Dawson et al. 2010). In addition, few programs have attempted to incorporate the teaching of vital social/communication skills throughout sport sessions. Finally, few effects to our knowledge have been reported for sport programs involving a high-degree of both balance and fine-motor training such as golf, tennis, or baseball. Therefore, the current study aimed to expand on these limitations and further explore the influence of physical activity/sport training on symptoms of ASD by including (1) a larger sample size of participants involved in the same program ($N = 46$), (2) a sport training program (i.e. golf) that is particularly focused on fine-tuning balance and motor abilities while incorporating social training, and (3) a large range of outcome measures.

Method

Participants

In total, 46 individuals aged 6 to 24 years ($M = 11.46$, $SD = 6.21$) took part in the golf training program. All participants (37 male, 9 female) had received a prior diagnosis of ASD according to reports provided from a parent or teacher. Participants had a wide range of abilities and degree of functioning as there was no minimal level of social, communication, or fine/gross motor skills required to sign up. A brief demographic questionnaire was administered to parents to gather information on the age, gender, golf-experience, expressive communication, and receptive communication of the participants at baseline. Of the 46 participants, 26 were described as “beginner golfers” and 20 as “first time players”. Regarding receptive communication, 35 could understand “full sentences” while 11 could understand “1–2 words”; and considering expressive communication 36 had “verbal abilities”, 8 communicated “with pictures” and 2 communicated “with devices”. The program was administered at several locations throughout the U.S. including Jupiter, Miami, Dallas, Aiken, Providence, and Hilton Head. Each participant was rated by the same individual for both the pre- and post-tests. To clarify, a different individual completed the ratings at each center but did so for all participants at that particular location. These raters were asked to indicate their prior knowledge of ASD on a 1–10 Likert scale and the average score across all sites was 5.62. All participants were treated in accord with the ethical considerations outlined by the American Psychology Association (APA) and The Code of Ethics of the World Medical Association (Declaration of Helsinki).

Materials and Procedure

Ernie Els #Game on Autism Golf Program

The Ernie Els #GameON Autism (TM) Golf Program consists of 12 group lessons, with each 45-min session containing a specially designed lesson plan that delivers golf instruction incorporated with targeted autism learning objectives. The program is entirely developed by the Els for Autism Foundation, a program created by golfer Ernie Els and wife, Liezl Els with the mission of helping people on the autism spectrum fulfill their potential to lead positive, productive, and rewarding lives. The curriculum is a comprehensive program for individuals with autism and utilizes multiple evidence-based practices identified by the National Professional Development Center on Autism

(Odom et al. 2014). All individuals with ASD or other developmental disabilities should be encouraged to participate as the lesson plans and degree of instruction can be adapted for different groups or to meet the needs of an individual. For this study, the program was held at various golf courses, however it is replicable at any location that contains a large field of grass, within which holes can be manually created, or targets can be used as a replacement. It is important to note that each class occurred in a group setting to promote additional socialization and team building exercises, with no more than a 4 to 1 student to golf professional ratio. In most cases, volunteers assisted so that more individual instruction could be provided for those with less advanced motor abilities. Class sizes ranged anywhere from 5 individuals to 15 and the number of stations was adjusted accordingly so that there were no more than 5 individuals at one station at a time. Because the majority of participation involved only 1 to 2 stations there was minimal walking required by each class.

This golf program is unique because instructors not only emphasize golf instruction but also incorporate autism learning objectives into each class. The lesson plans center around one of four core learning concepts targeted to the needs of individuals with ASD including communication skills, regulatory skills, motor skills, and social skills. Additionally, one of four critical golf skills (distance control, getting the ball in the air, aiming at the target, and taking practice swings) is also a focal point of the lessons. In this procedure, each of the 12 sessions followed a similar structure consisting of warming up, reviewing the schedule and rules, reviewing the two learning objectives (one golf, one autism learning), water break, participating in the golf station, and then cleaning up and closing with a team meeting. A range of golf skills were taught throughout the lessons including putting, pitching, small swings, chipping, full-swings, taking practice swings, ball control, and aiming. Autism learning objectives incorporated throughout the lessons consisted of following directions, trying new things or every activity, maintaining focus/patience, motor coordination, taking turns and sharing, responding and asking for help, getting comfortable, visualization, working with others, and having fun with friends. Several materials are needed to implement the program including various sizes of kid's golf clubs and putters, colored golf balls, hula hoops, colored training spots and lines, as well as plastic cones. Specifically designed visual supports are also an integral part of the program including station signs with a visual task analysis of each golf swing, visual rules list, visual schedule, picture communication symbol commenting board, and receptive communication cards used by instructors and volunteers to support understanding of basic commands. In addition, the program utilizes a priming video to prepare participants prior to the first lesson that reviews the key elements of the program,

as well as two different-level golf activity books to provide participants and volunteers with basic knowledge of golf concepts and vocabulary.

Several fitness exercises were regularly incorporated into the golf training sessions during warm up routines as well. The exercises target four aspects of fitness (abdominal strength, lower body strength, balance, and flexibility) that are critical for ameliorating golf technique and endurance. Exercises included plank (holding oneself off the ground with arms straight below shoulders fully extended), standing long-jump (two-foot jump from the starting line going for maximum distance), individual leg balance (raise each leg to 90° and hold as long as possible), and V-Sit and Reach (sit on ground in “v-shape” and reach as far as possible).

Pre- and Post-training Evaluation

The domains of behavior captured by the evaluation were receptive communication skills, expressive communication skills, social skills, regulatory skills, and motor skills. For all five sections, scores were recorded on a (1–5) Likert scale with 1 being the lowest and 5 the highest. Receptive communication scores were calculated as the average score on two separate statements (i.e. “The student listens and responds to individual instruction with only one reminder/prompt” and “The student listens and responds to group instructions with only one reminder/prompt”). Expressive communication scores were calculated by averaging scores from three separate items (i.e. “The student asks for help with words, signs, pictures, or gestures”, “The student responds to peer or adult interactions using words, signs, pictures or gestures, and “The student responds to simple questions using words, signs, pictures, or gestures”). Social skills score was calculated as the average score of four items (i.e. “The student waits for his/her turn”, “The student shares equipment/materials”, “The student interacts well with others by keeping personal space”, and “The student demonstrates sportsmanship by cheering on a peer”). Regulatory scores were calculated as the average of three items (i.e. “The student is able to stay calm or be easily calmed when he/she is frustrated”, “The student obtains sensory input or sensory reduction as needed”, and “The student uses a golf club safely”). Finally, Motor scores were averaged from two items (i.e. “The student demonstrates motor coordination” and “The student demonstrates motor planning”). Additionally, a questionnaire was administered to several teachers and therapists across the locations to gauge the community perception of the program's effectiveness. The questions focused on whether the teacher had observed improvements in social, communication, motor, and regulatory domains while the individual was involved in the program. The raters were asked to answer these questions on a 1 to 5 Likert scale

(1 = strongly disagree, 2 = somewhat disagree, 3 = neutral, 4 = somewhat agree, 5 = strongly agree).

Results

To analyze the efficacy of the golf intervention, a 2×5 repeated-measures ANOVA was conducted with time (pre/post) and measure (expressive communication, receptive communication, social skills, motor skills, and regulatory skills) as the within-subjects variables. The two-way interaction effect of time and measure did not reach significance, $F(4, 180) = 3.24, p = .164$, however both the main effect of time, $F(1, 45) = 31.64, p = .000$ as well as the main effect of measure $F(4, 180) = 96.77, p = .000$ were statistically significant. To determine which specific measures were changed following the golf program, five paired samples t-tests were conducted and analyzed using a Bonferroni correction to control for the family-wise error rate (i.e. $\alpha = .01$). Significant pre-to-post improvements were identified in all skill-domains including receptive communication $t(45) = -5.63, p = .000$, expressive communication, $t(45) = -3.03, p = .004$, social, $t(45) = -3.73, p = .000$; regulatory, $t(45)$

$= -4.19, p = .000$; and motor, $t(45) = -4.84, p = .000$. The results are visualized in Fig. 1 and the pre- and -post means can be found in Table 1. Additionally, the analysis was repeated multiple times with age, gender, location of training, baseline golf ability, baseline expressive communication, and baseline receptive communication entered as covariates. None of these additional factors had significant main effects on the outcome measures; nor did they have a significant interaction effect with “time” or “type of measure” (all p 's $> .05$). The community perception questionnaire showed that 100 percent of the raters ($N = 5$) reported that their student's improved (somewhat agree or strongly agree) in all measured skills (communication, social, motor, and regulatory) following the program. The complete results of this questionnaire can be found in Table 2.

Discussion

The aim of this article was to evaluate the efficacy of a 6-week golf training program that was created as an enjoyable, recreational activity to stimulate motor skills and social/communicative functioning in individuals with ASD. It is noteworthy that participants displayed significant increases in receptive/expressive communication skills, social skills, regulatory skills, and motor skills following the program. It was also encouraging that all five teachers who completed the community perception scale perceived that the program had a positive impact on their students. Physical activity and sport approaches to treating autism have been underappreciated, as evidenced by the relatively scarce literature on this topic (Sowa and Meulenbroek 2012). Here, we show preliminary evidence that sport training (in this case golf) has the potential to improve hallmark characteristics of ASD. Future studies should replicate this program using more rigorous methodologies to confirm the long-term influence of sport participation on the functioning of individuals with autism. The Ernie Els #GameON Autism (TM) golf program is unique in that it combines physical activity with methods to train communication, social, and regulatory skills. For example, all sessions focus on two learning objectives; one

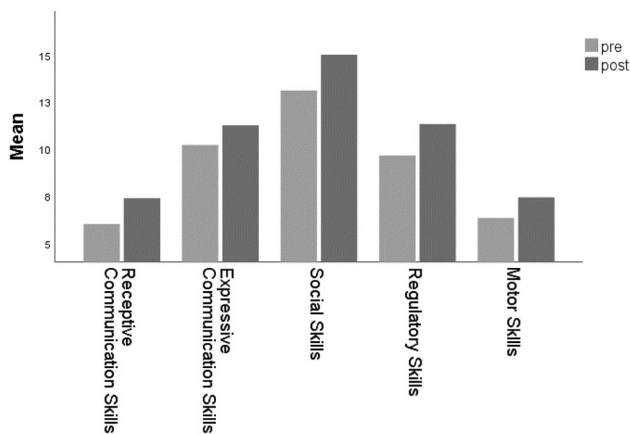


Fig. 1 Changes in social, communicative, motor, and regulatory functioning (pre- to -post)

Table 1 Post-hoc results for specific domains of behavior

Measure	Sample size	Pre-test mean (SD)	Post-test mean (SD)	p value
Receptive communication	46	6.00 (2.01)	7.37 (2.11)	.000**
Expressive communication	46	10.22 (3.77)	11.26 (3.51)	.004**
Social skills	46	13.11 (3.97)	15.02 (4.21)	.001**
Regulatory skills	46	9.65 (3.18)	11.33 (3.28)	.000**
Motor skills	46	6.33 (2.38)	7.41 (2.49)	.000**

There were significant increases in all behavioral skills from pre to post using a bonferonni criteria to control family wise error rate

Subsequently, all p -values less than .01 are marked for significance (**)

Table 2 Community perceptions of program effectiveness

Survey questions (1–5) scale	Teacher 1	Teacher 2	Teacher 3	Teacher 4	Paraprofessional 1
Did the golf instructors effectively deliver the autism learning concepts during each golf session?	4 (Somewhat agree)	4 (Somewhat agree)	4 (Somewhat agree)	5 (Strongly agree)	5 (Strongly agree)
Did your students demonstrate the autism learning concepts (communication skills)?	5 (Strongly agree)	5 (Strongly agree)	4 (Somewhat agree)	4 (Somewhat agree)	4 (Somewhat agree)
Did your students demonstrate the autism learning concepts (regulatory skills)?	5 (Strongly agree)	5 (Strongly agree)	4 (Somewhat agree)	4 (Somewhat agree)	4 (Somewhat agree)
Did your students demonstrate the autism learning concepts (social skills)?	5 (Strongly agree)	5 (Strongly agree)	4 (Somewhat agree)	4 (Somewhat agree)	5 (Strongly agree)
Did your students demonstrate the autism learning concepts (motor skills)?	5 (Strongly agree)	5 (Strongly agree)	4 (Somewhat agree)	5 (Strongly agree)	5 (Strongly agree)
Did you observe changes in the following behaviors for any of your students Please check all that apply	Better focus, improved wait time, willingness to clean up, interest in golf	Better focus, improved wait time, willingness to clean up, better turn taking, interest in golf	Better focus, improved wait time, willingness to clean up, decreased frustration, interest in golf	Better focus, improved wait time, willingness to clean up, better turn taking, interest in golf, increased peer communication	Better focus, improved wait time, willingness to clean up, interest in golf

golf-related (i.e. putting or getting the ball in the air) and one life-skill related (i.e. complimenting another player). Prior studies have demonstrated improvements in autism-related symptoms following jogging, swimming, and horseback riding sessions, particularly for regulating stereotyped behaviors and improving focus (Pan et al. 2017; Todd and Reid 2006). To our knowledge, this is the first study to highlight positive changes in ASD targeted behaviors following training with golf. Golf may be particularly advantageous for the fine-tuning of motor skills (deficient in ASD) given the importance of hand–eye coordination, strength, balance, and motor control in this sport (Bezzola et al. 2011). Another advantage is that golf is not overly taxing on cardiovascular systems, allowing for increased opportunity for socializing with instructors and peers, which is an integral aspect of this particular golf program. This could also be viewed as a limitation of golf-based training given that other activities such as running and swimming have proven to be advantageous for cardiovascular health as well as stimulating brain neurotrophic factor (Rasmussen et al. 2009). Still, aerobic exercises such as plank, jump squats, and v-sits were frequently integrated into the program. Overall, the comprehensive approach utilized in this golf program is advantageous and can be replicated with other sports as the focal point such as tennis, soccer, ping-pong and volleyball, if golf equipment is unavailable.

There were methodological limitations to the study that are important to consider when drawing conclusions about the effects of this training on common characteristics of ASD. First and foremost, there was no comparative control group and thus, the influence of confounding effects such as time and alternative treatments can not be ruled out. Many of the participants were receiving other forms of therapy during the duration of the program and it also remains possible that their symptoms simply improved over time or with age. However, the effects of the program were robust, as all 46 participants showed improvements in at least one of the four measured domains (social, communication, regulatory, motor) and none of the participants showed reductions in any skills. Second, the pre- and -post measures were only rated by one individual and so inter-rater reliability of the outcome measures could not be confirmed. Lastly, the outcome measures were all based on observed behaviors which are susceptible to experimenter bias. To account for these limitations, it is important for future studies to include a wait-listed control group, multiple raters of the behavioral measures, as well as the use of objective biomarkers of ASD such as brain functionality (EEG), motor responses (eye-tracking), or more robust behavioral data collection.

In conclusion, a 6-week comprehensive golf training program yielded significant improvements in four core characteristics of ASD (impairments in communication, social, regulatory, and motor skills). The strengths of this study

were the (1) advancement of a relatively unexplored topic (i.e. sport training as an intervention program of autism), (2) the large sample size of participants (46) compared with prior studies, and the (3) presentation of a unique golf training program that integrates social, regulatory, and fitness elements with golf instruction. Group sport sessions offer a prime opportunity for individuals with autism to improve their motor and social skills in an atmosphere that is both engaging and enjoyable. Such programs should be seriously considered as viable components of autism treatment programs as well as school curriculums.

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Compliance with Ethical Standards

Conflict of interest All authors declare that they have no conflict of interest.

Human and Animal Rights All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent Informed consent was obtained from all individual participants included in the study.

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