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Quantitative Paper

Examining the Impact of a Multi-Sport Camp for Girls Ages 8–11 With Autism Spectrum Disorder

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Abstract

Research on Autism Spectrum Disorder (ASD) has increased significantly over the past decade; however, rarely does research focus solely on girls with ASD. Girls with ASD are more likely to have less proficient motor skills than both their peers with typical development, and boys with and without ASD. This further discourages participation in sport, recreation, and leisure activities and deprives the opportunity to develop social skills among peers; both of which are primary goals of therapeutic recreation. The purpose of this study was to examine the impact of a multi-sport camp intervention aimed at improving motor skills, physical activity levels, physical self-perceptions, and adaptive behaviour of 13 girls with ASD between the ages of 8 to 11. Results indicated that the camp was effective at improving motor skills ($p<0.0001$), physical self-perceptions ($p=0.044$) and social skills ($p=0.005$); however, further research with larger samples and a longer duration of intervention is necessary.

Keywords

Autism spectrum disorder, girls, fundamental motor skills, physical activity, summer camp intervention, therapeutic recreation

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Introduction

Autism Spectrum Disorder (ASD) is defined by the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-5) by significant difficulties in social communication and reciprocity, developing and maintaining relationships, restricted and/or repetitive patterns of behaviour, and deficits in nonverbal communication (American Psychiatric Association, 2013). ASD has significantly increased in prevalence over the last few decades, and it affects approximately 1 in 68 children (Frieden, Jaffe, Cono, Richards, & Iadermarco, 2014). Boys are diagnosed more frequently with ASD than girls, with a ratio of 4:1, respectively (Carter et al., 2007). It is possible that there is an underestimation of girls being diagnosed with ASD as they can display a different developmental profile (Dworzynski, Ronald, Bolton, & Happe, 2012).

Girls and boys with ASD are often grouped together in therapy interventions including physiotherapy and occupational therapy. Therapeutic recreation, another evidence-based modality of intervention for children with ASD, also groups boys and girls together in the interest of economy and scale (García-Villamisar & Dattilo, 2010; García-Villamisar, Dattilo, & Muela, 2017). Additionally, many approaches to intervention such as Applied Behaviour Analysis (ABA) have been designed based on the needs of boys with ASD due to the high prevalence of boys. Therefore, there is substantially more research available on boys with ASD compared to the research on unique characteristics and sex differences in girls with ASD (Cridland, Jones, Caputi, & Magee, 2014; Van Wijngaarden-Cremers et al., 2014). Although clear evidence has not been established, it may be beneficial for girls with ASD to have separate and different learning environments. Current research suggests that girls often desire a less competitive environment (Dean et al., 2014). It is also well established that therapeutic camp settings can also positively impact psychosocial domains for children and adolescents (American Camping Association, 2005). More research is needed to expose the unique characteristics of girls with ASD in order to make the most effective interventions available to them.

Fundamental motor skills (FMS) are essential skills that develop throughout childhood and are crucial for more complicated and activity-specific skills, which enable participation in sport, recreation, and leisure activities (Barnett, van Beurden, Morgan, Brooks, & Beard, 2008; García-Villamisar et al., 2017; Lubans, Morgan, Cliff, Barnett, & Okely, 2010). FMS include locomotor and object control skills that contribute to overall physical, cognitive, and social development (Lubans et al., 2010). Delays in FMS development have been strongly correlated with Intellectual Quotient (IQ) and executive functioning, which often becomes more prominent with age (Westendorp et al., 2014). Regardless of IQ, children with ASD often have significant motor delays compared to their peers with typical development (TD) (Lloyd, MacDonald, & Lord, 2013; Whyatt & Craig, 2012). It is suggested at a young age, girls with ASD tend to have less refined motor skills than boys with ASD (Carter et al., 2007), but it is still unclear why children with ASD have poor motor skills.

Early intervention (before the age of 5 years), using methods such as ABA or intensive behavioural intervention techniques (IBI), is considered best practice for children with ASD. Most of the early interventions provided by government-funded programs focus on the areas of social, communication, and behavioural skills. We propose that interventions focusing on FMS, therapeutic recreation, and leisure

activities may be overlooked in this population (McPhilemy & Dillenburger, 2013). A recreational setting may be a normalizing environment for children with various conditions or abilities to take part in (Dawson, Knapp, & Farmer, 2012). Greater motor skill proficiency and physical function have been linked with greater social skills; psychological, physiological, and behavioural outcomes; as well as cognitive learning in children with ASD; which is beneficial in improving daily living skills (Bremer, Balogh, & Lloyd, 2014; MacDonald, Lord, & Ulrich, 2011).

The ability to move with competence is required in structured and unstructured recreational activities, as well as free play in various settings. For school-age children, these are important social scenarios that children with ASD may miss out on due to lack of skill. Past research on school-age children with ASD has shown that motor skill interventions have positive effects on social skills for children with ASD including a reduction in maladaptive behaviours and improvements in functional engagement with peers (Bremer & Lloyd, 2016; Bremer et al., 2014; MacDonald et al., 2011). It is important to intervene with motor skills so that children with ASD have the skills necessary for active play and recreational activities, and don't fall further behind their peers in motor proficiency.

Participation in physical activity (PA) is crucial to one's physical, emotional, and cognitive health, and is associated with greater health for all populations (King et al., 2009). PA is also critical at a young age to form friendships, develop life skills, and express creativity in the form of active play (Murphy & Carbone, 2008). Research indicates that girls with TD are less physically active at any age compared to their male counterparts (Colley et al., 2011; Colley, Gorber, & Tremblay, 2010). It has also been shown that girls with ASD participate in less PA than boys with ASD (Memari et al., 2013). Girls with and without a disability often have a lower self-competence of their motor skills and lower physical self-perceptions (Cairney et al., 2005) which may act as a barrier to PA, along with lack of opportunity. While little is known about the involvement of PA among girls with ASD, it is well established that PA levels in girls with TD drastically decrease around puberty (Colley et al., 2011). Thus, it is important to intervene at the pre-pubertal age to provide a strong FMS foundation to promote the enjoyment and engagement in PA.

Among children and adolescents, a significant association is consistently found between PA and physical self-perceptions and self-efficacy (Babic et al., 2014). Involvement in PA has been shown to improve self-efficacy and self-perceptions of PA among children with Developmental Coordination Disorder (DCD), who display similar motor problems as children with ASD (Cairney et al., 2005). A positive relationship has also been noted between motor skills, which helps predict levels of PA and physical self-perceptions of physical ability among children with TD (Robinson, 2011); however, this link has not been established among girls with ASD.

PA can also provide numerous benefits for girls, including increased physical conditioning, decline in isolation, improved psychosocial health, enhanced independence and self-efficacy, autonomy, and overall enjoyment (Lewis, Marcus, Pate, & Dunn, 2002). Girls who are more physically active and participate in leisure activities have reported having stronger self-esteem and confidence levels than those who are not; however, there remains a large portion of girls that is not physically active. A group of girls with physical disabilities reported that physical activity was an

equalizer for them, gave them perceptions of fitting in with their peers, and improved body image, self-esteem, and sense of empowerment (Bedini & Anderson, 2005). Many studies have examined this relationship in girls with TD and other disabilities (Bedini & Anderson, 2005; Crocker, Eklund, & Kowalski, 2000; Knowles, Niven, Fawkner, & Henretty, 2009); however, to our knowledge, none have studied this in girls with ASD.

Separate PA interventions designed specifically for girls, or the intersection of disability, sex, and PA has rarely been examined (Bedini & Anderson, 2005). Fox (2014) created a 6-week individualized exercise intervention for adolescent girls with ASD and found that the exercise regimen was effective at introducing and reinforcing PA as well as increasing self-competence to facilitate exercises with minimal to no adult assistance. Although children with ASD were not involved, Allsop, Negley, and Sibthorp (2013) ran a summer camp for adolescents with chronic illness, where the participants were able to relate to each other's medical conditions, and found social performance was positively affected through the use of a summer camp setting. Another study by Pan (2009), found that children with ASD who had more frequent social engagements with adults displayed higher levels of PA. By gaining confidence in the skills to perform PA, and by interacting with adults more often, it is more likely that girls with ASD will maintain active lifestyles.

The purpose of this study was to examine the impact of participation in a multi-sport skills day camp on motor skills, social skills, physical self-perceptions, and adaptive behaviour of girls ages 8–11 with ASD. It was hypothesized that the girls would improve their motor skills after attending the one-week multi-sport summer camp, which would enable them to be more physically active, improve their confidence in their skills, and improve socialization abilities through participation.

Methodology

Ethical approval was obtained from the local children's centre research committee and the University Research Ethics Board. This study followed a pre-test, post-test quasi-experimental design with an 8-week follow-up assessment. All measurements were conducted at the University with the children in the presence of their parents/guardians. The camp intervention was conducted at a local school gymnasium with indoor and outdoor activity space.

A total of 13 girls aged 8–11 years (*mean*=9.76 ± 1.00) participated in the study (Table 1). Participants were included based on their diagnosis by their physician. All participants attended a five day multi-sport camp intervention. Two participants had a diagnosis of PDD-NOS from the DSM-IV, which is now considered to be a diagnosis of ASD under the new DSM-5 criteria. Exclusion criteria included: aggressive behaviour, self-injurious, uncontrolled seizures, non-ambulatory, unable to follow 2-step instructions, high flight risk or comorbid diagnosis of Cerebral Palsy, or Spina Bifida. The exclusion criterion was necessary for the health and safety of each participant given the location, staffing ratio and nature of the camp. All children involved in the study provided assent, and all parents/guardians provided verbal and written informed consent prior to the first assessment.

Table 1

Participant Characteristics

Participant	Age (years & months)	Diagnosis	Age of Diagnosis of ASD (years)	Additional Diagnosis and Difficulties	Previous Motor Intervention
1	8 yrs 6 mo	PDD-NOS[1], DCD[2], Selective Mutism	5	Anxiety, Developmental Delay, Communication Difficulties, Low Self-Esteem, Social Isolation	Yes
2	9 yrs 7 mo	ASD[3]	8	ADHD[4], Developmental Delay, Sensory Integration Disorder, Communication Difficulties	Yes
3	10 yrs 6 mo	ASD	6	Social Isolation	No
4	9 yrs 2 mo	ASD	6	Anxiety, Sensory Integration Disorder, Low Self-Esteem	Yes
5	8 yrs 8 mo	ASD	1	Visual Problems, Communication Difficulties, Social Isolation	Yes
6	8 yrs 5 mo	ASD	6	Anxiety, Communication Difficulties, Social Isolation	No
7	8 yrs 2 mo	ASD	4	Anxiety, Sensory Integration Disorder, Other	Yes
8	11 yrs 2 mo	PDD-NOS	9	Developmental Delay, Communication Difficulties, Social Isolation	Yes
9	10 yrs 9 mo	ASD	5	Visual Problems, Low Self-Esteem	Yes
10	10 yrs 5 mo	ASD	3	Learning Disability, Communication Difficulties, Low Self-Esteem, Social Isolation	Yes
11	10 yrs 10 mo	ASD	2	Communication Difficulties, Low Self-Esteem, Social Isolation	No
12	10 yrs 4 mo	ASD	7	Anxiety, Communication Difficulties, Social Isolation	No
13	9 yrs 9 mo	ASD	3	Social Isolation	Yes

[1] PDD-NOS - Pervasive Developmental Disorder, Not Otherwise Specified; [2] DCD – Developmental Coordination Disorder; [3] ASD - Autism Spectrum Disorder; [4] ADHD – Attention Deficit Hyperactivity Disorder

Outcomes

Motor proficiency. The Test of Gross Motor Development (TGMD-2) is a standardized motor proficiency assessment that measures fundamental motor skills, and is validated for children with developmental disabilities ages 3 through 11 (Ulrich, 2000). The TGMD-2 consists of a score on 12 motor skills within two subscales: locomotor (run, gallop, hop, leap, horizontal jump, and slide) and object control (stationary ball strike, stationary dribble, kick, catch, overhand throw, and underhand roll) (Ulrich, 2000). The TGMD-2 is frequently used to assess motor skills among children with ASD (Bremer et al., 2014; Bremer & Lloyd, 2016).

Physical activity. A time-stamped pedometer (Omron Pocket Pedometer Model Number HJ-729ITCCAN) was used to measure PA for seven consecutive days at all assessments and measured total steps by day and time. The participants and their parents were instructed to clip the pedometer onto their right hip when they woke up, and to take it off at night. All participants were given stamped, self-addressed return envelopes to mail back to the principal investigator. Pedometer data from participants was included in the analysis if there were between 1,000 steps and 30,000 steps per day for the minimum three to seven days required, for quality assurance (Tudor-Locke & Bassett Jr, 2004; Tudor-Locke et al., 2005); all other data were excluded from analyses.

Physical self-perceptions. The Children and Youth Physical Self-Perception Profile (CY-PSPP) (Whitehead, 1995) is used for children and youth to study how self-perceptions influence PA and other psychosocial constructs (Welk & Eklund, 2005). The CY-PSPP is a 36-item questionnaire with insight on six subscales: sport/athletic competence, condition/stamina competence, attractive body adequacy, strength competence, physical self-worth, and global self-worth (Whitehead, 1995).

The Children's Self-Perceptions of Adequacy in and Predilection for Physical Activity (CSAPPA) is an effective measurement to generalise self-efficacy in PA and

has been used for children with and without disabilities (Cairney et al., 2007; Hay, Hawes, & Faught, 2004). The CSAPPA is a 20-item scale and provides the researcher with information regarding each child's adequacy, predilection, and enjoyment toward PA (Hay, 1992). Higher scores calculated on the CSAPPA represent greater adequacy, predilection and enjoyment for PA.

A 4-item feedback questionnaire was completed by the parents/guardians at the first post-test. The questions included: (1) Do you think this multi-sport camp helped your daughter make any improvements in her motor skills? Please explain using an example(s); (2) Do you think this camp helped your daughter gain confidence? Please explain using an example(s); (3) Do you think that your daughter has taken more interest in being physically active since the camp ended? If yes, will she likely join a new or return to a physical recreational activity or sport in the future?; and lastly, (4) Would you recommend this camp to other parents with a daughter with an intellectual/developmental disability? Please explain why.

Social and adaptive behaviour. The Social Skills Improvement System (SSIS) (Gresham & Elliott, 2008) was designed to assess children ages 8 to 18 who are suspected of having significant social difficulties or ASD characteristics. It is a standardized assessment used to measure social skills, problem behaviours, and academic competence (Gresham & Elliott, 2008). This assessment was completed by the parents at the pre-test and at the 8 week follow-up test for the convenience of the parents.

The Vineland Adaptive Behaviour Scales, 2nd edition (VABS-2) (Sparrow, Cicchetti, & Balla, 2005) was used to assess communication, daily living skills, and socialization. It is useful to identify any deficits in adaptive behaviour and is a standard assessment for children with Intellectual and Developmental Disabilities (IDD) (Darsaklis, Snider, Majnemer, & Mazer, 2013; Eldevik et al., 2009). This assessment was completed by the parents only at the pre-test and then again at the 8-week follow-up test.

Intervention

The five full-day Multi-Sport Camp took place during the summer. Motor skills were incorporated into active group games in order to facilitate a high level of practice and repetition in realistic situations. The camper to councillor ratio of 3:1 ensured safety and provided opportunity for one-to-one support if necessary. The camp curriculum was inspired by Special Olympics FUNdamentals program, which falls within the Long Term Athlete Development Model (LTAD) to target the development of fundamental motor skills of young children with IDD (Special Olympics Canada, 2007). Skills taught at the camp included locomotor (run, gallop, leap, jump, hop, slide) and object control skills (underhand roll, dribble, overhand throw, catch, kick, strike). The skills taught progressed in difficulty throughout the week and were implemented into translational sport settings including: track and field, basketball, soccer, and baseball. Each day was overseen by the PI, with the assistance of trained camp staff, and a research assistant from the University.

Statistical Analysis

Part 1–Intervention Impact. Descriptive characteristics were calculated on all variables at the baseline assessment by participant. A one-way repeated measures ANOVA was used with Bonferroni corrections for the TGMD-2, CY-PSPP, CSAPPA, and pedometer. A paired-sample *t*-test was used to compare results from the SSIS and

VABS-2 assessments. Pearson product correlations were conducted between variables following the intervention. Interrater reliability was determined for the coding of the TGMD-2 videos; intraclass correlation coefficients were calculated between the PI and a trained research assistant on 30% of the videos. Although participants' data were labeled by numbers to ensure confidentiality, coders were not blinded when watching the videos as they were present for data collection.

Part 2–Exploring Parent Feedback. The 4-item questionnaire was completed by the parents of every participant immediately following the camp at the post-test. Responses were qualitatively examined and primarily used to capture clinically and functionally meaningful findings, and support quantitative results.

Results

Motor Skill Proficiency

Participant characteristics are found in Table 1. Baseline descriptive statistics from the pre-test are presented in Table 2. A majority of participants had very poor, poor, or below average gross motor skills on the TGMD-2. Most participants had higher locomotor scores compared to their object control scores, and a vast majority of participants fell below the 25th percentile for both locomotor and object control skills. Two participants fell in the <1 percentile for Locomotor Skills, and three participants fell in the <1 percentile for Object Control Skills.

Table 2

Baseline Descriptive Characteristics, Motor Proficiency, Physical Activity, Physical Self-Perceptions, and Social Skill Scores

	Participants (mean ± SD)
TGMD-2 Gross Motor Quotient (0-140)*	71.38 ± 16.04
Average Pedometer Steps/Day	6717.7 ± 805.30
CSAPPA Adequacy for Physical Activity (0-28)	16.83 ± 6.29
CSAPPA Predilection for Physical Activity (0-36)	23.83 ± 7.87
CSAPPA Enjoyment of Physical Activity (0-12)	9.42 ± 2.71
CSAPPA Total Score (0-76)	50.08 ± 15.02
CY-PSPP Sport/Athletic Competence (0-4)	2.28 ± 0.80
CY-PSPP Condition/Stamina Competence (0-4)	2.22 ± 0.79
CY-PSPP Attractive Body Adequacy (0-4)	3.18 ± 0.69
CY-PSPP Strength Competence (0-4)	2.25 ± 0.68
CY-PSPP Physical Self Worth (0-4)	3.35 ± 0.53
CY-PSPP Global Self Worth (0-4)	3.13 ± 0.65
CY-PSPP Total Score (0-144)	98.5 ± 17.63
VABS-2 Adaptive Behaviour Composite Score (20-160)	76.23 ± 18.56
SSIS Social Skills Score (40-132)	76.23 ± 20.19

*(available range of scores possible)

The results of the one-way ANOVA with repeated measures on the TGMD-2 are presented in Table 3. There were significant group changes at all three assessment periods for all gross motor variables. Post-hoc analyses with Bonferroni corrections revealed significant improvements in the TGMD-2 Locomotor Standard Score between the pre-test and post-test (*p=0.003*), and between the pre-test and 8-week follow up (*p=0.009*). The TGMD-2 Object Control Standard Score significantly improved between the pre-test and post-test (*p=0.011*), and between pre-test and 8-week follow up (*p=0.002*).

There were no significant changes in any of the variables within the pedometer data; however, there was a slight increase in PA during weekend wear time between the pre-test and post-test, which then decreased at the 8-week follow-up test.

Table 3

Repeated Measures ANOVA for Pre-, Post-, and 8-Week Follow-Up TGMD-2 Scores

	Pre-Test (mean ± SD)	Post-Test (mean ± SD)	8-week follow-up (mean ± SD)	*F*	*p*-value	Effect size
Locomotor Raw Score	32.15 ± 10.65	35.85 ± 11.33	37.69 ± 8.96	13.252	$p < 0.0001$*	0.525
Locomotor Standard Score	5.54 ± 2.47	7.08 ± 2.90	7.54 ± 3.05	10.773	$p = 0.001$*	0.509
Object Control Raw Score	27.54 ± 9.81	32.15 ± 8.26	34.08 ± 7.21	24.860	$p < 0.0001$*	0.675
Object Control Standard Score	4.92 ± 3.20	6.54 ± 3.18	7.15 ± 2.73	13.438	$p < 0.0001$*	0.528
Sum of Standard Scores	10.46 ± 5.35	13.62 ± 5.69	14.69 ± 5.48	20.669	$p < 0.0001$*	0.633
Gross Motor Quotient	71.38 ± 16.04	80.85 ± 17.08	84.08 ± 16.45	20.669	$p < 0.0001$*	0.633
Gross Motor Quotient Percentile Rank	8.54 ± 10.18	19.00 ± 15.62	23.46 ± 18.08	15.784	$p < 0.0001$*	0.568

*Statistically significant at an alpha level of <0.05

Physical Self-Perceptions

There were no significant group changes at all three assessments for all variables pertaining to the CSAPPA measure. There were significant group changes found for the total score on the CY-PSPP (*p=0.044*), as well as Sport/Athletic Competence (*p=0.054*) (Table 4). Post-hoc analyses with Bonferroni corrections revealed the Global Self-Worth variable on the CY-PSPP significantly improved between the pre-test and the 8-week follow-up test (*p=0.050*).

Social and Adaptive Behaviour

Significant improvements were present among the Social Skills Domain, including Interpersonal adaptive level (*p=0.005*), coping raw score (*p=0.045*), and all overall Social domain scores (*p=0.005*) between the pre-test and 8-week follow-up test. Although there were no significant improvements found among the Play and Leisure Time variable of the Social Skills domain.

There were significant positive correlations between the TGMD-2 gross motor quotient and CSAPPA adequacy (*R=0.588, p=0.044*), enjoyment (*R=0.676, p=0.016*) and total score (*R=0.578, p=0.049*) at the 8-week follow-up test.

Table 4

Pre-, Post-, and 8-Week Follow-Up for CY-PSPP Scores

	Pre-Test (mean ± SD)	Post-Test (mean ± SD)	8-week follow-up (mean ± SD)	*F*	*p*-value	Effect size
Sport/Athletic Competence	2.28 ± 0.80	2.80 ± 0.79	2.83 ± 0.69	3.829	$p = 0.054$*	0.298
Condition/Stamina Competence	2.22 ± 0.79	2.53 ± 1.02	2.69 ± 0.98	2.650	$p = 0.105$	0.227
Attractive Body Adequacy	3.18 ± 0.69	3.08 ± 0.49	3.20 ± 0.52	0.177	$p = 0.811$	0.019
Strength Competence	2.25 ± 0.68	2.55 ± 0.53	2.63 ± 0.64	1.835	$p = 0.205$	0.169
Physical Self Worth	3.35 ± 0.53	3.32 ± 0.58	3.47 ± 0.41	0.500	$p = 0.614$	0.053
Global Self Worth	3.13 ± 0.65	3.35 ± 0.56	3.53 ± 0.41	3.127	$p = 0.074$	0.258
Total Score	98.5 ± 17.63	105.80 ± 15.85	109.50 ± 14.22	3.994	$p = 0.044$*	0.307

*Statistical significance at alpha level <0.05

Discussion

To the best of our knowledge, this is the first study to implement an intervention to improve motor skills among girls ages 8-11 with ASD. The purpose was to investigate the impact of a one-week multi-sport camp intervention on motor skills, PA, physical self-perceptions, social and adaptive behaviour of 8- to 11-year-old girls with ASD. Baseline results indicated that all participants began the study with significant motor delays as measured by the TGMD-2 (Ulrich, 2000). All participants scored below the 50th percentile indicating significantly delayed motor skills, which is consistent with previous studies (Lloyd et al., 2013; Whyatt & Craig, 2012). It has been suggested that girls with ASD have even less motor skill proficiency than boys with ASD (Carter et al., 2007) mirroring what has been recorded for girls with TD where the girls demonstrate less proficient motor skills than boys (van Beurden, Zask, Barnett, & Dietrich, 2002). Liu and Breslin (2013) found that girls with ASD had low motor skills proficiency compared to peers, and recommended future studies incorporate more girls with ASD. Baseline results indicated that locomotor skills were more proficient compared to the object control skills for all participants in the study, which is consistent with other findings where girls with TD have poorer object control skills than locomotor skills (Barnett, van Beurden, Morgan, Brooks, & Beard, 2010).

The motor skills of each participant in this study significantly improved immediately following the camp intervention (Table 3). Previous studies have found that motor skill interventions can be effective at improving motor skills of children with DCD (Pless & Carlsson, 2000), developmental delays (Kirk & Rhodes, 2011), and children with ASD (Bremer et al., 2014). However, there have been no studies to examine or implement a motor skill intervention separately for girls with ASD. No significant differences were found between the post-test results to the 8-week follow up; however, there was no significant regression, which suggests that there was retention of learned motor skills. Parents responded positively when asked if there were any notable improvements in motor skills at home, "Yes, she has been more surefooted and coordinated in her motions, sports activities, as well as general mobility." Because children with ASD

tend to have delayed motor milestones and are often considered clumsy (Lloyd et al., 2013) any improvement to their motor skills would provide clinical or real-life benefits. Many daily tasks, such as playing at a local park, gym class, or recess with peers, require children to move proficiently. If girls with ASD can improve their motor skills, they might be more inclined to actively participate in physical education class, at recess or after school, or in other recreation and summer camp settings, which ultimately provides greater socialization opportunities with their peers. It is recommended that health care providers, recreation instructors, and therapeutic recreation professionals consider motor skills to be an area of primary concern that warrants intervention for all children with ASD, particularly girls with ASD.

Pedometers were used to objectively evaluate levels of PA of each participant at each assessment period. The current minimum PA recommendation for children is 60 minutes per day of moderate-to-vigorous physical activity (MVPA) (Tremblay et al., 2011). This equates to between 11,000 (Vincent & Pangrazi, 2002) and 12,000 steps per day (Colley, Janssen, & Tremblay, 2012). The girls in this study had an average of 6,303 steps per day, which is well below girls with TD who had an average of 10,327 steps per day, as measured in the Canadian Health Measures Survey on a nationally representative sample (Colley et al., 2011). The participants accumulated considerably less than the recommended daily steps for children, indicating that interventions to increase PA are needed. It is also important to note that some parents reported the girls removing the pedometer for swimming lessons or leisure swim time. Given that most data collection was during the summer, it is possible that the low steps detected by the pedometer might not give a completely accurate representation of how active the girls with ASD were. However, the low level of PA observed is consistent with previous findings where Pan, Tsai, and Hsieh (2011) found that children with ASD participated in significantly less PA than their peers in physical education class. The results from the current study warrant future research to explore different ways to measure and increase PA levels among girls with ASD.

The pedometer data indicated no significant changes after the intervention, which might be partly explained by the seasonal effect in Canada (Tucker & Gilliland, 2007). The first two assessments took place during the summer, when outdoor PA is considered to be more inviting (Stone & Faulkner, 2014), whereas the last assessment took place in the fall when the children were back in a structured school environment. Future research should include a control group to the design in order to account for this. Ketcheson (2014) implemented an 8-week motor skill intervention for children with ASD, where motor skills significantly improved and also found no improvements in PA. This may indicate that due to very low baseline PA levels demonstrated in girls with ASD, it may take longer than one summer for a FMS intervention to have a lasting impact on overall PA. PA is likely influenced by other factors in this population, such as sensory issues, short attention span, fear and anxiety in new situations or changed routines, lack of body awareness or overall poor coordination (Rogers, Hepburn, & Wehner, 2003); however, more research to understand these factors is needed.

There is very limited research in the area of motor skills, psychosocial development, and adaptive behaviour among school age girls with ASD. Results in this study demonstrated no significant improvements in physical self-perceptions and self-efficacy of PA scored by the CSAPPA. There were, however, numerous gains within self-perception measures. It is possible these improvements provide clinical or

functional benefits despite the lack of statistical significance. For instance, many daily tasks, such as playing at a local park, during gym class or at recess, require confidence in the ability to perform the task at hand, and any gains in self-perceptions could have a positive impact on participation. These functional benefits are supported by parent reports, "With making new friends that looked up to her in regards to sports, she did gain confidence by trying new sports and finding out she could play them she also gained confidence in herself. She can now take part in more sports at school gym class without being self-conscious on her performance." Greater sample sizes or including girls with TD may demonstrate more distinguishable improvements in physical self-perceptions of PA.

Significant improvements were found on the perception profile scored by the CY-PSPP; specifically the Sport/Athletic Competence and total overall score. As the motor skills of the participants increased, self-efficacy for PA and Sport/Athletic Competence increased as well. These significant improvements may lead to functional gains; improved self-confidence and physical abilities may encourage the girls in this study to participate in typical school aged activities amongst their peers. It was also noted that the girls who had previously participated in sports, had greater self-perceptions of their abilities to participate and were more likely to participate in each activity during the intervention. Despite encouraging results, a control group would be necessary to determine if the increases were direct results of the camp intervention.

Children with ASD experience significant delays in their social and communicative skills (American Psychiatric Association, 2013). No significant group improvements in social skills were found using the SSIS at the post-test; however, there were small increases among social skills, cooperation, empathy, and self-control. These results have also been noted in a study by Dawson et al. (2012), where pediatric oncology patients demonstrated a uniform positive movement for independence, social skills, and self-esteem following a summer camp intervention; however, there were no patients with ASD in this study. We also found declines within bullying, hyperactivity, and internalizing within the problematic behaviours noted, which are common challenges among children with ASD (American Psychiatric Association, 2013). Significant improvements were found within the Social Skills domain reported on the VABS-2. One parent stated, "[name] was happy and excited to go to a new environment which is new for her (often she has a lot of anxiety surrounding attending events with groups of people she is not familiar with). She felt more confident speaking with the other girls and made new friends." Regarding adaptive behaviour changes within the participants, one parent reported, "[her] social skills improved a lot. She now follows instructions very well," indicating that there are functional gains as perceived by the parents, apart from any statistical significance. Previous studies involving children with ASD that have implemented other variations of motor skill interventions have also found significant improvements in social skills, and decreases in maladaptive behaviours (Bremer et al., 2014; MacDonald et al., 2011). Although the sample in the current study was all female, the significant gains in social skills following a motor skill intervention support the work from previous studies (Bremer et al., 2014; MacDonald et al., 2011), and are very encouraging and warrant further study.

Significant positive correlations were detected between motor skills and physical self-perceptions at the follow-up test. This indicates that the participants with greater motor skill proficiency have greater adequacy for PA, enjoyment of PA, and overall

greater self-perceptions of their involvement in PA after the intervention. With more refined motor skills, greater confidence in abilities occurs, allowing further exploration in activity to further develop activity-specific skills (Stodden & Goodway, 2007). This cycle can create an overall positive effect on confidence and self-efficacy in PA skills. Johnson, Barbieri, Breaux, and Carrasco (2014) implemented a PA intervention among school-age children and found significant improvements in self-efficacy of PA, as well as improved behavioural adherence. Greater motor skill proficiency and having greater perceived competence in the skills to engage in PA are necessary to participate among peers. The girls in the current study reported being relatively isolated in school as they are often the only girl with ASD in their class. During the camp, the girls were provided the opportunity to learn amongst other girls who were like them. This is especially important for children with ASD as they are often excluded from their peers (Bauminger, Shulman, & Agam, 2003; Dean, Adams, & Kasari, 2013). Other camps involving participants with same diagnoses have reported successful interactions among their campers, as children are able to relate to one another (Allsop, Negley, & Sibthorp, 2013; Dawson, Knapp, & Farmer, 2012; Hill et al., 2015). Greater perceptions of having the adequate skills to participate is also a contributing factor in order to engage in active games in a social setting apart from school (Cairney et al., 2005) and may translate into more frequent engagement with peers, providing more opportunity for social interactions (Hawkins, Ryan, Cory, & Donaldson, 2014).

Limitations

There are a number of limitations to the study that need to be addressed. First, this study did not include a control group, which would allow us to assess the effectiveness of the camp intervention. A greater sample size would have increased the power of the study to detect differences; however, this was not feasible for this project. Possible participant/parent bias is present, where parents who registered their children for the multi-sport camp were more inclined to promote PA within their children regardless of participation in the study. Therefore, this sample may not provide an accurate representation of all girls with ASD. Although many staff were trained prior to the camp and curriculum was inspired by Special Olympics Canada, the therapeutic recreation process and Certified Therapeutic Recreation Specialists were not used in the daily operations of the camp; however, the camp was facilitated by the Therapeutic Recreation department of the children's treatment centre (Hill et al., 2015). Future research should investigate whether or not having Therapeutic Recreation Specialists as the camp leaders would further promote positive outcomes. Several assessments were self-reporting measures. This method may not provide an accurate sample of the desired outcomes as answers may be overestimated to be socially acceptable (Adams et al., 2005). There was also no measurement of IQ, which is known to be related with poor motor skills (Hartman, Houwen, Scherder, & Visscher, 2010; Rintala & Loovis, 2013; Westendorp et al., 2014). Most participants were considered high functioning, which may not provide accurate representation of all girls with ASD. It is recommended that future studies include BMI measurements as BMI has been inversely related with PA in children (Remmers et al., 2014; Siwik et al., 2013). Despite various limitations, there were significant improvements after one week of intervention.

Implications and Recommendations

The measurement tools used in this study including motor skills, physical self-perceptions and physical activity, provided important information regarding girls with ASD. Therapeutic Recreation Specialists would benefit using the TGMD-2 to measure motor skills, and other tools that were used in this study to measure social skills and physical self-perceptions, in programs focusing on improving gross motor function and self-perceptions to track individual improvements. Although the time commitment needed for these assessments should be considered prior to using these tools, smaller groups would allow this to be more feasible or shortened versions of the tools may be used with larger groups of children.

Due to the fact that recommended physical activity levels are not being met by all children (Colley et al., 2011), not just children with ASD, more therapeutic recreation summer camps should be designed to focus on motor skills and improving physical activity levels in all children. If children are able to learn refined motor skills, they likely will have greater confidence in their abilities and be more inclined to participate in activities involving rigorous physical activity. Increased participation in sport, recreation and leisure, as well as free play will increase opportunities for inclusion and overall participation with peers.

The curriculum used for this study was inspired by the Special Olympics Canada FUNdamentals program, which fits into the Long-Term Athlete Development model (Special Olympics Canada, 2007), and could be incorporated into therapeutic recreation programs involving motor skills and physical activity. This curriculum allows each important motor skill to be broken down into simple steps, enabling children of all abilities to grasp the basics of each skill, and slowly incorporates the learned skills back into everyday games and activities for functional play. These skills are the foundation skills needed for longtime participation in sport, recreation and leisure activities.

Finally, it is important for collaboration among health science researchers and therapeutic recreation researchers so that expertise and best practices can be shared, and a greater community of practice is established, to serve children with ASD in a variety of settings.

Conclusion

The purpose of this study was to examine the impact of a multi-sport skills camp intervention at improving motor skills, PA, physical self-perceptions and self-efficacy of PA, social skills, and adaptive behaviour of school age girls with ASD. Results indicated that motor skills significantly improved, as well as physical self-perceptions and self-efficacy of sport ability, and social skills following the intervention. These functional gains may have important implications for daily living skills of school age girls with ASD; however, additional research is required in longer durations, greater volume intensity interventions, and in larger samples of girls with ASD with a true control group.

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