

The effectiveness of an outdoor adventure programme for young children with autism spectrum disorder: a controlled study

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ABBREVIATIONS

ASD	Autism spectrum disorders
RRB	Restricted and repetitive behaviours
SRS	Social Responsiveness Scale
VABS	Vineland Adaptive Behavior Scales

AIM Outdoor adventure programmes aim to improve interpersonal relationships using adventurous activities. The current study examined the effectiveness of an outdoor adventure programme in children with autism spectrum disorders (ASD).

METHOD The study included 51 participants (40 males, 11 females; age 3y 4mo–7y 4mo) enrolled in ASD special education kindergartens. Only the intervention group ($n=30$) participated in the outdoor adventure programme for 13 weeks, completing challenging physical activities that required cooperation and communication with peers and instructors. The control group ($n=21$) was not significantly different from the research group in age, sex, cognitive, and adaptive behaviour measures.

RESULTS Outcomes after the intervention revealed significant improvement in social-communication and different directions in the two groups in the social cognition, social motivation, and autistic mannerisms subdomains of the Social Responsiveness Scale. While the group that received an outdoor adventure programme showed a tendency toward a reduction in severity, the control group showed the opposite ($p<0.010$).

INTERPRETATION The outdoor adventure programme required problem-solving skills and forced the child to communicate in exciting situations. This study suggests that an outdoor adventure programme may be an effective intervention in addition to traditional treatments in young children with ASD. Future studies should examine the outcome of outdoor adventure programmes delivered for longer periods of time and maintenance of the achievements over time.

Autism spectrum disorder (ASD) is a neurodevelopmental disorder characterized by a dyad of socio-communicative impairments and the display of restricted and repetitive behaviours and interests.¹ Early and intensive intervention in ASD has reported gains in cognitive and adaptive functioning, and a decrease in severity of ASD symptoms.^{2–7} In addition to the traditional forms of intervention in ASD, professionals have sought adjunct effective treatments. An outdoor adventure programme refers to education aimed at improving intrapersonal skills and interpersonal relationships using adventurous activities to provide individual and group problem-solving and challenge tasks.⁸ The necessary tools for a successful outdoor adventure programme include establishing individual and group goals, building trust among participants, and providing activities that challenge and evoke stress but are nevertheless enjoyable.⁹

The importance of the outdoor adventure programme as a therapeutic tool was previously described in relation to various disabilities in young people¹⁰ and adults.¹¹ The achievements included enhanced self-concept and

self-esteem, personal growth, increased social adjustment, positive behavioural changes, and growth in interpersonal relationships.^{10,11} Previous research on outdoor education for children with developmental disabilities found improved social interaction between children with and without disabilities.¹² Only a few studies have examined the effects of physical and adventure activities on outcome in ASD. Therapeutic horseback riding in ASD documented improvements in sensory integration, directed attention, social motivation, decreased inattention and distractibility,^{13,14} irritability, hyperactivity, language, social cognition, and social communication.¹⁵ Physical activity in children with ASD increased athletic group play, improved speech skills,¹⁶ and significantly decreased inappropriate behaviours.¹⁷

The added value of an outdoor adventure programme, provided with more established interventions in ASD, has not been thoroughly examined in the research literature. The rationale for investigating the effectiveness of an outdoor adventure programme in young children with ASD is

based on the nature of the outdoor activities, which encourage social interaction and communication – two skills that are impaired in ASD. The current study is the first controlled study to examine the additive effect of an outdoor adventure programme in a population of children with ASD in a special education programme. Specifically, the study focused on the impact of the outdoor adventure programme on severity of autism symptoms, adaptive skills and teachers' perception of the child's expected future capabilities.

METHOD

Participants

The study included 51 participants, 40 males, 11 females, with an age range of 3 years 4 months to 7 years 4 months (mean [SD] 5y 4mo [11mo]). All participants were previously diagnosed with ASD based on medical and psychological evaluations and met Diagnostic and Statistical Manual of Mental Disorders – 4th edition Text Revision (DSM-IV TR) criteria. The participants were recruited from seven ASD special education kindergartens from the same city.

Measures

The Social Responsiveness Scale (SRS)¹⁸ is a questionnaire that assesses the severity of social impairment as it relates to ASD. The version for children aged 4 to 18 years old contains 65 items scored on a 4-point scale by parents or teachers who interact with the child. A higher total score reflects more social impairment. The SRS yields a total score that reflects the severity of autism symptoms and has five treatment subscales that represent autism-specific behaviours: social awareness, social cognition, social communication, social motivation, and autistic mannerisms. The SRS 60T to 75T scores refer to Mild to Moderate severity range, 76T scores or higher refer to Severe range with a standard error of measurement (SEM) of 2.1. The SRS total score serves as an index of severity of social deficits in ASD. The SRS subscale scores are provided as sex-specific *T* scores and are used solely for treatment planning and measuring treatment effectiveness. Scores of 60T and higher in any given subscale reflect significant deficits. *T* score SEMs are specific to each subscale (4.2–7.1). A change of 1 to 2 SEM on a single subscale over time is considered significant. The validity of the SRS involved psychiatric patients with and without ASD and randomly selected children.¹⁹ The ASD population in the SRS validity paper fits to the current research population.

The Vineland Adaptive Behavior Scales (VABS)²⁰ is a standardized caregiver interview designed to assess adaptive behaviours in children from birth through to age 18 years. The VABS is organized into four subdomains: communication, daily living skills, socialization, and motor skills, each of which yields a standard score (mean 100, SD 15). In addition, the measure yields a total score, the Adaptive Behavior Composite (mean 100, SD 15). In the VABS, higher scores reflect better functioning.

What this paper adds

- Outdoor adventure programme intervention may reduce severity of autism spectrum disorder (ASD) symptoms.
- Outdoor adventure programmes may add to social communication skills improvement alongside traditional intervention.
- They may reduce the severity of restricted and repetitive behaviours.
- They encourage problem-solving and interpersonal communication in exciting situations.
- They provide a secondary effective intervention in ASD.

The items of the Teachers' Perceived Future Capabilities Questionnaire were constructed based on the Perceived Capabilities Scale developed by Siperstein et al.²¹ The adapted questionnaire measured a teacher's perception of the changeability of her students with ASD and inquired into the teacher's prediction of the students' future socio-communication and learning skills (Appendix S1, online supporting information). The questionnaire consists of 14 items rated on a 6-point Likert scale. The coefficient alpha index of internal consistency reliability was 0.98 for the Teachers' Perceived Future Capabilities Questionnaire.

Procedure

Four of the seven special education kindergartens were randomly chosen out of a hat to participate in an outdoor adventure programme, and students in these educational facilities were deemed the intervention group. Students in the other three kindergartens did not participate in the outdoor adventure programme and served as the control group. The intervention group included 30 participants (26 males, four females), and the control group included 21 participants (14 males, seven females). Five children out of 56 potential participants (three from the research group and two from the control group) were excluded from the study because of their inability to comply with the motor requirements of the outdoor adventure programme. The parents of all the remaining children consented to the research. The participants completed each day of the intervention if they were present in the kindergartens.

All seven special education kindergartens used the same educational protocols, and the intervention group also received an outdoor adventure programme. The kindergartens operated 50 hours a week. The educational protocol was based on behavioural and developmental principles. The individual learning programme focused on language, communication, social skills, daily living skills, cognitive skills, and gross and fine motor skills.

Information on the study population regarding age, sex, cognitive ability, and adaptive skills (VABS) was obtained from the participants' files. Cognitive and adaptive skills assessments were administered by the kindergarten psychologists. The kindergarten teachers completed the Social Responsiveness Scale (SRS), the VABS, and the Teachers' Perceived Future Capabilities questionnaire at baseline before beginning the outdoor adventure programme, and again after completing 13 weeks of the outdoor adventure programme. For comparison of outcome in adaptive skills, VABS raw scores were used at pre- and post-intervention

times. This measure is more sensitive for detecting small changes after a short period of intervention.

The research was approved by the ethics committee of the department of education as required. Parents of all the participants signed an informed consent form approving the participation of the child in the research and the use of the obtained data, according to ethics committee requirements.

The intervention programme

The outdoor adventure programme was provided by a non-profit organization that aims to enable people with special needs to enhance their abilities and self-image by means of outdoor training and adventure-based activities. The intervention group underwent 13 weekly sessions of challenge-based activities with instructors. Each session lasted 30 minutes and took place in urban parks near the participants' kindergartens. Each session started with an opening song, after which the children began using the devices, moving from one to another throughout the session. These activities required the child to communicate with the instructor and with their peers – for example, to ask for help – while being involved in enjoyable and adventurous activities. At the end of the session, everyone gathered for a brief closing meeting, in which the children were asked, 'how was it?' and, 'what activities did you enjoy doing?'. Then the group sang a closing song.

Four devices were used in each session (see also Video S1, online supporting information):

1. Two-way climbing rope ladder, in which the child is required to climb on one side, pass through to the other side and then descend back to the ground. This device requires facing motor challenges and fear of heights, concentration, and planning and coordinating movements (Photograph a, Appendix S2, online supplementary information).
2. Rope elevator, a group activity in which one child is connected with a harness to a rope with a pulley block tied to the top of a tree, while the group of children pulls him upward. This device requires trust and responsibility towards a friend, being attuned to the requests and the emotional state of the child on the rope, and social coordination (Photograph b, Appendix S2).
3. Rope bridge, these are hung between four trees, constituting three sections of bridges. Passing from one section to the next requires the child to seek help from the instructor, in detaching the rings from the rope and re-connecting them in the next section. This device requires coping with fear, seeking assistance, learning, fine motor skills, environmental attention (as the child shares the bridge with other children) and being attuned to self and others' pace of progress (Photograph c, Appendix S2).
4. Hammock and rope swing, these are hung between the trees and each child in rotation is swung by a staff member. This device is built to provide the children

with a sense of relief and rest. It also requires them to show trust in the instructors, self-awareness, experience movement in space, and practice turn-taking (Photograph d, Appendix S2).

In addition, a hammock and a rope ladder were installed and remained throughout the intervention period in the intervention group kindergartens, for the children to practice and generalize the skills between the sessions.

The activities were led by the outdoor adventure programme staff, including a senior guide and two field instructors. The senior guide defined the research rationale and the characteristics of the intervention, and gave professional feedback. Every field instructor underwent an extensive internal training programme provided by the organization. The senior guide's involvement in all the research stages and in the extensive training programme ensured fidelity of implementation of the intervention.

Statistical analysis

At baseline, the two groups were compared for age, cognitive ability, and autism severity (SRS total scores) using one-way analyses of variance (ANOVAs) and for adaptive skills (VABS subdomain standard scores) using a one-way multivariate analysis of variance (MANOVA). In addition, the two groups were compared for male:female ratio using the χ^2 test. To evaluate the effect of intervention, we compared the two groups for differences in autism severity between pre- and post-intervention times using 2×2 ANOVAs (Group \times Time) with repeated measures for time for the SRS total and subdomain scores. For evaluating pre-post VABS subdomains raw scores, a 2×2 MANOVA (Group \times Time) with repeated measures for time was performed. In addition, a 2×2 ANOVA (Group \times Time) with repeated measures for time was performed for the Teachers' Perceived Future Capabilities questionnaire scores. When Time \times Group interactions were significant, simple main effect tests were used.

RESULTS

The intervention and control groups did not differ at baseline in age, cognitive ability, and VABS subdomain (communication, daily living skills, socialization, and motor skills) scores (Table I). In addition, the male:female ratio

Table I: Participants characteristics in the examined groups

	Research group	Control group	F	p	$p\eta^2$
Age (y)	5:6 (0.9)	5:0 (1.0)	2.1	0.149	0.042
Cognition (<i>T</i> scores)	<i>n</i> =17 84.8 (15.0)	<i>n</i> =14 86.4 (13.4)	1.0	0.391	0.003
VABS subdomain <i>T</i> scores	<i>n</i> =24	<i>n</i> =19	1.0		0.092
Communication	66.4 (19.1)	73.0 (17.3)	1.3	0.252	0.032
Daily living skills	67.0 (14.2)	74.9 (15.2)	2.3	0.087	0.054
Socialization	64.3 (15.9)	71.9 (14.0)	3.1	0.108	0.070
Motor	72.3 (11.7)	78.8 (15.9)	2.7	0.133	0.060

VABS, Vineland Adaptive Behavior Scales.

did not differ significantly between the two groups ($\chi^2=2.9$, $p=0.087$).

We then compared the SRS evaluations at pre-intervention among the seven kindergarten teachers. No significant difference was noted among the teachers' evaluations ($F_{6,44}=1.130$, $p=0.361$, $\eta^2=0.134$). The two examined groups were in the Mild to Moderate autism severity range based on their SRS total scores. Examination of the two groups at their pre-intervention time in all the measures used for evaluating the effectiveness of outdoor adventure programme did not reveal any significant differences in their autism severity (SRS total scores) ($F_{1,49}=0.2$, $p=0.980$, $\eta^2=0.005$), adaptive skills, subdomain raw scores ($F_{4,46}=0.1$, $p=0.407$, $\mu^2=0.077$) and in the Teachers' Perceived Future Capabilities questionnaire scores ($F_{1,45}=0.0$, $p=0.943$, $\eta^2=0.000$).

As shown in Table II, examining the effect of outdoor adventure programme on the total score of autism severity based on the SRS standard scores revealed a significant Group \times Time interaction. Examining the change in the SRS total scores for each group separately, only the control group showed a significant increase over time ($F_{1,20}=5.3$, $p=0.028$, $\eta^2=0.210$).

In examining each of the SRS subdomains, significant Group \times Time interactions were noted for four subdomains (social cognition, social communication, social motivation, autistic mannerisms), but not for the social awareness subdomain. The effect sizes indicated high effects ($\eta^2>0.1$) for SRS total scores, social motivation, and autistic mannerisms, and moderate effects ($0.05<\eta^2<0.1$) for the social cognition and social communication subdomains. Figure 1(a-e) presents the significant pre-post differences between the groups in the SRS measures.

As shown, there is a similar pattern of change over time in the examined measures. The intervention group showed a reduction in SRS standard scores, whereas the control group showed an increase in SRS standard scores. Examining the change in SRS subdomain standard scores in each group separately revealed that the intervention group showed a significant Time effect only for the social communication subdomain ($F_{1,29}=4.2$, $p=0.05$, $\eta^2=0.126$). The control group showed a significant increase in the SRS autistic mannerisms subdomain ($F_{1,20}=10.6$, $p=0.004$,

$\eta^2=0.347$). This increase reflects a 1 SEM (5.5) change for this subscale, which is considered to be clinically significant.

Evaluating the change in VABS subdomain raw scores at pre- and post-intervention times, a significant time effect ($F_{4,46}=3.6$, $p=0.013$, $\eta^2=0.238$) was noted. Examining each VABS subdomain separately revealed a significant increase in VABS communication and daily living skills, and a trend for statistical significance in the motor skills subdomain (Table III). The effect sizes indicated a medium time effect. The MANOVA did not yield a significant Time \times Group effect.

Examining the change over time in the Teachers' Perceived Future Capabilities questionnaire scores revealed no significant Time effect ($F_{1,48}=0.5$, $p=0.494$, $\eta^2=0.010$), nor significant Time \times Group interaction ($F_{1,48}=1.1$, $p=0.305$, $\eta^2=0.022$).

According to the instructors' qualitative descriptions, it appeared that the participants showed an increased ability to use the devices, more enjoyment during the activities, and a reduced level of anxiety throughout the sessions. However, direct assessment of the participants' performance on the devices was not evaluated at pre- and post-intervention times.

DISCUSSION

The current study is a pioneer in examining the effects of a novel outdoor adventure programme for young children with ASD. The study found that the outdoor adventure programme intervention had a significant impact on ASD symptom severity. This severity remained within the Mild to Moderate range per the SRS definition for both groups. However, the two groups showed different trajectories over time, with the outdoor adventure programme group showing a mild reduction in ASD symptoms and the control group showing the opposite trend. Post-intervention outcomes revealed different directions in the two groups in the social cognition, social motivation, social communication, and autistic mannerisms SRS subdomains. Children who received the outdoor adventure programme in addition to standard behavioural-developmental intervention in special education facilities showed a reduction in ASD symptom presentation, which was especially noteworthy in

Table II: Social Responsiveness Scale *T* scores at pre- (T1) and post- (T2) intervention time for the intervention and control groups

	Intervention group		Control group		<i>F</i>	Time \times group interaction	
	T1 Mean (SD)	T2 Mean (SD)	T1 Mean (SD)	T2 Mean (SD)		<i>p</i>	$\rho\eta^2$
Total scores	66.2 (9.9)	64.2 (9.5)	64.9 (9.2)	68.9 (12.4)	8.1 ^a	0.007	0.141
Social awareness	62.7 (12.2)	64.3 (12.5)	62.0 (10.1)	67.5 (13.8)	1.3	0.255	0.026
Social cognition	69.5 (8.9)	67.1 (8.9)	68.0 (9.5)	71.1 (11.9)	5.4 ^b	0.024	0.099
Social communication	66.1 (10.3)	63.5 (10.3)	64.8 (10.8)	66.4 (13.5)	4.2 ^b	0.046	0.079
Social motivation	59.7 (9.4)	60.0 (9.2)	57.6 (8.25)	60.7 (11.8)	6.8 ^a	0.012	0.123
Autistic mannerisms	67.2 (13.0)	64.1 (12.2)	65.8 (12.1)	71.5 (13.7)	8.2 ^a	0.006	0.143

^a $p<0.01$; ^b $p<0.05$.

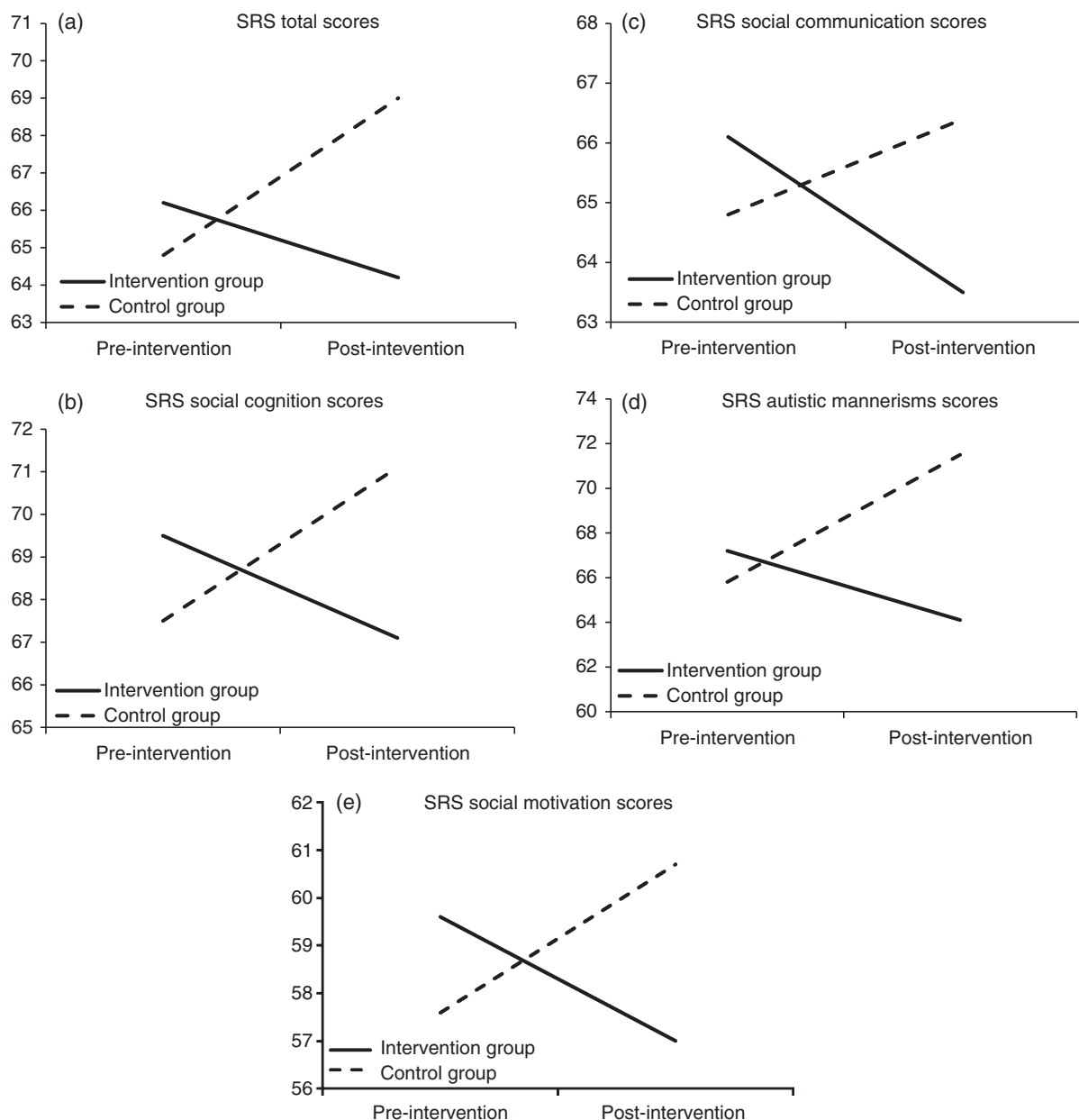


Figure 1: (a) Social Responsiveness Scale (SRS) total *T* score means in the pre- and post-intervention times for the intervention and the control groups. (b) SRS social cognition *T* score means in the pre- and post-intervention times for the intervention and the control groups. (c) SRS social communication *T* score means in the pre- and post-intervention times for the intervention and the control groups. (d) SRS mannerism *T* score means in the pre- and post-intervention times for the intervention and the control groups. (e) SRS social motivation *T* score means in the pre- and post-intervention times for the intervention and the control groups.

the SRS social communication subdomain. This improvement reflects gains in verbal and non-verbal communication, imitation, and social reciprocal behaviours.¹⁸ The outdoor adventure programme offered opportunities for the children to cooperate with their peers, and required the use of interpersonal communication to achieve group goals. In addition, the intervention required problem-solving skills and forced the child to communicate in extreme, exciting, and emotionally driven situations. Therefore,

these outdoor adventure programme components may have facilitated the development of social communication skills.

It is worth noting that the severity of the restricted and repetitive behaviours (RRB) became more pronounced over time in the control group, but not in the group that received the outdoor adventure programme. It is possible that the involvement in active, meaningful physical activities prevented the possible worsening of stereotypical behaviours. Several studies have reported that in children with

Table III: Vineland Adaptive Behavior Scales (VABS) raw scores at pre- and post-intervention times

	Pre-intervention Mean (SD)	Post-intervention Mean (SD)	<i>F</i>	<i>p</i>	$\rho\eta^2$
VABS subdomain raw scores					
Communication	25.6 (7.5)	26.8 (7.5)	5.7 ^a	0.021	0.104
Daily living skills	25.4 (4.6)	27.4 (5.8)	10.0 ^b	0.003	0.169
Socialization	23.6 (6.7)	24.2 (7.0)	0.5	0.453	0.012
Motor skills	18.1 (3.4)	19.2 (5.4)	3.2 ^c	0.082	0.061

^a $p < 0.05$; ^b $p < 0.01$; ^c $p < 0.1$. SD, standard deviation.

ASD, RRB become more apparent with time.^{22,23} In addition, a slight increase in the frequency of RRB over time was described in children with ASD who were enrolled in the Preschool Autism Communication Trial sites.²⁴ Similar trends for RRB severity were documented in the Early Start Denver Model study for children with ASD who received community-based intervention; however, no statistical analysis was reported for this measure.⁶ It is possible that teachers can identify these RRB symptoms better as the child matures and has more defined symptoms. Improvements in communication and daily living adaptive skills were noted for the entire population as measured by VABS raw scores. However, no additional effect of the outdoor adventure programme was evident on adaptive skill gains. All the participants of this study were enrolled in autism-specific special education kindergartens and received intensive comprehensive treatments. Therefore, the improvements in the adaptive skills subdomains described above were anticipated. It is possible that the outdoor adventure programme intervention was applied for too short a period and could not be translated into significant changes in adaptive skills.

The teachers' perception of the children's future capabilities in the two groups was not different in the pre-intervention time, reflecting the similarities between the two studied groups. The teachers' perception of future capabilities at post-intervention did not change over time in either group. These findings could be because the intervention was delivered for too short a period of time to allow change in this measure, or that the documented changes in the children's behaviours were too small to affect the perceived changeability by the teachers.

Most previous studies examined the effect of an outdoor adventure programme in young people and adults, and included different motor, sensory, and cognitive disabilities, and psychiatric conditions. Most of these studies reported improvements in behavioural problems, well-being, self-esteem, reduced anxiety, and improved cooperation and communication skills.^{11,25} Generally, the research on outdoor adventure programmes is limited, and only a few studies have examined the effect of outdoor adventure programmes on young children. Previous studies that examined the effects of horseback riding and physical activity programmes in ASD reported improvements in social interaction, sensory integration, and attention measures,^{13–16,26} and a significant decrease in self-stimulatory and inappropriate

behaviours.^{17,27} The only study that specifically examined the effect of outdoor adventure programmes in ASD was a single case descriptive study showing improved social interaction skills of a child with ASD with a typically developing group during a 3-day rock climbing trip.²⁸

The current study describes a new path for enhancing and preserving social skills in ASD, in addition to traditional interventions. Outdoor adventure education in general is considered an amalgamation of environmental education and adventure education. This educational method is aimed at increasing participants' awareness of the environment with which they engage, as well as facilitating personal and social development using all senses.²⁹ Theoretically, the study supports the importance of learning new skills through challenging physical activities. The value of learning through adventure experiments is not only in acquiring the skills, but also, perhaps more importantly, in the participants' ability to internalize the communication requirements during enjoyable social situations and to apply them to future occasions. The study has clinical implications for the implementation of outdoor adventure programmes in treatment protocols for young children with ASD. Further development of the outdoor adventure programme is needed to explore those outdoor activities that most significantly affect progress in ASD.

The current study is innovative in its examination of the effectiveness of outdoor adventure programmes in children with ASD, specifically in young children. The study has several strengths. Previous studies that examined the effects of physical activities in ASD mostly used single study, multiple case study designs, or pre-post evaluations. The current study is a controlled study that includes a control group similar to the experimental group in age, sex, autism severity, cognitive ability, and level of adaptive skills. The selection of the participating kindergartens was random; however, full randomization of the participants was not feasible. The two groups received the same type and intensity of special education services and interventions, directed by the same professional team, in the same municipal area. In addition, the outdoor adventure programme included a detailed intervention protocol, was delivered by professionals in this field, and post-intervention progress was assessed using standardized measures.

The study has several limitations. As mentioned before, the study was not fully randomized and the teachers who

completed the questionnaires were aware of whether or not the participants received the additional outdoor adventure programme intervention. The performance of the participants on the outdoor adventure programme devices was not assessed as it was not the main focus of the study. The adapted Teachers' Perceived Future Capabilities Questionnaire yielded high reliability between the items, therefore it is recommended to reduce the number of items in future studies.

This study suggests that an outdoor adventure programme might be an important complementary intervention alongside more traditional treatments in young children with ASD. In subsequent studies it will be important to use another source for the evaluations, such as an independent rater, which will add to the validity of the research and will reduce the potential for bias. Assessment

of executive function in addition to the study measures may increase understanding of the intrapersonal skills and the problem-solving capabilities, and could provide valuable information on the importance of this intervention. Future studies should further examine the contribution to optimal outcome of this type of intervention delivered for longer periods, and evaluate the maintenance and generalization of skills over time.

SUPPORTING INFORMATION

The following additional material may be found online:

Appendix S1: Teachers' Perceived Future Capabilities Questionnaire.

Appendix S2: Devices used in each session.

Video S1: The children of Etgarim.

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