HORTICULTURAL THERAPY AS AN INTERVENTION FOR ENHANCING SOCIAL SKILLS IN CHILDREN WITH AUTISM SPECTRUM DISORDER: A MIXED-METHODS STUDY

Lilit KARAPETYAN, *PhD, Associate Professor at the Chair of Special Pedagogy and Psychology, Armenian State Pedagogical University*
E-mail: *karapetyanlilit41@aspu.am*
Kima SARGSYAN, *M.S. in Special Psychology, M.S. student in Special Pedagogy Master Programme, Armenian State Pedagogical University*
E-mail: *sargsyankima-9@aspu.am*

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ABSTRACT

Children diagnosed with autism spectrum disorder (ASD) frequently experience persistent difficulties in social communication, interpersonal interaction, and adaptive behavior, limiting their participation in educational and community environments. Nature-based interventions have recently attracted increasing attention as complementary therapeutic approaches capable of supporting children's cognitive, emotional, and social development. Among these interventions, horticultural therapy integrates structured gardening activities with therapeutic objectives, creating a natural environment that promotes communication, cooperation, emotional regulation, and independence.

The present study investigated the effectiveness of horticultural therapy in improving the social skills of children with ASD. A mixed-methods research design was employed, combining structured behavioral observation, semi-structured interviews with parents and specialists, and an intervention program based on therapeutic gardening activities. Twenty-six primary school-aged children with ASD participated in the study. Fourteen children formed the experimental group and participated in horticultural therapy sessions twice weekly in addition to their regular behavioral and occupational therapy, whereas twelve children in the control group received only conventional interventions.

The findings demonstrated noticeable improvements among participants in the experimental group. Increased social engagement, enhanced communication initiation, improved cooperative behavior, better emotional regulation, and greater independence were consistently observed throughout the intervention period. Parents and therapists further confirmed positive behavioral changes beyond the therapeutic setting.

These findings suggest that horticultural therapy represents a promising complementary intervention capable of promoting social competence among children with ASD. The integration of structured gardening activities into special education and rehabilitation programs may contribute to improved social participation and overall quality of life. Nevertheless, additional longitudinal studies with larger samples are required to confirm the long-term effectiveness of this intervention.

Keywords: *Autism spectrum disorder; horticultural therapy; social skills; nature-based intervention; special education; rehabilitation; communication; social participation*

INTRODUCTION

Autism spectrum disorder (ASD) is a neurodevelopmental condition characterized by persistent deficits in social communication and interaction accompanied by restricted, repetitive patterns of behavior, interests, and activities. These characteristics frequently interfere with children's participation in educational settings, peer relationships, and everyday social functioning. Despite considerable advances in behavioral and educational interventions, promoting meaningful social interaction remains one of the greatest challenges for professionals working with children diagnosed with ASD.

The prevalence of ASD has increased substantially during the past two decades, making the development of evidence-based intervention strategies an international public health priority. While behavioral interventions remain the cornerstone of treatment, researchers have increasingly emphasized the importance of complementary approaches capable of addressing emotional well-being, sensory processing, motivation, and social participation simultaneously.

Nature-based interventions have emerged as promising therapeutic approaches because they provide multisensory experiences within predictable and emotionally supportive environments. Among these interventions, horticultural therapy has received growing scientific attention due to its ability to combine physical activity, environmental engagement, structured learning, and social interaction. Gardening activities naturally encourage cooperation, communication, shared responsibility, problem solving, and emotional regulation while simultaneously reducing anxiety and sensory overload.

The theoretical foundations of horticultural therapy are grounded in environmental psychology, occupational therapy, sensory integration theory, and experiential learning. Interaction with living plants offers children opportunities to experience responsibility, observe tangible outcomes of their efforts, and participate in meaningful collaborative activities. Such experiences may be particularly beneficial for children with ASD, who often demonstrate stronger engagement when learning occurs through concrete, predictable, and sensory-rich experiences.

Previous research has reported positive effects of horticultural therapy on psychological well-being, stress reduction, attention, emotional regulation, and social functioning across various populations. Nevertheless, empirical evidence specifically examining its effectiveness for improving social skills among children with ASD remains limited. Existing studies often involve small samples, heterogeneous intervention protocols, or insufficient methodological rigor, highlighting the need for further investigation.

The present study addresses this gap by evaluating the impact of a structured horticultural therapy program on the development of social skills among children with autism spectrum disorder.

The study was guided by the following research question:

Does participation in a structured horticultural therapy program improve the social skills of children with autism spectrum disorder?

The study hypothesized that children participating in horticultural therapy would demonstrate measurable improvements in communication, social interaction, cooperative behavior, emotional regulation, and independence compared with children receiving conventional rehabilitation alone.

LITERATURE REVIEW

AUTISM SPECTRUM DISORDER AND SOCIAL SKILLS DEVELOPMENT

Autism spectrum disorder (ASD) is a neurodevelopmental condition characterized by persistent difficulties in social interaction and communication, together with restricted and repetitive patterns of behavior, interests, and activities. Early descriptions of autism were provided independently by Leo Kanner and Hans Asperger in the 1940s. Kanner described autism as a distinctive developmental condition characterized by difficulties in emotional and social contact (Богдашина, 2016).

Children with ASD may experience qualitative impairments in social interaction, including difficulties interpreting social and emotional cues, establishing reciprocal relationships, using eye contact, facial expressions, and gestures appropriately, and participating in shared activities. Communication difficulties may involve delayed or absent speech, limited spontaneous communication, repetitive or stereotyped language, echolalia, and difficulties initiating or maintaining conversations. Restricted interests, repetitive behaviors, insistence on routines, and atypical sensory interests are also commonly observed (Богдашина, 2016; Шамрея & Марченко, 2019). Thus, communication, socialization, and imagination are among the developmental areas most significantly affected in children with ASD.

The etiology of ASD is complex and multifactorial. Different theoretical approaches have emphasized psychogenic, genetic, immunological, and neurochemical factors. Current evidence particularly supports the contribution of genetic and neurobiological mechanisms, including alterations in neurotransmitter systems (Volkmar, 2021).

The prevalence of ASD has increased substantially in recent decades, although the reasons for this increase remain unclear (Chiarotti & Venerosi, 2020; Isaksen et al., 2013). Given the central role of social difficulties in ASD, scientifically supported interventions aimed at improving social development are essential for promoting social inclusion, independence, and quality of life.

THERAPEUTIC HORTICULTURE AND ITS POTENTIAL ROLE IN ASD

Therapeutic horticulture has historical roots in the use of gardens and natural environments for restoration and well-being. Its therapeutic value received greater scientific recognition in the nineteenth century, particularly through the work of Benjamin Rush, who emphasized gardening as a beneficial activity for people with mental health difficulties (Niepel & Pfister, 2010).

Interaction with nature and participation in meaningful outdoor activities may provide psychological and physical benefits and may be particularly valuable for vulnerable populations, including people with learning and physical disabilities (Sempik et al., 2014). Research also suggests

that individuals with ASD may demonstrate interest in nature and gardening (Grove et al., 2018), while their characteristic restricted interests may potentially be incorporated into strength-based interventions (Hume et al., 2021).

Therapeutic horticulture represents a multidimensional intervention combining contact with nature, purposeful activity, sensory experiences, and social interaction. For children with ASD, gardening activities may support attention, concentration, creativity, motor coordination, and communication while simultaneously creating opportunities for social participation (Niepel & Neuhauser, 2010). According to Putz (2010), the effects of therapeutic horticulture can be considered across five interconnected domains: physical, cognitive, psychological-emotional, social, and identity/self-esteem development.

In the physical domain, gardening activities can support fine and gross motor coordination, balance, and sensory engagement. Cognitively, horticultural activities may stimulate perception, creativity, temporal and spatial orientation, and language development. Psychologically, interaction with plants and nature may contribute to emotional regulation, stress reduction, self-confidence, resilience, and motivation. The social dimension is particularly important because group gardening creates opportunities for cooperation, communication, mutual assistance, and a sense of belonging (Putz, 2010).

Several studies have explored the potential of nature-based and horticultural interventions for people with ASD. Barakat et al. (2019), for example, proposed a sensory garden specifically designed for individuals with ASD, incorporating stimulation of the five primary senses as well as balance and body awareness. Li et al. (2019) also demonstrated the potential suitability of natural environments for therapeutic interventions involving people with ASD.

Although these findings are promising, the evidence base remains limited. Few studies have specifically examined therapeutic horticulture as an intervention for ASD, and research addressing its long-term effects and mechanisms of influence on social development remains insufficient (Kamp-Becker & Bölte, 2021). Existing research also provides limited methodological guidance for systematically implementing horticultural therapy in educational and rehabilitation settings.

This gap is particularly important because social, sensory, and emotional development are closely interconnected in children with ASD. Nature-based interventions may provide an integrated environment in which these domains can be addressed simultaneously. Recent evidence continues to suggest that nature exposure and horticultural activities may support social interaction, sensory regulation, and well-being among individuals with ASD, while also emphasizing the need for more rigorous research.

Therefore, the relevance of the present study is determined by the need to further investigate therapeutic horticulture as a potential intervention for developing social skills in children with ASD. The combination of purposeful gardening activities, sensory experiences, and structured social interaction may provide an alternative and potentially valuable approach within contemporary educational and rehabilitation practices.

RESEARCH AIM

The aim of the study is to examine the effect of therapeutic horticulture on the development of social skills in children with autism spectrum disorder.

RESEARCH QUESTION

What effect does therapeutic horticulture have on the development of social skills in children with autism spectrum disorder?

MATERIALS AND METHODS

STUDY DESIGN

This study employed a **mixed-methods quasi-experimental research design**, integrating quantitative and qualitative approaches to evaluate the effectiveness of horticultural therapy in improving the social skills of children with autism spectrum disorder (ASD). A mixed-methods approach was selected to provide a comprehensive understanding of behavioral changes by combining objective observational data with the experiences and perceptions of parents and rehabilitation professionals.

The quantitative component consisted of pre- and post-intervention behavioral assessments conducted using structured observation protocols. The qualitative component included semi-structured interviews with parents and specialists to explore perceived changes in children's communication, social interaction, and emotional functioning throughout the intervention period.

RESEARCH SETTING

The study was conducted at the Child Development Foundation in Yerevan, a multidisciplinary rehabilitation center providing behavioral, occupational, and educational services for children with developmental disorders. The intervention was implemented within the institution's therapeutic garden, which was specifically organized to facilitate structured horticultural activities in a safe, predictable, and sensory-supportive environment.

The therapeutic garden contained designated planting areas, raised beds, child-friendly gardening tools, flowering and edible plants, and sufficient open space for cooperative group activities. The environment was intentionally designed to minimize sensory overload while encouraging exploration, communication, and collaborative participation.

SAMPLE

Twenty-six children diagnosed with autism spectrum disorder participated in the study. Participants were recruited through purposive sampling from children receiving rehabilitation services at the Child Development Foundation.

The participants were divided into two groups:

1. **Experimental group (n = 14):** Children participated in horticultural therapy in addition to their regular behavioral therapy and occupational therapy.
2. **Control group (n = 12):** Children continued receiving behavioral therapy and occupational therapy without participation in horticultural therapy.

All participants were of primary school age and had previously received a clinical diagnosis of ASD according to internationally accepted diagnostic criteria established by qualified healthcare professionals.

INCLUSION CRITERIA

Participants met the following inclusion criteria:

1. clinical diagnosis of autism spectrum disorder;
2. primary school age;
3. regular attendance at rehabilitation sessions;
4. medical ability to participate in outdoor therapeutic activities;
5. written informed consent provided by parents or legal guardians.

EXCLUSION CRITERIA

Children were excluded if they:

1. presented severe physical disabilities preventing participation in gardening activities;
2. had acute medical conditions requiring intensive treatment;
3. demonstrated behavioral difficulties that posed safety risks during group activities.

INTERVENTION PROGRAM

The horticultural therapy program was implemented over the intervention period through two sessions per week conducted alongside participants' routine rehabilitation services.

Each therapy session followed a standardized structure consisting of four sequential phases:

4. **Introduction and orientation**, during which children were introduced to the planned activities and necessary gardening materials.
5. **Practical horticultural activities**, including soil preparation, planting seeds or seedlings, watering plants, removing weeds, observing plant growth, and maintaining the therapeutic garden.
6. **Cooperative group tasks**, designed to promote communication, turn-taking, joint attention, shared responsibility, and collaborative problem-solving.
7. **Reflection and feedback**, allowing children to discuss their experiences, observe the results of their work, and reinforce positive social behaviors through therapist-guided interaction.

The intervention followed a gradual progression from simple individual tasks toward increasingly cooperative activities. This approach enabled participants to develop confidence before engaging in more complex social interactions.

DATA COLLECTION

Multiple data collection methods were employed to increase methodological rigor through data triangulation.

STRUCTURED BEHAVIORAL OBSERVATION

Behavioral observation served as the primary quantitative assessment method. Observations were conducted before and after the intervention using a standardized observation checklist developed specifically for the study.

Children's behaviors were evaluated during both individual and group activities across four primary domains:

1. social interaction;
2. communication initiation;
3. participation in group activities;
4. emotional and behavioral regulation.

Each behavioral indicator was rated using a 4-point Likert-type scale (0–3), where higher scores indicated better social functioning.

SEMI-STRUCTURED INTERVIEWS

Semi-structured interviews were conducted with parents and rehabilitation specialists following completion of the intervention.

Interview questions explored:

1. perceived changes in social interaction;
2. communication behaviors;
3. emotional regulation;
4. independence;
5. behavioral changes observed at home and during therapy sessions.

The flexible interview format enabled participants to provide detailed descriptions while ensuring consistency across interviews.

OUTCOME MEASURES

The primary outcome was improvement in children's social skills following participation in horticultural therapy.

Secondary outcomes included:

1. communication initiation;
2. cooperative behavior;
3. joint attention;
4. emotional regulation;
5. behavioral stability;
6. independence during therapeutic activities.

Changes were evaluated through comparison of baseline and post-intervention assessments together with qualitative interview findings.

DATA ANALYSIS

Quantitative data were analyzed using descriptive statistical methods.

Frequencies, percentages, means, and standard deviations were calculated to summarize participant characteristics and behavioral outcomes. Comparisons between pre- and post-intervention observations were performed to identify changes in social functioning within the experimental and control groups.

Qualitative interview data were analyzed using thematic analysis. Interview transcripts were coded independently according to recurrent themes related to communication, cooperation, emotional regulation, and social participation. Emerging themes were subsequently compared with observational findings to enhance the credibility and trustworthiness of the results.

The integration of quantitative and qualitative findings provided a comprehensive understanding of the effects of horticultural therapy on children's social development.

RESULTS

SAMPLE CHARACTERISTICS

A total of 26 children diagnosed with autism spectrum disorder (ASD) participated in the study. Fourteen children were allocated to the experimental group, which received horticultural therapy in addition to routine rehabilitation services, whereas twelve children formed the control group and received standard behavioral and occupational therapy only. No participants withdrew during the intervention period.

Table 1. Participant Characteristics

Characteristic	Experimental Group (n = 14)	Control Group (n = 12)
Participants, n	14	12
Mean age (years)	8.1 ± 1.4	8.3 ± 1.2
Male, n (%)	11 (78.6)	9 (75.0)
Female, n (%)	3 (21.4)	3 (25.0)
Receiving behavioral therapy	14 (100)	12 (100)
Receiving occupational therapy	14 (100)	12 (100)
Receiving horticultural therapy	14 (100)	0 (0)

BASELINE SOCIAL FUNCTIONING

Baseline behavioral observations demonstrated considerable deficits in social functioning among children in the experimental group prior to intervention. Most participants showed limited social engagement, communication difficulties, reduced initiative during peer interactions, and low participation in cooperative activities.

Table 2. Baseline Behavioral Characteristics of the Experimental Group

Behavioral Indicator	Children Demonstrating Difficulty, n (%)
Low social engagement	11 (78.6)

Behavioral Indicator	Children Demonstrating Difficulty, n (%)
Communication difficulties	10 (71.4)
Limited social initiative	9 (64.3)
Low interest in group activities	12 (85.7)
Preference for solitary activities	8 (57.1)
Limited peer interaction	10 (71.4)

These findings indicate substantial impairments in the core domains of social functioning before implementation of the horticultural therapy program.

CHANGES FOLLOWING HORTICULTURAL THERAPY

Behavioral observations conducted throughout the intervention demonstrated progressive improvements in several domains of social functioning among children in the experimental group.

The greatest improvements were observed in participation in cooperative activities, communication initiation, peer interaction, and shared attention.

Table 3. Improvements Observed During the Intervention (Experimental Group)

Outcome	Children Improved, n (%)
Increased participation in group activities	10 (71.4)
Increased social interaction	9 (64.3)
Development of cooperative behavior	8 (57.1)
Improved joint attention	7 (50.0)

Children gradually became more willing to cooperate with peers while participating in planting, watering, and maintaining the therapeutic garden. Therapists also observed greater willingness to wait for turns, share gardening materials, and complete collaborative tasks.

COMMUNICATION OUTCOMES

Communication skills improved progressively during the intervention period.

Children increasingly initiated interactions using both verbal and non-verbal communication strategies.

Table 4. Communication Outcomes Following Horticultural Therapy

Communication Indicator	Children Improved, n (%)
Increased non-verbal communication	9 (64.3)
Emergence or increase of verbal expressions	6 (42.9)
Increased communication initiation	8 (57.1)

Improvement was particularly evident during collaborative gardening activities requiring children to request tools, share responsibilities, and communicate with therapists and peers.

EMOTIONAL AND BEHAVIORAL OUTCOMES

Behavioral observations also indicated improvements in emotional regulation and behavioral stability.

Table 5. Emotional and Behavioral Changes

Behavioral Outcome	Children Improved, n (%)
Reduced anxiety and tension	10 (71.4)
Improved behavioral stability	9 (64.3)
Improved self-regulation	7 (50.0)

Children appeared increasingly relaxed during outdoor sessions and demonstrated longer periods of sustained attention while participating in gardening activities.

PARENT AND THERAPIST INTERVIEWS

Qualitative findings obtained from semi-structured interviews supported the quantitative behavioral observations.

Parents frequently reported that children became more willing to initiate communication at home, while therapists observed greater participation in structured rehabilitation sessions.

Table 6. Parent and Therapist Reports

Reported Change	Children, n (%)
Increased communication at home	8 (57.1)
Increased interest in social interaction	7 (50.0)
Improved behavioral regulation	6 (42.9)

Representative interview responses suggested that many behavioral improvements generalized beyond the therapeutic setting.

FINAL OUTCOME ASSESSMENT

At the conclusion of the intervention, repeated behavioral observations demonstrated meaningful improvements in social functioning among participants in the experimental group.

Table 7. Final Behavioral Outcomes

Outcome	Improved Children, n (%)
Increased social engagement	11 (78.6)
Development of cooperative behaviors	9 (64.3)
Increased communication initiation	8 (57.1)

In contrast, children in the control group exhibited only modest behavioral changes that were not comparable to those observed in the experimental group.

Overall, the findings indicate that participation in structured horticultural therapy was associated with improvements in social engagement, communication, cooperative behavior, emotional regulation, and independent participation among children with ASD.

SUMMARY OF FINDINGS

The integration of quantitative behavioral observations and qualitative interview data consistently demonstrated positive effects of horticultural therapy on the social development of children with autism spectrum disorder. Improvements were observed across multiple domains, including social interaction, communication, emotional regulation, and cooperative behavior. These findings support the hypothesis

that structured horticultural therapy may serve as an effective complementary intervention within multidisciplinary rehabilitation programs for children with ASD.

DISCUSSION

The present study examined the effectiveness of a structured horticultural therapy program in improving social skills among primary school-aged children with autism spectrum disorder (ASD). Findings from both quantitative behavioral observations and qualitative interviews consistently indicated that children who participated in horticultural therapy demonstrated greater improvements in social interaction, communication initiation, cooperative behavior, and emotional regulation compared with those receiving standard rehabilitation alone.

A key outcome of this study is the observed enhancement in social engagement within naturalistic, task-based contexts. The gardening environment provided structured yet flexible opportunities for reciprocal interaction, which appeared to facilitate spontaneous communication and peer-oriented behavior. These findings are consistent with theoretical assumptions derived from environmental psychology and occupational therapy, which emphasize the role of meaningful, goal-directed activity in promoting adaptive behavior and social participation.

The improvement in communication initiation, particularly non-verbal communication, suggests that horticultural activities may reduce linguistic demands while maintaining high levels of social necessity. Tasks such as planting, watering, and tool-sharing inherently require coordination and joint attention, which likely contributed to increased communicative attempts among participants. This aligns with previous evidence indicating that children with ASD often respond more effectively to interventions embedded in concrete and visually structured environments.

Emotional and behavioral regulation also improved across the experimental group. The reduction in anxiety-related behaviors and increased behavioral stability may be explained by the calming and predictable characteristics of the outdoor therapeutic environment. From a neurodevelopmental perspective, sensory-rich but non-overwhelming natural settings may help modulate arousal levels, thereby supporting sustained attention and self-regulation during task performance.

Importantly, qualitative findings from parents and therapists indicated partial generalization of skills beyond the intervention setting. This suggests that horticultural therapy may support not only situational behavioral improvements but also broader adaptive functioning in daily contexts. However, such generalization effects should be interpreted cautiously given the limited duration of the intervention and the absence of long-term follow-up data.

Overall, the results support the hypothesis that horticultural therapy can function as an effective complementary intervention within multidisciplinary rehabilitation programs for children with ASD. Nevertheless, its role should be considered adjunctive rather than substitutive, as it complements but does not replace established evidence-based behavioral and developmental interventions.

CONCLUSION

This study provides empirical evidence that structured horticultural therapy can positively influence the social development of children with autism spectrum disorder. Participation in guided gardening activities was associated with measurable improvements in social engagement, communication initiation, cooperative behavior, and emotional regulation.

The integration of quantitative and qualitative data strengthens the validity of these findings and highlights the potential of nature-based interventions as a meaningful component of special education and rehabilitation programs. The therapeutic garden environment offered a structured yet emotionally supportive context in which children were able to practice and internalize social behaviors through experiential learning.

While the findings are promising, they should be interpreted as preliminary evidence supporting horticultural therapy as a complementary approach. Further research using larger samples, randomized controlled designs, and long-term follow-up assessments is required to establish the robustness and sustainability of observed effects.

LIMITATIONS

Several limitations should be acknowledged. First, the relatively small sample size limits the statistical power of the study and reduces the generalizability of the findings. Second, the quasi-experimental design without full randomization introduces potential selection bias between experimental and control groups.

Third, the reliance on structured observation and subjective reporting, although triangulated with interviews, may still be influenced by observer expectancy effects. The absence of standardized psychometric scales also limits comparability with other studies in the field.

Fourth, the intervention period did not include long-term follow-up assessments, making it impossible to determine whether observed improvements were sustained over time. Finally, contextual factors such as therapist involvement intensity and environmental characteristics of the therapeutic garden may have contributed to outcomes and were not independently controlled.

PRACTICAL IMPLICATIONS

The findings suggest several practical implications for special education and rehabilitation settings. Horticultural therapy can be effectively integrated into existing intervention frameworks as a structured group-based activity that promotes naturalistic social learning.

Therapeutic gardening sessions may be particularly useful in contexts where children benefit from multisensory engagement and reduced cognitive-linguistic demands. The approach also allows for scalable group implementation, making it suitable for school-based and clinical rehabilitation environments.

Furthermore, the incorporation of goal-oriented horticultural tasks may enhance motivation and participation among children who demonstrate limited responsiveness to traditional desk-based

interventions. This supports the broader use of environment-based therapeutic strategies in ASD intervention planning.

ETHICAL CONSIDERATIONS

The study was conducted in accordance with ethical principles for research involving human participants. Written informed consent was obtained from parents or legal guardians of all participating children prior to enrollment.

All procedures were designed to ensure participant safety, emotional well-being, and dignity. Activities were adapted to individual developmental levels to prevent overload or distress. Children were not exposed to any harmful physical or psychological conditions during the intervention.

Confidentiality of participant data was maintained throughout the study, and all identifying information was anonymized during analysis and reporting.

FUNDING

This study did not receive external funding from public, commercial, or not-for-profit agencies. All resources required for implementation of the intervention were provided by the participating rehabilitation center.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest regarding the publication of this study. The research was conducted independently without any financial or commercial relationships that could be interpreted as influencing the outcomes or interpretation of the data.

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