

# Sensory garden: piloting an affordable nature-based intervention for functional behavior of children with Attention Deficit Hyperactivity Disorder (ADHD).

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## Abstract

**Background:** Nature disconnectedness had been suggested to have a link with childhood disorders such as Attention Deficit Hyperactivity Disorder (ADHD). The core symptoms interfere with the functional behaviors at different contexts. Sensory Integration is the most common treatment approach to these children but confined to established units. Multisensory experiences of nature are recognized as beneficial for multiple medical conditions. Therefore, this study develops nature based Sensory Garden and examines its influence on functional behavior of children with ADHD and replicability of Sensory Garden (SG) in home settings.

**Methods:** Ten participants, aged 6-12 years were recruited by screening with ADHD rating scale and Short Sensory Profile. Randomly, equal number of participants was allotted to either of the two groups by convenience sampling. Baseline scores of functional behavior were collected by using Weiss Functional Impairment Rating Scale (WFIRS). The subjects of Experimental group were exposed to combined outdoor Sensory Garden (SG) and indoor Sensory Integration (SI) whereas Control group only SI intervention. The duration of intervention extended for a period of 3 months (46 sessions). At the end of last session, post test scores were collected.

**Results:** The statistically significant result suggested nature based Sensory Garden with indoor SI intervention as a better therapeutic approach in enhancing functional behavior in children with ADHD. Three parents replicated SG either wholly with all the senses or partially based on child's preference and space availability at home.

**Conclusion:** Sensory Gardens enable children to have rich sensory stimulation experience during daily play at outdoors and serve as a potential therapeutic adjunctive tool and also can be created easily and quite economically at home settings to have an enduring influence.

**Keywords:** Attention Deficit Hyperactivity Disorder (ADHD), Conceptualized, Centre for Disease Control (CDC).

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## Introduction

Attention Deficit Hyperactivity Disorder (ADHD), a frequent neuro behavioral disorder characterized by the core symptoms of inattentiveness, hyperactivity, and impulsivity that has long been recognized as affecting the behavior of children [1]. Centre for Disease Control (CDC) had identified ADHD as “ a serious public health concern” by virtue of wide prevalence and severity of disorder, impairment in pivotal areas of life impeding overall participation and limited effective interventions [2]. Although some of the core symptoms improve with maturity, if not optimally managed, many remain symptomatic across the life span affecting one's behavior in functional aspects such as relationships with family members and peers, and also performance at school or work [3]. Even though pharmacological treatment can lead to improvements in behavior in many, few children with ADHD may not exhibit favorable response or may have insufferable after effects such as facial tics, anorexia and hypertension affecting both the ADHD child and family in daily life functioning [4,5]. Finally, approximately 30% of children under medication do not respond [6]. Furthermore, cognitive behavioral therapies are

also offered in addition to medical interventions as an adjunct. Overall on a whole, a multimodal approach of treatment is implemented which is a blend of pharmacological, psychoeducational, psychotherapeutic and Occupational therapy [7]. Considering the increase of children with ADHD worldwide and corresponding economic burden it may have [8,9]. A clear public concern to explore new alternative and complementary treatments are essential to combat ADHD symptoms and enhance quality of life of children and families [5]. Thus, it is a high need of the hour to incorporate other perspectives into the current ongoing treatments for the long term efficiency. The sensory information processing in children with ADHD is either too much or too little in all of the sensory systems such as visual, auditory, olfactory, gustatory, tactile, proprioceptive and vestibular resulting in maladaptive behaviors by compromising functional behaviors which thereby having a profound impact on the academic performance at school, peer interaction during play and community participation [10]. The natural elements of nature with rich diverse senses is considered as an effective, economical and a

sustainable tool to recover from day today stresses in general and attentional fatigue in particular [11,12]. Intentional contact with nature and its elements in a pleasant and enjoyable environment is recognized as the best way to facilitate the processing of all senses especially in children with ADHD as deficits in sensory processing are more common besides the core symptoms [13]. Greener the child's play area the deficits are less likely to be experienced by the children affected by ADHD [14]. Garden, in some form or the other interacts with nature in a complex manner and promotes healing [15]. Sensory gardens, a type of therapeutic garden are a part of nature-based intervention which is designed to stimulate the five basic senses (sight, hearing, smell, taste and touch). Contemporary sensory gardens are often intended to stimulate holistic sensory systems which also focus on movement (vestibular) and joint position sense (proprioception) apart from 5 basic senses [16]. Sensory Integration (SI) approach assists of sensory information and filtering it for an adaptive functional use [17]. Based on individual sensory processing needs, a well-balanced sensory diet consisting of all senses namely vision, hearing, smell, taste, touch, movement and proprioception are provided in the form of sensory motor activities in order to maintain a calm and alert state [18]. The purpose of the research is to develop a sensory garden and to examine whether the program implementation resulted in increase in (1) functional behavior of children with ADHD and (2) parental/caregiver initiation to replicate Sensory Garden at home setting.

## Materials and Methods

The study was conducted between November 2016 to June 2017 at SRM Hospital & Research Centre, Chennai.

### Study design

Quantitative quasi experimental pre-test and post-test design.

### Participants

Randomly ten children (9 males and 1 female) who fulfilled the DSM-IV criteria for ADHD were recruited from Occupational Therapy clinic, SRM Hospital & Research Centre, Chennai, over a period of 8 months. The participants between the ages of 6 and 12 years were included by screening with ADHD rating scale and Short sensory profile. Children with Mental Retardation (MR), other developmental disorders, visual and/or hearing impairment, epilepsy and those allergic to certain plants were excluded.

### Instrumentation

ADHD rating scale to screen children with ADHD. Short Sensory Profile (SSP) to frame individualized sensory diet. Weiss Functional Impairment Rating Scale (WFIRS) outcome measure to score the functional behavior.

### Intervention

The subjects according to the inclusion criteria were included to participate in this pilot study. After obtaining formal written consent forms signed, the subjects were allotted to either

experimental group (Group A) or control group (Group B). Each group had equal number of subjects conveniently in a random order. After screening with ADHD rating scale, the base line measurements, SSP and WFIRS were collected from the children of both the groups. The experimental group was exposed to combined outdoor sensory garden based on sensory diet and indoor Sensory Integration (SI) therapy. On the other hand, control group was provided with only SI in indoors. The intervention lasted for 3 months (12 weeks) with the interval of 3 times a week (45 minutes/session) for a total of 46 sessions. Both the interventions were carried out as a morning sessions. Post intervention measurements were administered and calculated after completion of intervention program.

**Group A:** Experimental Group (Sensory Garden and SI)

**Group B:** Control Group (SI only)

### SI Intervention

Indoor activities of walking on textured door mats, ball throwing, playing in a ball pool, building the blocks, climbing on a monkey bar, walking on a balance board, jumping on a trampoline and swinging on bolster swing.

### Sensory Garden: Nature based Intervention program

**Sensory Garden design development:** Sensory Garden in 2017 was conceptualized, designed and implemented by 3 research team members of SRM College of Occupational Therapy in SRM Hospital & Research Centre, Chennai after formal approval. It was designed with sensory stimulation therapeutic program in mind which can be easily replicable and implemented by the parents of special children from clinical setting to home setting. It converts an open underused fringe area to a small, user friendly, low cost, well protected and delimited space attached to Occupational Therapy clinic which made it easily accessible and safe to explore by the special needs children attending the treatment. It is composed of various natural elements which provide opportunity to respond to various senses such as water (hearing and touch), loose materials on the surface of textured paths such as gravel and sand separated by wood edgings (tactile), natural grass on plain surface and ramp (tactile, vestibular, proprioceptive), aromatic and edible herbs (smell, taste), colorful plants and flowers and unused cycle rim (sight), low concrete wall with wired fence (proprioceptive, vestibular) tree swing and hammock (vestibular). Thus, the garden became a therapeutic device in itself. The rehabilitation offered sensory-motor based activities which was intended to stimulate the participants' sensory experiences (visual, auditory, olfactory, gustatory, tactile, proprioceptive and vestibular) through exposure to nature in a Sensory Garden.

**Sensory garden intervention:** The Group A (Experimental group) were exposed to sensory garden and were allowed to explore and engage in sensory motor activities in the garden. Sensory diet through nature based outdoor sensory garden consisted of all senses namely visual, auditory, olfactory, gustatory, tactile, and vestibular and proprioception through natural elements. The sensory motor activities include walking

on textured pathway, climbing and sliding on the grass ramp, walking on the concrete wall across the fence, sand play, water play, balancing on uneven logs, building steps with logs and climbing, jumping on to the grassy platform from raised platform, swinging (tree swing and hammock), listening to birds chirping, smelling scented plants (Mint, Tulsi, Curry leaf, Rose Mary),tasting edible herbs (Mint, Tomato, Country Borage-Karpuravalli in Tamil, Basil),watering the plants, Peeling Aloe vera leaf, playing with wooden drum, watching brightly colored plants and flowers and finally singing rhyme-ringing roses while walking around the Areca Palm plant. After engaging in outdoor sensory motor activities in sensory garden, the children were given SI intervention indoors for 15 minutes.

## Results

The findings of functional behaviour was analysed using non parametric Mann-Whitney U test by comparing the results

**Table 1.** Global WFIRS mean scores of Group A.

S. No.	Test	Group	N	U	P-Value
1	Pre test	A	5	8	0.344
		B	5		
2	Post test	A	5	0	0.009*
		B	5		

**Table 2.** Comparison of mean difference of global WFIRS.

Condition	No. of subjects	Mean difference	U
A	5	33	0
B	5	13.4	



**Figure 1.** Sensory Garden how it looks and works.

## Discussion

### *Effects of SG intervention*

This pilot study was to investigate the effects of sensory garden intervention, based on individual's sensory diet on functional behaviour in children with ADHD. These findings back up and expand the existing evidence stating that sensory experience in a comprehensive manner enhances functional performance besides skill performance which impacts everyday life activities. Afore mentioned statement has been validated by the

between the groups. The P value was less than 0.01 and hence results are significant and can be claimed as nature based sensory garden intervention was effective. Therefore, null hypothesis of the study can be rejected and support the experimental hypothesis. The global mean scores of group A (experimental) and group B (control) are 33 and 13.4 respectively proving that the combined intervention in outdoor sensory garden and indoor SI can have a better beneficial effect on behaviour than just indoor SI intervention in children with ADHD (Table 1 and 2) (Figure 1).

studies [19,20] that states, each individual's sensory diet i.e., Particular quality and quantity of sensory experiences play a crucial role to perform activities of daily life in a skillful, adaptive and organized way. Further, a large body of research upholds the idea that sensory experiences influence the function, structure and neurochemistry of brain [21,22]. Better gains in functional behavior exhibited by experimental group may be attributed to active connection to natural environment enriched with natural elements although it is a self-contained small garden space. The elements of nature allowed exploring varied sensory experiences spontaneously through sensory motor activities in sensory garden. The garden experience encouraged the children to engage in intervention actively and also eased the researcher's efforts. User accessibility in exploring the nature in knowing how it feels, sounds, tastes and smells the natural elements and its restorative benefits may have better effects on control of ADHD symptoms, hyperactivity and impulsivity in particular and subsequently had impacted better functional behaviour. The adaptive performance of children and participation in indoor SI intervention activities were considerably better after outdoor sensory garden exposure than their counterparts. These findings are consistent with previous research that indicates reduction of ADHD symptoms than usual after participating in

activities in a relatively greener area. In addition, aftereffects of activities were performed better after exposure to outdoor greenery [23,24]. According to the sensory diet requirements the outdoor environment provided diversified sensory experiences as per the participant's specific needs either less or more sensitive to senses in a comprehensive way. Parents also reported improvements in their children's behaviors related to sensory processing based on daily response to sensory events. Furthermore, the compliance to the entire sensory garden program intervention was found to be quite high as the participants recalled the time spent was fun filled [25]. Finally, response of the children was more relaxed and calmer with relatively limited nature connectedness through doses of Sensory Garden that emphasised the importance of outdoor play. Thus, the current findings upholds 'leave no child inside', a nationwide movement [26,27]. Initiation to replicate the Sensory Garden. Among 10 parents/caregivers, 3 of them replicated the design of sensory garden at residential setting in an adaptive way to meet the particular sensory needs of the children. Seven parents had verbalised the desire to replicate partly as per the needs of the children.

- **SG No. 1 (complete):** Natural elements were so utilized in a compact manner with priority added to miniature grass lawn as the child was tactile sensitive but fortunately seeking the grass sensory experience. Unused backyard garage was constructively remodeled as an economical sensory garden.
- **SG No. 2 (partial):** A small sized scented garden in balcony considering limited availability of residential outdoor space and child's preference. Scented herbs planted were mint, basil of different varieties and Indian Borage.
- **SG No. 3 (partial):** In an already existing outdoor garden, few elements like unused wooden planks were used for balancing activities. Dedicated space for Sand to encourage sand play as per child's preference was introduced.

Finally, the parents/caregivers had responded in appreciating the advantages of outdoor sensory garden activities which overtook other indoor activities with additional value added to such activities. The replication of Sensory Garden was context and need specific.

## Conclusion

In conclusion, the purpose of the present pilot study was to investigate the effects of an economical Sensory Garden on functional behavior of children with ADHD. The findings revealed the potential of outdoor Sensory Garden intervention had better gains on functional behavior in all its domains resulting in a better quality of living and a potential adjunctive tool. Future study needs to consider larger sample and randomization to validate the results. In addition, the lasting effects of intervention on functional behavior at varied contexts would be valuable to verify. Furthermore, it would add additional value to the outcomes of intervention by considering the choice of children and needs of parents while selection of natural elements. The concept of Sensory Garden as an outdoor medium of play is easily replicable either wholly or partly at

home settings with affordable cost, based on individual child needs to have an enduring influence.

## Ethical Consideration

Approved was obtained from Research team of SRMIST College of Occupational Therapy, Chennai following thorough scrutinization of the relevant papers and consent letter approval from all parents.

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## Conflicts of Interest

Nil

## Author's Contributions

Silpa Immanuel Voola led the research, conceived and developed the idea, implemented the intervention, preparation of manuscript. Vijaya Kumari implemented the intervention

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