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How Nature Affects The Behavior of ADHD Children: A Case Study in Northeastern Brazil

Mônica Maria Siqueira Damasceno [I]
Jane Marcia Mazzarino [II]
Aida Figueiredo [III]

Abstract: The present study involves children diagnosed with Attention Deficit Hyperactivity Disorder (ADHD) from public schools of the municipality of Crato - CE, northeastern region of Brazil. The overall objective was to analyze the profiles of six children, before and after interventions with nature, in order to identify potential changes in behavior resulting from experiencing direct contact with nature. The method used is exploratory and descriptive, and it is a multiple case study with an action-research character. The results showed changes in behavior with mitigated ADHD symptoms regarding cognitive and socio-affective aspects. Among other behavioral aspects, higher motivation for studying, better understanding and adaptation to rules, extended states of tranquility, higher receptivity to social contact, decreased aggressiveness, hyperactivity, impulsivity, and higher tolerance to oneself and others were noticeable.

Keywords: Attention Deficit Hyperactivity Disorder (ADHD), children, development, nature.

[I] *Federal Institute of Education, Science and Technology of Ceará (IFCE), Juazeiro do Norte, CE, Brazil.*

[II] *University of Vale do Taquari (Univates), Lajeado, RS, Brazil.*

[III] *University of Aveiro, Aveiro, Aveiro, Portugal.*

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Introduction

ADHD refers to difficulty in focusing attention and reasoning, and it is considered a health issue, with implications that directly affect school performance and might cause psychological and social problems to the individual (GOMES et al., 2007). Despite the relative knowledge about this disorder, there is no consensus as to the magnitude of difficulties caused by inattentiveness, hyperactivity, and impulsivity related to ADHD. Hyperactivity, an aspect that is independent of the child's will, is commonly confused with defiance, which leads to prejudice against patients who have this disorder.

Although ADHD is not included in the category of Learning Disorders, its characteristics have been considered to inhibit learning, leading to significant hindering of school performance. Children with ADHD might have learning limitations, as inattention and problem behaviors affect the learning process in the classroom (MATTOS, 2007). This disorder is also associated with low grades in reading and mathematics, higher retention rates, and low graduation rates (LOE; FELDMAN, 2007). In the family setting, ADHD is considered a factor that leads to a difficult daily interaction (OSWALD; KAPLER, 2010).

ADHD is a behavioral disorder typically diagnosed in children; however, there is no consensus regarding its prevalence. While some studies estimate 3% to 7%, others indicate a prevalence closer to 10%; there are also those that provide estimates between 3% and 5% (CARDOSO; SABBAG; BELTRAME, 2007). Regarding intensity, ADHD children have moments of defective attention and a lack of control of their impulses. This deficit is considered severe and chronic in 8% of American children, as it substantially affects the functioning of multiple areas of life (CENTER FOR DISEASE CONTROL, 2005).

The treatments currently available for ADHD contemplate pharmacological and behavioral interventions, and stimulants are indicated as priority ADHD medications, especially for patients with no comorbidities (ROHDE; HALPERN, 2004; ANDRADE et al., 2011). According to Andrade et al. (2011, p. 460), among the "results obtained with stimulant-based treatments, one might expect improvement in hyperactivity, attention, self-control, and impulsivity, reduced complaints, and decrease in verbal and physical aggressions". Although medications are the most common and scientifically recognized treatment, other ways to mitigate ADHD symptoms should not be overlooked; one of them is increased contact with nature.

An integrative analysis of studies conducted by Damasceno (2019) showed that there are few studies addressing the direct relationship between children experiencing nature and ADHD. Among these studies are Kuo & Taylor (2004) and Taylor & Kou (2009 e 2011), which provide important subsidies for understanding the importance of this relationship in the development of ADHD children. The authors indicate that common weekend activities and practices in settings within nature might be widely effective in decreasing ADHD symptoms.

> If controlled experiments and clinical trials bear out this potential, such natural treatments promise to supplement current approaches to managing ADHD, with the advantages of being widely accessible,

> in-expensive, nonstigmatizing, and free of side effects. (KUO; TAYLOR, 2004, p. 1580).

Three other studies, published more recently, validate the potential nature has to mitigate ADHD symptoms. Yang, et al. (2019) concluded, in a study with Chinese children, that there might be a beneficial association between green spaces surrounding schools or kindergartens and ADHD symptoms. Donovan et al. (2019), on the other hand, showed that exposure to natural setting is protective against ADHD. The third paper, by Martins, Peres & Souza (2019, p. 12), concluded that the term Nature Deficit Disorder (NDD) - coined by Richar Louv - constitutes "a broader notion of what ADHD is, and both disorders could be treated with the prescription of green time/nature therapy".

Louv (2015) even believes that if nature therapy decreases ADHD symptoms, the latter could even represent a group of symptoms intensified by the very lack of exposure to nature. The author analyzed numerous studies addressing the benefits of nature and observed that they all point towards the same direction: the lack of contact of children with nature might help develop ADHD. Therefore, if nature can be beneficial as a supplementary or preventive therapy for children diagnosed with ADHD, which changes might it indicate?

Taylor & Kuo (2011) showed that regularly experiencing outdoor activities in green spaces provides numerous benefits to children. Experiencing nature might be a resource to mitigate symptoms for those who need to regain self-confidence, calm, and focus, which is the case of ADHD children.

The present paper monitors the trajectory of six children diagnosed with ADHD in the municipality of Crato, state of Ceará. They took part in PhD research, with the aim to understand how experiencing nature might affect cognitive and socio-affective development and the intensity of ADHD symptoms. The aim of the study was to analyze changes in the behavioral profile of ADHD children, before and after guided activities with and within nature. The Flow Learning method by Joseph Cornell was used in the intervention process.

The Flow Learning Method inspires awareness and lovingness through playful and fun experiences, which comprise four stages that lead to a shift from a restless stance to higher focus and engagement. They are: awakening enthusiasm, focusing attention, direct experience, and sharing inspiration (CORNELL, 2008).

Method

This is an exploratory and descriptive research, and a multiple-case study with an action-research character. A survey was conducted with the Department of Education of the municipality of Crato - CE to quantify and identify children diagnosed with ADHD, and a total of 18 cases were found.

The shared criterion among participants included in the group was to have been diagnosed with ADHD. Additonally, the following inclusion criteria were adopted: being

between 7 and 12 years old at the beginning of the study; having a diagnostic report of ADHD; and being regularly enrolled in a municipal public school of Crato. Of the children included, eleven met the inclusion criteria, and seven were removed. The exclusion criteria adopted were being an adolescent, attending a municipal school in the rural area, not having an adequately signed Free Informed Consent Term (TCLE).

The on-line Qminim software was used for randomization using the minimization process to select the subjects who would comprise the Intervention Group. The names of the eleven study subjects were added for software processing, and six of them were selected to comprise the Intervention Group, based on the increasing order shown by Qminim; these subjects participated in the experiences with nature for a period of six months.

Initially, a retrospective profile was performed using medical reports, as well as an ex-ante evaluation with parents/guardians and teachers, to understand how these informers characterized these ADHD children. Subsequently, a new profile of the subjects was prospectively outlined through field research, by conducting new interviews with parents and teachers, and through observations during the interventions, which were recorded in field journals. In order to understand the profile of the study subjects, contextualizing the settings where these children were inserted was deemed necessary.

The experiences with nature were based on the four stages proposed by Cornell: awaken enthusiasm, focus attention, offer direct experience, and share inspiration. The interventions started with a free exploitation of the natural setting. After that moment, which was identified as a loving contact with nature, the games and/or activities would start. Observation guides were used while experiences were applied and were developed to monitor the evolution of the subjects, considering cognitive and socio-affective aspects, as well as intensity and predominance of ADHD symptoms (DAMASCENO, 2019). Eight guides were used, one for each meeting, each with four activities according to the stages proposed by Cornell. An individual guide was used for each subject. After an interval of three months, the same experiences were performed again, in order to compare the potential evolution of each participant. Therefore, there were a total of 16 meetings.

Diagnose of the municipality of Crato regarding ADHD children

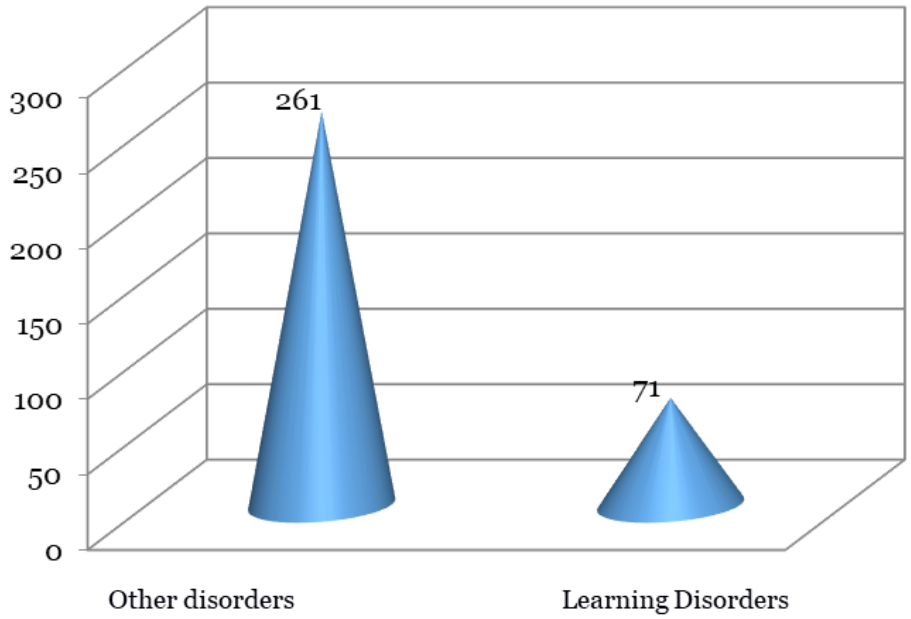
The municipality of Crato has 66 municipal schools (36 rural and 30 urban[1]). Of those, only 07 provide a Specialized Educational Service (SES) room; four in the rural area and three in the urban area. This reality precludes a better care for children diagnosed with deficiencies or with Special Educational Needs (SEN).

In 2015, the Coordination for Inclusion and Diversity of the Municipal Department of Education of Crato started to survey children/adults registered in the municipality who had any type of disorder. The diagnosis and the report were performed by a doctor from the Unified Health System (Serviço Único de Saúde - SUS), and sent to the Department of

1 - The quantitative data used in this work correspond to those made available by the Secretariat of Inclusion and Diversity, during the period of application of the research

Education, due to complaints by teachers and some parents/guardians and/or via request by school principals. The doctor sent the report to the Department of Inclusion and Diversity for the monitoring of cases. Figure 1 shows a comparison between the number of children with Learning Disorders and those with other Disorders in the municipality.

Figure 1 – Comparison of the existing disorders in schoolchildren in the municipality of Crato (CE)



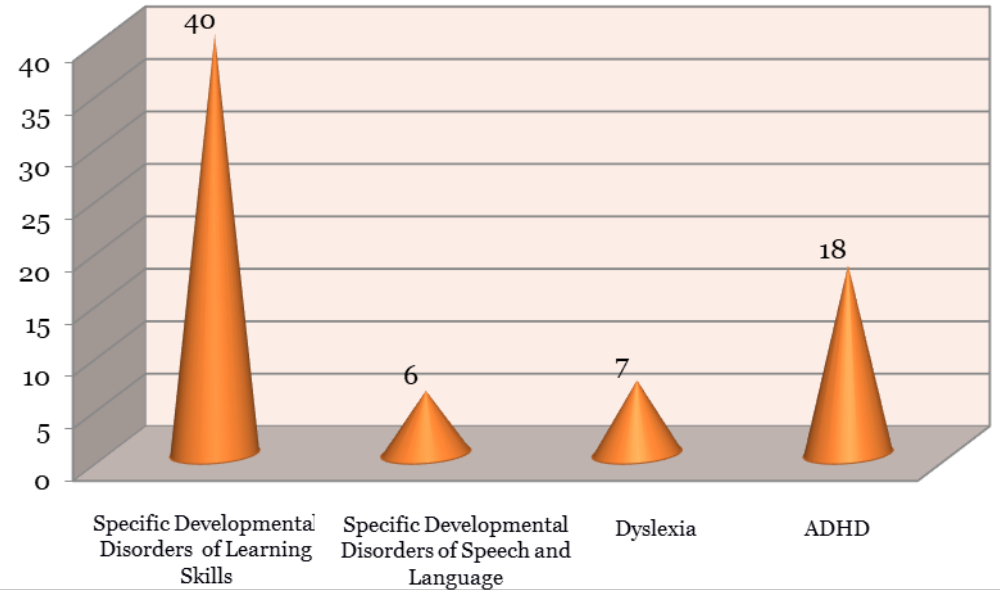
Source: The authors

The data indicate that, in 2015, 332 children enrolled in municipal schools were diagnosed with some type of disorder that placed them in the Special Education category. Of this total, 261 were classified as having other disorders, namely: Kabuki Syndrome, Down syndrome, Psychological Development Disorder, Epilepsy, among others. Additionally, 71 were diagnosed with Learning Disorders (LD).

Figure 2 shows the Learning Disorders (LD) found. Although ADHD is not specifically a LD, it was included in this category as it is among the disorders that most frequently leads to impaired learning process. Of the 71 children diagnosed, 40 were identified by the Manual of Classification of Mental and Behavioral Disorders of the International Classification of Diseases-10 (CID-10) as belonging to group F81, which refers to Specific Developmental Disorders of Learning Skills; 6 were classified as F80, related to Specific Developmental Disorders of Speech and Language; 7 were classified as R48, referring to Dyslexia; and 18 were classified as F90.0, which corresponds to Attention Deficit and Hyperactivity Disorder. The latter are therefore the subjects considered in

the present study.

Figure 2 – Distribution of Learning Disorders in the municipality of Crato (CE)



Source: The authors

According to Granato & Casella (2015), the Diagnostic Statistical Manual of Mental Disorders - 5 (DSM-5) provides a new approach to LD's. Hence, the Special Learning Disorder (315) is now a single global diagnosis, which encompasses all deficits that affect academic performance, although it provides specifiers of reading, written expression, and math learning disabilities. The CID-10, on the other hand, provides a general classification for Specific Disorders of School Skills (CID-10:F81), also with subdivisions referring to each skill affected. The medical reports that show the diagnoses of the ADHD subjects are based on CID-10.

The diagnosis of cases in the municipality allowed identifying the subjects who comprised the Intervention Group, as well as the profiles before and after their experiences with nature.

Initial profile of children who participated in the experiences with nature

All children included in the study came from low-income families. Some of them live in a dysfunctional family setting and in homes with minimum hygienic conditions. This information was surveyed in the interviews, in visits to the residences, and by applying the socio-demographic questionnaire, which allowed knowing the family setting in which the subjects lived.

Family structure of the participants of this research were predominantly nuclear, followed by the extended family structure, which included the grandmother; there was also family structure with children from a previous relationship of either (or both) parent(s).

Four of the participants of the Intervention Group lived in houses that belonged to Programa Minha Casa Minha Vida (My House, My Life Program). According to their parents, the subjects took medications, yet none underwent any type of cognitive-behavioral therapy or regular psychological counseling.

According to parents/guardians, four of the six children used medications before and during the study; two of them changed medications during the intervention period, i.e. they stopped using Ritalin because they could not afford the medication. One child took Neuleptil in the morning, and was always sleepy during classes. According to the SEN coordinator, this fact caused the parent to change the child's medication schedule.

Children who had a report only with CID-90 (ADHD) were not entitled to a caregiver[2]. The school allowed them to attend the SEN class. However, they were frequently unsupervised, and remained most of the time outside the SEN room, with no guided activities. Regarding profile, the six subjects had the following disorders according to the information in the medical reports:

> I declare that (child's name) has undergone a cognitive evaluation for difficulty with learning, and has been diagnosed with CID-10 F90.0 (Attention Deficit and Hyperactivity Disorder) (REPORT 01, 2017).

> Patient with ADHD, CID F90.0, has delayed education, presents with coherent conversation, and is cooperative (REPORT 02, 2017).

> I have analyzed (child's name) and he/she exhibits symptoms compatible with ADHD, CID-10 F90.0. We have started medication treatment today (REPORT 03, 2017).

> The child (child's name) needs special attention and must remain performing his/her school activities to avoid losses in his/her academic life. Symptoms compatible with ADHD, CID-10 F90.0 (REPORT 04, 2017).

> Patient with ADHD, takes Ritalin. Presents with cognitive deficit and hyperactivity and needs the following treatment: with O.T., psychologist, psychopedagogue [...] (Unintelligible writing) (REPORT 05, 2017).

2 - Caregiver is the professional required for children, adolescents, and young people who have conditions that deem them dependent on daily care in the school. these professionals must be qualified to help the person they assist to conduct daily and routine activities (BARBOSA, 2018).

> (Child's name) presents ADHD, Attention Deficit and Hyperactivity Disorder, CID -10 F90.0, and needs to take Ritalin (REPORT 06, 2017).

It is noticeable that all reports follow the same pattern: they have few details, provide the ADHD diagnosis, and mention the corresponding CID-10. The municipality has only one psychopedagogue, who confirmed that not all children have a medical report. No access to psychopedagogical assessments was provided. According to the psychopedagogue, the high demand hampers the performance of psycho-pedagogical reports. Moreover, a neurological report is considered enough for school supervision. The neurological report provides a diagnoses of the disorder, but is not enough to outline the profile of a child with LD. Evidently, a psychopedagogical assessment provides a broader view of the child's situation, as it allows assessing cognitive, pedagogical, socio-affective, and motor development.

In addition to the reports, and in order to outline the profile of subjects, an initial description of each subject was created according to the interviews with parents/guardians, teachers, and with the children themselves.

SI1[3], nine years old, attends 3rd grade. She is evidently underweight and does not appear to receive the required hygienic care. She lives with her mother, her stepfather, and a twin brother with mental deficiency (the mother's speech is as follows: "he is worse than SI1, and that is why he studies at another school"). SI1 lives in the rural area but studies in the urban area. In the afternoons, she stays at the house where the mother works as a cleaner.

SI1 is described by the mother as a "very hyperactive" girl, who needs more care, more supervision, and she has great difficulty with learning. Her mother said that she is good with her brother, but "doesn't listen to anyone", and throws tantrums. Her mother informs that she takes calmantezim as she was quite aggressive for a period. According to her mother, SI1 needs a psychologist and a phonoaudiologist as she has trouble speaking. Her mother suspects she has some "hearing problem" because it is sometimes necessary to speak very loud with her.

The teacher describes her as a sociable child, who interacts well with her classmates and with her teachers. She participates in the classes, sometimes she over-participates, cutting in when people are speaking, sometimes even disturbing the class. According to her teacher, she arrives early at school. She believes SI1 goes to school without having eaten, as she is "very cold" to the touch when she arrives at school, and wears clothes that do not warm her. There are days when she is much more restless, and it is difficult to work with her. She believes SI1's medical report has expired and that she has not been taking her medication.

When SI1 was interviewed, she was full of energy, and at the same time, very fragile. She could not stay still for a moment and fiddled with everything on the table. She answered the questions with roughly three words, and hardly answered what was

3 - To preserve the anonymity of the participating children, SI1 was used to indicate Intervention Subject 1, and so on.

being asked. Corroborating the teacher, she was observed to interrupt a lot when talking to someone. Her tone of voice was loud and her speech was quite unintelligible; however, she was nice and interactive all the time.

SI2, twelve years old, attends 6th grade; however, he cannot read or write. His appearance is of a well-cared child. He lives with his parents and two brothers. According to his mother, he is a very restless boy; he does not even watch TV and is very forgetful. He is not patient, "his little head hurts a lot". He is aggressive and "doesn't know how to do anything" at school. His mother reported that one day he cried and complained of a headache, because everybody but him knew how to read and write in his class. According to her, the school does not attempt to provide him help. She says that SI2 is aggressive but is also caring, and only becomes aggressive when his brother teases him. There have been no complaints about his behavior at school, only about his tasks. When he takes his medication, Neuleptil, he sleeps. If someone wakes him, he throws up; that is why his mother does not take him to school.

His teacher described SI2 as very quiet, who does not like to get involved with anybody in the classroom. He always sits in the last chair at the back and does not like to be helped with his activities. He does everything alone, but he does nearly nothing, because he cannot even copy the instructions. She reports that he has no behavioral problems and sees him as a four-year-old child although he is 12.

SI2 was very shy when he was interviewed. He always asked to repeat questions. Then, without looking at the interviewer, he would answer in a very low voice. At no point in the interview was he restless or aggressive. When informed of the experiences, he asked if they were mandatory. The answer was that no, they were not mandatory, but if he were picked, he might like to participate. He asked if there were activities with a ball; if so, he might want to go.

SI3, nine years old, attends 2rd grade. He seems small for his age. He lives with his mother, three brothers (one of whom has a severe mental deficiency), one cousin, and his mother's boyfriend. The window in his house has had its glass broken. His mother informed it was broken because he tried to run away. She requested the interview be conducted at school because there were people sleeping in the house and it was a mess. She described SI3 as a child who is sometimes caring and other times, sassy, and even threatening sometimes. "He is too evil, he doesn't want to leave anything be". She told that, when she tells him off, he only laughs and wears a mean expression. "People say that he is one person with me and turns into someone else when I leave." He says he sometimes likes going to school; other times, he says he does not like his teacher. His mother reports that it is hard for him to focus. She thinks that it is because of the medications. She also says that when he goes shopping, he does everything right, without making any math mistakes.

His teacher says that SI3 will not stop still, keeps looking through the window, and leaves the classroom at any opportunity. She says that he can recognize some letters and numbers, but has difficulty with learning. If someone teases him, he becomes quite aggressive. He frequently arrives sleepy at school.

The interview with SI3 was very difficult because he was literally sleeping; he could

not even raise his head. Walking around with him for a while helped him answer the questions later, but he provided only one-word answers. He said he likes to go to school but is too impatient to learn the difficult letters. According to his teacher, SI3 takes so many medications that he spends all the time sleeping. That is why he was transferred to the afternoon period.

SI4, ten years old, is a nice and curious child. She lives with her mother and two sisters, one younger and one older, who is mentally challenged. Her mother is older. Her house is tidy, and so is SI4. She takes two medications. Her mother praised her a lot and proved to take good care of her child.

Her teacher started the interview saying that SI4 has Down syndrome (but that is not corroborated by the information provided in the report). He described her as very communicative and willing to learn, but she needs the information taught to be repeated because she cannot remember it completely, even if she is paying attention. Although she is communicative, he has relationship issues with other children; therefore, she cannot perform group activities. She can work with no more than one classmate at a time. She can focus but everything must be near her; school material, books etc. She does not like anything disorganized.

During the interviewing, SI4 showed to be a well-cared and very curious girl. She answered all the questions easily. However, she interrupted the interview three times to mimic animals, with movements and sounds. Other times, she would pick the interviewer's hair and look at it with great focus.

SI5, ten years old, attends 5th grade. He is thin but appears healthy. He has big, curious, and restless eyes. His mother describes him as a very happy child, with great difficulty with learning and with focusing at school. According to her, he interacts with other children but finds it hard to focus on anything. He cannot be still because of hyperactivity. When interacting with his classmates, she notices that he sometimes "curses, hits, throws stones". When he is upset, he becomes aggressive.

According to his teacher, SI5 is a very restless child, who does not interact much with his classmates and does not participate in the activities. However, he likes to barge in. He has difficulty with writing and reading. He is tidy and clean when he goes to school and takes his medication every day.

In the interview, SI5 was quite restless and interrupted all the time. He asked many questions and answered everything he was asked. He was a quite careful and curious child. ADHD symptoms, particularly impulsivity and hyperactivity, were very clear at first sight. He spoke very fast and loud, and sometimes it was difficult to understand what he was saying.

SI6, 12 years old, is thin and tall. His behavior resembles that of an adult. He attends 6th grade, but find it difficult to follow the year syllabus. He lives with his grandmother in a house with three other people. His parents are separated and both live with another partner. His mother occasionally shows up. His father lives in another city. The child says he does not like to be with his father because he suffers violence. The report from the Department of Health informs he has ADHD. However, his grandmother believes

he is schizophrenic, due to his behavior. Moreover, one doctor was reported to have diagnosed him with schizophrenia. At home, he is calm but becomes aggressive when his sister bothers him; he has even tried to kill her twice. His grandmother reported that SI6 was one year old when he came to live with her, as his mother was ill at the time. However, once his mother got better, she decided to go away, leaving the children with the grandmother. Regarding learning, the grandmother says he has learned how to write his name, but she thinks the school does not challenge him enough. She informed that he had a caregiver, who she did not like very much.

The grandmother's report shows she cares and is concerned about the child. On the day of the interview, the child, the sister, and the grandmother were sleeping (at 10 A.M.). Their house was untidy and with poor cleanliness. In the living room, on top of a cluster of things, lay a mattress with no sheets where SI6 sleeps, according to his grandmother.

In the interview with his teacher, she reported that SI6 finds it difficult to follow classes, that he always prefers to be outside the classroom with his caregiver, and that he is frequently absent from classes. During the interview, it was evident that SI6 has difficulty with learning, does not like to be asked questions, and answers reluctantly. His answers were always monosyllabic. When asked if he would like to participate in the nature project, he answered with another question: "What is in it for me?"

Highlighting the elements that arose spontaneously in the interviews with the parents/guardians and teachers, the following behavioral adjectives were the most frequent in the informers' speeches: hyperactive, restless, antisocial, aggressive, does not learn, impatient, introvert, sad, extrovert, exaggerated/over the top, no focus, intolerant, disobedient, naughty, does not follow instructions, impulsive. These behaviors indicated by the informers are in line with ADHD characteristics.

Rohde et al. (2000), considering inattention, hyperactivity, and impulsivity in ADHD, provide some behaviors indicated by informers, such as difficulty in paying attention to details, inattention to people who are speaking to them, reluctance in following orders, easily distracted, tendency towards excessive restlessness, impatience and cutting in, among others. In addition, Nijmeijer et al. (2008) emphasized that a considerable number of ADHD children suffer from significant deficiencies in social interactions, resulting in conflicts confirmed by the family, frequent rejection by peers, and few friendships.

After the interviews, the subjects participated in the experiences with nature for a period of six months. At each new meeting, they were noticeably more at ease with the setting, and consequently, with themselves, with their teammates, and with the researchers. Their contact with nature, at first diffident (as this type of activity was not part of the children's daily lives), was used as an opportunity to explore and learn, with confidence, autonomy, and interaction, attitudes that were not visible initially, and which appeared throughout the experiences.

During the interventions, the children revealed how significant the experiences were to them, allowing them to build a connection to nature, which was reflected in their engagement to all activities proposed. The feeling of pleasure and joy was present

throughout this period, as indicated by their statements: "It's so nice to run this whole wide world" (SI6); "Monkina, did you see me climbing the tree? That was awesome" (SI3); "I saw the little soldier of Araripe, so pretty" (SI5); "Miss, I am so happy when I'm here looking at nature with my friends" (SI4).

They showed a behavioral maturing throughout the experiences, marked by a potential sense of belonging. Unlike the beginning of the intervention, they were more confident and whatever they expressed regarding the places where they experienced the activities was done in a resourceful a calm manner, which is quite desirable for people with ADHD.

After the period when they experienced nature, a new profile was outlined for the subjects by observing the group experiences they participated in and based on impressions and speeches by the parents/guardians and teachers. At this point, parents and teachers referred that the children's behavior had new elements, such as (higher or lower) introspection, tolerance, calm, good manners, effort, lower impulsivity, persistence, and proactivity, as well as motivation, comprehension, attendance, and interest in participating in the activities. These elements that were emphasized dispute the data from the first interview, indicating potential changes, which might derive from the group experiences with and within nature. Aside from these general impressions, individual changes in behavior were also identified.

The second profile was outlined and new impressions arise

SI1 still talks too much, yelling, and is nearly unintelligible. At the beginning of the experiences, she found it very difficult to understand the rules. Throughout the activities, she started to become more interested and was able to perform the activities easily. She also interacted with the other children. Her mother and her mother's employer said that they were impressed with the changes they saw in SI1. "She seems calmer and she chats, telling us what she has been doing, and she is more 'polite'." During the last interview with SI1, when she was asked about how she felt regarding her participation in the experiences with and within nature, she answered smiling: "when am I going again?" "I like being in nature with the teacher and the boys." SI1's answer reveals how important the experiences were to her.

SI2 found it very difficult to establish social relationships. However, from the fourth meeting onwards, his social incursions, although timid, progressed visibly and gradually. He became sweeter, more obedient, and calm. He still had an evident low self-esteem, but there was a discernible progress compared to the beginning of the experiences, when he did not even get close to the other children. Despite his difficulty, he reported that he would like to learn how to read and write; therefore, he would not skip school anymore. Throughout the experiences, his behavior gradually changed. When interviewed, SI2 said that he made friends when he was in nature and that would miss the "trips". Considering his difficulty with having social interactions, this speech indicates how much his social development was positively affected by experiencing nature.

SI3 had had an impressive latent aggressiveness, which was visibly assuaged throughout the experiences. SI3 showed strong emotional intensity, a mix of a great deal of love and hate. Throughout the process, his outbreaks decreased considerably. His mother mentioned that, on the days of the experiences, he would arrive home and remain calm for a long time, without fighting. His relationship with his classmates was another aspect that greatly changed, according to his teacher: "he started to interact without attacking them." SI3 did not have any difficulty and was not restless during the interview. When asked what he had liked the most in the experiences, he answered: "why is it over? I like to go there play with my friends, climb on the trees, run, play, each lunch, and I miss you".

From an outsider's point of view, SI4 has no problems, as she is active, knows how to speak, and understands whatever is asked of her. When interacting with her, her tendency to fantasize and mix real with imaginary decreased remarkably. She was able to channel her imagination into the storytelling moments. Her tolerance to frustration continued to be low but she did not drive away from the group anymore. At the beginning, she struggled with relationships. Yet, after a while, she was already playing with everybody. She did very well in activities involving cognitive development; her performance was outstanding compared to the group. At the end of the process, she was more motivated to attend school and participate in the activities. She seemed sad during the interview. When asked why, she answered: "because the project is over and I miss going there, to nature, I miss the teacher and my friends." Similar to the other children, her speech shows the relevance of the activities with nature, which directly affected their socio-affective development.

At the beginning of the experiences, SI5 was the child that most frequently disrupted the group. He was hyperactive, had megalomania, ate compulsively, and had a sense of leadership. With the experiences, the hyperactivity and impulsivity symptoms decreased, as did the need to be the center of attention; however, the other characteristics remained. Before the experiences, he would become upset when he could not draw everyone's attention, and would give up on participating in the experiences. SI5 changed his behavior throughout the interventions, and started to adopt group rules. His teacher stated that he improved greatly in the classroom, that he does not disturb as much and performs the activities without complaining. During the interview, he was asked what he thought of participating in the experiences with nature. He immediately answered: "Oh! If you said, like, SI5, let's go to nature, I'd say: I'll go."

Interacting with SI6, it was noticeable that he used the other children to gain something from the group. He used to answer whatever he thought the group would like to hear. His difficulty with learning persisted; however, he was already dealing better with frustration. His trajectory throughout the experiences varied, with highs and lows; yet in the end, it was clear how that setting was beneficial to him. His guardian says he is very quiet, that he interacts more when he is angry but that these behaviors have improved. His teacher says that "he's much, much better. It's, like, first he would keep to himself. He would stay in a corner. Now he's already interacting with other classmates." The same question was asked regarding his participation in nature. SI6 also answered: "Miss, I like it a lot. And if you wanted to choose me again, 'I'd dig it'. I'd really like to be there."

What was evident is that all children had similar speeches, emphasizing their wish to be together with nature and their peers. This leads, once more, to the understanding that nature is essential for bio-psychosocial development.

Discussion

The analysis of the profile of the six children with diagnosis of ADHD, before and after the intervention with activities within nature, indicated the following major changes, which potentially derive from experiencing nature: better comprehension and adjustment to rules, increased states of calmness and introspection, higher receptivity to social contact, higher propensity to participate in activities, regulating imagination and reactions to frustration, as well as decreased aggressiveness, hyperactivity, and impulsivity, and lower need for being the center of attention.

Proactivity and tolerance with oneself and others were observed to have developed in the activities. The children emphasized that they felt more loved, acknowledged, welcomed; they showed joy and affection and opened up for the possibilities of games that were proposed, with nature and having the other children as partners. Regarding the learning process, there was increased motivation, persistence, comprehension, attendance, and interest in participating in the activities.

Changes might have been motivated by experiencing nature as a group. However, it is not possible to state that changes have occurred solely due to this "novelty" in the children's lives, since they were provided access to other stimuli during this period, which were out of the researchers' control. Even so, it must be taken into consideration that the existing correlational aspects between their behavior and the settings where they live and with which they interact cannot change drastically.

The changes in behavior identified here were reported spontaneously by the children, their parents/guardians, and teachers. Del Prette et al. (2016, p. 33), corroborating the findings by other authors, argue that Social Skill indicators in children must be obtained, where possible, by evaluating different informers, e.g. the children themselves, their parents, and their teachers. Therefore, to have an overview of the subjects involved in the study, different informers were interviewed, as guided by the authors, and these data were used along with the researcher's observations, which were recorded in field journals, throughout the interventions conducted with the ADHD children.

There are endless possibilities to be discovered by experiencing nature. Barbieri (2012) reminds that nature carries physical and aesthetical challenges, which encourage children to venture out in a universe of opportunities to be observed, questioned, and which allows them to play with all its elements, including the social group. According to the author, human beings are components of nature, and thus, can and must reconnect with it.

Each meeting generated deep reflections regarding the crucial aspects that pervade the lives of these children, including the changes that were observed between the beginning and the end of the interventions. To what extent the dichotomy between

normal and pathological, which pervades the history of each of these children, is but that which makes them so special?

It was a short period of time (six months) but it was enough for a study with this type of objective. The changes observed and reported indicate that ADHD symptoms were mitigated and are directly related to the development process of each child, especially cognitive and socio-affective development. Present in each meeting, ADHD did not cease to exist as a symptomatic reality. Although the symptoms remained present, they did start to lose strength once children experienced nature, especially the limitations related to social aspect.

Del Prette & Del Prette (2009, p. 5-6) mentioned that "social skills are learned, i.e. they are not innate; nor can they be understood as representing stable personality traits". According to these authors, the learning of social skills takes place in a non-systematic manner: first, in the family, and then, in other subsystems. One of these subsystems was created based on the interventions conducted by the group of researchers, combining ADHD children, nature, and adult researchers.

Comparing both profiles outlined, the changes were evident in the children during and after having experienced direct contact with nature, particularly the experiences concerning their own potentialities. In an empirical study, Neuenfeldt (2016) observed that experiencing nature assists in the self-discovery of potentialities, leads to new motor patterns, benefits the child's awareness regarding the natural setting, and raises awareness related to environmental topics.

ADHD children do no typically feel confident and have limited social skills; however, when each child directly experienced nature while performing the activities, they were provided with the opportunity to be with themselves (during individual activities), with their peers (throughout the activities in which they exploited social interactions), with nature, and with everything surrounding them, throughout the interventions. This favored aspects related to socio-affective and cognitive development (DAMASCENO, 2019).

One of the aspects indicated by the informers was the difficulty these children had with learning. In fact, they still have this difficulty; however, both teachers and parents/guardians indicated that this aspect improved. Coelho et al. (2015) advocated that a longer period in a natural setting might refine the manner through which children learn, might help children expand their focus, self-regulation, and reasoning, among other skills. These processes were valued in the activities proposed, which were defined and created taking into consideration the characteristics and symptoms of ADHD people. The aim of experiencing natural settings was to encourage and challenge the children to use higher psychological processes, which according to Vygotsky (2007), refer to planning skills, creativity, imagination, and perception, among others.

According to Kellert (2002), cognitive development is enabled by contact with the natural world. This was evident in the ADHD children who were part of the Intervention Group, who showed

improved focus, as well as improved cognitive aspect in general (and particularly socio-affective aspects), by directly and regularly experiencing nature.

Final Considerations

Considering the results shown in the speeches of the research informers, it is clear that activities with and within nature must integrate school activities, and nature must be considered as a source of learning through the senses, which might be used to promote pedagogical changes.

The research subjects had the opportunity to experience continuous and direct contact with nature for a reasonable period of time, which changed characteristics of their behavior. Therefore, the present study indicates how relevant it is for schools to consider the benefits of direct contact with nature in development processes. Children learn differently within nature, which in itself affects the emotional state of those who interact with it, as mentioned previously. The ADHD children who participated in the Intervention Group experienced higher quality in processes related to their different development domains, such as cognitive, social, and affective development. The guardians/parents and teachers of the children who participated in the study realized that activities with nature were reflected in these aspects.

By experiencing nature and performing the activities that gave way to the singularity of each child, providing them with affection and attention, behaviors inherent to ADHD could be mitigated. This affected the people with whom these children had social interactions, and this somewhat changed how they were perceived. Therefore, it can be inferred that people with ADHD especially benefit from doses of nature although certainly that benefit extends beyond them.

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Mônica Maria Siqueira Damasceno

✉ siqueiramonica@hotmail.com

ORCiD: https://orcid.org/0000-0001-7928-8630

Jane Marcia Mazzarino

✉ janemazzarino@univates.br

ORCiD: https://orcid.org/0000-0002-6051-5116

Aida Figueiredo

✉ afigueiredo@ua.pt

ORCiD: https://orcid.org/0000-0002-9580-6888

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AMBIENTE & SOCIEDADE 25 anos 25 años 25 years

SciELO

Interferências da natureza no comportamento de crianças com TDAH: estudo de caso no nordeste brasileiro

Mônica Maria Siqueira Damasceno
Jane Marcia Mazzarino
Aida Figueiredo

Resumo: O estudo envolve crianças diagnosticadas com Transtorno de Déficit de Atenção e Hiperatividade (TDAH), de escolas públicas do município de Crato -CE, Região Nordeste do Brasil. O objetivo geral foi analisar o perfil de seis crianças, antes e depois de intervenções na natureza, a fim de identificar possíveis alterações no comportamento, decorrentes de experiências de contato direto com a natureza. O método utilizado é a pesquisa exploratória e descritiva, sendo um estudo de caso múltiplo, com característica de investigação-ação. Como resultados, verificaram-se alterações no comportamento com a minimização dos sintomas do TDAH relativos aos aspectos cognitivos e socioafetivos. Evidenciaram-se, entre outros aspectos do comportamento, maior motivação para os estudos, melhor compreensão e adequação às regras, ampliação dos estados de tranquilidade, maior receptividade para o contato social, diminuição da agressividade, da hiperatividade e da impulsividade, maior tolerância consigo e com os outros.

Palavras-chave: Transtorno de Déficit de Atenção e Hiperatividade (TDAH); crianças; desenvolvimento; natureza.

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SciELO

Interferencias de la naturaleza en el comportamiento de niños con TDAH: un estudio de caso en el noreste de Brasil

Mônica Maria Siqueira Damasceno
Jane Marcia Mazzarino
Aida Figueiredo

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Resumen: El estudio involucra a niños diagnosticados con Trastorno por Déficit de Atención e Hiperactividad (TDAH), de escuelas públicas del municipio de Crato - CE, Región Nororiental de Brasil. El objetivo general fue analizar el perfil de seis niños, antes y después de las intervenciones en la naturaleza, con el fin de identificar posibles cambios de comportamiento resultantes de experiencias de contacto directo con la naturaleza. El método utilizado es la investigación exploratoria y descriptiva, siendo un estudio de caso múltiple con una característica de investigación-acción. Como resultado, se verificaron cambios en el comportamiento con la minimización de los síntomas del TDAH relacionados con los aspectos cognitivos y socioafectivos. Entre otros aspectos de la conducta, se evidenció mayor motivación para los estudios, mejor comprensión y adaptación a las reglas, expansión de estados de tranquilidad, mayor receptividad al contacto social, disminución de la agresividad, hiperactividad, impulsividad, mayor tolerancia contigo y con los demás.

Palabras-clave: Trastorno por Déficit de Atención e Hiperactividad (TDAH); niños; desarrollo; naturaliza.