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A Conceptual Framework for Nature-Based Art Therapy Based on a Neurological Approach for Children with Autism Spectrum Disorder

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A B S T R A C T

Purpose: The present study aimed to develop a comprehensive conceptual framework for nature-based art therapy grounded in neurological mechanisms to enhance emotional, sensory, cognitive, and social functioning in children with autism spectrum disorder.

Methods and Materials: This study was designed as a theoretical–applied research using a descriptive–analytical approach. Data were collected through a systematic review of Persian and international scientific literature in the domains of art therapy, autism spectrum disorder, nature-based interventions, and neuroscience. Relevant sources were identified using databases including SID, MagIran, Google Scholar, ScienceDirect, and Scopus. Inclusion criteria consisted of direct relevance to the study topic, scientific credibility, peer-reviewed status, and conceptual or empirical contribution. After screening and selection, the data were analyzed using qualitative content analysis. Key themes were extracted and categorized into three primary domains: art therapy processes, nature as an enriched therapeutic environment, and neurological mechanisms underlying intervention effects. Finally, conceptual inference was employed to integrate these domains into a coherent framework.

Findings: The analysis revealed that nature-based art therapy operates through a dynamic interaction between expressive artistic processes, enriched natural environments, and neurobiological mechanisms. The findings suggest that engagement in structured art activities within natural settings facilitates sensory–motor integration, emotional regulation, and attention restoration, which are mediated by processes such as neuroplasticity, modulation of limbic activity, and enhancement of executive functioning. The integration of these components is inferred to produce synergistic effects, leading to improvements in adaptive behavior, cognitive flexibility, emotional stability, and social interaction in children with autism spectrum disorder.

Conclusion: By emphasizing the interplay between experiential, environmental, and neurological factors, the model highlights the potential of nature-based art therapy as a holistic and developmentally responsive strategy for enhancing functional outcomes in affected children.

Keywords: *Nature-based art therapy, Autism spectrum disorder, Neurodevelopment, Neuroplasticity, Sensory integration, Emotional regulation, Enriched environment*

1. Introduction

Autism spectrum disorder is a complex neurodevelopmental condition characterized by heterogeneous patterns of social communication differences, restricted and repetitive behaviors, sensory processing variations, motor difficulties, and adaptive functioning challenges. Contemporary autism research increasingly emphasizes that autism cannot be adequately understood through a single causal pathway, a single behavioral profile, or a narrow deficit-based model. Instead, it is better conceptualized as a dynamic developmental condition emerging from the interaction of genetic, epigenetic, neurobiological, immunological, environmental, sensory, and contextual factors across early development (Manzo et al., 2025; Panisi & Marini, 2022). This broader view is especially important for therapeutic design because children on the autism spectrum often differ substantially in sensory responsiveness, emotional regulation, motor coordination, communication style, attention, motivation, and environmental tolerance. Therefore, interventions for autistic children should not be limited to behavioral symptom reduction, but should also address embodied experience, sensory regulation, neural development, emotional security, social participation, and environmental adaptation. Recent work on child neurodevelopment also shows that individual differences in fetal, infant, and toddler development require careful interpretation because early neurodevelopmental trajectories are highly variable and shaped by multiple interacting biological and environmental influences (Olson et al., 2025). This developmental variability supports the need for flexible, integrative, and child-centered therapeutic frameworks.

The increasing scientific attention to early identification and developmental risk in autism has further highlighted the need for interventions that begin from the child's sensory, emotional, and neurobiological needs. Early prediction and evaluation studies have attempted to identify risk patterns associated with autism, while pediatric perspectives on pre-autism emphasize the importance of early signs, developmental surveillance, and timely support before symptoms become functionally restrictive (Al-Beltagi, 2023; Ashmawi & Hammoda, 2022). Such perspectives are consistent with the idea that intervention should be developmentally sensitive and should support the child's emerging capacities rather than merely target observable behaviors. At the same time, research on protective and risk factors in autism indicates that developmental outcomes are shaped by a complex interplay of vulnerability and resilience factors, including prenatal influences, environmental exposures, immune processes, infections, nutrition, sensory experience, family context, and therapeutic opportunities (Joon et al., 2021). A neurological approach to intervention must therefore be grounded in the recognition that the autistic child develops within a layered ecology of brain, body, environment, relationship, and experience.

The developmental origins of autism and related neurodevelopmental conditions have been examined through multiple biological pathways. Prenatal epigenetic influences are increasingly recognized as important mechanisms linking early biological conditions to later mental health and neurodevelopmental outcomes (Álvarez-Mejía et al., 2025). Similarly, early-life exposures, including prenatal nutrient supplementation and environmental conditions, have been studied in relation to later neurodevelopmental functioning, suggesting that developmental trajectories are shaped long before formal diagnosis (Mohammadzadeh et al., 2022). Concerns have also been raised regarding the possible neurodevelopmental implications of pharmacological interventions used during infertility treatment or pregnancy, although such associations require careful interpretation within multifactorial models rather than deterministic assumptions (Varlas, 2023). In addition, prenatal alcohol exposure has been discussed as a possible contributor to autism-like neurophenotypes, reinforcing the importance of prevention, developmental monitoring, and contextual responsibility in early neurodevelopment (Rich, 2023). These bodies of evidence show that autism is embedded in developmental biology and that intervention models must be compatible with the complexity of early brain development.

Recent autism research also gives increasing attention to immune, inflammatory, metabolic, and microbiome-related mechanisms. A neuro-immunometabolic hypothesis of autism conceptualizes the condition as partly connected to interactions among immune activation, metabolic regulation, and neural development (Frasch et al., 2023). Related research has examined the role of viral infections and the neuro-immune axis in increasing vulnerability to autistic disorder, showing that immune-related developmental disruptions may influence brain maturation and later neurobehavioral functioning (Kim et al., 2022; Shuid et al., 2021). Inflammation has also been described as a stressor of brain development, particularly when early inflammatory processes alter neural maturation during sensitive developmental periods (Zengeler & Lukens, 2020).

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Moreover, systematic work on pesticide exposure and HIV/ART in child neurodevelopment underscores the need to understand environmental toxicants and medical exposures as part of the broader ecology of child development (Chilipweli et al., 2025). These findings are relevant to the present article because they support a therapeutic orientation that views the autistic child not as a collection of isolated symptoms, but as a developing organism whose nervous system is continuously influenced by biological, relational, sensory, and environmental conditions.

The gut-brain axis has also become a major area of inquiry in autism and neurodevelopment. Early exposure to food contaminants may reshape maturation of the brain-gut-microbiota axis, indicating that neurodevelopment is influenced by systemic physiological processes extending beyond the central nervous system alone (Sarron et al., 2020). More recent reviews have highlighted the possible influence of gut microbiota on neurodevelopment in children with autism spectrum disorder and have discussed dysbiosis, maternal immune activation, and maternal microflora as possible elements in shared developmental pathways (Alecrim et al., 2024; Suprunowicz et al., 2024a, 2024b). The gut-brain axis literature also suggests clinical and public health implications for neurodevelopmental disorders, particularly because gut, immune, metabolic, and neural systems interact dynamically across childhood (Kerna et al., 2024). For a nature-based art therapy framework, these findings provide a biological rationale for interventions that reduce stress, support autonomic regulation, enhance embodied sensory experience, and create conditions for physiological stability. Although art therapy and nature-based interventions do not directly modify microbiota in a pharmacological sense, they may contribute to broader regulatory processes through stress reduction, sensory organization, emotional engagement, and improved adaptive functioning.

At the neural level, autism has been associated with atypical patterns of synaptic function, neural connectivity, sensory integration, motor control, and regulatory network development. Studies on AMPA receptors have linked autism to circuit and synapse dysfunction, suggesting that differences in excitatory signaling and synaptic plasticity may be central to autistic neurodevelopment (Jiménez-Gómez et al., 2024). Brainstem assessment using magnetic resonance imaging histogram analysis has also been explored in autism, reflecting growing interest in neuroanatomical and neurofunctional markers beyond cortical explanations alone (Patel, 2022). Integrative frameworks of child and adolescent mental health increasingly conceptualize neurodevelopment through brain networks, emphasizing the importance of coordinated interaction among neural systems rather than isolated regional abnormalities (Dorjee, 2024). This network-based perspective is especially important for therapeutic models because meaningful change in autistic children often requires coordination across sensory, emotional, motor, cognitive, and social domains. A conceptual framework for nature-based art therapy can therefore be positioned as a network-oriented intervention model that aims to engage the child's nervous system through multisensory, embodied, creative, and emotionally meaningful experiences.

Sensory and motor dimensions are particularly central to autism and are highly relevant to art therapy and nature-based therapeutic environments. Motor impairments in autism have been systematically reviewed through automatic assessment approaches, indicating that motor differences are not secondary or incidental but may represent core developmental features that affect participation, communication, and adaptive behavior (Gargot et al., 2022). Neuro-psychomotor intervention studies in children with neurodevelopmental disorders further show that parent-report tools can capture meaningful changes in psychomotor functioning and everyday development (Tagliabue et al., 2024). Equine-assisted activities and therapies have also been reported as potentially effective for improving adaptive behavior and motor function in autism spectrum disorder, supporting the idea that embodied, relational, and environmentally rich interventions may benefit autistic children (Zoccante et al., 2021). These findings are highly compatible with nature-based art therapy because artistic activities often involve tactile exploration, visual-motor coordination, rhythmic movement, spatial awareness, and embodied engagement with materials, while natural environments provide varied sensory input, movement opportunities, and non-threatening contexts for exploration.

Art-based and rhythm-based interventions are particularly relevant for autistic children because they can create nonverbal pathways for expression, regulation, communication, and social connection. Music rhythmic therapy has been proposed as a versatile add-on support in pediatrics, suggesting that rhythmic, sensory, and creative modalities can complement conventional treatment by engaging attention, emotion, timing, movement, and interpersonal synchrony (Mastnak, 2020). Art therapy similarly provides children with opportunities to externalize

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internal experience through color, form, movement, texture, and symbolic representation. For children who experience difficulty with verbal communication, creative expression can function as an alternative or supplementary communicative channel. This is important in autism because therapeutic engagement should not depend exclusively on verbal insight or conventional social reciprocity. Nature-based art therapy extends this logic by using natural materials, outdoor settings, organic forms, light, sound, soil, leaves, water, stones, and open space as therapeutic media. Such materials may provide sensory richness while reducing performance pressure, allowing the child to experience therapy through exploration rather than rigid instruction.

A neurobiological framework for nature-based art therapy must also consider emotional regulation and autonomic functioning. The polyvagal theory has been critically examined in light of current neuroscience and clinical research, and although debates remain, it has contributed to therapeutic attention toward autonomic regulation, safety, social engagement, and embodied states (Manzotti et al., 2023). Children with autism frequently experience heightened arousal, sensory overload, anxiety, sleep problems, and difficulty transitioning between regulatory states. Melatonin research in neurodevelopmental disorders further highlights the relevance of sleep, circadian regulation, oxidative stress, and neurobiological rhythms in developmental functioning (Feybesse et al., 2023). A natural environment may support regulation through predictable sensory patterns, natural light, reduced artificial noise, and opportunities for calming movement. When combined with art therapy, these environmental conditions may help children shift from defensive or dysregulated states toward exploratory, expressive, and socially receptive states. Thus, nature-based art therapy can be understood as a regulatory intervention that works through the interaction of sensory input, affective safety, embodied action, and neurodevelopmental plasticity.

The rationale for developing a conceptual framework is further strengthened by current debates about intervention selection in autism. Early autism intervention literature emphasizes that families and clinicians often face the question of which therapy is appropriate for a particular child, and existing interventions differ in their theoretical assumptions, strengths, implementation conditions, and gaps (Purpura & Contaldo, 2023). A systemic perspective in autism argues for a change of gaze in research and practice, moving away from narrow and fragmented intervention models toward solutions that respond to the complex needs of autistic individuals (Panisi & Marini, 2022). This view is reinforced by neurocognitive mismatch theory, which proposes that neurodevelopmental conditions such as ADHD and autism may reflect incompatibilities between neurocognitive profiles and demanding environmental systems, rather than only intrinsic impairments located within the child (Kidwell, 2025). From this perspective, therapy should not only attempt to change the child; it should also redesign the environment so that the child's nervous system can function with greater coherence, predictability, sensory comfort, and meaningful engagement. Nature-based art therapy is consistent with this orientation because it modifies both the therapeutic activity and the therapeutic context.

At the same time, contemporary technological approaches to autism research, including multimodal artificial intelligence, are rapidly expanding possibilities for assessment, pattern recognition, and personalized intervention planning (Yan & Abdullah, 2025). While such developments are valuable, they also reveal the need for conceptual models that integrate measurable neurodevelopmental indicators with humanistic, creative, and ecological therapeutic practices. The future of autism intervention should not be reduced to technological monitoring or behavioral quantification alone. Instead, technological and neuroscientific advances should be used to deepen understanding of how children regulate, communicate, move, attend, and relate within real environments. Long-term outcome studies and developmental care discussions in neonatal neurology similarly emphasize that neurodevelopmental care involves ethical, clinical, and developmental complexity, requiring attention to long-term functioning rather than short-term symptom metrics alone (Abramsky et al., 2023). Therefore, a conceptual framework for nature-based art therapy should be sufficiently rigorous to align with neuroscience, but sufficiently flexible to respect the child's lived experience, creativity, sensory individuality, and developmental dignity.

On this basis, nature-based art therapy can be theoretically defined as an integrative therapeutic approach in which artistic expression is implemented within or through natural environments and materials to support sensory modulation, emotional regulation, motor coordination, attentional engagement, symbolic communication, social participation, and neural plasticity in children with autism spectrum disorder. Its neurological foundation rests on the assumption that repeated, meaningful, multisensory, and emotionally safe experiences

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can influence neural organization by engaging sensory-motor systems, limbic regulation, executive networks, autonomic pathways, and social engagement mechanisms. Its environmental foundation rests on the view that nature can function as an enriched therapeutic context that provides flexible sensory stimulation, restorative attention conditions, embodied movement opportunities, and reduced artificial demands. Its clinical foundation rests on the recognition that autistic children require interventions that are individualized, non-stigmatizing, developmentally appropriate, and responsive to their unique sensory and communicative profiles. By integrating art therapy, nature-based experience, and neurological explanation, the proposed framework attempts to bridge a gap between creative therapies, environmental interventions, and neurodevelopmental science.

The aim of the present study was to develop a conceptual framework for nature-based art therapy grounded in a neurological approach for children with autism spectrum disorder.

2. Methods and Materials

2.1. Study Design and Participants

The present study was conducted as a theoretical–applied study using a descriptive–analytical approach. The main purpose of the study was to develop a conceptual framework for nature-based art therapy grounded in a neurological approach for children with autism spectrum disorder. Since the study aimed to formulate a conceptual model rather than to test an intervention empirically, no human participants were directly recruited. Instead, the study sample consisted of selected scientific sources, including peer-reviewed articles, books, theoretical papers, review studies, and empirical research related to art therapy, autism spectrum disorder, nature-based interventions, nature therapy, enriched environments, sensory processing, neurodevelopment, and neuroscience. The sources were selected through a systematic review of Persian and international scientific literature. The databases used for source identification included SID, MagIran, Google Scholar, ScienceDirect, and Scopus. The selection criteria included direct relevance to the research topic, scientific credibility, peer-reviewed status, citation potential, methodological quality, and theoretical contribution to one or more of the main domains of the study. Sources that lacked scientific validity, were not directly related to the study objectives, or did not provide sufficient conceptual or empirical evidence were excluded. Through this process, the study sought to create a reliable theoretical foundation for explaining how nature-based art therapy may support emotional, sensory, cognitive, and neurological functioning in children with autism spectrum disorder.

2.2. Measures

Data were collected through a systematic review protocol designed by the researchers in accordance with the objectives of the study. This protocol guided the identification, screening, selection, and organization of relevant scientific sources. The search strategy was based on key terms related to art therapy, autism spectrum disorder, nature-based therapy, nature therapy, ecological environments, enriched environments, sensory integration, neuroplasticity, emotional regulation, executive functioning, and neurological mechanisms. Equivalent Persian and English keywords were used in the selected databases to ensure comprehensive coverage of both Persian and international literature. After identifying the initial body of literature, the titles, abstracts, and full texts of the sources were reviewed based on the inclusion and exclusion criteria. A source evaluation form was also used to record bibliographic information, research objectives, theoretical foundations, methodological characteristics, key findings, and relevance to the conceptual dimensions of the study. This form enabled the systematic extraction of data from each source and helped organize the reviewed materials according to the three main axes of the study: art therapy, nature as an enriched therapeutic environment, and neurological mechanisms involved in the functioning of children with autism spectrum disorder.

2.3. Data Analysis

The collected data were analyzed using qualitative content analysis. After the eligible sources were finalized, the texts were read repeatedly to identify central concepts, theoretical propositions, and empirical findings relevant to the development of a nature-based art therapy framework. In the first stage, open coding was used to extract meaningful units from the selected sources. These units included concepts related to sensory stimulation, symbolic expression, emotional regulation, social interaction, attention restoration, embodied experience, environmental enrichment, neuroplasticity, stress reduction, and integration of sensory–motor experiences. In the next stage, similar codes were compared, merged, and classified into broader

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categories. These categories were then organized around three main thematic axes: art therapy as a medium for expression and regulation, nature as an enriched and regulating environment, and neurological mechanisms as the explanatory foundation of therapeutic change. In the final stage, conceptual inference was used to integrate the extracted themes into a coherent theoretical structure. This process led to the formulation of the proposed conceptual framework for nature-based art therapy based on a neurological approach. The final framework explains how the integration of artistic expression, sensory engagement with natural environments, and neurodevelopmental mechanisms may contribute to improved regulation, communication, sensory processing, and adaptive functioning in children with autism spectrum disorder.

3. Findings and Results

Given the conceptual and non-empirical nature of the present study, the findings are derived from the systematic analysis of the selected scientific literature rather than from human participants. A total of 112 sources were initially identified across the selected databases, of which 68 met the inclusion criteria after screening based on relevance, scientific rigor, and alignment with the study objectives. Of these, 24 sources focused primarily on art therapy interventions in children with autism spectrum disorder, 19 sources addressed nature-based or environmental therapeutic approaches, and 25 sources provided neuroscientific explanations related to sensory processing, neuroplasticity, emotional regulation, and cognitive functioning in autism. The reviewed studies were predominantly published between 2005 and 2025, reflecting contemporary theoretical and empirical developments in the intersection of therapy, environment, and neuroscience. Most of the sources were peer-reviewed journal articles, complemented by a smaller number of theoretical books and systematic reviews. This distribution ensured a balanced integration of empirical evidence and theoretical insight for constructing the proposed conceptual framework.

Table 1

Extracted Core Components of Nature-Based Art Therapy Framework

Component Domain	Subcomponents	Description	Neurological Basis
Art Therapy	Symbolic Expression	Use of drawing, painting, and creative forms to express internal states	Activation of prefrontal cortex and limbic modulation
	Sensory–Motor Integration	Engagement with materials (clay, colors, textures)	Integration of somatosensory and motor cortices
	Emotional Regulation	Structured creative activities for reducing anxiety	Regulation of amygdala reactivity
Nature Environment	Sensory Enrichment	Exposure to natural stimuli (light, sound, textures)	Enhancement of neural connectivity and sensory pathways
	Attention Restoration	Reduction of cognitive fatigue through natural settings	Activation of default mode network and attentional systems
	Stress Reduction	Calming effects of natural environments	Reduction in cortisol and autonomic regulation
Neurological Mechanisms	Neuroplasticity	Adaptive neural changes due to repeated engagement	Synaptic strengthening and cortical reorganization
	Sensory Processing	Modulation of hypersensitivity or hyposensitivity	Thalamocortical regulation
	Executive Function	Improvement in attention, planning, and flexibility	Prefrontal cortex activation

The results presented in Table 1 demonstrate that the proposed framework is composed of three interrelated domains, each contributing uniquely to therapeutic outcomes. The art therapy domain emphasizes expressive and regulatory functions through symbolic and sensory–motor engagement, while the nature environment domain provides a context of enriched and restorative stimulation that enhances these processes. The neurological mechanisms domain explains how these experiences translate into measurable changes in brain functioning, particularly in areas associated with emotional regulation, sensory integration, and executive functioning. The integration of these domains suggests a multi-layered therapeutic process in which environmental, experiential, and neurobiological factors interact dynamically.

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Table 2

Thematic Categorization of Therapeutic Processes and Outcomes

Main Theme	Subtheme	Observed Outcome	Functional Impact
Emotional Processes	Anxiety Reduction	Decreased behavioral distress	Improved emotional stability
	Self-Expression	Increased symbolic communication	Enhanced emotional awareness
Sensory Processes	Sensory Modulation	Balanced sensory responses	Reduced hypersensitivity
	Environmental Engagement	Increased interaction with surroundings	Improved adaptive behavior
Cognitive Processes	Attention Enhancement	Sustained focus in activities	Improved task completion
	Cognitive Flexibility	Adaptation to new stimuli	Increased problem-solving ability
Social Processes	Interaction Initiation	Increased engagement with peers/therapist	Enhanced social responsiveness
	Joint Attention	Improved shared focus	Development of communication skills

The findings summarized in Table 2 indicate that nature-based art therapy influences multiple developmental domains simultaneously. Emotional processes are enhanced through safe expressive channels, sensory processes are regulated through structured interaction with natural elements, cognitive processes benefit from increased attention and flexibility, and social processes improve through shared engagement in therapeutic activities. These outcomes collectively support the effectiveness of an integrated therapeutic approach that addresses the complex and multidimensional needs of children with autism spectrum disorder.

Table 3

Mapping of Intervention Elements to Neurological Outcomes

Intervention Element	Target Brain Region	Mechanism of Action	Expected Outcome
Visual Art Activities	Prefrontal Cortex	Cognitive engagement and planning	Improved executive functioning
Tactile Art Materials	Somatosensory Cortex	Sensory stimulation and integration	Enhanced sensory processing
Natural Light Exposure	Circadian System	Regulation of biological rhythms	Improved mood and attention
Nature Sounds	Limbic System	Emotional calming and stress reduction	Reduced anxiety
Movement in Nature	Motor Cortex & Cerebellum	Coordination and motor planning	Improved motor skills
Multisensory Integration	Thalamus	Sensory filtering and integration	Balanced sensory responses

The results in Table 3 highlight the direct correspondence between specific therapeutic elements and their underlying neurological mechanisms. Each component of the intervention is associated with targeted brain regions and functional outcomes, reinforcing the neuroscientific validity of the proposed framework. The convergence of sensory, cognitive, and emotional pathways suggests that the therapeutic impact is not isolated but systemic, leading to holistic developmental improvements.

The conceptual model illustrated in Figure 1 represents the dynamic interaction between the three primary domains identified in this study: art therapy processes, nature-based environmental factors, and neurological mechanisms. The model depicts how engagement in artistic activities within enriched natural environments stimulates sensory–motor experiences, which in turn activate neurobiological processes such as neuroplasticity, emotional regulation, and executive functioning. These processes lead to observable improvements in behavioral, cognitive, emotional, and social domains. The figure emphasizes the cyclical and reinforcing nature of these interactions, suggesting that repeated exposure to such integrative therapeutic experiences can produce sustained developmental benefits.

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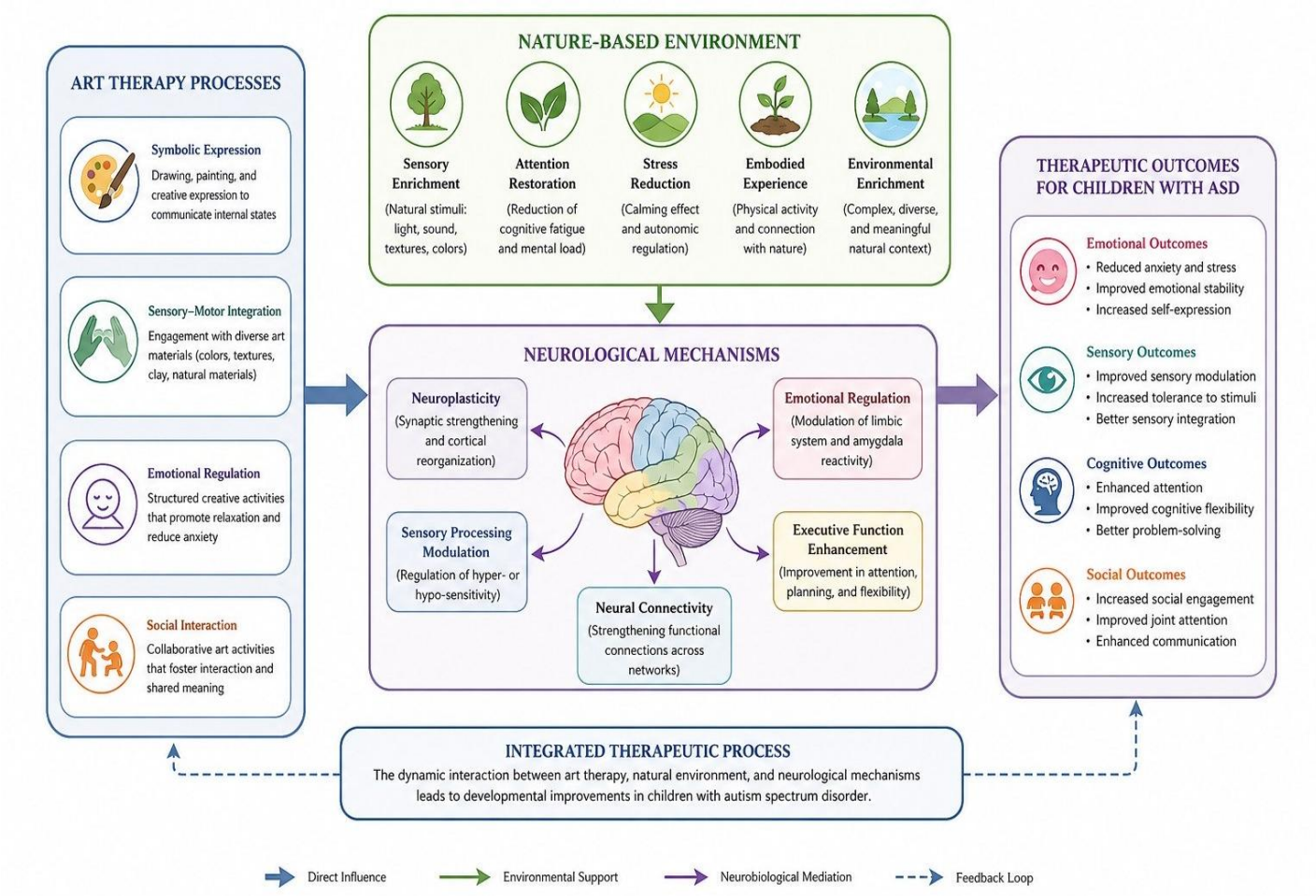
Figure 1

Conceptual Model of Nature-Based Art Therapy Based on a Neurological Approach for Children with Autism Spectrum Disorder



4. Discussion and Conclusion

The findings of the present study led to the development of a comprehensive conceptual framework for nature-based art therapy grounded in a neurological approach for children with autism spectrum disorder (ASD). The results demonstrated that the integration of three primary domains—art therapy processes, nature-based environmental engagement, and underlying neurological mechanisms—forms a dynamic and mutually reinforcing system that can facilitate developmental improvements across emotional, sensory, cognitive, and social domains. This integrative structure aligns with contemporary perspectives that conceptualize ASD not as a singular deficit but as a complex neurodevelopmental condition characterized by atypical neural connectivity, sensory processing differences, and multidimensional developmental trajectories (Manzo et al., 2025; Panisi & Marini, 2022).

One of the central findings of this study is the role of art therapy as a medium for symbolic expression, sensory–motor engagement, and emotional regulation. The extracted components suggest that artistic activities provide children with ASD an alternative channel for communication and self-expression, particularly in cases where verbal communication is limited. This finding is consistent with evidence indicating that early interventions focusing on expressive and experiential modalities can significantly enhance emotional awareness and behavioral regulation in children with ASD (Purpura & Contaldo, 2023; Tagliabue et al., 2024). Moreover, the sensory–motor aspects of art-making, such as tactile interaction with materials, align with research highlighting the importance of sensorimotor integration in improving adaptive functioning and reducing stereotyped behaviors (Gargot et al., 2022). From a neurobiological perspective, these processes are linked to activation in the prefrontal cortex and modulation of limbic structures, particularly the amygdala, which plays a crucial

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role in emotional regulation and stress response (Dorjee, 2024; Jiménez-Gómez et al., 2024).

Another key finding relates to the therapeutic role of nature as an enriched and regulating environment. The results indicated that natural environments contribute to sensory enrichment, attention restoration, and stress reduction, thereby enhancing the effectiveness of art therapy interventions. This is in line with research demonstrating that exposure to natural stimuli can positively influence neurodevelopment by promoting neural plasticity and reducing physiological stress markers such as cortisol levels (Shuid et al., 2021; Zengeler & Lukens, 2020). The concept of enriched environments has been widely discussed in neuroscience, suggesting that complex and stimulating surroundings can facilitate synaptic growth, neural connectivity, and cognitive flexibility (Kerna et al., 2024). In the context of ASD, where sensory processing abnormalities are prevalent, the structured and predictable aspects of natural environments may provide a balance between stimulation and regulation, thereby supporting adaptive functioning (Joon et al., 2021; Zoccante et al., 2021). Furthermore, the calming effects of nature are consistent with polyvagal theory, which emphasizes the role of environmental cues in regulating autonomic nervous system responses and promoting social engagement (Manzotti et al., 2023).

The integration of neurological mechanisms within the proposed framework represents another significant contribution of this study. The findings suggest that therapeutic experiences in nature-based art therapy are mediated through neurobiological processes such as neuroplasticity, sensory modulation, and executive functioning. This aligns with recent advances in neuroscience that emphasize the plastic and dynamic nature of the developing brain, particularly in response to environmental and experiential inputs (Álvarez-Mejía et al., 2025; Olson et al., 2025). For instance, repeated engagement in multisensory and emotionally meaningful activities can strengthen synaptic connections and facilitate cortical reorganization, leading to improved cognitive and behavioral outcomes (Frasch et al., 2023). Additionally, the involvement of the gut–brain axis and neuroimmune pathways in ASD suggests that environmental and sensory experiences may have broader systemic effects on neurodevelopment (Alecrim et al., 2024; Kim et al., 2022). These findings support the idea that interventions targeting both the brain and the body can yield more comprehensive and sustainable outcomes.

The results also highlight the importance of addressing multiple developmental domains simultaneously. The thematic analysis revealed that nature-based art therapy has the potential to influence emotional processes, sensory regulation, cognitive functioning, and social interaction in an integrated manner. This multidimensional impact is consistent with contemporary intervention models that emphasize the interconnectedness of developmental domains in ASD (Kidwell, 2025; Yan & Abdullah, 2025). For example, improvements in sensory processing can lead to better attention and engagement, which in turn facilitate social interaction and learning. Similarly, enhanced emotional regulation can reduce behavioral challenges and increase participation in therapeutic activities. These cascading effects underscore the importance of adopting holistic and integrative approaches in the design of interventions for children with ASD.

Another important aspect of the findings is the emphasis on early intervention and developmental timing. The literature reviewed in this study indicates that early identification and intervention are critical for optimizing outcomes in children with ASD (Al-Beltagi, 2023; Ashmawi & Hammoda, 2022). The proposed framework, by incorporating elements of sensory stimulation, emotional engagement, and environmental enrichment, is particularly well-suited for early developmental stages when neural plasticity is at its peak. Moreover, factors such as prenatal influences, environmental exposures, and early life experiences play a significant role in shaping neurodevelopmental trajectories, highlighting the need for interventions that are responsive to these factors (Chilipweli et al., 2025; Mohammadzadeh et al., 2022). The inclusion of these considerations in the framework enhances its ecological validity and applicability.

The findings of this study are also supported by research on alternative and complementary therapies for ASD. For instance, interventions such as music therapy and equine-assisted therapy have been shown to improve emotional, social, and motor functioning in children with ASD, suggesting that experiential and nature-based approaches can be effective components of comprehensive treatment plans (Mastnak, 2020; Zoccante et al., 2021). Similarly, the role of reinforcement and motivation in shaping behavior, as highlighted in behavioral theories, aligns with the engaging and intrinsically motivating nature of art and nature-based activities (Donahoe & Palmer, 2022). These findings reinforce the relevance of the proposed framework and its potential for integration with existing therapeutic modalities.

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In addition, the study's findings resonate with emerging research on multimodal and interdisciplinary approaches to autism intervention. The integration of art, environment, and neuroscience reflects a shift toward more holistic and personalized models of care that consider the unique needs and strengths of each child (Varlas, 2023; Yan & Abdullah, 2025). Such approaches are particularly important in light of the heterogeneity of ASD, which requires flexible and adaptable intervention strategies. The proposed framework, by combining multiple domains and mechanisms, offers a versatile model that can be tailored to different contexts and populations.

Despite these strengths, the study also acknowledges several limitations. The reliance on secondary data and theoretical analysis may limit the empirical validation of the proposed framework. Additionally, variations in the quality and methodology of the reviewed studies may introduce biases in the findings. However, the systematic approach to source selection and analysis helps mitigate these limitations and enhances the credibility of the results.

The limitations of this study primarily stem from its theoretical and non-empirical design. Since the framework was developed based on a systematic review and qualitative content analysis, it has not yet been tested through experimental or longitudinal studies. Furthermore, the heterogeneity of the reviewed sources, including differences in methodologies, sample characteristics, and cultural contexts, may affect the generalizability of the findings. Another limitation is the potential for selection bias in the inclusion of sources, despite the use of systematic criteria. Additionally, the absence of direct clinical data limits the ability to assess the practical effectiveness and feasibility of the proposed framework in real-world settings.

Future research should focus on empirically testing the proposed framework through experimental and quasi-experimental designs involving children with autism spectrum disorder. Longitudinal studies are needed to examine the sustained effects of nature-based art therapy on neurodevelopmental outcomes. Researchers should also explore the differential impact of specific components of the framework, such as types of art activities or characteristics of natural environments, to identify the most effective elements. The use of neuroimaging techniques and physiological measures could provide deeper insights into the underlying mechanisms of change. Additionally, cross-cultural studies would help assess the applicability of the framework in diverse settings and populations.

From a practical perspective, the findings of this study suggest that therapists, educators, and clinicians should consider integrating nature-based elements into art therapy programs for children with autism spectrum disorder. Creating structured yet flexible environments that combine artistic expression with natural sensory experiences may enhance engagement and therapeutic outcomes. Training programs for practitioners should include knowledge of neurological principles and environmental design to support the implementation of such interventions. Collaboration between professionals in psychology, neuroscience, education, and environmental design is also essential for developing comprehensive and effective therapeutic models.

Authors' Contributions

All authors significantly contributed to this study.

Declaration

In order to correct and improve the academic writing of our paper, we have used the language model ChatGPT.

Transparency Statement

Data are available for research purposes upon reasonable request to the corresponding author.

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Declaration of Interest

The authors report no conflict of interest.

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Ethical Considerations

In this study, to observe ethical considerations, participants were informed about the goals and importance of the research before the start of the interview and participated in the research with informed consent.

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References

Abramsky, R., Alkhadem, Z., Alsup, S., Anwar, T., Arroyo, M., Bonfanti, C., Boomsma, M. F., Boswinkel, V., Cabacungan, E., Chang, T., Cimino, C., Cohen, S., Cuzino, I. A., Vries, L. d., Demšar, J., DiPietro, J., Dündar, N. O., Engür, D., Fontana, C., . . . Zengi, I. (2023). Proceedings of the 14th International Newborn Brain Conference: Long-Term Outcome Studies, Developmental Care, Palliative Care, Ethical Dilemmas, and Challenging Clinical Scenarios in Neonatal Neurology. *Journal of Neonatal-Perinatal Medicine*, *16*(s1), S103-S118. https://doi.org/10.3233/npm-239006

Al-Beltagi, M. (2023). Pre-Autism: What a Paediatrician Should Know About Early Diagnosis of Autism. *World Journal of Clinical Pediatrics*, *12*(5), 273-294. https://doi.org/10.5409/wjcp.v12.i5.273

Alecrim, F. M., Silva, C. A. d., Maria Izabelly Justino da, S., Tenorio, S. L. P., Germana Rafaela Pontes de Carvalho, C., Ana Márcia Tenório de Souza, C., Nascimento, G. C. d., Wily Rogê Barbosa de Almeida, F., Pimentel, C. M. M., Carvalho, L. d. L., Oliveira, E. d., & Ozarlan Michel Pereira de, O. (2024). The Influence of Gut Microbiota on Neurodevelopment in Children With Autism Spectrum Disorder (Autism Spectrum Disorder): A Systematic Review of the Literature. *International Journal of Health Science*, *4*(99), 1-30. https://doi.org/10.22533/at.ed.1594992414115

Álvarez-Mejía, D., Rodas, J. A., & Leon-Rojas, J. E. (2025). From Womb to Mind: Prenatal Epigenetic Influences on Mental Health Disorders. *International Journal of Molecular Sciences*, *26*(13), 6096. https://doi.org/10.3390/ijms26136096

Ashmawi, N. S., & Hammoda, M. A. (2022). Early Prediction and Evaluation of Risk of Autism Spectrum Disorders. *Cureus*. https://doi.org/10.7759/cureus.23465

Chilipweli, P., Manyiri, M. W., Basinda, N., Kidenya, B. R., Nyanza, E. C., Manji, K., & Ngowi, A. V. (2025). Assessing the Combined Impact of Pesticide Exposure and HIV/ART on Child Neurodevelopment in Eastern and Southern Africa: A Systematic Review. *BMC pediatrics*, *25*(1). https://doi.org/10.1186/s12887-025-05895-z

Donahoe, J. W., & Palmer, D. C. (2022). Acquired Reinforcement: Implications for Autism. *American psychologist*, *77*(3), 439-452. https://doi.org/10.1037/amp0000970

Dorjee, D. (2024). Conceptualising Child and Adolescent Mental Health and Wellbeing Neurodevelopment: an Integrative Brain Networks Framework. https://doi.org/10.31234/osf.io/7vx45

Feybesse, C., Chokron, S., & Tordjman, S. (2023). Melatonin in Neurodevelopmental Disorders: A Critical Literature Review. *Antioxidants*, *12*(11), 2017. https://doi.org/10.3390/antiox12112017

Frasch, M. G., Yoon, B.-J., Helbing, D.-L., Snir, G., Antonelli, M. C., & Bauer, R. (2023). Autism Spectrum Disorder: A Neuro-Immunometabolic Hypothesis of the Developmental Origins. *Biology*, *12*(7), 914. https://doi.org/10.3390/biology12070914

Gargot, T., Archambault, D., Chétouani, M., Cohen, D., Johal, W., & Anzalone, S. M. (2022). Automatic Assessment of Motor Impairments in Autism Spectrum Disorders: A Systematic Review. *Cognitive Computation*, *14*(2), 624-659. https://doi.org/10.1007/s12559-021-09940-8

Jiménez-Gómez, A., Nguyen, M. X., & Gill, J. S. (2024). Understanding the Role of AMPA Receptors in Autism: Insights From Circuit and Synapse Dysfunction. *Frontiers in Psychiatry*, *15*. https://doi.org/10.3389/fpsyt.2024.1304300

Joon, P., Kumar, A., & Parle, M. (2021). The Interplay of Protective and Risk Factors Linked to Autism. *Journal of Clinical Images and Medical Case Reports*, *2*(2). https://doi.org/10.52768/2766-7820/1070

Kerna, N. A., Ngwu, D. C., Keke, C. O., Pruitt, K. D., Olaniru, F. O., Jomsky, B. M., Nwafor, B. N., Carsrud, N. D. V., Flores, J. V., Holets, H. M., McKee, D., & Anderson, J. (2024). The Gut-Brain Axis in Neurodevelopmental Disorders: Mechanistic Insights, Clinical Implications, and Public Health Strategies. *European Journal of Theoretical and Applied Sciences*, *2*(6), 580-596. https://doi.org/10.59324/ejtas.2024.2(6).53

Kidwell, J. S. (2025). ADHD and Autism in Neurocognitive Mismatch Theory: Distinct Neurodevelopmental Incompatibilities With the Market-Based System. *Frontiers in psychology*, *16*. https://doi.org/10.3389/fpsyg.2025.1617192

Kim, J., Erice, C., Rohlwink, U. K., & Tucker, E. W. (2022). Infections in the Developing Brain: The Role of the Neuro-Immune Axis. *Frontiers in Neurology*, *13*. https://doi.org/10.3389/fneur.2022.805786

Manzo, J., Hernández-Aguilar, M. E., Toledo-Cárdenas, M. R., Herrera-Covarrubias, D., Coria-Ávila, G. A., Libreros-Jiménez, H. M., Fernández-Cañedo, L., & Ortega-Pineda, L. A. (2025). The Long and Winding Road to Understanding Autism. *Neurosci*, *6*(3), 84. https://doi.org/10.3390/neurosci6030084

Manzotti, A., Panisi, C., Pivotto, M., Vinciguerra, F., Benedet, M., Brazzoli, F., Zanni, S., Comassi, A., Caputo, S., Cerritelli, F., & Chiera, M. (2023). An In-depth Analysis of the Polyvagal Theory in Light of Current Findings in Neuroscience and Clinical Research. *Developmental Psychobiology*, *66*(2). https://doi.org/10.1002/dev.22450

Mastnak, W. (2020). Music Rhythmic Therapy - A Novel Versatile Add-on Support in Paediatrics. *J Pediatr Res Rev Rep*, 1-10. https://doi.org/10.47363/jprrr/2020(2)109

Mohammadzadeh, P., Rosenberg, J. B., Vinding, R., Jepsen, J. R. M., Lindberg, U., Følsgaard, N., Sørensen, M., Sulaiman, D. K., Bilenberg, N., Raghava, J. M., Fagerlund, B., Vestergaard, M. B., Pantelis, C., Stokholm, J., Chawes, B., Larsson, H., Glenthøj, B., Bønnelykke, K., Ebdrup, B. H., & Bisgaard, H. (2022). Effects of Prenatal Nutrient Supplementation and Early Life Exposures on Neurodevelopment at Age 10: A Randomised Controlled Trial - The COPSYCH Study Protocol. *BMJ open*, *12*(2), e047706. https://doi.org/10.1136/bmjopen-2020-047706

Olson, H., Camacho, M. C., Abdurokhmonova, G., Ahmad, S., Chen, E. M., Chung, H., Lorenzo, R. D., Dineen, Á. T., Ganz, M., Licandro, R., Magnain, C., Marrus, N., McCormick, S. A., Rutter, T. M., Wagner, L., Carr, K. W., Zöllei, L., Vaughn, K. A., & Madsen, K. S. (2025). Measuring and Interpreting Individual Differences in Fetal, Infant, and Toddler Neurodevelopment. *Developmental Cognitive Neuroscience*, *73*, 101539. https://doi.org/10.1016/j.dcn.2025.101539

Panisi, C., & Marini, M. (2022). Dynamic and Systemic Perspective in Autism Spectrum Disorders: A Change of Gaze in Research Opens to a New Landscape of Needs and Solutions. *Brain Sciences*, *12*(2), 250. https://doi.org/10.3390/brainsci12020250

Patel, H. (2022). Evaluation of the Brain Stem Using Magnetic Resonance Imaging Histogram Analysis in Asd. *Journal of Pharmaceutical Negative Results*, 1896-1904. https://doi.org/10.47750/pnr.2022.13.s08.229

Purpura, G., & Contaldo, A. (2023). What Therapy for My Child? Features, Strengths, and Gaps to Fill for the Implementation of Early Autism Interventions. https://doi.org/10.5772/intechopen.109402

Rich, S. D. (2023). Perspective Chapter: Autism Spectrum Disorder Neurophenotype With Preconceptional and Prenatal Alcohol

E-ISSN: 3041-8828

Exposure – A Call for Industry Responsibility in Prevention. https://doi.org/10.5772/intechopen.108820

Sarron, E., Pérot, M., Barbezier, N., Delayre-Orthez, C., Gay-Queheillard, J., & Anton, P. M. (2020). Early Exposure to Food Contaminants Reshapes Maturation of the Human Brain-Gut-Microbiota Axis. *World Journal of Gastroenterology*, *26*(23), 3145-3169. https://doi.org/10.3748/wjg.v26.i23.3145

Shuid, A. N., Jayusman, P. A., Shuid, N., Ismail, J., Nor, N. K., & Mohamed, I. N. (2021). Association Between Viral Infections and Risk of Autistic Disorder: An Overview. *International journal of environmental research and public health*, *18*(6), 2817. https://doi.org/10.3390/ijerph18062817

Suprunowicz, M., Tomaszek, N., Urbaniak, A., Zackiewicz, K., Modzelewski, S., & Waszkiewicz, N. (2024a). Between Dysbiosis, Maternal Immune Activation and Autism: Is There a Common Pathway? *Nutrients*, *16*(4), 549. https://doi.org/10.3390/nu16040549

Suprunowicz, M., Tomaszek, N., Urbaniak, A., Zackiewicz, K., Modzelewski, S., & Waszkiewicz, N. (2024b). Between the Mother's Microflora and the Child's Autism: Is There a Common Pathway? https://doi.org/10.20944/preprints202401.1489.v1

Tagliabue, L., Cerroni, F., Salatiello, R., Ricci, C., Zanchi, S., Monaco, E., Nacinovich, R., Carotenuto, M., & Purpura, G. (2024). Neuro-Psychomotor Intervention in Children With Neurodevelopmental Disorders: An Exploratory Study by Using Parent-Report Tools. *Journal of Intellectual Disabilities*, *29*(1), 86-99. https://doi.org/10.1177/17446295241228635

Varlas, V. (2023). Autism Spectrum Disorder – The Possible Trigger of Pharmacological Interventions Used in Infertility Treatments or During Pregnancy. *Farmacia*, *71*(6), 1109-1119. https://doi.org/10.31925/farmacia.2023.6.1

Yan, Y., & Abdullah, E. (2025). Trends in Multimodal Artificial Intelligence for Autism Research in Children and Adolescents: A Scientometric Study. *Journal of Korean Academy of Child and Adolescent Psychiatry*, *36*(4), 185-195. https://doi.org/10.5765/jkacap.250041

Zengeler, K. E., & Lukens, J. R. (2020). Inflammation Stresses Out Brain Development. *Nature Neuroscience*, *24*(2), 155-157. https://doi.org/10.1038/s41593-020-00775-4

Zoccante, L., Marconi, M., Ciceri, M. L., Gagliardoni, S., Gozzi, L. A., Sabaini, S., Gennaro, G. D., & Colizzi, M. (2021). Effectiveness of Equine-Assisted Activities and Therapies for Improving Adaptive Behavior and Motor Function in Autism Spectrum Disorder. *Journal of clinical medicine*, *10*(8), 1726. https://doi.org/10.3390/jcm10081726

E-ISSN: 3041-8828