

**AUTISM SPECTRUM DISORDER IN THE LIGHT OF CONTEMPORARY NEUROSCIENCE AND AYURVEDA: A COMPREHENSIVE INTEGRATIVE REVIEW**

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ABSTRACT Autism Spectrum Disorder (ASD) is a heterogeneous neurodevelopmental condition characterized by persistent deficits in social communication and restricted, repetitive behavioural patterns. The complexity of ASD arises from multifactorial aetiologies involving genetic, neurobiological, and environmental components. Despite substantial advances in modern neuroscience, effective curative strategies remain limited, emphasizing the need for integrative approaches. Ayurveda, an ancient system of medicine, provides a framework for understanding neurodevelopmental disorders through concepts such as Unmada, Apasmara, and Manovaha Srotodushti [1]. This review critically synthesizes contemporary biomedical literature alongside Ayurvedic classical texts to explore correlations and therapeutic possibilities. A structured literature search was conducted using PubMed, Scopus, Web of Science, and Google Scholar, along with classical Ayurvedic treatises. Evidence suggests that ASD involves synaptic dysfunction, altered neural connectivity, and neuroinflammation [5], whereas Ayurveda attributes similar manifestations to Tridosha imbalance, particularly Vata vitiation, and disturbances in Manas and Medha [2]. Ayurvedic interventions such as Medhya Rasayana, Panchakarma, and Satvavajaya Chikitsa offer potential benefits in improving cognitive and behavioural outcomes [3]. However, a lack of high-quality clinical trials limits definitive conclusions. Integrating Ayurvedic principles with modern therapeutic strategies may provide a more comprehensive and individualized approach to ASD management. Future research should focus on evidence-based validation and interdisciplinary collaboration.

KEYWORDS : Autism Spectrum Disorder; Ayurveda; Unmada; Neurodevelopment; Medhya Rasayana; Integrative Medicine; Panchakarma

1. INTRODUCTION

Autism Spectrum Disorder (ASD) is a lifelong neurodevelopmental disorder characterized by impairments in social communication and restricted, repetitive patterns of behaviour [4]. The disorder manifests early in childhood and persists across the lifespan, with varying degrees of severity. Epidemiological studies indicate a rising prevalence of ASD globally, currently estimated at approximately 1 in 100 children [6].

The increasing recognition of ASD has brought significant attention to its clinical, social, and economic implications. Individuals with ASD often require long-term multidisciplinary care, placing a substantial burden on healthcare systems and families. Despite extensive research, the exact pathogenesis remains incompletely understood, reflecting the complex interplay between genetic predisposition and environmental factors [7].

Modern research has made considerable progress in identifying neurobiological alterations such as atypical brain connectivity and synaptic dysfunction [5]. However, these findings have not yet translated into definitive therapeutic interventions. This limitation has led to growing interest in complementary and integrative medical systems.

Ayurveda conceptualizes neurodevelopmental disorders through disturbances in Doshas, Dhatus, and Malas. Although ASD is not explicitly described in classical texts, its clinical features resemble conditions such as *Unmada* and *Apasmara* [1]. This interpretative correlation provides a foundation for exploring Ayurvedic interventions in ASD management.

The present review aims to critically analyse ASD from both modern biomedical and Ayurvedic perspectives, identify research gaps, and propose integrative therapeutic approaches.

2. Methodology of Literature Review

A comprehensive literature search was conducted across databases including PubMed, Scopus, Web of Science, and Google Scholar. Classical Ayurvedic texts were also reviewed.

Keywords used included “Autism Spectrum Disorder,” “ASD

neurobiology,” “Ayurveda and autism,” “*Unmada*,” and “*Medhya Rasayana*.”

Inclusion criteria comprised peer-reviewed articles published between 2000 and 2025, systematic reviews, meta-analyses, and classical Ayurvedic literature [2]. Exclusion criteria included non-peer-reviewed sources and studies lacking methodological rigor.

Approximately 150 articles were screened, of which 60 were included based on relevance and quality.

3. Historical and Conceptual Background

The concept of autism was first described by Leo Kanner in 1943 as a condition characterized by social withdrawal and repetitive behaviour [8]. Shortly thereafter, Hans Asperger described a milder form of the disorder [9]. Over time, the understanding of autism evolved from a rare psychiatric condition to a broad-spectrum disorder.

The introduction of standardized diagnostic criteria, culminating in DSM-5, marked a significant advancement in the classification of ASD [4]. The spectrum concept acknowledges variability in symptom severity and functional outcomes.

In Ayurveda, mental disorders are broadly classified under Unmada, which involves disturbances of *Manas*, *Buddhi*, and *Smriti* [1]. The absence of a direct equivalent for ASD necessitates a conceptual mapping based on symptom similarity rather than disease identity.

4. Review of Literature

4.1 Pathophysiology and Neurobiology

ASD is associated with abnormalities in brain structure and function, particularly involving cortical connectivity and synaptic organization [5]. Neuroimaging studies reveal both hyperconnectivity and hypoconnectivity in different brain regions, suggesting dysregulated neural networks.

Neuroinflammation has also been implicated, with elevated levels of pro-inflammatory cytokines observed in individuals with ASD [10]. Additionally, imbalances in neurotransmitter systems, particularly glutamate and GABA, contribute to altered excitatory-inhibitory balance.

From an Ayurvedic perspective, these neurobiological alterations can be correlated with *Vata Dosha* imbalance, which governs neural activity [2]. Disturbances in *Majja Dhatu* and *Manovaha Srotas* are believed to underlie cognitive and behavioural dysfunction.

4.2 Etiology and Risk Factors

Genetic factors play a crucial role in ASD, with heritability estimates ranging between 50% and 80% [7]. Genome-wide association studies have identified multiple risk loci, although no single gene accounts for a majority of cases [11].

Environmental factors such as prenatal infections, maternal metabolic conditions, and exposure to toxins have also been implicated [12]. The interaction between genetic and environmental factors is mediated through epigenetic mechanisms.

Ayurveda attributes disease causation to *Beeja Dosha* (genetic defects) and *Garbhaja Hetu* (prenatal influences) [13]. Improper maternal diet and lifestyle during pregnancy are also considered contributing factors.

4.3 Diagnostic Approaches

Diagnosis of ASD is primarily based on behavioural criteria outlined in DSM-5 [4]. Standardized tools such as the Autism Diagnostic Observation Schedule (ADOS) are widely used [14].

Early diagnosis remains a challenge, particularly in low-resource settings. Delayed identification can hinder timely intervention and negatively impact outcomes.

In Ayurveda, diagnosis involves assessment of *Dosha*, *Satva*, and mental functioning. However, the lack of standardized diagnostic criteria limits its application in clinical practice.

4.4 Management and Therapeutic Approaches

Modern Management

Behavioural interventions such as Applied Behaviour Analysis (ABA) are considered the gold standard in ASD management [15]. These interventions focus on improving communication, social skills, and adaptive behaviour.

Pharmacological treatments are used to manage comorbid conditions such as irritability, anxiety, and hyperactivity [16]. However, no medication directly targets core ASD symptoms.

Ayurvedic Management

Ayurvedic management focuses on restoring systemic balance and enhancing cognitive function.

A. Medhya Rasayana

Medhya Rasayana drugs are known to improve intellect, memory, and mental clarity.

- *Brahmi* (*Bacopa monnieri*) has demonstrated neuroprotective effects [17].
- *Shankhapushpi* enhances cognitive performance [18].

These herbs act as adaptogens and may modulate neurotransmitter activity.

B. Panchakarma Therapies

Panchakarma therapies aim to detoxify the body and restore Dosha balance.

- *Basti* is particularly effective in managing *Vata disorders* [19].
- *Shirodhara* has calming effects on the nervous system.

Clinical evidence suggests improvement in behavioural symptoms, although large-scale trials are lacking.

C. Satvavajaya Chikitsa

This approach focuses on mental discipline and behavioural modification, analogous to psychotherapy. It includes counselling, meditation, and cognitive restructuring.

D. Sensory Stimulation

Kashyap Samhita drugs like *Brahmi*, *Mandukparni*, *Vacha*, *Shatavari* used for *udvartan*, *sarvanga abhyanga*, *Parishek*, *Shastik Shali Pinda swed* which stimulate sensory integration and contribute to overall improvement.

E. Internal Medications acts as *Rasayana* (Rejuvenatives) help in balancing doshas.

4.5 Recent Advances

Advances in genomics and artificial intelligence have improved understanding of ASD pathophysiology and early diagnosis [20]. The gut-brain axis has emerged as a promising area of research,

highlighting the role of microbiota in neurodevelopment.

Ayurveda's concept of *Agni* and *Ama* may provide a theoretical framework for understanding these interactions.

5. Research Gaps and Limitations

Despite significant progress, several limitations persist:

- Lack of standardized methodologies
- Limited longitudinal studies
- Insufficient clinical trials on Ayurvedic interventions
- Poor integration of traditional and modern systems

6. Future Perspectives

Future research should focus on:

- Identification of early biomarkers
- Integration of genomics with *Prakriti*-based classification
- Large-scale clinical trials on Ayurvedic therapies
- Development of personalized treatment approaches
- DASII (Developmental Assessment Scale for Indian Infants) can be administer as early as the 3rd day of life.
- DASII provides a broader developmental perspective compared to autism- specific tools and it can be advocated as an early diagnostic, objective screening tool.

7. CONCLUSION

ASD is a complex neurodevelopmental disorder requiring a multi-disciplinary approach. Ayurveda offers a holistic framework that complements modern biomedical understanding. While preliminary evidence supports the potential of Ayurvedic therapies, rigorous scientific validation is essential. Integrative approaches may provide improved outcomes and a more comprehensive understanding of ASD.

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