

**CRITICAL REVIEW ON GLOBAL DEVELOPMENTAL DELAY WITH SPECIAL
EMPHASIS ON AYURVEDIC CONCEPTS**

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INTRODUCTION

Development is a complex and continuous process through which an individual acquires a wide range of abilities necessary for optimal functioning in a social environment. This process begins in early childhood and continues throughout the entire lifespan, gradually shaping physical, cognitive, emotional, and social capacities. However, the most rapid and significant developmental changes occur during the first few years of life, which are considered a critical period for growth and overall development.^[1]

Global Developmental Delay (GDD) is a significant neurodevelopmental condition observed in early childhood, characterized by a marked delay in the attainment of developmental milestones across multiple functional domains. It is typically diagnosed in children under the age of 5 years, when standardized and reliable assessment of intellectual functioning is limited. The term “global” indicates that the delay is not restricted to a single area but involves two or more domains of development, including gross motor, fine motor, speech and language, cognitive abilities, social–personal interaction, and activities of daily living.^[2]

It serves as an umbrella term used before a definitive diagnosis, such as intellectual disability, can be established. As the child grows older, particularly beyond 5 years, more accurate cognitive testing allows for classification into intellectual disability based on IQ and adaptive functioning.^[3]

According to recent estimates by the World Health Organization and UNICEF (2023-2025), approximately 52.9 million children under five years of age are affected by developmental disabilities, with nearly 95% living in low-and middle-income countries.^[4] This corresponds to roughly 6-8% of children globally.^[5] Broader WHO-based literature further suggests that developmental delays affect about 6-9% of children worldwide.^[6] However, specific prevalence data for Global Developmental Delay (GDD) are limited, and it is generally estimated to affect approximately 1-3% of

children under five years of age.^[7]

In high-income countries such as the United States, the prevalence of developmental and behavioural disorders is extensively documented. Reports indicate that nearly 16–18% of children under 18 years of age are affected by one or more developmental or behavioural conditions.^[8] These conditions include disorders such as autism spectrum disorder, attention-deficit/hyperactivity disorder, learning disabilities, and other neurodevelopmental disorders, reflecting a substantial burden of developmental challenges in pediatric populations.^[9]

In the Indian context, available studies suggest that developmental delay affects approximately 1.5-2.5% of children under 2 years of age.^[10] Although these figures appear lower compared to global estimates, they may be influenced by underdiagnosis, limited screening programs, and variability in assessment methods across different regions.^[11]

Similar trends have also been observed in several low-and middle-income countries. For instance, studies report that the prevalence of childhood disability is approximately 15% in Jamaica and Pakistan, and about 8% in Bangladesh. These variations may be attributed to differences in socioeconomic conditions, healthcare accessibility, nutritional status, environmental risk factors, and awareness regarding early childhood development.^[12]

The etiology of GDD is diverse and multifactorial. Causes may be broadly categorized into prenatal, perinatal, and postnatal factors. Prenatal causes include genetic abnormalities (such as chromosomal disorders), intrauterine infections, and exposure to teratogens. Perinatal causes often involve birth asphyxia, prematurity, or neonatal complications. Postnatal causes include central nervous system infections, trauma, environmental deprivation, and metabolic disorders. Despite extensive evaluation, a significant proportion of cases remain idiopathic.^[13]

Clinically, children with GDD may present with delayed motor milestones (e.g., delayed sitting or walking), poor speech development, difficulty in social interaction, or impaired problem-solving skills. These delays may be isolated initially but often become more apparent as the child grows older and developmental expectations increase. A comprehensive evaluation involving detailed history, physical and neurological examination, developmental screening tools, and targeted investigations is essential to identify the underlying cause and associated conditions.^[14]

In Ayurveda also disease like GDD presentation have been described in deferent ways it resembles with *Vata vyadhi* or *vikara* considering the classification and their respective feature, *symptomatology and etiological factors* almost all neurological disorders are identified with *vata dosha*. Such presentations can be correlated with *Janma Bala Pravritta Vyadhi*^[15] (congenital disorders), *Shiro Marmabhighata*^[16] (injury to vital cranial structures), and *Vata Vyadhi*^[17] (neurological disorders caused by vitiation of Vata Dosha).

Clinical features observed in GDD closely resemble manifestations described under *Vata Vyadhi*. These include *Pangulya*^[18] (locomotor disability), *Mooka*, *Minmin*, and *Gadgada*^[19] (speech impairment or mutism), *Badhirya*^[20] (hearing loss), *Ekanga Roga*^[21] (monoplegia), *Sarvanga Roga* (quadriplegia), *Pakshaghata*^[22] (hemiparesis), *Pakshavadha* (hemiplegia), and *Vepathu*^[23] (involuntary movements resembling choreoathetoid activity).

Additionally, conditions such as *Phakka Roga*^[24] (nutritional deficiency disorders), *Mukha Vikriti*^[25] (facial palsy), and *Ardhanga Vata* or *Hatekpaksha*^[26] (partial or complete motor impairment of one side of the body) further demonstrate overlapping features with developmental delays. Some of these manifestations may also be interpreted under pediatric conditions like *Skandagraha*^[27] and *Bala-samvardhana Vikara*^[28] which affect growth and developmental milestones in children.

MATERIALS AND METHODS

This review article was compiled using references from Classical Ayurvedic texts: Charaka Samhita, Sushruta Samhita, Ashtanga Hridaya, Kashyapa Samhita.

Modern references: Nelson Textbook of Pediatrics, Ghai Essential Pediatrics, WHO, developmental guidelines, Research articles indexed in PubMed and Google Scholar Relevant literature regarding etiology, clinical features, diagnosis, developmental domains, and Ayurvedic management was critically reviewed.

OBSERVATION

Global Developmental Delay (GDD) can be correlated with conditions involving impaired growth and delayed development of physical, mental, speech, and social functions in children. Ayurveda explains these developmental abnormalities mainly through imbalance of Doshas (especially Vata Dosha), improper nourishment of Dhatus, defects in Beeja (genetic factors), and disturbances occurring during pregnancy and early childhood. Conditions such as Phakka Roga, Balashosha, and Manasika Vikara are often considered closely related to developmental delay. Improper maternal diet and lifestyle during pregnancy (Garbhavastha Apachara), psychological stress, malnutrition, infections, and congenital abnormalities may disturb fetal development, leading to delayed milestones after birth. Vitiated Vata Dosha affects neuromuscular coordination, speech, cognition, and motor development, while weakened Majja Dhatu and Ojas impair intellectual and physical growth. Thus, Ayurveda considers GDD as a multifactorial disorder involving prenatal, natal, postnatal, physical, and manshik (psychological) factors.

Beeja Dushti (Genetic or Congenital Defect)

Beeja Dushti refers to abnormalities in the sperm or ovum at the time of conception. Defective Beeja, Beeja Bhaga, or Beeja Bhag-avayava can lead to congenital disorders and impaired development of organs and intellect. Children may present with delayed speech, poor cognition, motor disability, or intellectual impairment from birth.^[29]

1. Garbhavastha Apachara (Improper Maternal Regimen During Pregnancy)

Improper diet, stress, trauma, excessive physical activity, intake of incompatible food, or unhealthy lifestyle during pregnancy can disturb fetal nourishment and development. These factors may cause defective growth of the fetal brain and nervous system, resulting in delayed developmental milestones after birth.^[30]

2. Vata Dosha Prakopa

Vata Dosha governs movement, nervous system activity, speech, and motor functions. Aggravated Vata can impair neuromuscular coordination, balance, speech development, and intellectual functions. Hence, Vata vitiation is considered the principal Dosha involved in developmental delay.^[31]

3. Majja Dhatu Kshaya (Depletion of Nervous Tissue)

Majja Dhatu is responsible for proper functioning of the

nervous system and higher mental functions. Deficiency or improper nourishment of Majja Dhatu can result in poor memory, delayed cognition, weak motor activity, and learning difficulties in children.^[32]

4. Oja Kshaya (Loss of Vital Essence)

Ojas represents immunity, vitality, and mental stability. Decreased Ojas leads to weakness, recurrent illness, poor growth, lack of enthusiasm, and delayed physical and mental development.^[33]

5. Balashosha (Childhood Malnutrition)

Inadequate nutrition causes depletion of body tissues and affects overall growth. Malnourished children may develop delayed motor milestones, poor speech development, reduced social interaction, and cognitive impairment.^[34]

6. Phakka Roga

Phakka Roga described in Kashyapa Samhita resembles severe developmental delay associated with malnutrition and neuromuscular weakness. The child becomes unable to walk, speak, or achieve age-appropriate milestones due to weakness and improper nourishment.^[35]

7. Manasika Nidana (Psychological Factors)

Fear, anxiety, neglect, emotional deprivation, and disturbed family environment can affect mental and social development. Ayurveda recognizes the influence of mental health on cognitive and behavioural growth in children.^[36]

8. Agnimandya (Impaired Digestion and Metabolism)

Weak digestive fire leads to improper digestion and poor tissue nourishment. As a result, Dhatus are inadequately formed, causing delayed physical growth and developmental impairment.^[37]

9. Janma Asphyxia and Birth Trauma (Sukha Prasava Vikara)

Difficult labor, birth injury, or lack of oxygen during delivery can damage neurological functions. Ayurveda correlates such conditions with Vata aggravation affecting brain and motor functions, leading to delayed development.^[38]

SIGNS AND SYMPTOMS OF GDD^[39]

1. Delay in Gross Motor Milestones

Children with GDD may show delayed head holding, sitting, crawling, standing, and walking. Muscle weakness, poor balance, abnormal gait, and difficulty in coordinated movements are commonly observed.

2. Delay in Fine Motor Development

Children may have difficulty holding objects, grasping toys, transferring objects from one hand to another, drawing, or performing coordinated hand movements.

3. Speech and Language Delay

Speech delay is one of the most common symptoms of GDD. The child may not babble, speak single words, form sentences, or understand commands according to age.

4. Cognitive and Intellectual Impairment

Children with GDD often show poor memory, reduced learning ability, lack of concentration, difficulty understanding instructions, and delayed intellectual development.

5. Social and Personal Developmental Delay

Affected children may have poor eye contact, lack of social smile, decreased interaction with parents, inability to play with peers, and difficulty expressing emotions.

6. Behavioural Problems

Hyperactivity, irritability, aggression, repetitive behaviour, poor attention span, and temper tantrums are commonly seen in children with GDD.

7. Feeding Difficulties

Some children with GDD experience poor sucking, swallowing difficulty, drooling of saliva, and poor appetite.

8. Hypotonia or Muscle Weakness

Children may appear floppy, weak, or unable to maintain posture properly due to reduced muscle tone.

9. Seizures and Abnormal Movements

Some children with GDD may develop seizures, involuntary movements, or abnormal posturing.

10. Poor Growth and Failure to Thrive

Children with GDD may have low weight, short stature, and inadequate physical growth.

MANAGEMENT

Prevention of Global Developmental Delay (GDD)

Acharya Charaka, the eminent scholar of Ayurveda, emphasized the prevention of psychological and developmental disorders in children not only after birth but also during the pre-conceptual and antenatal periods. This holistic approach highlights the importance of maintaining proper physical, mental, and emotional health of the parents before conception to promote healthy fetal growth and neurological development. Ayurveda advocates various preventive measures during the pre-conceptual, prenatal, natal, and postnatal periods to reduce the risk of developmental abnormalities such as Global Developmental Delay (GDD).^[40]

Before Conception

Before conception, Acharya Charaka described several dietary, behavioural, and lifestyle guidelines to be followed during Ritukala (fertile period) and prior to conception. Proper purification of the body, intake of wholesome diet, maintenance of mental well-being, and

avoidance of harmful activities are advised for both parents to ensure healthy progeny. These measures help in preventing defects in Beeja (sperm and ovum), thereby reducing the chances of congenital and developmental disorders including GDD. Following these pre-conceptual regimens contributes to proper fetal development and supports healthy neurological maturation.^[41]

During Pregnancy and Delivery

During pregnancy, Acharya Charaka advised pregnant women to avoid improper diet, unhealthy habits, psychological stress, trauma, and exposure to factors known as Garbhopaghatakara Bhavas (factors harmful to the fetus). These detrimental influences may interfere with normal fetal growth and can result in physical as well as psychological abnormalities, including delayed developmental functions.^[42]

Ayurveda describes that during the fourth month of pregnancy, the fetal heart, considered the seat of consciousness (Chetana), becomes active. At this stage, the fetus expresses its desires through the mother, a condition termed Dauhrida Avastha (bi-cardiac phase). Suppression or neglect of the desires of the pregnant woman may adversely affect fetal development and may lead to congenital anomalies or neurodevelopmental disorders such as GDD.^[43]

Special care during labor and the neonatal period is also emphasized in Ayurveda. Complications such as prolonged labor, birth trauma, fetal hypoxia, and neonatal asphyxia should be prevented, as these conditions may aggravate Vata Dosha and impair neurological functions, ultimately contributing to developmental delay in children.

Application of Medhya Rasayana (Neurocognitive Rejuvenators)

In Ayurveda, Medhya Rasayana drugs are considered beneficial for enhancing intellect, memory, cognition, and neurological functions. Medicines such as Mandukaparni, Brahmi, Shankhapushpi, and Guduchi are traditionally used to support brain development and improve coordination between the brain and nervous system. In children with Global Developmental Delay (GDD), these drugs help promote cognitive abilities, speech development, attention, memory, learning capacity, and emotional stability. They also help maintain the balance of Doshas, particularly Vata Dosha, which plays a major role in neurological and developmental functions.

Panchakarma Therapy

Panchakarma therapy is an important therapeutic approach in Ayurveda for the management of neurodevelopmental disorders, including Global Developmental Delay (GDD). These therapies help in detoxification, balancing of Doshas, nourishment of body tissues, and improvement of neurological functions.

Panchakarma procedures not only improve the physical and mental health of the child but also enhance overall quality of life and functional abilities. Therapies such as Basti, Nasya, Shirodhara, Abhyanga, and Shashtika Shali Pinda Sweda are considered particularly beneficial in developmental disorders.

Abhyanga

Abhyanga is a therapeutic oil massage performed using medicated oils and specific massage techniques. It provides relaxation, improves circulation, strengthens muscles, and supports nervous system functioning. In Ayurveda, the skin (Twak) is considered an important site of Vata Dosha, and oil massage helps pacify aggravated Vata. Through tactile stimulation, Abhyanga positively influences emotional and psychological well-being, helping reduce anxiety, irritability, stress, and restlessness in children with GDD. Shiroabhyanga (head massage) specifically nourishes the sensory organs and promotes mental calmness, concentration, and better sleep.^[44]

Shashtika Shali Pinda Sweda

This therapy provides both nourishment (Brimhana) and sudation (Swedana), making it highly beneficial in children with neuromuscular and developmental disorders such as Global Developmental Delay (GDD).

The therapy helps improve muscle strength, tone, flexibility, circulation, and coordination of movements. It nourishes body tissues, especially Mamsa Dhatu and Majja Dhatu, thereby supporting proper growth and neurological development. Since GDD is predominantly associated with aggravated Vata Dosha, Shashtika Shali Pinda Sweda helps pacify Vata and reduces stiffness, weakness, and delayed motor functions.^[45]

Basti Therapy

Basti is regarded as the most effective treatment for disorders caused by aggravated Vata Dosha. Since Vata governs all neurological and motor activities, Basti therapy plays an important role in improving developmental functions in children with GDD. It helps nourish body tissues, maintain proper functioning of Doshas and Dhatus, and improve strength and vitality. Basti therapy is also believed to influence neurological pathways through the gut-brain connection, thereby supporting cognitive and neuromuscular functions. Regular administration of medicated Basti may help improve motor activity, speech, coordination, and overall developmental progress in affected children. Proximately 100 million neurons exactly equal to the number in the entire spinal cord. This makes the role of Basti in neurological disorders very clear. Basti reaches *Acharya Dalhana Pittadhara Kala* and *Majjadhara Kala* up to Grahani. Grahani possess Pittadhara Kala. As per are same. Thus, it can be interpreted that Basti reaches up to Majja. Moreover, being the best pacifier of Vata, it normalizes the functioning of Vayu. Thus, the role of Basti in neurodevelopmental disorders.^[46]

Nasya Karma

Nasya Karma involves the administration of medicated oils or herbal preparations through the nasal route. Ayurveda considers the nose as the gateway to the head (“Nasa Hi Shiraso Dwaram”), allowing medicines to directly influence higher neurological centers. Nasya therapy helps stimulate and nourish the brain and nervous system, thereby improving cognitive functions, memory, concentration, speech, and emotional stability.^[47] It is particularly beneficial in neurobehavioral and developmental disorders where higher mental functions are affected.

Shirodhara

Shirodhara is a calming Ayurvedic therapy in which a continuous stream of medicated liquid is gently poured over the forehead. This therapy produces deep relaxation and mental calmness by reducing stress and promoting psychosomatic balance. Shirodhara helps improve sleep, concentration, emotional stability, and adaptive responses to stress.^[48] By calming the nervous system and pacifying aggravated Vata, it may support behavioural and cognitive improvement in children with GDD.

DISCUSSION

Global Developmental Delay is a multifactorial neurodevelopmental disorder requiring early diagnosis and multidisciplinary intervention. Ayurveda provides a holistic understanding emphasizing prenatal care, nutrition, neurodevelopment, and restoration of functional abilities.

Ayurveda offers a comprehensive and safe management approach for children with Global Developmental Delay (GDD), emphasizing long-term intervention and gradual improvement after each treatment course. Prevention and early intervention strategies are equally important, and public awareness regarding concepts such as Garbhini Paricharya (antenatal regimen), Garbhopaghatakara Bhavas (factors harmful to fetal development), and premarital genetic counselling for non-consanguineous marriages can help minimize genetic predisposition (Beeja Dosha) and pregnancy-related complications associated with developmental disorders.

Ayurvedic management of GDD includes a multidimensional therapeutic approach comprising Deepana-Pachana drugs for improving digestive and metabolic functions, Medhya Rasayana drugs for enhancing cognitive abilities, yoga therapies, dietary modifications, and Panchakarma procedures such as Basti, Shirodhara, Nasya, and Abhyanga. These therapies help in balancing Vata Dosha, nourishing the nervous system, and promoting physical, cognitive, behavioural, and speech development in affected children.

Through this holistic Ayurvedic framework, children with GDD may achieve noticeable improvement in developmental milestones, functional abilities, and

quality of life. Further scientific research and clinical studies are required to strengthen the evidence base for Ayurvedic interventions in the management of Global Developmental Delay.

CONCLUSION

Global Developmental Delay significantly affects the physical, cognitive, and social development of children. Although Global Developmental Delay (GDD) is not described directly in Ayurveda, many clinical features resembling delayed physical, cognitive, speech, and social development are explained under various Ayurvedic concepts related to impaired growth and neurodevelopment. According to Ayurvedic principles, Vata Dushti plays a major role in the pathogenesis of developmental disorders, and management primarily aims at balancing Vata Dosha according to the child's age, strength, and tolerance.

Ayurveda gives greater importance to prevention than treatment, highlighting the significance of awareness and early care to reduce the risk of neurodevelopmental disorders. Important preventive measures include Medhya Rasayana (nootropic and cognitive rejuvenative therapies), Ayurvedic formulations for maternal and child health, Preconceptional Shodhana (purification before conception), Panchakarma procedures, and yoga practices. Adoption of these preventive strategies may support healthy neurodevelopment and reduce the occurrence of developmental abnormalities.

Effective management of GDD can be supported through various Panchakarma therapies and supportive Ayurvedic interventions. These include Abhyanga (therapeutic oil massage), Shiro abhyanga (head massage), Shashtika Shali Pinda Swedana (sudation therapy with medicated rice bolus), Shirodhara, Shirobasti, Basti (medicated enema), and Nasya (nasal medication). These therapies help pacify aggravated Vata Dosha, nourish the nervous system, and improve motor, cognitive, behavioral, and speech functions. By incorporating these holistic Ayurvedic approaches, children with GDD may experience better developmental outcomes and improved quality of life.

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