

Role of *Medhya Rasayanas* (Nootropic Drugs) in Developmental Disabilities of Children

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ABSTRACT

Developmental disabilities are a group of disorders resulting from injury to the developing brain (prenatal, perinatal or postnatal). Developmental disabilities are a severe chronic disability that is attributed to a mental or physical impairment or a combination of both conditions. Broad definition of developmental disabilities included; mental retardation, cerebral palsy, communication disorders, learning disability, attention deficit hyperactive disorder and childhood autism. These disabilities can occur in isolation or in combination (multiple handicaps). Together developmental disabilities account for 10-15% of the population of children and associated with considerable burden of disease, physical co-morbidities, high economic costs, and very poor quality of life (QOL).

Modern medicine has very limited success in treatment of developmental disabilities due to multi-factorial nature of these diseases. Ayurveda represents an ancient system of traditional medicine prevalent in India about 5000 years old. *Medhya Rasayanas* are group of medicinal plants described in Ayurveda to improve memory and intelligence. The *Medhya rasayanas* (herbal nootropic drugs) are beneficial to improve the power of retention, power of grasping, power of discrimination and power of recollection etc. In *Charaka samhita* mainly four medicinal plants mentioned as “*Medhya Rasayanas*”. They are Mandukaparni (*Centella asiatica*) swarasa, Yastimadhu (*Glycyrhiza glabra*) churna, Guduchi (*Tinospora cordifolia*) swarasa and Shankhapushpi (*Convolvulus pluricaulis*) kalka. The recent article focuses on establishing a new potential of *Medhya Rasayanas* (herbal nootropic drugs) for treatment of developmental disabilities in children.

Keywords: Medhya rasayanas, Developmental disabilities, nootropic drugs.

INTRODUCTION

Developmental disabilities are combination of many conditions such as physical impairment, learning impairment, language impairment and behavior impairment etc. Developmental disabilities arise through the developmental period i.e. infancy (birth to 1years old), early childhood (3 to 6 years old), middle childhood (6 to 12 years old), and adolescence (12 to 18 years old) may influence on day-to-day function and

usually last throughout a person’s lifetime.

^[1] A suitable definition has been given by the Federal government of the United States of America (federal development disability act USA title V of the rehabilitation act 1978) as follows: “developmental disability is chronic disability that has mental, physical or both impairment and can be manifested up to 18 years of age.”^[2]

Medha means intelligence or power of retention and *Rasayana* means rejuvenation therapy. By *Rasayana* one gets

the excellence of Rasa and apart from the excellence of Rasa, the individual is endowed with Psychic excellence like sharp memory etc. In *Charak Samhita* mainly four “*Medhya Rasayanas*” are described which help in enhances memory, cognition, intelligence and nerve functions. They are Mandukaparni (*Centella asiatica*) swarasa, Yastimadhu (*Glycirrhis glabra*) churna, Guduchi (*Tinospora cordifolia*)swarasa and Shankhapushpi (*Convolvulus pleuricaulis*) kalka. [3] The word nootropic was derived from the Greek words nous, or ‘mind’ and trepein meaning "to bend/turn". Nootropic drugs are referred as memory enhancer, cognition, intelligence and nerve tonic. Nootropic drugs improve the oxygen supply of brain by stimulating nerve growth. Recent article elaborate a new potential of *Medhya Rasayanas* (herbal nootropic drugs) for treatment of developmental disabilities of children.

Developmental disabilities of Children

Developmental disabilities have broad definition, it include a complex group of disorders that cause physical, intellectual and speech disabilities. Incidence of developmental disabilities in children are mention in table no– 1

Table No-1 (Incidence of developmental disabilities in children per thousand (1000))

Cerebral palsy	02-03
Mental retardation	25-30
Attention deficit hyperactive disorder	75-100
Learning disability	75
Childhood autism	02-03

Cerebral palsy

Cerebral palsy (CP) is a form of chronic motor disability which is non-progressive, non-fatal, yet non-curable and results from damage to the growing brain before birth, during birth or after birth. It is one of the three most common lifelong developmental disabilities; the other two are autism and mental retardation which affected individuals and their families. [4] The incidence of CP is approximately 2.5 cases/1000 live births worldwide. [5] But in India it is 3.8% of population [6] which includes approximately 25 Lakhs Cerebral

Palsy children as per the last statistical information. [7] Nearly 15-20% of total physically handicapped children are suffering from CP. [4] Cerebral palsy results from insult of developing brain in antenatal, natal and postnatal life. [8] The incidence of cerebral palsy is higher in premature babies than mature babies and 15-20% of total physically handicapped are due to cerebral palsy in India. [4] Main clinical presentation of cerebral palsy is spasticity, hypotonia, delayed milestone, learning disabilities, feeding difficulties, involuntary movements like seizures etc., speech disability, hearing impairment, gait abnormality and mental retardation. In 1000 cases of Cerebral Palsy from India, it was found that spastic quadriplegia constituted 61% of cases followed by diplegia 22%. [9] For management of cerebral palsy, multidisciplinary approach is necessary and use of *Medhya rasayanas* (nootropics herbal drugs) can give significant result to control spasticity, hypotonia, delayed milestone and speech disability.

Mental retardation

Mental retardation is defined as significantly sub average general intelligence, with onset during early developmental period and concurrent deficits in adaptive functioning [10] Mental retardation (MR) is second most commonly detected neuropsychiatric disorders among children and adolescents. Its occurrence among young individuals is about 1 to 2 % [11] Mental Retardation is more common in males and common presentation is speech delay, behavioral disorders, or low school performance [12] Intelligence quotient (IQ) tests are more valid and reliable in children older than five years age [13] and many authors prefer to use other names for MR, such as developmental delay, [14] learning disabilities, [15] developmental disorder [16] or developmental deficiency. Widely accepted medical classification (ICD-10) and DSM IV of the American psychiatric association (1994) recognize 4 categories of intellectual disability based on IQ level shown in table no-2.

Table No-2 Category or degree of Mental retardation according to IQ

Category or degree of MR	IQ
Mild mental retardation	50 - 69
Moderate mental retardation	35 - 49
Severe mental retardation	20- 34
Profound mental retardation	below 20

An IQ greater than 85 is reflected normal, and individuals with an IQ level 70-85 are considered borderline. [17] *Medhya rasayanas* (nootropics herbal drugs) can give significant result in symptom such as speech delay and low school performance.

Attention deficit hyperactive disorder

Attention deficit hyperactive disorder (ADHD) is a symptom complex characterized by poor ability to attend a task, motor over activity and impulsivity. Moderate to severe level of disorder are accompanied by poor school and social performance resulting in easy distractibility. The incidence of ADHD is 5-10% population of India and more common in school going children (6 to 12 years age). [18] Recent studies show ADHD is due to autosomal dominant gene transmission and 4 to 6 times more common in boys than girls. [19] ADHD is mostly associated with family history of mental disease like depression, anxiety etc. [20] Diagnosis of ADHD is made by Revised of DSM-5 Criteria. [21] Diagnostic features are divided in mainly two categories, first are Hyperactivity & Impulsivity category and second are inattention category. For management a multidisciplinary approach is necessary and use of *Medhya rasayanas* (nootropics herbal drugs) can give significant result to control hyperactivity, inattention and emotional difficulties.

Learning disability (LD)

Learning disabilities, or learning disorders, are just like an umbrella term for a wide variety of problems related to learning. This is developmental disorders that usually manifest during the period of education and one of the important causes of poor academic performance in school going children. Learning disabilities is also known as Intellectual disability, learning

disorder and learning difficulty. In India about 5-15% of school going children suffers from learning disability. Learning disability is six times more common in boys than girls. [22] "Learning Disabilities" is combination of many specific conditions, such as dyslexia (affects reading and language skills), dyscalculia (affects mainly mathematics facts) and dysgraphia (affects handwriting ability and fine motor skills). In Indian primary school children, incidence of dyslexia is 2-18%, dysgraphia 14%, and dyscalculia 5.5%. [23] Majority of children belongs to 8-12 years age group and referred by parents or teachers for academic issues. Most common associated comorbidities are ADHD, Enuresis and anxiety. Children with learning disability usually present with behavioral difficulties, hyperactivity, poor attention span, day dreaming, impulsive distractible, bed wetting and school failures. For management a multidisciplinary approach is necessary and use of *Medhya rasayanas* can give significant result to improve poor school performance.

Childhood autism

Autism is a neurobehavioral and neuro-developmental disorder which was first described by Dr. Leo Kanner in 1943 hence Autism is also called Kanner's syndrome and it means alone. In India incidence of autism is 4-6 per 10,000 children. [24] Typical age of presentation is 18-24 month children but impairment can begins in the first 3 years of life. Autism is characterized by atypical social behavior, poor communication skills, communication difficulties and/or, in some cases, habitual or repetitive behavior. [25,26] Most of the children present with problems in communication, speech and language delay, impairment in comprehension and language. Autism are usually diagnosed before the age of 3 years but by keen observation and detail examination it can be done up to age of 2 years age. [27] Till date in modern medical sciences there is no perfect treatment for autism but by the use of *Medhya rasayanas* (Herbal nootropic drugs)

we can help these children and improve their mental power and intelligence.

MATERIALS AND METHODS

In this review article, the keywords such as *Medhya rasayanas* in Ayurveda, nootropic herbal drugs, nootropic herbal medicine and developmental disabilities of children were used to retrieve eligible articles indexed in the web of sciences, Scopus, Pub Med, ISI, Google Scholar, and Thomason return databases.

RESULTS

Based on the materials mentioned as nootropic herbal medicine in Ayurveda, the mental enhancer medicinal plants such as Mandukaparni (*Centella asiatica*), Yastimadhu (*Glycyrrhiza glabra*), Guduchi (*Tinospora cordifolia*) and Shankhapushpi (*Convolvulus pleuricaulis*) are found to be effective on developmental disabilities such as Cerebral palsy, Mental retardation, Attention deficit hyperactive disorder (ADHD), Learning disability and Childhood autism. *Medhya Rasayanas* can be used either in polyherbal preparations or alone.

DISCUSSION

In Ayurveda, *Medhya* is described much vastly and it means power of Grasping, retention discrimination and recollection of knowledge and *Rasayana* means rejuvenation. In Ayurvedic system many medicinal plants are classed as brain tonics or rejuvenators. Developmental

disabilities are a severe chronic disability of mental or physical impairment or a combination of both. Broad definition of developmental disabilities included; mental retardation, cerebral palsy, communication disorders, learning disability, attention deficit hyperactive disorder and childhood autism. Main goal in treatment of developmental disabilities is to repair physical and mental impairment by boost brain function and make brain healthier. *Medhya Rasayanas* (Herbal nootropic drugs) are group of medicinal plants described by *Acharya Charaka* for improve memory and intellect by *Prabhava* (specific action). *Acharya Charaka* described four *Medhya rasayanas* e.g., *Mandukaparni swarasa*, *Yastimadhu churna*, *Guduchi swarasa*, and *Shankhapushpi kalka* for improve the intelligence. [28] These drugs can be used singly or in combinations. [29] Developmental disorders of children are generally associated with loss of memory, cognitive deficits, impaired mental function etc. *Medhya Rasayanas* are established in boost the brain function and make the brain healthier also. They act as a vasodilator against the veins and small arteries in the brain. [30] *Medhya* drugs activate brain function by improve the function of *Agni* and get better circulation of *Rasa* by cleaning the micro channel. [31] Main function of *Medhya rasayanas* is to improve power of grasping, power of Retention, power of discrimination and power of recollection.

Table No-3: -Pharamaco-dynamic property of Medhya Rasayanas [31]

Medhya Rasayanas drugs	Botanical name	Rasa	Guna	Virya	Vipaka
Mandukaparni	Centellaasiatica Linn.	Tikta	Laghu	Sita	Madhura
Yastimadhu	Glycyrrhiza glabra Linn	Madhura	Guru, Snigdha	Sita	Madhura
Guduchi	Tinospora cordifolia Willd.	Tikta, Kashaya	Guru, Snigdha	Ushna	Madhura
Shankhapushpi	Convolvulus pleuricaulis Chois.	Tikta	Snigdha, Picchil	Sita	Madhura

Mode of action:

Medhya Rasayanas drugs are known to have specific effect on mental performance by producing neuro-nutrient effect and improve cerebral metabolism. [32] These drugs support the Intellect (*Dhi*)

Retention power (*Dhriti*) and memory (*Smriti*). The pharmacodynamic action of *Medhya Rasayana* having *Shita Virya* and *Madhura Vipaka* promotes *Kapha* and enhances “*Dharana Karma*” (retention of cognition) e.g., Yastimadhu,

Mandukaparni, Bramhi and Sankhpushpi. *Medhya Rasayana* having *Ushna Virya* and *Tikta Rasa* promotes *Pitta* and enhances *Grahana karma* (grasping power and Memory) e.g., Guduchi and Vacha.

Mandukaparni (*Centella asiatica* Linn.):

Mandukaparni plays an important role in improving cognition and memory. It has anti-oxidant and anti-apoptotic property. Juice of whole plant juice is used as cognitive enhancer (*Medhya*) property. [31] Major constituents of Mandukaparni are saponins such as medacoside, asiaticoside, medacassoside, Asiatic acid and triterpenic acid. [33] Asiatic acid in Mandukaparni, have neuro-protective effects both in vitro and in vivo. [34] This was revealed to assuage glutamate-induced cognitive deficits of mice. [35] Mandukaparni act on behavior in addition being brain growth promoter [36] improve learning and memory [37] and anti convulsion activity. [38] *C. asiatica*, owing to an increase in the concentration of GABA (γ -aminobutyric acid) in the brain. [39]

Yastimadhu (*Glycyrrhiza glabra* Linn.)

Fine powder of Yastimadhu dried root is use for *Medhya* property. Its effect is more supportive when use with milk. Active ingredients of Yastimadhu are glycyrrhizine, flavonones, phenolic compounds, isoflavones and glycyrrhetic acid etc. [40, 41] Yastimadhu *Churna* is effective for spatial learning and cerebral ischemia. [42, 43] It has free radical scavenger activity, Memory-strengthening activity and antioxidant activity. [44] The dried roots of Yastimadhu area competent brain tonic; it increases the circulation of CNS system and help to balance the blood sugar level. [45] Yastimadhu significantly improve in learning and memory on scopolamine induced dementia and have significant action on memory enhancing activity in dementia. [46]

Guduchi (*Tinospora cordifolia* Wild)

Main constituents of Guduchi are alkaloids, steroids, glycosides, diterpenoid lactones, phenolics and polysaccharides. [47] Guduchi *swarasa* is rich source of trace elements such as Zinc and Copper which act

as antioxidants and protects cells from the harmful property of oxygen radicals generated at some stage of immune activation. [48] It has neuro-protective activity, learning and memory enhancing activity [49] antioxidant activity [50, 51] and anti-stress activity. [52] Guduchi helps in cognitive enrichment by increase production of acetylcholine, which enhances choline. [53] Another important action of Guduchi is immune-modulator. [54] Guduchi *Swarasa* may also play an efficient role alongside ischemic brain damage in rat. [55]

Shankhapushpi (*Convolvulus pleuricaulis* Chois.)

Kalka of *Shankhapushpi* is used as *Medhya rasayans* (intellect promoter) and its important ingredients are microphyllic acid, kaempferol-kaempferol-3-glucoside, 3, 4 dihydroxycinnamic acid and sitosterols. It has neuroprotective activity, intellect promoting activity, free radical scavenging activity and antioxidant activity. [56] CCRAS develop Ayushman-8 which is effective in *Manasika-mandata* (mental retardation) and its main ingredients are *Shankhapushpi*, *Brahmi* and *Vacha*. [57] Shankhapushpi is also effective in anxiety, neurosis, insomnia, cerebral abnormalities and serve as wonderful nervine tonic. [58] Shankhapushpi enhances memory function due to its Antioxidant and Acetyl cholinesterase Inhibitory Properties. [59]

CONCLUSION

Herbal nootropic drugs (*Medhya rasayanas*) improve memory, sharpen concentration, and improve grasping, without the side effects, tolerance, or withdrawal. *Medhya rasayanas* help in increasing circulation to the brain, varying the concentration of neurotransmitters, falling brain inflammation, activating the formation of new brain cells and defending the brain from free-radical damage. *Medhya rasayanas* act at different levels such as at level of *Rasa*, act by stimulating and improving the function of *Agni* and improve circulation of *Rasa* by opening and cleaning the micro channel for improve mental

performance. Hence, this is need of present era to explore medicinal plants globally for improving cognitive function and mental performance owing to their minimum adverse effects.

Conflict of interest- None Declared

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