



Review Article

Dyslexia: A solution through Ayurveda evidences from Ayurveda for the management of dyslexia in children: A review

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Abstract

Dyslexia is one of the commonest learning disability. It is defined as a disorder where a child, in spite of all the classroom teaching, is not able to attain the language skills of reading, writing and spelling according to their level of intelligence. *Dyslexia* individuals often have difficulty in relating to the association between sound and their respective letters. Reversing or transposing the letters while writing is characteristic with letters such as b and d, P and q, etc., The prevalence among school children is reported as 9.87% and in the selected families, it is 28.32%. *Dyslexia* significantly interferes with academic achievement or activities of daily life and are not primarily due to sensory, motor or mentally handicaps. About 40% of *dyslexic* children and adolescents dropout of schools. According to Ayurveda, learning is a result of successive and complex interaction of *Indriyas* (cognitive and motor organs), *Indriyartha* (sense organs), *Mana* (psyche), *Atma* and *Buddhi* (intellect). Above all, the functioning of these factors is governed by *Tridosha* (*vata*, *pitta* and *kapha*) and *Triguna* (*Sattva*, *Raja* and *Tama*) in a specific coordination and balance Any disturbance in these *Tridosha* and *Triguna* will cause disordered functioning of *Indriya*, *Mana* and *Buddhi* leading to impaired learning or dyslexia Ayurvedic drugs can help in the management of dyslexia by making these *Tridosha* and *Triguna* in well-balanced state and also by providing *Medhya* (intellect promoting) drugs to improve the learning ability in these children.

Key words: Ayurveda, dyslexia, *Medhya*, *Tridosha*, *Triguna*

Introduction

Dyslexia is one of the commonest learning disability. It is defined as a disorder where a child, inspite of all the classroom teaching, is not able to attain the language skills of reading, writing and spelling according to their level of intelligence.^[1] *Dyslexia* individuals often have difficulty in relating to the association between sound and their respective letters. Reversing or transposing the letters while writing is characteristic with letters such as b and d, P and q, etc., The prevalence among school children is reported as 9.87% and in the selected families, it is 28.32%.^[2] *Dyslexia* significantly interferes with academic achievement or activities of daily living and are not primarily due to sensory, motor or mentally handicaps. About 40% of *dyslexic* children and adolescents dropout of schools.^[3] Exact

cause of dyslexia is not known.^[4] It has been estimated that there has been a complex interaction among genetics, biology, cognition, behavior, temperament, family factors, environment and social factors in the genesis of dyslexia.^[5]

Dyslexia is diagnosed when the individual's reading or writing skill is substantially below the expected for his or her age, schooling and level of intelligence. These disabilities significantly interfere with the academic achievement or activities of daily living and are not primarily the result of sensory, motor or mental handicaps. Symptoms usually noticed once the children become 5 or 6 years in age of starting schooling.

The cascading effects of dyslexia can adversely affect the self esteem, future goals, peer and family relationships and child's ability to progress through subsequent developmental stages.

According to Ayurveda, learning or acquisition of knowledge is a result of successive and complex interaction and coordination of *Indriyas* (cognitive and motor organs), *Indriyartha* (sense organs), *Mana* (psyche), *Atma*, and *Buddhi* (intellect).^[6] Above all, the functioning of these factors is governed by *Tridosha* (*Vata*, *Pitta* and *Kapha*) and *Triguna* (*Sattva*, *Raja* and *Tama*) in a specific

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coordination and balance.^[7] Any disturbance in these *Tridosha* and *Triguna* will cause disordered functioning of *Indriya*, *Mana* and *Buddhi* leading to impaired learning or dyslexia.^[8] Ayurvedic drugs can help in the management of dyslexia by making these *Tridosha* and *Triguna* in a well-balanced state and also by providing *Medhya* (intellect promoting) effect to improve the learning ability in these children.

In Ayurvedic classics there are mounting evidences regarding the drugs and compounds which are indicated in various domains of cognitive deficits. The four *Medhya Rasayana* viz., *Mandukaparni* (*Centella asiatica*), *Shankhapushpi* (*Convolvulus pluricaulis*), *Madhuyashti* (*Glycyrrhiza glabra*) and *Guduchi* (*Tinospora cordifolia*) are especially mentioned as intellect promoting drugs.^[9] Also various compound preparations like *Brahmi Ghrita*,^[10] *Vachadi Ghrita*,^[11] *Ashtanga Ghrita*,^[12] *Ashta Mangal Ghrita*^[13] and *Guduchyadi Rasayana*.^[14] These drugs can be used for improvement in children with dyslexia.

Various clinical and experimental studies with these Ayurvedic *Medhya* drugs are mentioned which directly or indirectly provide evidences regarding improvement in cognitive functions and intellect promoting which may be helpful in improving the disability in a dyslexic child. The review is based on the principle that the results of clinical studies providing evidences can be applied to manage the various areas of child's functioning in a dyslexic child.

The article presents a review of various clinical and experimental studies which provide clue to the use of Ayurvedic drugs in the management of dyslexia in child on the basis of their proven efficacy on various domains of cognitive function. Material related to dyslexia has been collected from different Ayurvedic and modern treatises. References are also collected from various journals of different areas and studies cited on MEDLINE and Pubmed. The key words used are dyslexia, *Medhya*, Learning and Memory, Ayurvedic drugs.

Drugs Helping in Learning and Memory: Some Evidences

Brahmi (*Bacopa monniera*)

1. In an experimental study, neonatal rat pups 10-day-old were given different doses of *Bacopa monniera* (BM) extract orally for different periods of time. These rats were then subjected to spatial learning (T-Maze) and passive avoidance tests along with the age-matched normal and gum acacia control rats. The data were compared with those of control rats. The result showed improvement in spatial learning and enhanced memory performance in neonatal rats treated with extract of BM. The result provides evidence that treatment with BM extract during growth spurt period of neonatal rats enhances learning and memory.^[15]
2. In a study, 61 subjects of both sex with an age range of 62-75 years were selected. Twenty-eight aged had cognitive deficits particularly the memory loss. Whereas 33 were normal aged. The subject of both group were treated with organic extract of BM in effective doses continuously for 6 months and evaluated on various neuropsychological parameters. The results obtained at the end of 6 months

revealed beneficial effect in improving memory and attention span and also associated behavioral problems among demented elderly people. The neurochemical loss was checked and enhanced in senile dementia cases. The test drug has potentiality to improve memory and other cognitive deficits among the aged suffering from dementia and associated behavioral problems.^[16]

3. In a clinical study on the effects of *Brahmi* (BM) on human memory, 76 adults aged between 40 and 65 years took part in a double blind randomized, placebo-control study in which various memory functions were tested and levels of anxiety measured. The results showed a significant effect of the BM on a test for the retention of new information. Follow up tests showed that the rate of learning was unaffected suggesting that BM decreases the rate of forgetting of newly acquired information.^[17]
 1. In a clinical study, BM significantly improved speed of visual information processing measured by the IT task learning rate and memory consolidation compared to placebo, with maximal effects evident after 12 weeks.^[18]
 2. Extensive pharmacological studies, mostly conducted with standardized extract have shown that *Bacopa* improved the acquisition, retention and retrieval of learned tasks.^[19]
 3. A study to test the efficacy of *Bacopa* on children for 6 weeks, 50 normal school children split into two groups were given either *Bacopa* or placebo. At the conclusion, they were evaluated for attention, concentration, and memory. *Bacopa* was shown to improve mean reaction time (Auditory and visual) significantly.^[20]
 4. In a study 36 children in the 8-10 year age group were selected for a double blind, randomized trial. Nineteen were given 50 mg of *Bacopa* twice daily, 17 others received placebo. After 12 weeks of treatment, the children were subjected to a battery of specialized tests. The data revealed a significant improvement in the areas of sentence repetition, logical memory and pair associative learning (matching things that go together; e.g. "test" and "grade") in all 19 ADHD children who took *Bacopa*.^[21]
 5. Also demonstrated a significant memory promoting effect in animal models of Alzheimer's disease.^[22]
 6. The *bacosides* enhanced vital protein activity and produced an increase in protein synthesis in the hippocampus, a part of the brain that is important for long-term memory.^[23]
 7. To investigate the effect of *Bacopa* in school children aged 6-8 years, 40 children were given *Bacopa* syrup equivalent to 1 g dried herb daily for 3 months, in a single-blind design. Immediate memory, perception and reaction/performance times improved with *Bacopa* treatment.^[24]

Mandukaparni (*Centella asiatica*)

1. In an experimental study, fresh *C. asiatica* plant extract was given orally to rat pups ($n = 5$), from P7-P49 (6 weeks, 2 ml/kg/day). These and age matched normal control ($n = 5$) rats were subjected to learning tests in T-maze and passive avoidance test. Following this, rats were sacrificed and amygdaloid nucleus was processed for Golgi staining. Results showed a significant increase in the percent correct

response (control: 86.44 + 2.33% vs Expt. 93.44 + 3.90%) in plant extract-treated rats. Passive avoidance retention test revealed a significantly memory retention, dendritic intersection was significantly increased at all concentric circles, except at 100 μ m. Dendritic branching points also significantly increased in the inner three zones. These results indicate a correlation between improved learning capacity and increased dendritic arborization in amygdaloid nucleus. This may be the neural basis for enhanced learning in *C. asiatica*-treated rats.^[25]

- Subfractions of *C. asiatica ethanolic* extract were tested (100 μ m mL – 1) for neurite elongation in the presence of nerve growth factor (NGF). Greatest activity was found with a nonpolar fraction (GKF4). Relatively polar fractions (GKF 10 and GKF 13) also showed activity, although less than GKF4. The findings indicate that components in *Centella* ethanolic extract may be useful for accelerating repair of damaged neurons.^[26]
- Treatment during postnatal developmental stage with *C. asiatica* extract can influence the neuronal morphology and promote the higher brain functions of juvenile and young adult mice.^[27]
- Treatment with *CeA* (*Centella*) fresh leaf juice during growth spurt period of neonatal rats enhances memory retention.^[28]
- An aqueous extract of *C. asiatica* is effective in preventing the cognitive deficits, as well as the oxidative stress^[29]

Madhyashti (*Glycyrrhiza glabra*)

- To investigate the effects of *G. glabra*, on learning and memory, the elevated plus- maze and passive avoidance paradigm were employed to evaluate learning and memory parameters. Three doses (75, 150 and 300 mg/kg p/o) of aqueous extract of *G. glabra* were administered for 7 successive days in separate groups of mice. The dose of 150 mg/kg of the aqueous extract of liquorice significantly improved learning and memory of mice. Furthermore, this dose reversed the amnesia induced by diazepam 1 mg/kg i.p.), scopolamine (0.4 mg/kg i.p) and ethanol (1 mg/kg i.p).^[30]
- Memory-enhancing agent in the entire laboratory models employed.^[31]

Shankhapushpi (*Convolvulus pluricaulis*)

Shankhapushpi (*C. pluricaulis*) induces an increase in brain protein content thus increasing acquisition efficiency.^[32]

Jatamansi (*Nordostachy jatamansi*)

- A 15-day treatment in rats with *N. jatamansi* resulted in a significant increase in the levels of NE, DA, 5-HT, 5-HIAA and GABA. These data indicate that the alcoholic extract of the roots of *N. jatamansi* causes an overall increase in the levels of central monoamines and inhibitory amino acids.^[33]
- In an experimental study undertaken to assess the potential of *N. jatamansi* as a memory enhancer, elevated plus maze and the passive avoidance paradigm were employed to evaluate learning and memory parameters. Three doses (50, 100, and 200 mg/kg. p.o.) of an ethanolic extract of *N. jatamansi* were administered for 8 successive days to both young and aged mice. The 200 mg/kg dose of *N. jatamansi* ethanolic extract significantly improved learning and memory in young mice and also reversed the amnesia induced by

diazepam (1 mg/kg, i.p.) and scopolamine (0.4 mg/kg.i.p.). Furthermore, it also reversed aging-induced amnesia due to natural aging of mice. Hence, *N. jatamansi* might prove to be a useful memory restorative agent in the treatment of dementia seen in elderly persons.^[34]

Ashwagandha (*Withania somenifera*)

In an experimental study, daily administration of *Ashwagandha* root extract (50,100 and 200 mg/kg orally) for 6 days significantly improved memory-consolidation in mice receiving chronic electroconvulsive shock (ECS) treatment. *Ashwagandha* administered on day 7, also attenuated the disruption of memory consolidation, produced by chronic treatment with ECS. On the elevated plus maze *Ashwagandha* reversed the scopolamine (0.3 mg/kg) induced delay in transfer latency on day 1. On the basis of these findings it is suggested that *Ashwagandha* exhibits a nootropic-like effect in naive and amnesic mice.^[35]

Guduchi (*Tinospora cordifolia*)

An experimental study undertaken with the objective of studying the effect of *T. cordifolia* (Tc) on learning and memory in normal rats and on cyclosporine-induced memory deficits, both alcoholic and aqueous extract of *T. cordifolia* enhanced the cognition in normal rats as were seen in behavioral tests- Hebb William maze and the passive avoidance task.^[36]

Jyotismati (*Celastrus paniculatus*)

- Ethanol extract of *C. paniculatus* was administered at the rate of 2 g/kg body weight orally 16 days before trial experiment in male Wister albino rats of 3, 12 and 20 months old animals. They were studied for learning and memory process as well as for any change in the serum biochemistry. All animals were trained on Y-maze. Each animal received a daily session of 10 trials for 5 days i.e., a maximum of 50 trials. Increase in response of 5th session as compared to 1st session was taken as criteria of learning and memory. There was a significant increase in learning and memory in the treated group with respect to its control. Results showed that *C. paniculatus* preferentially affects learning and recall of memory and also regulate the serum biochemistry.^[37]
- In a study, Jyotismati oil from seeds of *C. paniculatus*, widely used in the indigenous medicinal systems to treat brain-related disorders was used to determine its effect on the learning process in the adult male Wistar rats. To study effect on learning and memory radial arm maze paradigm was used. The data indicated enhancement in radial arm maze acquisition with chronic administration of CP oil (400 mg/kg body weight). A decrease in AChE activity was noted in the treated animals leading to increased cholinergic activity in the brain. There was significant decrease in the AChE activity assayed from hypothalamus, frontal cortex and hippocampus of the rat brain treated with 400 mg/kg body weight. No side effects were observed with administration of the seed oil.^[38]

Conclusions

- Dyslexia is defined as a disorder where a child, inspite of all the classroom teaching, is not able to attain the

language skills of reading, writing and spelling according to their level of intelligence.

2. According to Ayurveda, learning is a result of successive and complex interaction and coordination of *Indriyas* (cognitive and motor organs), *Indriyatha* (sense organs), *Mana* (psyche), *Atma*, and *Buddhi* (intellect).
3. Drugs mentioned as *Medhya* (intellect promoting) and those indicated to improve cognitive functions can be used successfully in cases of dyslexia.
4. The review indicates the Ayurvedic drugs like *Brahmi*, *Mandookaparni*, *Shankhapushpi*, *Jyotishmati*, *Ashwagandha*, *Jatamansi*, *Madhuyashti* and *Guduchi* have the potential to provide a significant improvement in children suffering from dyslexia. All these drugs improve the brain functions and also the sensory and motor systems as a result of their medhya properties and thereby can help in management of various areas of dyslexic child's malfunctioning.

This is only a conceptual study, but the information provided can be utilized in clinical researches.

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हिन्दी सारांश

डिस्लेक्सिया-एक आयुर्वेदीय अध्ययन

अनीता शर्मा, विनोद के. गोठेचा, निशा के. ओझा

डिस्लेक्सिया एक प्रकार की अध्ययन सम्बन्धी बीमारी है। इस बीमारी से ग्रस्त बच्चे को कक्षा में अच्छी प्रकार से पढ़ाने के बावजूद पढ़ने-लिखने तथा शब्दों का सही ज्ञान नहीं हो पाता। वह अपनी उम्र के बच्चों की अपेक्षा बहुत पीछे होता है। इन बच्चों में शब्दों को सही प्रकार से विभेद करने की भी क्षमता नहीं होती यथा b और d में, p तथा q इत्यादि में। यह स्कूल जाने वाले बच्चों में ९.८७% पाया जाता है। इस रोग से ग्रस्त प्रायः ४०% बच्चे स्कूल जाना छोड़ देते हैं। आयुर्वेद मतानुसार अध्ययन या सीखना; इन्द्रिय, इन्द्रियार्थ, मन, आत्मा और बुद्धि का आपस में सामन्जस्य के परिणामस्वरूप होता है। किसी भी कारण से त्रिदोष या त्रिगुण की दुष्टि, मन, बुद्धि, आत्मा तथा इन्द्रियों को प्रभावित करती है। जिससे व्यक्ति के सीखने में बाधा होती है जैसे कि डिस्लेक्सिया में देखा जाता है। विभिन्न मेध्य रसायन त्रिदोष तथा त्रिगुण को समत्व की स्थिति में रखते हैं, जिससे बालक की धी, धृति, स्मृति में वृद्धि होती है।