UNDERSTANDING DYSLEXIA IN INDIAN CHILDREN: IDENTIFICATION AND INTERVENTION STRATEGIES

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Abstract
Children with reading difficulties (dyslexia) have poor academic performances and suffer mentally, emotionally, and psychologically. Because of the higher neural plasticity of a child's developing brain, evidence suggests that an early identification of this neurobiological disorder can effectively minimize reading and other cognitive deficits of children with dyslexia through proper intervention. Although extensive research has been conducted worldwide for the assessment and remediation of learning disabilities, little is known about dyslexia prevailing among Indian schoolgoers. Therefore, the present review intends to shed light on various areas related to dyslexia management in India based on existing literature. It covers underlying factors that cause dyslexia and different tools available to screen susceptible adolescents in the country. It also gives a detailed overview of remediation methods developed to improve reading skills and other cognitive abilities of Indian children with dyslexia. It can be concluded that limited research, lack of replicative studies, and associated challenges hinder the remediation process which needs to be addressed immediately.

Keywords: children, dyslexia, India, remedial interventions, reading disability, risk factors

1. Introduction

Dyslexia is the most common form of specific learning disability that affects a child's ability to read letters or words appropriately due to impaired phonological processing (Karande et al., 2011; WHO, 2016; Scaria et al., 2023;). There is malfunctioning of the sensory systems and their processing in children suffering from dyslexia (Kujala et al., 2001; Bansal & Singh, 2021). Most of the symptoms identified among dyslexic school students are related to lexicon, phonology, morphology, and orthography (Jena, 2022). They face difficulties in reading words that are new, long, or with complex orthographies (Schatschneider & Torgesen, 2004; Prunty & Barnett, 2017). These children are also reported to show a high percentage of graphemic errors such as deletion and substitutions of vowels during reading (Gupta, 2004). Not only the reading ability is impaired in children with

dyslexia, but also the ability to identify letters or words and recollect them while writing is impaired, resulting in poor performance in spelling (Soriano & Miranda, 2010). They get confused with words having mirror images (b/d) or inverted images (p/b) and frequently ignore punctuation marks during reading or writing (Sharma et al., 2012). Individuals associated with this learning disability generally read loudly, unable to understand the sounds of letters and fail to recall or draw conclusion from what they read but create stories in their mind based on their imagination. Reading is a multistep and complicated process in brain which requires coordination between various parts responsible for performing this cognitive task (Wajuihian, 2012). According to Pugh's model (Pugh et al., 2001), the left hemisphere of a human brain particularly, inferior frontal (anterior), temporo-parietal (posterior) and occipito-temporal regions (posterior), is responsible for reading. Hypoactivation of two posterior regions (Shaywitz & Shaywitz, 2008) and malfunctioning of neural networks for information processing (Bailey et al., 2018) cause dyslexia. In addition, structural changes like reduced neuroplasticity of left hemisphere (Kershner, 2019), increased myelination of left perisylvian cortex (Skeide et al., 2018), abnormal neural connectivity, defective sulcal patterns, low white matter in arcuate fasciculus (Norton et al., 2015; Ozernov-Palchik & Gaab, 2016) were observed to be associated with dyslexia. Consequently, dyslexia is identified as a neuro-developmental disorder that results in failure of a child's learning through reading and writing. Apart from reading and writing skills, children with dyslexia struggle to follow instructions or directions like right and left and perform basic activities by themselves (Rao et al., 2017). They cannot copy from blackboards, count numbers in reverse order or remember days, months in correct sequences. They are shown to stammer or to give pauses before answering due to poor oral function system (Pandey et al., 2016). In addition, dyslexia often co-exist with other psychiatric disorders, of which attention deficit hyperactivity disorder (ADHD) is the most common (Jhanjee, 2015; Sharma et al., 2018). Nearly 10%-40% of children diagnosed with dyslexia were reported to be associated with ADHD (Del'Homme et al., 2007; Karande et al., 2007). Since all these problems greatly hinder a child's education, dyslexia become a major cause of academic failure of such school-goers. Consequently, most of them suffer from low self-esteem and confidence, depression, frustration and other emotional issues despite having intelligence equal to or sometimes more than the average (Plante, 2004; Sharma et al., 2012; Pandey et al., 2016). If left untreated, the condition becomes so severe that these adolescents get involved in substance abuse and depict behaviors related to juvenile delinquency (Jhanjee, 2015). Therefore, it is imperative to understand this disability to create awareness and save children with dyslexia from being more vulnerable.

The world epidemiological longitudinal statistics reveal that this neurodevelopmental disorder is prevalent among 10%-20% of the overall population irrespective of any gender (Wu et al., 2022). It tends to affect 15%-20% of school-going children, especially in developing countries (Shaywitz et al., 1998; Moats & Dakin, 2007). In India, 5%-15% of school goers, mostly males, show symptoms of such reading difficulties (Karande et al., 2011; Rao et al., 2017; Vaidya et al., 2021; Garje et al., 2015). These 35 million affected children show no visual, intellectual, or physical issues or any form of hearing impairment (Karande, 2022).

In recent years, research on dyslexia have gained more interest by many groups and have been extensively carried out in the world (Mather et al., 2020; Maunsell, 2020; Wu et al., 2022). However, a dearth of research exists on Indian population which is also the result of ignorance and lack of proper intervention to remediate this disorder. Considering these, the present review has been undertaken to aid in understanding this hidden and much-ignored disability, especially among Indian children. It addresses the various risk factors and shed light on the assessment tools available till now for early detection of dyslexia in Indian children. Consequently, various intervention methods available in this country to eliminate or reduce this disorder were discussed. Finally, the challenging areas faced by the Indians for treating children with dyslexia were identified and clues for future research which are imperative to cure this neurobiological disorder were provided.

2. Risk factors

A number of risk factors (genetic and environmental) and their interactions are believed to be involved in the occurrence of dyslexia in individuals (Becker et al., 2017; Benítez-Burraco, 2010; Parameshwari & Lalithaa, 2022; M. J. Snowling, 2015). Among those, genetic predisposition plays a critical role wherein it has been observed that most children suffering from this disorder have at least one family member with dyslexia (Rao et al., 2017). Studies have shown that dyslexia is inherited in a child from an affected individual depending on the degree of relatedness between the two (Sanfilippo et al., 2020). The occurrence of dyslexia among identical twins is much higher (68%) as they are related genetically to maxiumum level whereas dyslexia is transmitted to 50% of children from their first-degree relatives due to 50% gene similarity (Grigorenko, 2009; Snowling & Melby-Lervåg, 2016).

Apart from hereditary factors, several other factors can add to the risk for having dyslexia in children (Parameshwari & Lalithaa, 2022; Singh et al., 2017). These risk factors include perinatal factors such as psychological stress to the mother, socio-economic conditions (Singh et al., 2017), exposure of toxic chemicals or consumption of drug/alcohol by pregnant women, birth injury, premature child birth or low weight during birth, lesions or injuries in vital areas of brain, children suffering from neural disorders like epilepsy, cerebral palsy, developmental differences in brain structures related to reading skill and the home environment affect a child's reading capability (Parameshwari & Lalithaa, 2022). However, empirical evidences in context to India regarding the impact of these risk factors on children to cause dyslexia are lacking.

3. Early identification of Developmental Dyslexia

Children with dyslexia show severe negative emotions and criminal behavior if not diagnosed at right time (Prasadh & Burle, 2022). Therefore, identification of symptoms at early stage is vital (Moharana, 2019) as it can lead to proper intervention to improve neural circuitry of a developing brain due to its high plasticity during childhood (DeFelipe, 2006; Kolb & Gibb, 2011). Even though it is highly desirable to detect developmental dyslexia early, however, it is almost impossible to detect a dyslexic child below five years of age as they may not be actively engaged in phonological tasks (Parameshwari & Lalithaa, 2022). Moreover, in a overpopulated developing country like India, the identification of dyslexics is even more challenging (Misquitta et al., 2023). These factors delay actual identification and subsequent treatment processes from its earliest possible detection period and creates dyslexia paradox (Ozernov-Palchik & Gaab, 2016) which in turn has a negative impact, both socioemotionally and academically, on the affected child. It is already well-established that dyslexia is heritable in nature which means children having family risk are more likely to develop dyslexia than the children without such risk (Esmaeeli et al., 2019). Therefore, family history can act as a potential marker which pediaitricians can use to screen high-risk toddlers before they are admitted to school (Sanfilippo et al., 2020). During this screening method, children who have dyslexia in their family are identified with higher risk of having dyslexia and can be kept under close monitoring. This will effectively reduce dyslexia paradox for effective intervention by detecting affected children before they demonstrate symptoms for reading difficulties. However, family risk is measured through self-evaluation of reading difficulties and skill assessments of children's parents (van Bergen et al., 2016; Khanolainen et al., 2020; Khanolainen et al., 2022). The former method is both time and cost-consuming and rely on questionnaires that tap into reading abilities of adults (Lefly & Pennington, 2000; Snowling et al., 2012; Tamboer & Vorst, 2015). However, it is found to be less reliable as the results are based on their perceptions that can vary on various factors like surrounding people, socioeconomic status, demographich profile, intensity of reading difficulties which can distort their self-reporting behaviour (Deacon et al., 2012; Snowling et al., 2012). Similarly, the predictive power skill assessment method for family risk is questioned by many authors as reading difficulties of adults faced during childhood gradually become less pronounced in later stages due to educational and work experiences (Deacon et al., 2012; (Tamboer et al., 2013; Eloranta et al., 2018). It is suggested that ability of family risk to predict dyslexia in a

child can be enhanced by employing both self report (with multiple items) and skill assessment methods simultaneously (Khanolainen et al., 2022).

Apart from family history, screening can be possible through behavioural assessments of children who have no formal schooling experience. Because dyslexia is a reading disorder, it is recognized in children until they start involved in reading activities. However, these affected children also experience difficulties in visual activities (Puolakanaho et al., 2007; Ozernov-Palchik & Gaab, 2016). According to American Academy of Pediatrics , these visual deficits can be used as an early predictor for dyslexia in toddlers who have still not reached the age to read (AAP, 2009). In this situation, the role of pediatricians is very crucial who must be adept at recognizing these warning signs, evaluating them and devising an appropriate remedial plan. Although pediatricians commonly use a standardized checklist to assess a child's developmental progress in various areas according to their ages, it is important to note that cognitive deficiencies are children-specific and task-specific (Wilkinson et al., 2019). Therefore, measures for addressing dyslexia cannot be generalized and requires careful analysis on individual-based symptoms.

For school goers, learning disabilities can be easily identified by observing their pattern in reading and writing skill. Because class teachers spend much time with them with respect to these activities, they can play vital roles in assessing these vulnerable groups by identifying symptoms associated for dyslexia (Hemadharshini et al., 2020; Moharana, 2019; Shetty & Rai, 2014). Unfortunately, most of them either lack scientific understanding of this disorder or have a misconception (Peltier et al., 2022). In India, majority of school teachers have mild to moderate knowledge about this disorder and its identification, although they are aware of it (Kamala & Ramganesh, 2013; Shetty & Rai, 2014; Charan & Kaur, 2017; Moharana, 2019; Hemadharshini et al., 2020). The level of knowledge was found to be dependent on demographic background of the teachers such as age, education, marital status, and most importantly their teaching or training experiences (Shetty & Rai, 2014; Charan & Kaur, 2017). Further, it was construed that neither had most of the teachers attended any special training on dyslexia (Bhawar & Jadhav, 2022; Kamala & Ramganesh, 2013). Apart from this, more than half of the teachers (56.4%) in selected schools of Punjab had a negative attitude towards children with dyslexia and considered this disorder as an excuse for lazy students (Charan & Kaur, 2017). Thus, to improve the current situation, increased teachers' knowledge about instruction strategies, counselling methods, guidance and awareness level is required (Shukla & Agrawal, 2015). Such training programs were found to be effective to identify and manage children with specific learning disability in a better way (Moharana, 2019). Therefore, appropriate training programs are considered as the foremost step for early identification of children with dyslexia (Joseph & Devu, 2022).

The Government of India has legitimized dyslexia as a disability, being covered under the "Rights of Persons with Disabilities (RPWD) Act, 2016" (Karande, 2022). This Act mandates the screening of each eight-year-old student for any learning disability. Many assessment tools have been developed to help teachers, psychologists, and professionals to screen children with dyslexia. The assessment tools available in India have been discussed below in detail.

3.1 Dyslexia Assessment for the Languages of India (DALI)

DALI, which was developed by Dr. Nandini Chatterjee Singh and her colleagues of the National Brain Research Centre along with the support of the Government of India (Cognitive Science Initiative, Department of Science and Technology), is the first promising tool standardized for lower grades students (class 1-5) (Mather et al., 2020). It is designed to screen and assess dyslexia in struggling readers of Kannada, English, Hindi and Marathi languages by teachers and psychologists respectively (Mather et al., 2020; Raman et al., 2020; Sahu et al., 2022). For screening, DALI consists of Junior Screening Tool for classes 1-2 and Middle Screening Tool for classes 3-5. The assessment tool, on the other hand, uses Indian Language Assessment Battery (i-LAB) to examine reading skills and psychological functioning (phonological awareness, rapid naming, fluency and literacy) of children. According to Rao et al. (2021), Dyslexia Assessment Battery (DAB) of DALI (DALI-DAB) evaluated reading (word decoding, reading comprehension,

spelling) and mediator skills (oral language, phonological awareness, processing automaticity, executive function) for assessing dyslexia in bilingual children. The education system of the country mandates learning of two languages (English and Indian language) in schools and children take 5-7 years to acquire proficiency in English language (Roseberry-McKibbin & Brice, 2000; Viswanatham, 2001). Therefore, challenges faced by struggling readers can be either due to delay in achieving proficiency English language or specific learning disability (Raman et al., 2020) which makes a formidable task for teachers to differentiate between the two. To overcome this issue, DALI-DAB targets both languages to understand their learning potential and reasons underlying linguistic deficit in biliterates. An individual is called a poor reader of a language if he/she scores at or below cutoff value set for that specified language and particular grade-level. A child will be at higher risk for dyslexia if he/she qualifies as poor a reader for both languages (Rao et al., 2021).

3.2 Curriculum-based measurement (CBM)
Curriculum-based measurement (CBM) is another reliable tool for screening students who encounter difficulties in reading, writing or calculating (Deno, 1985). CBM is used by teachers to measure number of words correctly read by students (oral reading fluency) in one minute and to monitor their progress with time (Wayman et al., 2007; Tindal, 2013). By determining academic progress of children, CBM helps to recognize children who demand for special education (Fore III et al., 2006) and device appropriate individualized educational plans for them (Deno et al., 1984). Previous literatures have reported its effectiveness and mentioned its positive implications towards screening poor readers or readers with dyslexia in different countries like Arab (Abu-Hamour et al., 2013; Mahfouz & Mohamed, 2023), Germany (Voß & Blumenthal, 2020), Spain (Gutiérrez et al., 2019) and USA (Nelson et al., 2019). However, there was no CBM tool developed in India to administer on Indian students. CBM tools which were designed by western countries (DIBELSNext and easyCBM) were used with minor changes to evaluate reading impairments among school children in India (Shenoy et al., 2020). Recently, a digital CBM tool named as Fluency Assessment for Benchmarking in Literacy education (FABLe) was developed for the first time in India to identify children who are at higher risk of having dyslexia (Misquitta et al., 2023). It screens students based on their oral reading proficiency in order to provide them appropriate intervention. The effectiveness of this digital tool was investigated by conducting a pilot study in Mumbai where students of Grade 3 from an English medium school were tested. During the assessment, the teachers track the number of words correctly read by students in digital devices (mobile, tablet) and after one minute they allow students to recall those words. The children are then scored by quantitative (number of errors made by them while reading, accuracy level) and qualitative (decoding, retelling, prosody) indicators. Students who score between lower cut-off value and benchmark criterion are allotted to Fluency intervention group for improving reading skill while those who cannot meet the lower cut-off score are recommended for intensive reading interventions. Even the app can monitor the progress of each student by recording and analyzing his/her previous assessment reports. However, the effectiveness of this tool is currently being tested through pilot studies in two states of India (Maharashtra and Gujarat).

3.3 NIMHANS Index
Often children with dyslexia also face challenges in writing (dysgraphia) or mathematical calculation (dyscalculia). Therefore, the National Institute of Mental Health and Neurosciences (NIMHANS), Bangalore has invented a tool to diagnose children (5-12 years) suffering from one more type of learning disabilities (Kapur et al., 2002). This is the most recommended test in India due to its approval from the Government of India (Nair et al., 2017; Scaria et al., 2023). It is free of cost and available in English, Hindi and Kannada languages (Sahu et al., 2022). It examines a child's visual-motor skills, auditory and visual functioning, skills for reading, writing, spelling and comprehension, mathematical power and encompasses assessment tests for attention, speech, language, auditory behavior, and verbal expressions (Nisha & Kumar, 2013).

3.4 Grade Level Assessment Device (GLAD)

This device was developed by the National Institute for the Mentally Handicapped (NIMH) to assess school children (6 years or above) having learning deficit based on their curriculum activities (Nair et al., 2017). It is also free of cost and is available in two languages i.e., Hindi and English.

3.5 Information and Communication Technologies (ICTs)

Information and Communication Technologies (ICTs) are fast and convenient tools used across the world to screen dyslexic children from regular readers based on their cognitive skills through various sensory approaches (Drigas & Politi-Georgousi, 2019). RU-Lexic is an example of a screening tool that is available in India (Bai et al., 2016). This proposed instrument is automated in nature and web-based which evaluates fine motor movements of children with dyslexia, particularly toddlers through sensory perception. However, its efficacy of this tool among school children with dyslexia has not been investigated.

3.6 Informal and formal assessments

Assessing learning disabilities among Indian children through informal and formal tests have been recommended by the Rehabilitation Council of India (Nair et al., 2017). Depending on age and cognitive potential of a child, intellectual assessment (Malin's Intelligence Scale for Indian Children), achievement test (Woodcock Johnson III), test for cognitive ability (Woodcock Johnson Psycho-Educational Battery Revised, Weschler Memory Scales Revised, Benton Visual Retention Test, Benton Visual Retention Test, Beery Visual-Motor Integration Test, Rey Auditory-Verbal Learning Test, Bender Visual Motor Gestalt Test) are employed in India.

In recent years, researchers have started using artificial intelligence to predict dyslexia in children at a very early stage and assist them in receiving early treatment for achieving academic success. Compared to controls, dyslexic individuals show ample differences in patterns associated with handwriting, eye movement and brain structure or activation as reflected by functional magnetic resonance imaging, diffusion tensor imaging, electroencephalogram and electrooculography (Jankovic, 2022). Modern technologies utilize these dyslexia related aspects to diagnose dyslexia. By acquiring these data from medical and/or educational organizations, various machine learning (ML) and deep learning (DL) models have been proposed by many countries including India to detect dyslexia in a multi-step process (Prabha et al., 2021; Alqahtani et al., 2023; Jan & Khan, 2023). Although ML models have showed outstanding performance (Usman & Muniyandi, 2020), they are unable to handle raw data while diagnosing dyslexia (Sharma et al., 2022). In contrary, DL models comprise of neural networks that do not depend on feature extraction (Carin & Pencina, 2018). Instead, they learn hierarchical features directly from the data and predict dyslexia based on these features accurately. Among different DL-based models (ANN, CNN, MLP), CNN is commonly adopted by most studies due to its ability to predict dyslexia from unstructured data (eye-tracking, handwriting images) with high rates of accuracy (86%-96.6%) (Nerušil et al., 2021; Alqahtani et al., 2023). However, low sample size, limited usage of expensive brain imaging technologies, difficulties in data acquisition from handwriting images of dyslexic children have been encountered to hinder the predictive performance of DL model (Spoon et al., 2019; Alqahtani et al., 2023). Therefore, it is important to give much attention to these factors while building predictive models for dyslexia in future using artificial intelligence (Wajuihian, 2012).

3.7 Limitations of existing assessment tools

Although identification of children associated with dyslexia as early as possible can facilitate the intervention process and result in improvements in their academic performances, it is a formidable task in India (Misquitta et al., 2023). This is because the early detection process through formal tests and assessment battery currently available take longer time to complete, causing a delay in their intervention (Karande et al., 2011). The existing recommended tests are restricted to diagnose children only between the age of 8-12 years; moreover, the validity of the screening tests as well as the assessment tests are questionable even now (Karande, 2022). Secondly, most existing scales

measure children's learning disorder based on English but not native Indian languages for which validity of such tests in a multi-linguistic country like India have been questioned (Kalyanpur, 2020; Scaria et al., 2023). Thirdly, these tests may include other deficits such as low IQ, hearing impairments or problems in English language which need to be excluded.

4. Intervention methods
4.1 Remedial education
Remedial education is considered as one of the efficient intervention methods for dyslexia when administered at early stages (students at primary level) due to higher adaptive features of their central nervous system (Karande & Kulkarni, 2005; Karande et al., 2011). In this method, deficiencies in academic skills of every affected child are identified based on which an appropriate educational program is formulated by a remedial teacher to eliminate his/her weaknesses (Karande & Sholapurwala, 2013). Through this program, the children learn segmentation, deletion, matching, counting and substitution of phonemes as well as the relationship between phonemes and phonics (Alexander & Slinger-Constant, 2004). Spelling improvement is done through color-coded segmentation, sight word identification, word formation and by using mnemonics. In addition, other strategies such as recalling previous lessons, specifying about the topics to be taught, mentioning clearly all requirements for performing activities and reducing distractions need to be followed by a remedial teacher during the session (Karande & Sholapurwala, 2013). However, to achieve significant results, the children need to undertake these training sessions regularly for some years (Karande et al., 2011; Karande & Sholapurwala, 2013).

4.2 Dyslexic Phonemic R3 Approach
Dr. Ananta Kumar Jena, India, developed the dyslexic phonemic R3 appraoch consisting of three sessions where dyslexia symptom is first identified followed by phonemics repetition and word reconstruction (Jena, 2022). Different reading techniques through word substitution, word derivation and word separation are taught to learners with the impairment. Dyslexic students of Silchar, treated with this approach, showed positive results in terms of their reading skill, strategy, phonemic fluency, spelling and phonological awareness.

4.3 Text-to-speech software
Assistive technology such as, text-to-speech software helps dyslexic children to use their sense organs in order to understand the meaning of each word read by them and reduce difficulties with decoding (Wood et al., 2018). There is only one study conducted on Indian children having dyslexia (6-12 years) to examine the impact of text-to-speech tool on their academic performances (Bhola, 2022). Remarkable positive results were shown by these children after four months of this intervention, supporting the positive role of this software in treating dyslexia.

4.4 Tangible Interactive BLOcks (TIBLO)
Tiblo is a learning aid that is designed for children (8-12 years) with reading difficulties to improve emotional and psychological challenges by utilizing both auditory and optical systems (Pandey & Srivastava, 2011). It is made of multiple blocks that can be joined with each other to form variable shapes. It is electronic in nature that can play pre-recorded sounds for 10 seconds to enhance the child's memory and retention capability. By using this tool, the affected groups showed increased level of engagement and attachment during their activities.

4.5 Training programs
Different training programs are found effective in remediating children associated with learning disabilities if given at early stage. Kujala et al., (2001) demonstrated the positive effects of audiovisual training not only on reading skills but also on auditory functions in first grade school children who were dyslexic. Because of higher neural plasticity of their brains, such improvements were explained by the changes in auditory cortex of their brain with increased electrophysiological

mismatch negativity and speed of reaction times required for sound changes. Cognitive re-training is another efficient remedial program which enhances skills for reading, decoding or comprehension, cognitive abilities and behavioral difficulties of children with disabilities (Bansal & Singh, 2021). This training can be either provided manually (Manualized cognitive re-training) or with the help of digital devices (Computer-assisted cognitive re-training). The former method is a traditional one which is conducted by an expert using papers and pencils as per the need of the individuals with dyslexia. In the latter type, tasks were designed in the form of computer games by specialists to stimulate sensory systems of children with impairment. Due to low cost, less time-consuming and easy access even in remote places, re-training assisted by computers seems advantageous. Despite that very few studies were conducted in India in the context of dyslexia remediation using cognitive re-training (Nisha & Kumar, 2013; Kumar, 2014), indicating a need of replicative studies to prove its efficacy.

4.6 Application of drugs

According to some authors, plant-based medicines have the potential to significantly improve the condition of children affected by dyslexia (Pandey et al., 2016; Vaidya et al., 2021). Sharma et al., (2012) has mentioned the role of many ayurvedic drugs or compounds in promoting intellect, memory and other cognitive processes. Therefore, the author claimed that these drugs can have direct or indirect effects in managing children with dyslexia by improving their motor and sensory functions. But, due to lack of sufficient records, Karande & Sholapurwala, (2013) contradicted the role of ayurveda in treating dyslexia and claimed for more research in this regard. In addition to ayurvedic drugs, the efficacy of homeopathic medicines in treating ADHD was reported (Dhawale et al., 2014). Significant changes in certain areas of reading skills along with ADHD were observed when administered among Marathi-medium school children for one year. However, these positive responses were noticed only when they were treated with homeopathy along with remedial education.

4.7 Reading programs, graphosyllabic analysis and cognitive strategies

According to Parameshwari & Lalithaa, (2022), treatment of dyslexia can be done through various reading programs. In this program, children learn about splitting of words, separating letters in each word, sound of syllables and word recognition. Prasadh & Burle, (2022) found significant improvements in reading fluency among students with dyslexia of Visakhapatnam after five weeks of graphosyllabic analysis in contrast to the control groups. Another study showed that school-going kids (primary level) of Coimbatore having dyslexia had improved phonemic awareness in their reading comprehension through cognitive strategies (Thangarajathi & Menaha, 2020). Since, phonemic awareness is important for word recognition and spelling, this finding indicates high potentiality of cognitive strategy in managing dyslexia. Furthermore, the importance of proper nutrition of a child, support, guidance, counselling, speech or psychotherapy therapy, parent's education and consultation with experts cannot be ignored to manage dyslexia.

5. Challenges faced during screening and possible solutions

In spite of the availability of numerous assessment tools and intervention methods, various issues are encountered while dealing with adolescents with dyslexia. Ignorance and lack of awareness among parents or school teachers result in delay of detection and remediation (Bajaj & Bhatia, 2019). Teachers often have a negative attitude towards children with learning disabilities due to their limited knowledge (Charan & Kaur, 2017). They do not show empathetic behavior or give support to learners with impairments due to excess workload. In addition, most schools in India, particularly in rural areas, do not have remedial teachers, remediation rooms or assessment tests (Karande & Kulkarni, 2005; Karande, 2008). Dyslexia remains undetected among non-English speaking learners due to unavailability of measuring scales for that language (Karande et al., 2011). Some of the other limitations include a limited number of qualified special educators in the country and the lack of appropriate infrastructure to support remedial interventions (Karande, 2022). To

address these challenges, some state-governments like Government of Tamil Nadu has started imparting techniques, and content (E-Shikshnam) for remediation as well as proper teaching strategies to teachers (Govindaraju, 2019). To give support and increase awareness among teachers and parents, India has three global partners of the International Dyslexia Association (IDA) (Mather et al., 2020). Concession for dyslexic children is given in some states like Tamil Nadu, Karnataka, Kerala, Goa and Gujarat (Karande et al., 2011). However, other areas like conducting training workshops for teachers, initiating degree courses for the subject to make more special educators and employing them to schools, developing psychological tests for native Indian languages, providing knowledge on different teaching strategies to class teachers, setting up remediation centres in schools and counselling of anxious parents are also crucial and require attention.

6. Conclusion and Recommendations

Dyslexia is a type of learning disability that affects many children every year throughout the world including India. Despite having normal intelligence, adolescents with dyslexia have poor academic performance leading to low self-esteem and other psychological disorders. High prevalence rate of specific learning disability among Indian youngsters has become a major concern as this impairment affects overall career of this future generation if remain unattended. Based on extant literatures, the present review concludes that people's (pediatricians, educationists, caregivers, parents, psychologists, clinicians) understanding on dyslexia s symptoms and associated risk factors is the foremost step in dyslexia management among Indian children that helps in their early identification followed by effective intervention (Figure 1).
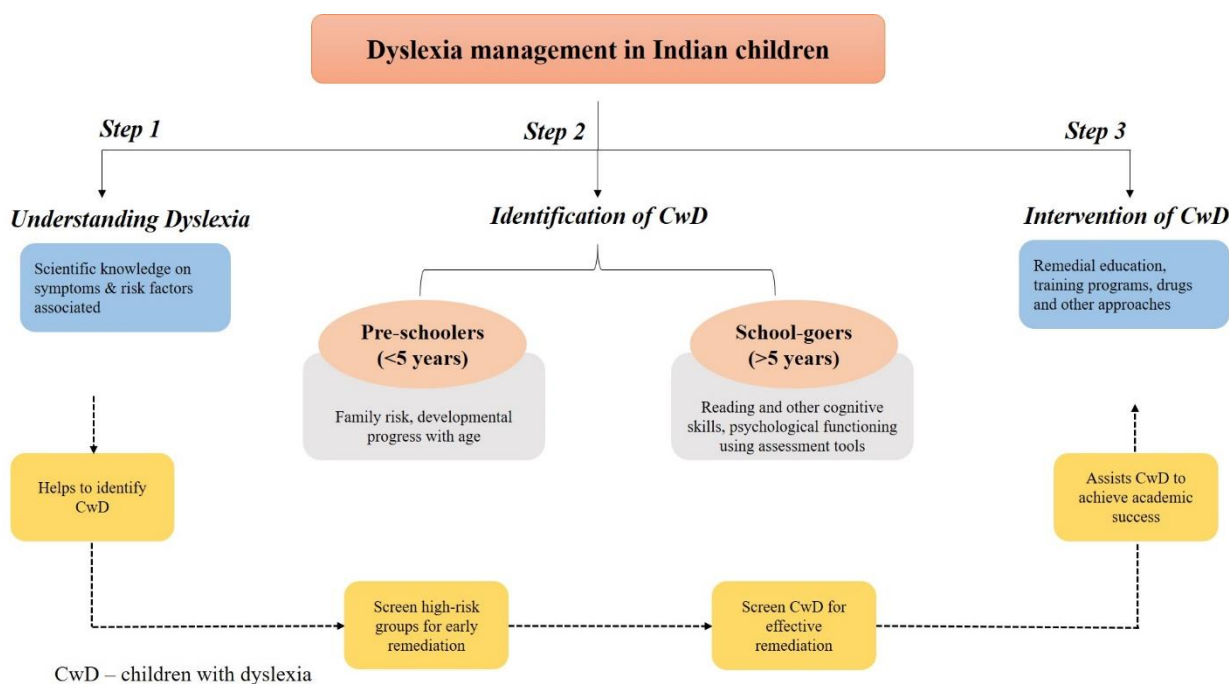

Figure 1: Steps for dyslexia management

This study also highlights various assessments tools and battery tests available in India to recognize these vulnerable children followed by proper intervention methods to treat dyslexia. The paper also mentions about challenges encountered by both teachers and parents to manage children with dyslexia and provides possible solutions. Through this study, it was realized that the screening and management of dyslexic children needs to be prioritized. Moreover, the government needs to increase awareness, develop norms and validated processes to identify the students who are at a high risk of developing this disorder. Based on these, remedial interventions need to be launched in both urban and rural areas to facilitate the lives of these individuals. The core issues towards implementation of interventions need to be resolved.

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