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Recognizing and Supporting Dyslexia in Elementary Classrooms: A Review

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Abstract

A neurological condition defined as the inability to read within the range of normal cognitive ability. In 1887, the word was first invented by Rudolf Berlin. A person with dyslexia, or a learning disability, has considerable trouble decoding wordsaccurately and quickly. Conception of text and spelling are also affected. Sometimes individuals confuse dyslexia with a visual problem. They imagine it as children writingbackwards or inverting letters. But dyslexia are not a problematic trade with vision or with seeing letters in the incorrect track.Kids with this matter are just as smart as others teens. From a general estimation, minimum 5% and maximum 17-20% cases found within the population. Since it is a brain illness, the most likely causes of this condition include low birth weight or early birth, exposure to alcohol, nicotine, or infection during pregnancy, as well as occasionally genetic factors. The key to the diagnosis may lie in late talking, slowly picking up new orders, trouble spelling, trouble remembering anything's order, difficulties with math, and trouble memorizing. It is necessary to quit treating patients in an obnoxious manner or as propsfor other people's jokes and enjoyment. Treatment options that may be beneficial include loud reading, large fonts for letters, developing a vocabulary of recognized words, and providing constant love and support.

Keywords: Dyslexia, neurological disorder, learning disorder, brain anatomy.

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INTRODUCTION:

Dyslexia is a common learning impairment that occurs in 4-8% of children [1,2,3]. This condition often lasts into adulthood [4,5]. Dyslexia is not about intelligence but it is about the brain [6]. The disorder is a neurodevelopmental disorder with reading and spelling difficulty in the context of normal intellectual functioning, schooling and perception [7]. Reading and spelling skills can be impacted individually or in combination. Compared to children of the same age who are not affected, children with dyslexia actually have lower learning capacities. Usually there are issues that arise in elementary school. Dyslexia is a complex, multidimensional disorder that has detrimental social and economic effects.

However, there has been some progress in the study of dyslexia in recent years. For instance, it has been demonstrated that dyslexia has a strong genetic component and that there may be changes in brain structure [8,9] and function [10,11] associated with the condition. The knowledge gained from this study of the bibliometric nature has been applied to a wide variety of diseases, such as endodontics, diabetes and cancer. [12].

According to the U.S., the following are the most frequent causes of school dropouts. Department of Education research: • Lack of support for education: Many students grudgingly leave high school because their parents don't support or encourage their scholastic endeavours. • Special needs: Students who need extra help because of a specific circumstance, such dyslexia or other learning issues, might stop going to high school. • Financial concerns: dyslexia cannot be cured, and society has tremendous difficulties in mitigating financial risks. [13].

Different definitions of dyslexia have been proposed all throughout the world. Because of this, there isn't yet a widely recognised definition of this experience. Dyslexia, says the International Dyslexia Association (IDA), "is a specific learning disability of a neurobiological origin. It is characterised by difficulties with accurate and/or fluent word recognition, as well as poor spelling and decoding abilities. The challenges are typically attributed to lack of the phonological component of language relative to other language skills and the ability to deliver an efficient classroom education [14].

The Diagnostic and Statistical Manual of Mental Disorders (DSM 5) categorizes dyslexia as a unique learning disability due to its inability to read written text, its spelling issues and its tedious and incorrect word recognition. These must have been problems which were below the person's age-appropriate abilities for at least 6 months. IP, poor vision and hearing, other neurological or emotional disorders, stress, unfamiliarity with academic teaching language and insufficient educational background are not more advantageous explanations for the problems [15].

Historical Context:

Wortblindheit (word-blindness) was first identified by German physician Adolph Kussmaul (1822–1902). The term "dyslexia" was first used in 1877 by German ophthalmologist Rudolf Berlin. Many of his senior patients suffer from difficulties with reading, even with normal vision. He believed that the disease was due to changes in the brain.

The Greek concepts "lexis" (language or words) and "dys" (inadequate or bad) are the basis of the word "dyslexia." The first case report of a child with progressive dyslexia was written by British physician Dr. William Pringle Morgan in 1896. He spoke about a 14 year old named Percy F. who was smart and bright and had a lot of issues with reading. In 1992, neurologist Samuel Orton pointed out the neurological aspect of the disease [16]. This component takes years to mature and may be intimately related with the linguistic specialisation of the left hemisphere.

Rate and prevalence:

In the last few decades there has been extensive research on dyslexia in Western countries. It is estimated that it occurs between 5% and 17% of school-age children [17]. A population-based study in Rochester, Minnesota reported cumulative incidence rates of reading impairment ranging from 5% to 11% based on the different techniques employed [18]. Estimating the prevalence of dyslexia, however, is difficult as the disease is different in various languages, different screening procedures can be used, and there may be ranges and variations.

Aetiology

Reading is a composite ability that is acquired by combining various processes, such as language cognition, vision, and attention. There are several hypotheses regarding how dyslexia develops.

1. According to the phonological deficit theory, poor reading is caused by deficiencies in loading, representing, or recovering phonemes [19].
2. According to the rapid auditory processing theory, auditory difficulties in recognising brief or rapidly changing sounds are the reason [20].
3. According to the visual deficiency theory, dyslexia is caused by issues with the visual magnocellular system and its relationship to the posterior parietal cortex [21].
4. The cerebellar deficit idea holds that cerebellar issues are to blame [22]. The "Causal Modelling Framework," developed in 1995 by two developmental psychologists, John Morton and Uta Frith, is a crucial tool that links several hypotheses regarding developing illnesses and identifies their commonalities. The cognitive, biological, and behavioural

levels are the three levels described by this theory. According to this concept, each of the three is equally significant and interconnected [23].

Dyslexia-related factors:
There are several contributing aspects to dyslexia, including genetic, psychological, neurological, and environmental variables.
1. Neurobiological factors:

A typical adult's left inferior, frontal superior, temporo-parietal, and middle temporal areas are the main brain regions involved in single word reading, according to neuroimaging techniques. [24]. Dyslexics have smaller or symmetric peri-sylvian language areas than controls, according to research on the anatomy of the brain after death and structural imaging. However, there is a lack of consistency in these studies [25].
2. Psychological factors:

Quick automated naming and poor phonological awareness are the primary psychological causes underlying dyslexia [26, 27]. Additionally highlighted as contributing variables include issues with fundamental perceptual processes such as temporal processing, visual-spatial attention, and perceptual learning deficiencies [28].
3. Genetic variables:

There are many genetic and environmental risk factors, inheritance and family history that all influence the high development of dyslexia [29]. Only a few genes are associated with dyslexia, such as KIAA0319 or DCDC2 at DYX2, DYX1C1 at DYX1, ROBO1 at DYX5, MRPL19 and C2orf3 at DYX3, and KIAA0319L at DYX817. There are many genes that play a role in axon guidance, neuronal migration and brain development [30]. It is crucial to concentrate on the gene-environment link of the parental genes operating through the environment when evaluating the gene and environmental risk factors for dyslexia. It is not surprising that there is an association between the genotype of the parent and the genotype of the child (genetic risk) and that a parent with an impaired reading ability would create a negative literacy environment. [31].

4. Environmental variables:

In addition to the gene-environment link, a number of environmental risk factors for dyslexia have been found. The changing literacy view is that reading ability cannot be acquired as a discrete developmental phase. There's virtually no difference between reading competence and pre-reading. It suggests that the "Home Literacy Environment," or the literacy-related attitudes and stimuli kids get at home, may have an impact on preschoolers' future success as readers. The home literacy environment is a fluid concept that is influenced by a range of family attitudes, beliefs and practices which affect children's development. This is likely a two-way process, as much as a "passive" effect on the child. For example, a responding parent would probably be encouraged to read to their child more if they were loving what they were reading. Family socioeconomic status influences parents' attitudes to reading, types of parent-child relationships and children's initial reading interests. Higher socioeconomic level and a broader vocabulary are more strongly correlated, according to studies. A variety of factors such as stress in the family, family's ability to handle the stress, and discipline methods used could affect the child's development in the home [32].

Dyslexia paradox:

The disparity between the age at which recognition and supervision typically occur and the age at which straightforward identification is attainable is known as the "dyslexia paradox" [33]. This could have detrimental effects on the child's academic and socioemotional development and make it more difficult for them to participate in productive activities. In most nations nowadays, dyslexia is diagnosed in school grades two, three, or above. Sadly, by the time they are diagnosed with dyslexia, they have fallen behind their age-appropriate classmates academically and have been unable to read for a long time. The "wait-to-fail" approach is the name given to this tactic. Initiating interventions during what is thought to be the window of opportunity for interventions with higher brain plasticity in kindergarten and first grade may be delayed by this "wait-to-fail" strategy. [34].

IMPLICATIONS OF UNTREATED DYSLEXIA:

Children's communication, school, employment, and mental health can all be severely impacted by untreated dyslexia. Untreated dyslexia has been shown to be a major contributor to subpar academic achievement. Anxiety and sadness may be brought on by severe academic failure and a lack of confidence [35]. Therefore, it is conceivable that a child with undiagnosed dyslexia could be diagnosed with a depressive condition, which could be both antecedent and causative and obscure the primary focus of treatment. Due to their experiences with low academic achievement, which can make school appear unpleasant, children with dyslexia may be more likely to refuse to go. Some dyslexics avoid reading because they are afraid of failing, which makes their problem worse. This is referred to as the "Matthew effect of reading" [36]. Children with dyslexia are less motivated to finish school and do not pursue higher education [37]. Adolescents with dyslexia have been observed to exhibit higher rates of hostility, externalising conduct, and delinquent behaviour toward their peers of the same age who are proficient readers [38]. They are also more likely to interact with the juvenile justice system, and research indicates that between 28 and 45 percent of young people incarcerated have reading difficulties [39].

Dyslexia early predictors:

The advantages of preventing or decreasing the numerous negative outcomes that can be prevented or reduced, the benefit of early identification and intervention, and other considerations all point to the potential for therapeutic value with early identification of children's risk factors for dyslexia. At home, the literacy environment is a good predictor of the development of early reading ability. Family history is considered to be a risk factor and is highly heritable. Language deficits are also observed to be linked to dyslexia and impaired speech development may be one of the early signs of dyslexia [40]. A study in Italy revealed that the ability to attend visual spatial is a risk factor for reading ability in kindergarten children. Nonverbal intelligence is one way in which to identify and diagnose dyslexia. Two models have been used for diagnosing dyslexia, the reading achievement and the intellectual quotient (IQ) discrepancy models. Remarkably, a number of recent research have discovered a stronger genetic correlation between higher IQ and reading difficulties. In addition, it is suggested that IQ may be a therapeutic protective factor against dyslexia. Information is always in the active memory and is kept in working memory. Also, working memory is demonstrated to be a large, albeit somewhat significant predictor of reading. Children with other neurodevelopmental disorders, such as Tourette syndrome, ADHD, ADD, OCD, and dyspraxia may also have dyslexia; thus, children with these other disorders should be screened for dyslexic traits.

A clinician's part in the early detection of dyslexia:

A proper diagnosis and the reduction of the "dyslexia paradox" depend heavily on early detection and care. Medical officials who deal with children must also play a crucial part in this. They ought to be aware of this illness and focus on early warning signs and risk factors. A comprehensive history of speech and language development, any early issues with naming (letters, objects, or colours), and nursery rhymes should be obtained at a child's routine follow-up in order to test for dyslexia. Allowing the child to write freely and pointing out spelling errors is also very important. Three key characteristics of dyslexia include bad spelling with incorrect letter alignment, delayed, forceful reading, and inaccurate reading (misrepresentations, oversights, and interchange of words or portions of words). Standard tests, such as single-word reading, spelling, and fluency tests, can be used to conduct a thorough inspection following the initial monitoring. The degree of reading difficulty has been a major and enduring factor in identifying children with dyslexia. It is also crucial to rule out other explanations for reading difficulties, such as organic illnesses (visual and hearing issues, brain disorders), intellectual decline, and deficiencies (low socioeconomic background and inadequate stimulation).

Dyslexia management principles:

Four degrees of treatment are available for dyslexia, according to the 1989 "Multi-level model of Valatine." They regard partial performance inadequacies as secondary causes, biological risk factors as fundamental causes, emotional and behavioural disorders as secondary symptoms, and reading and writing difficulties as primary symptoms [42].

Dyslexia detection method:

1. The conventional method of identifying dyslexia:

various neuroimaging methods to comprehend the biology of reading and dyslexia. The greatest method for studying the brain networks that support successful (or unsuccessful) reading is functional magnetic resonance imaging (fMRI). Because electroencephalography (EEG) is sensitive to millisecond timing irregularities, it is a good tool for analysing the processing time course. The focus of the study then switches to neuroimaging research on developmental dyslexia, with an emphasis on the neurological impacts of remediation, the neural activation time course, and the brain networks activated during reading. Studies that serve as models for the various approaches are chosen. According to this study, the dyslexic brain has underactivated crucial reading neural networks. [43].

Adults from fMRI who are regarded to be at risk for dyslexia were compared to a similar age and gender group for changes in brain activation in response to visual stimuli with varied demands for literacy processing. Stimuli included pictures, well-known brand logos, and written words that were either more complex (called "orthographic") or frequently spelt using early learnt standards (called "alphabetic"). Brain responses differentiate between the presentation conditions as a function of group within several cortical regions [44].

47 individuals (16 dyslexics and 31 controls) had their brain activity monitored using fMRI and Event-Related Potentials (ERP) throughout two distinct, counterbalanced sessions. The participant silently read aloud while periodically criticising simple words that led to logical or illogical conclusions. The fMRI and ERP activation during sentence reading and semantic processing were examined for each subject, and a comparison between a dyslexic and a healthy subject was also carried out. When assessing sentence reading, each word in a sentence is taken into account. A left-lateralized language network activated during sentence reading. Both an electrical N400 effect with sustained left anterior source localisation after 240 ms and activation in the inferior frontal and

superior temporal cortical areas of the left hemisphere were indicative of semantic processing.

Semantic processing in inferior parietal areas and sentence reading in inferior parietal and frontal regions were both less active in dyslexics. Furthermore, this suggests that semantic loss during sentence reading reduces responses in left anterior brain areas in dyslexic individuals [45].

2. Techniques for extracting features:

This approach compares those who struggle mostly with slow, dull reading with those who have fewer reading faults. the eye movements of eleven age-matched dyslexic boys. The results from the controls were noted while reading lists of pseudo-words and text paragraphs. Comparisons between research show that the present German dyslexic eye movement findings are different from English-based findings by having a lower frequency of regressions (perhaps because German is more regular) and a longer fixation period (probably because Italian syllabic complexity).

Eye movements show a keen interest in understanding the specifics of reading challenges experienced by people with developmental dyslexia. In Bulgarian, a Cyrillic script language with proper spelling, the kids repeat passages. The texts contained target terms whose length and frequency were measured.

Eye movements during this period revealed highly significant group differences as well as interactions between the group component and word length, frequency, and total fixation times. It was believed that the oculomotor and perceptual demands of reading were still more similar to the non-reading exercise. The study's dyslexic and control subjects had to read aloud a series of fictitious words, like GUFT. The consonant strings were made by substituting consonants for the vowels of the pseudo-words. The spatial arrangement of pseudo-words and consonant strings was same. The eye movements of dyslexic and control readers were the same in the visual search test, but they differed significantly in the reading task. The idea that problems with oculomotor function or visual perception are the primary cause of developmental dyslexia was disproved by these findings [46].

3. Feature selection techniques:

A pre-processed Hidden Markov Model with two hidden states is used to measure each person's eye movements in the reading dyslexic and control groups. The two states of the model resemble fixations and saccades, two components of the eye movement signal. A one-dimensional linear Bayes classifier uses each item of the transition matrix as a feature. It has been demonstrated that using this method to control eye movements during the most basic nonverbal task can result in comparatively good performance. Thus, feature extraction was suggested in this work [47].

4. Classification-based techniques for identifying dyslexia:

This approach uses a genetic algorithm (GA) for extraction and a self-organising map (SOM) to detect eye movement signals in both horizontal and vertical directions. They came to the conclusion that the likelihood that the patient was healthy rose with reading speed. Six features were extracted from the data set using an inductive modelling technique, and these features were then fed into a self-organising map (SOM). The SOM created three clusters, demonstrating the suitability of the suggested approach for automated dyslexia analysis [49]. According to a different study, feature selection has been used for numerous applications where data contains hundreds of thousands of features. The authors used relevance to project a new context for feature selection.

1. **Eye movement-based dyslexia detection methods:**

A novel data source for studying the information search process is eye tracking. The majority of information science research employing eye tracking data has focused on eye fixations. A method for separating the features of eye movements from the temporal and frequency domain was created by some researchers. They were able to demonstrate that the classification based on Back Propagation (BP) had a higher detection accuracy than the Bayes network result. Analyzing the potential for dyslexiadetection using simply the eye movement signal was the major objective. A straightforward feature selection technique was used to choose a subset of meaningfulfeatures from the extracted time and frequency domain characteristics. [51,52,53].

CURRENT SCENERIO:

As per World Population Review, it is estimated that 5-10% of all people in mostcountries, up to 700 million people globally (Table I), have some degree of dyslexia. According to the Dyslexia Association of India, research showed that 10–15% of Indian children are dyslexic [54,55].

Name of country	Percentage
Belgium	5%
Nigeria	11%
Britain	4%
Finland	10%
Norway	3%
Poland	4%
Russia	10%

Greece	5%
Italy	1.3-5%
Japan	6%
Singapore	3.3%
Slovakia	1-2%
USA	8.3%

Table I:
Worldwide scenario in percentage

Conclusion

Classroom-based intervention programs that focused on vocabulary development, phonological awareness, and reading proficiency were beneficial for kindergarten-aged children who were identified as being at-risk for reading issues [56].

In India, dyslexia has gotten very little research attention, despite being a significant educational issue and a hidden disability. The education sector has also been negatively impacted by the coronavirus disease 2019 (COVID-19) pandemic, leading to school closures and online learning, which may have exacerbated the problem.

References:

Adnan S, Ullah R. Top-cited articles in regenerative endodontics: a bibliometric analysis. Journal of Endodontics. 2018 Nov 1;44(11):1650-64.

American Psychiatric Association. Diagnostic and Statistical Manual of Mental Disorders (DSM-5).Washington: American Psychiatric Pub, 2013.

Aylward EH, Richards TL, Berninger VW, Nagy WE, Field KM, Grimme AC, Richards AL, Thomson JB, Cramer SC. Instructional treatment associated with changes in brain activation in children with dyslexia. Neurology. 2003 Jul 22;61(2):212-9.

Berlinberg A, Bilal J, Riaz IB, Kurtzman DJ. The 100 top-cited publications in psoriatic arthritis: a bibliometric analysis. International Journal of Dermatology. 2019 Sep;58(9):1023-34.

Beshyah WS, Beshyah SA. Bibliometric analysis of the literature on Ramadan fasting and diabetes in the past three decades (1989–2018). Diabetes research and clinical practice. 2019 May 1;151:313-22.

Boder E. Developmental dyslexia: A diagnostic approach based on three atypical reading-spelling patterns. Developmental Medicine & Child Neurology. 1973 Oct;15(5):663-87.

Brumby DP, Howes A. Strategies for guiding interactive search: An empirical investigation into the consequences of label relevance for assessment and selection. Human–Computer Interaction. 2008 Feb 29;23(1):1-46.

Bullock N, Ellul T, Bennett A, Steggall M, Brown G. The 100 most influential manuscripts in andrology: a bibliometric analysis. Basic and Clinical Andrology. 2018 Dec;28:1-2.

Castillo A, Gilger JW. Adult perceptions of children with dyslexia in the USA. Annals of Dyslexia. 2018 Oct 15;68:203-17.

Cavalli E, Colé P, Brèthes H, Lefevre E, Lascombe S, Velay JL. E-book reading hinders aspects of long-text comprehension for adults with dyslexia. Annals of Dyslexia. 2019 Jul 15;69:243-59.

Cavalli E, Colé P, Brèthes H, Lefevre E, Lascombe S, Velay JL. E-book reading hinders aspects of long-text comprehension for adults with dyslexia. Annals of Dyslexia. 2019 Jul 15;69:243-59.

Daley EM, Vamos CA, Zimet GD, Rosberger Z, Thompson EL, Merrell L. The feminization of HPV: reversing gender biases in US human papillomavirus vaccine policy. American journal of public health. 2016 Jun;106(6):983.

Dyslexia Association of India. Available from: https://www.dyslexiaindia.org.in/Role-of-a-teacher.html. [Last accessed on 2022 Oct 05]

Fardi A, Kodonas K, Gogos C, Economides N. Top-cited articles in endodontic journals. Journal of Endodontics. 2011 Sep 1;37(9):1183-90.

Fortes IS, Paula CS, Oliveira MC, Bordin IA, de Jesus Mari J, Rohde LA. A cross-sectional study to assess the prevalence of DSM-5 specific learning disorders in representative school samples from the second to sixth grade in Brazil. European child & adolescent psychiatry. 2016 Feb;25:195-207.

From the IDA Fact Sheet. Definition of dyslexia. Available from: http://eida.org/definition-of-dyslexia/

Gao Y, Shi S, Ma W, Chen J, Cai Y, Ge L, Li L, Wu J, Tian J. Bibliometric analysis of global research on PD-1 and PD-L1 in the field of cancer. International immunopharmacology. 2019 Jul 1;72:374-84.

Gao Y, Shi S, Ma W, Chen J, Cai Y, Ge L, Li L, Wu J, Tian J. Bibliometric analysis of global research on PD-1 and PD-L1 in the field of cancer. International immunopharmacology. 2019 Jul 1;72:374-84.

Gomathi P.M. Karthika. D. Detailed review of various methods for dyslexia detection analysis. JETIR. 2018 5(11): 2349-5162.

Gomathi P.M. Karthika. D. Detailed review of various methods for dyslexia detection analysis. JETIR.2018. 5(11): 2349-5162.

Gondivkar SM, Sarode SC, Gadbail AR, Gondivkar RS, Choudhary N, Patil S. Citation Classics in Cone Beam Computed Tomography: The 100 Top-Cited Articles. International Journal of Dentistry. 2018;2018(1):9423281.

Gondivkar SM, Sarode SC, Gadbail AR, Gondivkar RS, Choudhary N, Patil S. Citation Classics in Cone Beam Computed Tomography: The 100 Top-Cited Articles. International Journal of Dentistry. 2018;2018(1):9423281.

Hutzler F, Kronbichler M, Jacobs AM, Wimmer H. Perhaps correlational but not causal: No effect of dyslexic readers' magnocellular system on their eye movements during reading. Neuropsychologia. 2006 Jan 1;44(4):637-48.

Karim I, Qayoom A, Wahab A, Kamaruddin N. Early identification of dyslexic preschoolers based on neurophysiological signals. In2013 International Conference on Advanced Computer Science Applications and Technologies 2013 Dec 23 (pp. 362-366). IEEE.

Kolkailah AA, Fugar S, Vondee N, Hirji SA, Okoh AK, Ayoub A, Al-Ogaili A, Rios LH, Kumar SK, Camacho MT, Rich JD. Bibliometric analysis of the top 100 most cited articles in the first 50 years of heart transplantation. The American journal of cardiology. 2019 Jan 1;123(1):175-86.

Kraft I, Schreiber J, Cafiero R, Metere R, Schaadt G, Brauer J, Neef NE, Müller B, Kirsten H, Wilcke A, Boltze J. Predicting early signs of dyslexia at a preliterate age by combining behavioral assessment with structural MRI. Neuroimage. 2016 Dec 1;143:378-86.

Kraft I, Schreiber J, Cafiero R, Metere R, Schaadt G, Brauer J, Neef NE, Müller B, Kirsten H, Wilcke A, Boltze J. Predicting early signs of dyslexia at a preliterate age by combining behavioral assessment with structural MRI. Neuroimage. 2016 Dec 1;143:378-86.

Landerl K, Moll K. Comorbidity of learning disorders: prevalence and familial transmission. Journal of child psychology and psychiatry. 2010 Mar;51(3):287-94.

Lesaux NK, Siegel LS. The development of reading in children who speak English as a second language. Developmental psychology. 2003 Nov;39(6):1005.

Macaš M, Lhotská L, Novák D. Hidden Markov models for analysis of eye movements of dyslexic children. In2013 18th international conference on digital signal processing (DSP) 2013 Jul 1 (pp. 1-5). IEEE.

Macaš M, Novak D, Kordik P, Lhotska L, Vyhnalek M, Brzezny R. Dyslexia detection from eye movements using artificial neural networks. InProceedings of the European Medical and Biological Engineering Conference, Prague, Czech Republic 2005 Nov (pp. 20-25).

Männel C, Meyer L, Wilcke A, Boltze J, Kirsten H, Friederici AD. Working-memory endophenotype and dyslexia-associated genetic variant predict dyslexia phenotype. Cortex. 2015 Oct 1;71:291-305.

Männel C, Meyer L, Wilcke A, Boltze J, Kirsten H, Friederici AD. Working-memory endophenotype and dyslexia-associated genetic variant predict dyslexia phenotype. Cortex. 2015 Oct 1;71:291-305.

Morgan WP. A case of congenital word blindness. British medical journal. 1896 Nov 11;2(1871):1378.

Neef NE, Müller B, Liebig J, Schaadt G, Grigutsch M, Gunter TC, Wilcke A, Kirsten H, Skeide MA, Kraft I, Kraus N. Dyslexia risk gene relates to representation of sound in the auditory brainstem. Developmental cognitive neuroscience. 2017 Apr 1;24:63-71.

Neef NE, Müller B, Liebig J, Schaadt G, Grigutsch M, Gunter TC, Wilcke A, Kirsten H, Skeide MA, Kraft I, Kraus N. Dyslexia risk gene relates to representation of sound in the auditory brainstem. Developmental cognitive neuroscience. 2017 Apr 1;24:63-71.

Novak D, Kordik P, Macas M, Vyhnalek M, Brzezny R, Lhotska L. School children dyslexia analysis using self organizing maps. InThe 26th Annual International Conference of the IEEE Engineering in Medicine and Biology Society 2004 Sep 1 (Vol. 1, pp. 1-4). IEEE..

Pan B, Hembrooke H, Joachims T, Lorigo L, Gay G, Granka L. In Google we trust: Users' decisions on rank, position, and relevance. Journal of computer-mediated communication. 2007 Apr 1;12(3):801-23.

Perazzo MF, Otoni AL, Costa MS, Granville-Granville AF, Paiva SM, Martins-Júnior PA. The top 100 most-cited papers in Paediatric Dentistry journals: A bibliometric analysis. International Journal of Paediatric Dentistry. 2019 Nov;29(6):692-711.

Peterson RL, Pennington BF. Developmental dyslexia. Annual review of clinical psychology. 2015 Mar 28;11(1):283-307.

Peterson RL, Pennington BF. Developmental dyslexia. Annual review of clinical psychology. 2015 Mar 28;11(1):283-307.

Peterson RL, Pennington BF. Developmental dyslexia. The lancet. 2012 May 26;379(9830):1997-2007.

Schulz E, Maurer U, van der Mark S, Bucher K, Brem S, Martin E, Brandeis D. Impaired semantic processing during sentence reading in children with dyslexia: combined fMRI and ERP evidence. Neuroimage. 2008 May 15;41(1):153-68.

Shadgan B, Roig M, HajGhanbari B, Reid WD. Top-cited articles in rehabilitation. Archives of physical medicine and rehabilitation. 2010 May 1;91(5):806-15.

Skeide MA, Kraft I, Müller B, Schaadt G, Neef NE, Brauer J, Wilcke A, Kirsten H, Boltze J, Friederici AD. NRSN1 associated grey matter volume of the visual word form area reveals dyslexia before school. Brain. 2016 Oct 1;139(10):2792-803.

Skeide MA, Kraft I, Müller B, Schaadt G, Neef NE, Brauer J, Wilcke A, Kirsten H, Boltze J, Friederici AD. NRSN1 associated grey matter volume of the visual word form area reveals dyslexia before school. Brain. 2016 Oct 1;139(10):2792-803.

Specht K, Hugdahl K, Ofte S, Nygård M, Bjørnerud A, Plante E, Helland T. Brain activation on pre-reading tasks reveals at-risk status for dyslexia in 6-year-old children. Scandinavian Journal of Psychology. 2009 Feb;50(1):79-91.

Van Noorden R, Maher B, Nuzzo R. The top 100 papers. Nature News. 2014 Oct 30;514(7524):550.

Vellutino FR, Fletcher JM, Snowling MJ, Scanlon DM. Specific reading disability (dyslexia): What have we learned in the past four decades?. Journal of child psychology and psychiatry. 2004 Jan;45(1):2-40.

Wang LC, Liu D, Xu Z. Distinct effects of visual and auditory temporal processing training on reading and reading-related abilities in Chinese children with dyslexia. Annals of Dyslexia. 2019 Jul 15;69:166-85.

Wang LC, Liu D, Xu Z. Distinct effects of visual and auditory temporal processing training on reading and reading-related abilities in Chinese children with dyslexia. Annals of Dyslexia. 2019 Jul 15;69:166-85.

Yoon DY, Yun EJ, Ku YJ, Baek S, Lim KJ, Seo YL, Yie M. Citation classics in radiology journals: the 100 top-cited articles, 1945–2012. American Journal of Roentgenology. 2013 Sep;201(3):471-81.

Yu L, Liu H. Efficient feature selection via analysis of relevance and redundancy. The Journal of Machine Learning Research. 2004 Dec 1;5:1205-24.

Yu T, Jiang Y, Gamber M, Ali G, Xu T, Sun W. Socioeconomic status and self-rated health in China: findings from a cross-sectional study. Medicine. 2019 Mar 1;98(12):e14904.

Zhang Y, Quan L, Xiao B, Du L. The 100 top-cited studies on vaccine: a bibliometric analysis. Human vaccines & immunotherapeutics. 2019 Dec 2;15(12):3024-31.

Zhao X, Guo L, Lin Y, Wang H, Gu C, Zhao L, Tong X. The top 100 most cited scientific reports focused on diabetes research. Acta Diabetologica. 2016 Feb;53:13-26.