SHORT COMMUNICATION

Dyslexia and it's modularity

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ABSTRACT

Understanding dyslexia and the factors underlying reading difficulties is becoming increasingly popular. Our understanding of reading ability and dyslexia has improved thanks to research into the morphological and physiological changes in the brain. In terms of poor reading and phonological measurements, investigations into brain chemistry and reading establish a neurometabolic framework of dyslexia. Furthermore, research into the genetic aetiology of reading has shown a number of genes and SNPs linked to dyslexia. However, nothing is known about the intersection of these two fields of study. As a result, we present a comprehensive view of dyslexia based on the concept of modularity, incorporating results and implications from brain morphological, neurophysiological, neurochemical, genetic, and educational perspectives on dyslexia. We believe that this project will lay a solid platform for pursuing the prospects of a comprehensive intervention and well-informed reading solutions.

Key word: *Dyslexia; Genetics; Neurochemicalneurometabolites; Reading disability*

INTRODUCTION

In recent years, there has been a surge in interest in learning more about dyslexia and the factors that cause reading difficulties. Inquiries into the morphological and physiological changes in the brain have helped to a greater understanding of insights into reading ability as brain imaging tools have become more available in recent years [1]. Information from a neurological perspective on the complex reading process has aided our knowledge of reading achievement, individual variances, reading challenges, and so on. A clearer knowledge of the basic neuroscience of reading and reading difficulties has resulted from extensive research on asymmetry of brain areas, decreased activation of the temporoparietal network, and diminished white and grey matter integrity, and so on.

With the growth of technology, it is now more important than ever to grasp the minute, yet complex process of reading in order to increase our understanding of reading issues. As a result, researchers are looking at the neurochemical and neurometabolic mechanisms that are involved in reading difficulties [2]. While adapting or modifying a new habit, neurochemicals are prone to synaptic long-term potentiation and long-term depression, as we all know. As a result, neurochemicals in our brain influence reading as a process of adaptation. Certain neurochemicals have been found to have a strong link to reading difficulties. During reading tasks, for example, an impaired reader's glutamate, choline, and N-acetylaspartate concentrations fluctuate. In turn, balanced cholinergic activity has been identified as critical for enhancing reading skills. Neurochemical information on dyslexia, together with insights into morphological and physiological abnormalities in a dyslexic brain, is critical to a comprehensive understanding of dyslexia [3].

The current discoveries in brain chemical metabolism studies on reading and reading difficulties are summarised in this article. To that goal, the discussion is based on a review of the existing literature on the morphological and physiological associations of dyslexia in the brain. In order to present a thorough view of dyslexia, the epigenetic and genetic aetiology of dyslexia, as well as its role to dyslexia learning, are briefly reviewed in tandem. Furthermore, the discussion aims to be aware of the dyslexia pedagogical intervention, which includes structured literacy and timely teaching for dyslexic children in order to systematically overcome problems and achieve educational accomplishment [4].

Dyslexia is a type of learning disorder that is caused by a neurological problem. Despite a strong IQ and effective educational instruction, it is characterised by difficulty in word identification, spelling, and decoding due to deficiencies in phonological processing. It's also marked by a lack of reading experience and understanding, which stymies vocabulary and background knowledge improvement. 4 Despite the fact that disordered reading was formerly thought to be linked to problems with visual perception, perceptual memory, and motor ability, the concept of dyslexia as a phonological impairment

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was changed. 5 Dyslexics' phonological skill deficit, on the other hand, is not intimately linked to speech perception or auditory perception. Dyslexics struggle with phonological processing because they are unable to decipher sound segments from words and encode sounds to letter and word correspondences, hurting their reading ability and experience [5]. Dyslexics struggle with a variety of skills, including spelling, writing, working memory, and others, in addition to language impairments. According to the International Dyslexia Association, roughly 15–20 percent of the world's population suffers with dyslexia symptoms.

The concept of modularity expresses the idea that a system's behaviour can be the result of two or more discrete elements with different specialised functions. Although the concept of modularity was originally limited to a cognitive system, different theories of modularity need the integration of multiple systems or modules for a total system's behaviour (see Thomas et al.8 for a detailed discussion on the concept of modularity and developmental disorders in terms of biology, and psychology). Reading as a system, for example, relies on the integration of different systems such as orthographic coding, phonological decoding and processing, speech and auditory perception, and so on. Despite substantial study into the morphological or physiological alterations in the brain, neurochemical profiles, genetic aetiology, and educational psychology, there is still a gap in integrating these discoveries for a comprehensive knowledge of dyslexia. For a better understanding and management of this complex neurobiological difficulty, it is critical to place dyslexia within the framework of modularity by integrating insights into reading difficulty from various fields such as neurophysiology, neurochemistry, genetics, epigenetics, and tailored pedagogy [6].

A large network of brain areas is in charge of reading, comprehension, and language processing. Various brain areas are recruited in the complex process of reading, according to the research on the neuroscience of reading. Visual word processing, lexical orthography, phonological encoding, and other aspects of reading are all implicated in these areas. Reading, on the other hand, is a complex activity that relies on three brain areas that can be generally classified. The superior temporal gyrus and the inferior parietal lobe facilitate the mapping of graphemes to phonemes in the first area. The inferior frontal gyrus, which monitors articulatory processes and actively analyses phonological aspects, is the second. Dyslexics' brain morphological variations from healthy readers show how dyslexics' brain material anomalies and asymmetry are inferred. In the occipitotemporal and parietotemporal areas, there is a reduction in grey matter volume [7]. 10 Dyslexics, for example, have less grey matter in the middle, inferior, and temporal gyri, the fusiform gyrus, supramarginal gyrus, and bilateral anterior cerebellum, which contributes to auditory and speech processing issues.

Neurotransmitters are chemical mediators that help convey impulses between neurons and have either an excitatory or inhibitory effect. Amino acids and biogenic amines are the two types of neurotransmitters that exist. Dopamine, epinephrine, norepinephrine, serotonin, histamine, and acetylcholine are classified as biogenic amines, while GABA, glutamate, aspartate, and glycine are classified as amino acids. B vitamins, like as B12, and folates, are also required as cofactors for neurotransmitter production. Neurotransmitter diseases, such as learning difficulties, are influenced by defects in neurotransmitter synthesis or breakdown.

Glutamate, choline, N-Acetylaspartate (NAA), and creatine are brain chemicals linked to phonological processing and reading. During the complex act of reading, these neurochemicals are sensitive to synaptic potentiation and depression, and they have been linked to reading difficulties. Bruno et al., for example, demonstrated strong negative relationships between phonological decoding and silent word reading and a typical choline concentration, implying that worse performance in both tasks are linked to a high choline concentration [8].

The input from the environment, as well as other biological functions, causes functional changes in the brain, particularly neuroplasticity. Good inputs and conducive learning environments have a positive impact on brain development and learning. The pedagogical strategies in use cater to dyslexics in terms of effective learning and learning environment.

Structured literacy and timely instruction are two dyslexia pedagogical strategies that help dyslexics overcome obstacles and achieve educational success. Dyslexics can learn spelling, decoding, vocabulary, writing, and reading comprehension abilities more effectively with tailored literacy, timely instruction, and personalised interventions. Reading longer paragraphs or exposing dyslexic youngsters to unnecessary visual cues might be overwhelming [9, 10].

Other than dyslexia, dietary choline has been demonstrated to help with memory and learning processing. It would be fascinating to examine if these therapies may be targeted or personalised based on the above-mentioned neurochemical and/or genetic/epigenetic investigations. If these therapies are shown to be effective, they could complement the benefits of individualised pedagogy in the treatment of dyslexia.

CONCLUSION

Although dyslexia is rarely thought of as a disease that requires medication, the prospects for improving memory, at least in the comorbid disorders, remain untapped. In order to arrive at a feasible biological intervention, insights from all of the discussed areas of knowledge are extremely important. The active involvement of choline in dietary intake in regulating neurometabolic mechanisms and methylation processes, for example, is indicative of its impacts in memory and learning processing in neurological disorders other than dyslexia. Given that dyslexia is frequently associated with conditions such as ADHD and may be linked to behavioural issues, exploring the possibilities of a holistic intervention that incorporates insights from brain morphological, physiological, neurochemical, genetic, and educational perspectives is crucial.

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