

Review Article

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Dyslexia, Neurodevelopmental Conditions and Comorbidity: A Rule Rather than an Exception

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Abstract

Different neurological Conditions that result from a disorder in a particular part of the brain may co-occur. Dyslexia is a specific learning difficulty which is neurological in nature and comorbid with other neurological conditions. Several studies have shown that this apparent co- occurrence is expected between dyslexia, Dyscalculia, Dysgraphia as well as Attention Deficit Hyperactivity Disorder (ADHD) and Autism Spectrum Disorder (ASD). This article considers the various definition and literature on the existence and comorbidity of these conditions. It is therefore recommended that assessments for these conditions should not be made in isolation to rule off misdiagnosis and enable proper support and treatment.

Keywords: Dyslexia; Dyscalculia; Dysgraphia; Attention deficit hyperactivity disorder; Autism spectrum disorder

Introduction

Dyslexia is a neurological condition that is evident in how people read. Dyslexia may co-occur with other neurological conditions. Individuals with dyslexia may also present a co morbidity of other learning disabilities, some of which includes; dysgraphia (dyspraxia) and dyscalculia. It can also co-exist with; anxiety, depression, obsessive or compulsive disorders [1]. Most children with specific language impairment (SLI) show signs of dyslexia (Research into Dyslexia Provision in Wales, 2013). There is also evidence of high overlap between dyslexia and; Autism, ADD/ ADHD, dyspraxia, dyscalculia, and general learning impairment. A school based research by Kadesjo and Gillberg [2] indicated that 40% of children with ADHD showed reading problems and 29% writing problems. There is Strong evidence that children with ADHD and Reading Disorder show typical deficit in rapid naming speed, so it may be interpreted that a processing speed deficit underlies the link [3].

There is evidence of a high overlap between symptoms of different developmental disorders and dyslexia [4,5]. In the case of developmental disorder co morbidity is a rule not the exception' [5]. This means that it is expected that developmental disorders will have lots in common and can coexist, this occurs more often than been an exception. In a study involving a sample of 179

children receiving special support in Calgary, students diagnosed for dyslexia had 51.6% chance of having other disorders; those diagnosed of ADHD had 80.4% chance of another disorder.

Dyslexia

Dyslexia simply means difficulty with words. Dyslexics have difficulty acquiring the necessary skills for the effective reading, spelling writing and pronunciation of words. These difficulties are persistent even when they have the necessary cognitive abilities and exposure to adequate instructions (IDA, 2008). This disorder is a complex neurologically based condition which may last a lifetime depending on its type and severity, making the dyslexic experience lack of academic progress, lowered self-esteem, depression and anxiety [6,7]. Ikediashi [8] citing Martin, Carlson & Buskist [9], sees dyslexia as a disorder that is associated with reading, writing and spelling impairments. Olson (2002) [10] opines that poor reading ability which is linked to deficient instructional and or home environment does not constitute dyslexia.

Dyslexia is a reading, spelling and writing disability, implying that dyslexics will rarely be excellent in tasks that involve lots of reading, writing and spelling [11]. Succinctly put, dyslexics are tailored to learn differently. They are better with learning tasks that

have little to do with writing, spelling and reading. National Institute of Child Health and Human Development (NICHD) agreeing with (Lyon, 1995) posits that dyslexia is a specific learning disability that is neurobiological in nature. This they believe is characterized by lack of accurate and fluent word recognition, poor spelling and decoding ability. It is defined as a specific learning difficulty affecting the acquisition of fluent and accurate reading and spelling skills. Irrespective of access to appropriate learning environment, these difficulties still present themselves. Reading, writing and spelling skills are basic skill to learning and academic achievement.

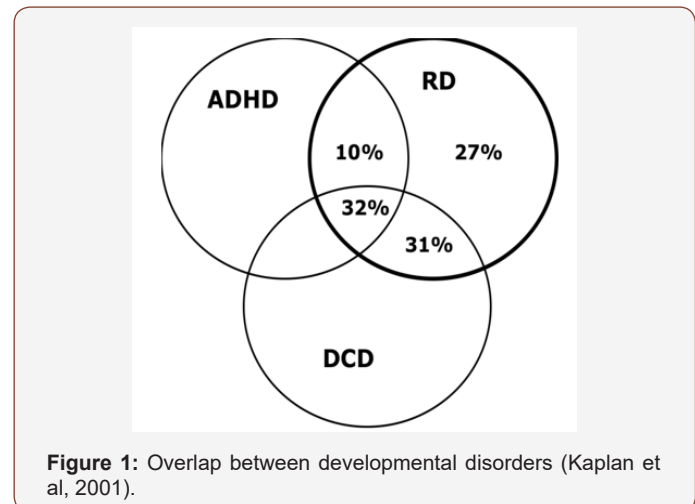
The difficulty experienced by people with dyslexia ranges from mild to severe and depending on the degree of difficulty experienced by the person, frustration is eminent. When a pupil is deficient in reading, spelling and writing skills a drop in academic achievement is resultant [6]. According to IKediashi [8] it is a learning disability that affects a child's reading, spelling, writing and speaking ability. Thus a concept manifesting in a continuum of specific learning difficulties related to the acquisition of basic skills in reading, spelling and or writing. In their view Dyslexia can be understood from behavioural, neurological and cognitive perspectives.

The National Institute of Neurological Disorder and Stroke [12] views dyslexia from a neurological perspective. It defines dyslexia as a disorder that impairs a person's ability to read which can visibly manifest as a difficulty with phonological awareness, phonological decoding, orthographic coding and auditory short term memory. According to the international panel of experts and consultants, the dyslexia consultancy e-team, dyslexia is a neurological condition which is often inherited and can last a lifetime. This is to say that there is notable difference in brain structure in pupils with dyslexia, compared with the brain of non-dyslexics, [13]. Elias [6] asserts that amongst the learning disability population, reading difficulty is the most prevalent affecting about 80% of the population. This disability results from poor development or deficit in the phonological component of language. This is not expected with good cognitive ability and where the class room instruction is effective. Pupils who have dyslexia have difficulty with accurate and fluent word recognition. They also experience problems with spelling and decoding. Poor reading experience, lack of practice can as well affect vocabulary and reading comprehension [14,9].

Dyslexia and ADD/ADHD

ADHD is also known as Hyperkinetic Disorder. The relationship between ADD/ADHD and dyslexia is scientifically evident. Both ADD/ADHD and dyslexia run in families and can be inherited. Genetics play a role in about half of the children diagnosed with AD/HD. For the other half, research has yet to identify a cause. Regarding dyslexia, about one third of the children born to a dyslexic parent will also likely be dyslexic. Dyslexia is a neurologically based condition, which is usually hereditary (parent-child and sibling concordance rates are 25-60% and 40% respectively). ADHD and dyslexia are separate conditions that regularly overlap, thus triggering some misunderstanding about the distinct nature of these conditions. ADHD is a more common developmental

problems, which affect 3–5% of students. It presents in inattention, distractibility, hyperactivity and impulsivity [1].



IDA, (2008) posits that about 30% of students living with dyslexia also have attention deficit disorder (ADD) or attention deficit hyperactivity disorder (ADHD). ADHD presents in three subtypes; firstly, this is manifested in children as; inability to remain on task for long periods, lack of response to instruction or easily distracted [29]. Secondly ADHD can also present symptoms of hyperactivity and impulsivity which is evident in wriggling, squirming, being unable to sit still for long, interrupting and finding it difficult to wait for turns. They are always on the move doing things usually in inappropriate situations when free to do so. Thirdly, it can be a co-existence of attention and hyperactivity issues with each behaviour occurring before the age of seven [15]. The capacity to selectively scrutinise information (attention) and to preserve that information in an available state (working memory) are important aspects of a person's cognitive competence. There is a close interaction and overlap between these two constructs especially during encoding and manipulation of information [16]. The ability to perform some complex tasks depends critically on the capacity of the person to scrutinize, select and preserve the relevant information for such tasks in a retrievable state in the working memory. Awh, Vogel and Oh [17] are of the view that the relationship between working memory and attention is dependent on the stage of attention and type of the information available in the working memory. Attention is the process of selection of some information at the expense of other information. The stage at which attentional selection occurs has been greatly debated. While some schools of thought are in strong support of the notion that attention can affect early perceptual processing others show equally strong support for the notion that attention can affect late perceptual processing [16]. This invariably indicates that there could possibly be more than one form of attentional selection [18,19]). There are three attention network that perform distinct roles; i) alerting network which coordinates the overall state of alertness to sensory stimulations, ii) orienting (perceptual) network which selects a division of sensory information for advantaged processing [18,20] and iii) executive (central) attention network which acts on post

sensory representations and useful when there is competition for access to a central, limited-capacity system [18,16].

Some students experience an alarming level of inattentiveness up to the age of 12 and are diagnosed as ADD while there are others whose inattentiveness is associated with a high level of hyperactivity (Research into dyslexia provision in Wales 2013). Students who show primary dyslexia and secondary ADD/ADHD are usually given extra attention to achieve maximally in regular classroom, but to some extent, symptoms of ADHD are expressed in reaction to home [21] and other environmental contexts [15]. Research findings indicate that Boys with ASD symptoms are given the diagnosis more frequently than girls with equivalent ASD symptoms [22].

Willcut, Pennington, Olson & DE Fries [23] reports a research where 40% of a sample of twins with either Reading Disorder RD or ADHD was co morbid for other disorder. Similarly, 54% of children with ADHD in a clinical sample showed reading problems. Research has shown that in ADHD, dyslexia and ASD, some children have more severe difficulties than others [15]. Research by Cheung, et al. [24] showed a correlation among ADHD, reading difficulty and IQ. So also, Over half, (53%- 72%) of the overlapping influences between ADHD and reading difficulties were not shared with IQ.

Dyslexia and Autism

Students with Autism Spectrum Disorder have chances of experiencing other neurodevelopment conditions and disorder [15]. It can also co-occur with other behavioural problems as well as anxiety and depression [1]. Autism like Dyslexia is known to exist in a continuum throughout the general population. Both conditions have a lot in common; autistic and learners with dyslexia both have auditory and visual processing difficulties similar to hyper or hypo sensitivity often associated with ASD, they both show similar strengths (logic, 3D design and creativity) and weaknesses (Research into dyslexia provision in Wales 2012).

Wright, Conlon, Wright and Dyck, (2011) is of the view that the number of children who have ASD and dyslexia is likely small and a handful share symptoms of ASD, Dyslexia and ADHD. A common problem of misinterpretation and comprehension of spoken language which overlaps with pragmatic language impairment (PLI) is virtually same with communication difficulties associated with high functioning autism. Thus there is good evidence that children do present symptoms of both dyslexia and ASD, but more frequent occurrence of a comorbidity between ADHD and ASD [15] as autistic traits are commonly seen in children with ADHD.

Dyslexia and Dysgraphia/DCD

Dysgraphia is a term that describes writing skills that are substantially below those expected given a person's age, education and intelligence. It is one of the specific learning disabilities that students' experience that affects their academic achievement, Research has indicated an overlap and existing relationship between dyslexia and motor skill deficits [25,26] reports. Research shows that 70% of children with developmental coordination

disorder (DCD) also showed evidence of dyslexia and phonological problems [27]. In a similar study 60% of students living with dyslexia showed evidence of DCD (Iversen et al, 2005). Nicolson and Fawcett [28] showed evidence for motor skills deficits in dyslexia across the age range from 8-17. In A Finnish family study, evidence for motor difficulties in preschool children who were later diagnosed as dyslexic.

Dyslexia and Specific Language Impairment

Specific language impairment is a disorder in which oral language skills are impaired but non-verbal ability remains within the normal range. Most students with SLI show dyslexia that is associated with poor language development, most often early readers rely on guess work, a good knowledge of what might fit into a sentence you are reading and the more fluent your language the more likely you show successful reading. Muter and Snowling (2009) is of the view that good Vocabulary knowledge can be a protective factor for children with phonological difficulties which seem to prevent or interfere with early diagnosis of dyslexia. Tomblin et al, (2000) reports that the prevalence of dyslexia in cases of early language impairment range from 25-90%. In a similar study, the reading and phonological skills of children with preschool diagnosis of SLI were found to be significantly impaired (Snowling, Bishop and Stoppard, 2000).

Dyslexia and Dyscalculia

Dyslexia and dyscalculia are developmental learning disabilities with a combined prevalence of at least 10% of the population. These disabilities occur irrespective of average intelligence and adequate learning environment (Butterworth, 2010; Peterson and Pennington, 2012). Dyscalculia is a term used to address an evident difficulty for calculation experience by learners. It is an inability to acquire arithmetical skills despite sufficient intellectual ability and motivation.

According to research, 40% of learners with dyslexia have difficulties with mathematics (Butterworth, 2003; Wilson, Andrews, Struthers, Rowe, Bogdanovic and Waldie, 2014). In another research 7.6% of children with dyscalculia showed poor reading (Dirks et al, 2008). The problems mostly were in the area of symbols (+, -, X, /) where they are mixed up and difficulty with understanding direction of sums and written questions. This could be based on the difficulty in accessing problems (Simmons and Singleton, 2008). It is also seen as mathematical disability or specific disorder of arithmetic skills (DSM-IV; ICD-10). This is so even when there is no intellectual disability (Landerl and Moll, 2010; Reigosa-Crespo et al 2011). Depending on their severity, they could be dyscalculia or mathematical learning difficulty when it is a sever difficulty with math or mathematical dysfluency or difficulty when it's not so severe (Geary, 2011; Reigosa-Crespo et al 2011; Wilson et al., 2014).

The causes of the co-occurrence of dyslexia and dyscalculia are not well known. Evidence shows that both difficulty are noticeable before school age and persists even to high school (Wilson et al.,

2014). The multiple deficit models of probability for developmental disorders opines that co-occurrence reflects multiple underlying impairments which impact each other and change over development (Cramer, Waldorp, Van der Mass and Borsboom, 2010; Wilson et al., 2014).

Conclusion

From the review of literatures and research, there is great support for the existence of overlap or comorbidity of dyslexia and other developmental disorders, it is apparent that there is a multifaceted web of interacting factors (De Smedt and Boet, 2010; Göbel and Snowling, 2010). Russell and Pavelka [22] posits that one of the most convincing explanations is that a genetic tendency may lead to abnormal neurological development which can be noticeable in diverse abnormal behaviours and developmental delays. Dyslexia, ASD, ADHD are highly heritable, and can reflect common genetic causes [22]. This shows great genetic composition, and thus the genetic theory is plausible (Russell and Pavelka, 2011) [22]. Furthermore, same genetic irregularity may lead to a number of disorders or psychiatric conditions. Thus one genotype may lead to several phenotypes [22]. In which case the origins of both sets of difficulties are due to familiar genetic anomalies that predisposes children to late or unusual neurological development. Sanders, Murtha, Gupta, Murdoch, Raubeson, Willsey, Ercan-Sencicek, (2012) posits that there are more than a thousand complex and multi factorial gene variations which could disrupt brain development enough to result in social delays. Environmental risk factors have also received credence in recent times [22]. In most health and disease categorise, a secondary purpose of diagnosis is to group people who have a similar aetiology. Recent prenatal and perinatal medical practices, altering diet, shifting family structures and childhood social activities have all been the issue of lay theories to elucidate growing incidence of ADHD, Dyslexia and ASD as well as other developmental disorders in childhood [22]. Theories of psychological mechanisms are often described as 'Narrow Cognitive Conceptualisations' (Bailey and Parr, 2003). They appear very different from some psychological theories that elucidate dyslexic type and attention and hyperactive difficulties (Willcutt, Doyle, Nigg, Faraone, and Pennington, 2005) [23]. The exclusion to this is that discrepancy in executive function has been suggested as contributory to ADHD, as they influence both cognitive and motivational systems. Taylor (2011) is of the view that if a child is inattentive (ADHD) there is the possibility that they may struggle to concentrate on learning to read (dyslexia), on the other hand, perhaps reading difficulties are prime in which case the inattention might come from frustration and helplessness to deal with task demands (Russell and Pavelka, 2011) [22]. The cognitive/psychological theories of dyslexia and autism seem separate, some research does suggest that children with both ADHD and dyslexia difficulties show a unique deficit in rapid naming speed, thus there is a possibility of an fundamental processing speed deficit (Bental and Tirosh, 2007) [3].

Gooch, Snowling and Hume (2011) posits that discrepancy in time perception have been found in children with both dyslexia and ADHD, they revealed that children with co morbid dyslexia and attention problems performed inadequately on measures of executive function as well as on phonological tasks. So also, their findings were interpreted as the effect of autonomous core cognitive causes. Although discrepancy in duration discrimination were connected with both dyslexia and attention problems. They concluded by supporting the claim that the two disorders are products of diverse cognitive defects arising from mutual genes with pleiotropic effects. Succinctly put, comorbidity is more of a rule than an exception. It is therefore possible that the same underlying genetic or neurological mechanisms may cause co-occurrence of dyslexia, ADHD, ASD. The reverse pathways are not at first obvious, but recent advances in structure biology have revealed that the environment of the cell affects gene appearance and protein fusion at molecular levels [29-33].

Recommendation

Based on recent literatures in support of the existence of apparent comorbidity of neuro developmental conditions, it is therefore recommended that diagnosis and assessments for any of these conditions should not be done in isolation, but people who are diagnosed for dyslexia should also be assessed for these other neurological conditions. This will enable proper treatment and support.

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Conflict of Interest

No conflict of interest.

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