Chapter

The Prevalence and Gender Differences in Specific Learning Disorder

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Abstract

Learning process including reading, writing, and arithmetic skills in children requires a normal cognitive development period. The presence of signs of disabilities of these skills needs clinical assessment of a specific learning disorder (SLD), a neurodevelopmental disorder. Specific learning disorder which is defined in DSM-V with three types has various prevalence rates according to age, sex, developmental process, environmental factors, and different assessments applied in studies. Comorbidity with other mental disorders reveals more severe symptoms of it. And also if clinical and educational interventions are not performed, behavioral and emotional symptoms may accompany this diagnosis. In this chapter, studies on the prevalence of specific learning disorder are reviewed by considering these factors.

Keywords: specific learning disorder, dyslexia, dyscalculia, prevalence, child

1. Introduction

Specific learning disorder (SLD) is defined as a neurodevelopmental disorder that includes the difficulties in understanding or learning, problems in writing or written expression, and difficulties in the perception/calculation of the numbers. These problems make the academic performance of the child lower than expected. This disorder is originated from biology affecting the acquisition or perception capabilities of the brain for the verbal and nonverbal information processes. There is an abnormality of cognitive level associated with behavioral findings in its etiology [1]. Therefore, it is defined as a failure to meet approved grade-level standards in listening comprehension, reading comprehension, basic reading and reading fluency skills, written expression, mathematics calculation, and/or mathematics problem-solving, despite age-appropriate learning opportunities and instruction [2]. These deficits are persistent and significantly interfere with academic achievement, occupational performance, or activities of daily life [3].

SLD is a multifactorial disorder which has in its etiology a genetic predisposition and family load, developmental and cognitive factors, language spoken, and environmental factors including the level of education and socioeconomic situation. In many studies, gender, level of intelligence, higher family history of learning disabilities, low parental education, the exposure during pregnancy to the use of medicines, exposure to radiation, smoking, infections, hypoxia, complicated deliveries, hypoxia during labor, premature labor, low birth weight, low Apgar

score, neonatal jaundice, convulsions, developmental delay, low-income families, and low socioeconomic status, leading to the occurrence of the SLD, are defined as predeterminants [4–11]. In the clinical examination of SLD, children's developmental, medical, educational, and family history are assessed. Test scores and teacher observations and response to academic interventions are also evaluated. For SLD, current academic skills must be well below the average range of expected scores given the person's chronological age (e.g., at least 1.5 standard deviations (SD)) below the population mean for age and age-appropriate education in culturally and linguistically appropriate tests of reading, writing, and/or mathematics [2, 3, 12] with normal levels of intelligence functioning (considering an intellectual coefficient (IQ) score greater than 70) [1]. These problems cannot be explained with mental retardation, loss of sense (vision or hearing), other psychiatric or neurological disorder, psychosocial difficulties, insufficiency of the language to be used in the academic environment, or education problems. The types like reading disorder (dyslexia), written expression disorder (dysgraphia), and mathematics disorder (dyscalculia) can be seen together or separately.

SLD are usually apparent in the early years of school; some children can show great learning difficulties later on, enabling diagnosis to be made at any point after formal education starts and in adolescence and even adulthood [1]. If treatment approaches are not initiated at an early age, the lives of children and adolescents with SLD are adversely affected due to academic failure. In almost 40% of cases dropout of school. Due to low academic failure, lack of self-confidence, social and behavioral problems may cause emotional problems. This can lead to anxiety disorders, depressive symptoms, somatic complaints, adaptation problems, and difficulties in maintaining a permanent job in the future [1, 13–16].

2. The prevalence rates evaluated in studies of specific learning disorder

The number of the prevalence studies with diagnostic criteria or scales for SLD is low. On the other hand, SLD is accepted as relatively frequent and is not known sufficiently [17–19]. There have been many studies on SLD from the past to today, and different ratios have been announced on the prevalence. The frequency and prevalence of the SLD are stated in various reports with different rates depending on the size of the sample and the inclusion criteria. For example, Al-Yagon et al. reported different prevalence rates that included 1.2% from Greek epidemiologic study in 2004 and 20.0% from a study in Australia in 2000 [20]. A lifelong prevalence estimative of learning disability was found to be 9.7% in children from 3 to 17 years of age by the 2003 National Survey of Children's Health (NSCH) in the USA [4]. The study in Finland in 2001 reported a prevalence of 21.2% in school-aged children referred to special education [15]. Del'Homme et al. reported this prevalence of 28.0% in 2004 [21]. In an epidemiological study with 2174 primary school children in Turkey by using checklists, the probable prevalence rates were found to be 13.6% [7]. An important problem that is making the performance of the epidemiological studies harder is the lack of generally accepted definitions or diagnostic criteria for SLD and evaluations based only on a scale or other assessments that measure the level of academic achievement. DSM-V located the diagnosis of SLD into the category of neurodevelopmental disorders and included severity ratings for its assessment. This means that SLD is conceptualized as a dimensional developmental disorder that occurred as a result of multiple risk factors interacting with each other. One of the important changes is the elimination of IQ-achievement discrepancy criterion in DSM-V despite the exclusion criterion of intellectual disability. IQ-discrepancy criterion was taken into consideration in DSM-IV criteria, so

prevalence rates have found different in studies. For example, in one of the recent studies with 1633 German children in third and fourth grades, the SLD frequency was investigated according to DSM-V criteria, and three different findings were calculated according to the 1, 1.25, and 1.5 standard deviations. Accordingly, the reading disorder for children having 1 as the standard deviation was estimated at 6.49%, written expression disorder was 6.67%, and mathematics disorder was 4.84%; the reading disorder for children having 1.25 as the standard deviation was estimated to be 5.14%, written expression disorder was 6.86%, and mathematics disorder was 3.31%; the reading disorder for children having 1.5 as the standard deviation had an estimated value of 3.8%, written expression disorder was 5.02%, and mathematics disorder was 2.39% [3]. In another study with 1618 Brazilian children and adolescents from second to sixth grades, different prevalence rates were found of SLD by using DSM-IV and DSM-V criteria. These rates were 7.6% for SLD (global) impairment, 5.4% for writing, 6.0% for arithmetic, and 7.5% for reading impairment. The prevalence rates were found to be higher by using DSM-V criteria as they expected [22]. In DSM-V, the American Psychiatric Association reports that the SLD prevalence of children from different languages and cultures is 5–15%, the prevalence of reading disorder is 4–9%, and the prevalence of mathematics disorder is 3–7 [1].

When the reading, writing, and mathematics difficulties were separated, or when reading and mathematics difficulties were grouped together, in studies conducted in different countries, the difficulty rates were found to be different from each other. In previous studies, researchers have suggested that arithmetic and reading functions may depend on similar cognitive predictors [23–25]. It was found that the same phonological processing abilities that are considered to influence growth in reading also appear to contribute to growth in general computation skills [24]. And it was determined that there is a relationship between deficits in processing words and accessing arithmetic facts in long-term memory by Geary [23]. Arithmetical skill is a skill that is based on counting, which involves number words and the use of phonological skills. Because counting involves the activation of number words, the association in long-term memory between problem and answer could be represented, at least in part, in the same phonetic and semantic memory systems that support word recognition. Therefore, it was suggested that the co-occurrence of reading and arithmetic disabilities might reflect a more general deficit in the representation or retrieval of information from semantic memory [26]. The roles of family history and genetic load are considered in reading difficulties and mathematics difficulties, and it is suggested that phonologic problems stated in the etiology of the reading difficulties can create different rates of reading difficulties interculturally, depending on the spoken language. The difficulties in phonemic compliance led to phonologic problems leading to reading difficulties; so, it is suggested that reading difficulties are seen less in countries that have good phoneme-grapheme harmony, and there are higher rates in countries that have poor phoneme-grapheme harmony. Majority of the studies suggested that the prevalence of reading disorder was 5–17% [27]. In the study conducted with 1476 children in 1983, the mathematics disorder rate was 3.6%, and the reading disorder was 2.2% [28]; in the study conducted by Lewis et al. [29] in 1994 with 1056 children who were 9–10 years old, the mathematics disorder was found to be 1.3%, and the reading disorder was 3.9%. In the study conducted by Miles et al. [30] in 1998, the reading disorder prevalence was suggested to be 4.19%, and also in the study of Badian [31] in 1999 with 1075 children, the reading disorder was suggested to be 6%, and the mathematics disorder was suggested to be 3.9%. The studies of Badian [31] and Lewis et al. [29] were designed to obtain an estimation of the prevalence of combined reading and arithmetic, reading only, and arithmetic-only disabilities. Badian found that the prevalence rate in arithmetic and reading was 3.4%, for

reading only 6.6%, and for arithmetic only 2.3%. And Lewis reported prevalence proportions as follows: 2.3% for combined reading and arithmetic, 3.9% for reading only, and 1.3% for arithmetic only. When different methods and materials are used in the prevalence studies, different results are obtained as in the studies of Badian and Lewis. While Badian evaluated comprehension in reading, Lewis evaluated word weakness. Although they are both reading processes, they in part require different cognitive skills. Therefore it leads to the identification of a different population of weak readers. Furthermore, another source of variable results across studies is the use of different cutoff scores for the identification of reading and arithmetic disabilities as in these studies. Similarly Dirks et al. [32] found a higher percentage of combined reading and arithmetic disabilities than the disability in reading or arithmetic alone by using different assessments as in studies of Badian and Lewis et al. And they emphasized that children with combined reading and arithmetic disabilities were different from those who had reading or arithmetic disability alone in terms of cognitive and neuropsychological differences [32].

In 2007, Von Aster et al. [33] performed a study with 337 children, and the reading disorder was found in 3.3%, writing disorder in 5.7%, and mathematics disorder in 1.8%. In the study conducted by Landerl and Moll [34] in 2010 with 2586 children, the reading disorder was found to be prevalent in 2.9%, written expression disorder was 4.1%, and mathematics disorder was 3.2%. A study in France detected prevalence rates of dyslexia between 5.0 and 10.0% in school-age children in the same year [35]. Dhanda and Jagawat [36] worked with 1156 children, and the reading disorder was 22%, written expression disorder was 22%, and mathematics disorder was 16%. After the findings with different results according to the different standard deviations in 2014 by Moll et al. [3], Cappa et al. [37] performed a study in 2015 that reading disorder was found to be 4.75%; Fortes et al., on the other hand, found the cases of prevalence of SLD to be 7.6%, with reading disorder at 7.5%, writing disorder at 5.4%, and mathematics disorder at 6.0% [22]; Gorker et al. determined 3.6% for reading, 6.9% for writing, and 6.5% for mathematics difficulties [7].

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There are no prevalence studies of mathematic disability that considered longitudinal data, except with 210 sample that were followed multiple times during a 4-year period that found 9.6% by Mazzocco and Myers (2003) [39]. Although large cohort studies do exist with a larger sample initially, a small subset of children is identified as potentially displaying mathematics difficulties, so these studies have not provided a detailed comparison of the cognitive and demographic characteristics of subtypes of learning difficulty. And also two studies investigated the prevalence of specific learning difficulties in arithmetic skills but did not assess their types (e.g., number sense, number facts, and mathematical reasoning) [3, 22]. Different levels of prevalence results of mathematics disability are attributed to some methodological differences of studies. One of them is the method that uses IQ-achievement discrepancy. In retrospective population-based study with 5718

	Specific learning disorder (%)	Reading disorder (%)	Written expression disorder (%)	Mathematic disorder (%)	Reading + mathematics disorder (%)	Methodology
Badian [28]		2.2		3.6		Questionnaire
Lewis et al. [29]		3.9		1.3	2.3	Standardized tests
Gross-Tsur et al. [45]				6.55		Standardized tests
Miles et al. [30]		4.19				Questionnaire and standardized tests
Badian [31]		6		3.9	3.4	Standardized tests
	20					Questionnaire
Hein et al. [42]				6.6		Standardized tests
Ramaa and Gowramma [46]				5.54–5.98		Standardized tests
Mazzocco and Myers [39]				9.6		Standardized tests
Desoete et al. [43]				2.27–6.59		Standardized tests
Barbaresi et al. [40]				5.9–13.8		Questionnaire and standardized tests
Altarac et al. [4]	9.7					Questionnaire
Von Aster et al. [33]		3.3	5.7	1.8		Standardized tests
Barahmand [41]				3.76		Standardized tests
Lagae [27]		5–17				Standardized tests
Dirks et al. [32]		19.9		10.3	7.6	Standardized tests
Landerl and Moll [34]		2.9	4.1	3.2		Questionnaire and standardized tests
Geary [44]				5.4		Standardized tests
Taanila et al. [15]	21.2					Questionnaire

	Specific learning disorder (%)	Reading disorder (%)	Written expression disorder (%)	Mathematic disorder (%)	Reading + mathematics disorder (%)	Methodology
Dhanda and Jagawat [36]		22	22	16		Questionnaire
Al-Yagon et al. [20]	1.2					Questionnaire
Moll et al. [3]		6.49	6.67	4.84		DSM-V criteria 1 standard deviation
		5.14	6.86	3.31		DSM-V criteria 1.25 standard deviation
		3.8	5.02	2.39		DSM-V criteria 1.5 standard deviation
Cappa et al. [37]		4.75				Questionnaire
Fortes et al. [22]	7.6	7.5	5.4	6		DSM-V criteria checklists and questionnaire
Gorker et al. [7]	13.6	3.6	6.9	6.5		Checklists
Morsanyi et al. [8]		5.6		6		DSM-V criteria and standardized tests

Table 1.
Overview of the prevalence rates of specific learning disorder, reading disorder, written expression disorder, mathematics disorder, and reading-mathematics disorder.

children assessed prevalence rates based on different formules and found 5.9% to 13.8% and also significantly more frequent among boys than girls [40]. Barahmand studied 1171 children who are at grades 2–5 and found 3.76% [41]. Others defined mathematics disability by the severity of the mathematics impairment have used performance cutoffs on standardized tests. Some of these studies and their prevalence rates are as follows: 3.6 and 3.9% by Badian's studies [28, 31], 1.3% by study of Lewis et al. [29], 6.6% by study of Hein et al. [42], 9.6% by studies of Mazzocco and Myers [39], 5.9–13.8% by study of Barbaresi et al. [40], 2.27–6.59% by study of Desoete et al. [43], 5.6–10.3% by study of Dirks et al. [32], and 5.4% by study of Geary [44]. The other researchers defined mathematics disability using a 2-year achievement delay as a diagnostic criterion. They found the prevalence rates to be 6.55 [45] and 5.54–5.98% [46]. Recently, Devine et al. compared mathematics and reading difficulties with 1004 primary school children and reported that there were no differences between boys and girls when a discrepancy criterion was applied [47]. The study in 2018 by Morsanyi et al. evaluated the prevalence rates of specific learning disorder in mathematics, gender differences, and comorbid conditions. The prevalence rate was 6%. They found persistent difficulties in reading (5.6%) and language difficulties in English (11.5%) and also found that they had other comorbid symptoms and disorders such as social, emotional, and behavioral difficulties, autism, or attention deficit hyperactivity disorder [8]. There is still no agreed definition of mathematics disability and are controversies between researchers based on cutoff decisions, specificity and gender differences. Prevalence rates are summarized in **Table 1**.

3. Comorbidity of specific learning disorder

In the prevalence studies of specific learning disorders, ADHD, which receives the most comorbidity and is the most studied disorder, should be considered [1, 48]. Two American national studies by the same researchers found 4% prevalence of comorbidity [17, 49]. DuPaul et al. reported this comorbidity rate as 18–60% and found that the incidence of SLD in ADHD patients was 7 times higher than that of the population [50]. Some clinical studies have reported extremely high prevalence rates of SLD as 70% or ADHD as 82.5% in comorbid cases [51, 52]. Genetic studies support that these two disorders may be associated with similar hereditary factors [53–55]. The high comorbidity between SLD and ADHD, inadequate SLD definitions, and different methods used in studies may have different results in evaluating the prevalence of SLD. And also symptoms of children diagnosed with SLD are more persistent when they have behavioral problems in the first years of school than with SLDs without ADHD or any comorbidity [56]. Therefore, early diagnosis and treatment interventions can significantly change the incidence and prevalence rates of SLD.

4. Gender differences of specific learning disorder

DSM-5 is stated that SLD is two to three times more prevalent in boys than in girls [1]. In 4 different epidemiologic studies including 9799 children from England, Wales, and New Zealand, boy/girl rates of reading difficulties were 21.6%/7.9%, 20.6%/9.8%, 17.6%/13.0%, and 18.0%/13.0%. In this study, reading and spelling deficits were not analyzed separately, so that it remained unresolved [12]. Landerl and Moll reported balanced gender ratios for reading (fluency) deficits but a disproportionate number of boys for spelling deficits in German population [34]. In a study of Moll et al., more problems in boys than girls for

combined reading and spelling problems were identified, and when isolated spelling disorder was evaluated, gender ratios were found balanced [3]. According to these studies, dyslexia was found to be higher in boys than girls. The most common reported in the literature is that of no gender difference of mathematics disability [8, 29, 39, 42, 43, 45, 47]. The other studies reported higher prevalence of mathematics difficulties in girls [3, 32, 34, 45] or boys [31, 40, 46, 57]. And also some studies reported inconsistency findings. For example, Devine et al. reported that although there was no gender difference in the prevalence of math learning difficulties between boys and girls, mathematics difficulties were much more common for girls than for boys [47].

5. Conclusion

SLD is a multifactorial disorder which has in its etiology a genetic predisposition and family load, developmental and cognitive factors, language spoken, and environmental factors including the level of education and socioeconomic situation. Comorbidity with other mental disorders reveals more severe symptoms of it. And also if clinical and educational interventions are not performed, behavioral and emotional symptoms may accompany this diagnosis. The use of diagnostic criteria and structured scales, whether the disorder is a uniform or mixed type of disorder, the characteristics of the spoken language, and the assessment of environmental factors will help to determine the prevalence rate results and treatment interventions more specific. An educational approach and early intervention treatment after the awareness of SLD findings will reduce the difficulties that may arise with this disorder in the preschool period.

Conflict of interest

The authors declare no conflict of interest.

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