



Neurodevelopmental Dysfunction and Specific Learning Disabilities in School-Aged Twins

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Abstract. The frequency of the developmental dysfunction and specific learning disabilities were assessed in the retrospective study in the group of 56 school-aged twins. The relationships between genetic, perinatal and social factors and learning disability were also determined. It was found that 12.5% of twins had learning disabilities. The most common neurodevelopmental dysfunction were language disorders, poor graphomotor fluency and poor fine motor dexterity. It was also found that educational difficulty were associated with prematurity, low Apgar scores, neonatal complications and familial predisposition.

Key words: Twins, Learning disability, Neurodevelopmental dysfunction, Risk factors, Education, Socio-economic factors

INTRODUCTION

Learning disabilities are common condition in pediatric patients. The etiology of these difficulties is multifactorial, reflecting genetic influences and abnormalities of brain structure and function, caused, at least partially, by environmental factors [3, 17, 29]. Early recognition and referral to qualified educational professionals is critical for the best possible outcome [4].

Recently, learning disorders have become an increasing scientific and public concern. The main goal is to identify risk factors and establish recommendations for multidisciplinary evaluation and management [4].

The influence of various familial, medical and sociodemographic factors on frequency of learning difficulties in twins may reflect contribution of genetic and environmental factors in etiology.

The aim of our study was to estimate the frequency of developmental dysfunction and learning disorders among twins and determine the possible influences of selected genetic, medical (perinatal) and environmental factors.

MATERIAL AND METHODS

The study group comprised 28 pairs of twins, aged between 8 and 20 years. Among them 18 pairs were dizygotic, and 10 pairs were identical (monozygotic twins). They were evaluated for gender, linguistic and perceptual skills, associated learned disabilities, symptoms of attention-deficit hyperactivity disorder (ADHD), perinatal risk factors and socio-economic status. The identification of learning problems was based on the school system's assessment. Children were tested in various standardized cognitive tasks including reading/spelling, writing and arithmetic assessment in grades 1, 5 and 8 of primary school. Teachers reported on the child's education status in a standardized questionnaire. They were asked to describe the educational skills of children, their cognitive profile and psychological traits. Another questionnaire concerning health status, psychomotor achievements, relationships with siblings and peers, and socio-economic status was sent to twins' parents.

Distribution of studied groups of twins by age and gender are presented in Figure 1.

Selected perinatal parameters in studied group are shown in Table 1.

All health records and socio-economic status of studied twins are presented in Table 2.

RESULTS

Frequency of learning disabilities among twins are given in Table 3.

The most common learning disability was difficulty with reading and writing: 12.5 per cent of children had dyslexia, and 10.7 per cent had dysgraphia. The frequency of dyscalculia in the study group was 3.6 per cent.



Fig. 1 - Distribution of studied twins by age and gender.

Table 1 - Perinatal data of studied twins

	Range	Mean
Gestational age (weeks)	30-40	36.2
Birthweight (grams)	1200-3450	2340
Apgar score (at 5 min.)	2-10	7
	Number	%
Fetal hypotrophy	14	25.0
Neonatal complications (respiratory distress syndrome, hyperbilirubinemia, hypoglycemia, infections, ICH)	10	17.6

Table 2 - Health and socio-economic status of studied twins

History of	Number	%
Recurrent infections	10	17.8
Meningitis	2	3.6
Severe anaemia	4	7.1
Brain injury	4	7.1
Hypothyroidism	0	–
Delayed physical growth	5	8.9
Overall health status		
abnormal vision	0	–
abnormal hearing	0	–
abnormal neurologic status	0	–
chronic diseases	0	–
Family history of learning difficulties	14	25.0
Poor social class	4	7.1

Table 3 - Frequency of specific learning disabilities among studied twins

Specific learning disabilities	Boys		Girls		Overall	
	number	%	number	%	number	%
Dyslexia	6	23.0	1	3.3	7	12.5
Dysgraphia	5	19.2	1	3.3	6	10.7
Dysorthographia	4	15.4	1	3.3	5	8.9
Dyscalculia	2	7.7	0	-	2	3.6

Table 4 - Frequency of neurodevelopmental dysfunctions in studied twins

Type of dysfunction	Boys		Girls		Overall	
	number	%	number	%	number	%
Attentional dysfunction	4	15.4	0	–	4	7.1
Dysfunction of memory	4	15.4	0	–	4	7.1
Language disorder (in 1st grade)	12	46.1	3	10.0	15	26.8
Visuospatial dysfunction	6	23.0	3	10.0	9	16.1
Difficulties in temporal-sequential ordering	5	19.2	1	3.3	6	10.7
Poor graphomotor fluency	7	26.9	4	13.3	11	19.6
Gross motor delay	2	7.7	0	–	2	3.6
Poor fine motor dexterity	7	26.9	4	13.3	11	19.6
Eye-hand incoordination	7	26.9	3	10.0	10	17.8
Delayed or mixed dominance	9	34.6	3	10.0	12	21.4
Hyperactivity	7	26.9	2	6.7	9	16.1
Social skills deficit	6	23.0	6	20.0	12	21.4

Table 5 - Distribution of factors probably associated with learning disabilities in twins with poor school achievement

Name of factor	Boys		Girls		Overall	
	number	%	number	%	number	%
Prematurity	9	34.6	7	23.3	16	28.6
Fetal hypotrophy	4	15.4	3	10.0	7	12.5
Low Apgar score (0-3)	3	11.5	7	23.3	10	17.6
Neonatal complications	6	23.0	4	13.3	10	17.6
History of meningitis	2	7.7	0	–	2	3.6
History of brain injury	2	7.7	2	6.7	4	7.1
Familial learning disorders	10	38.4	4	13.3	14	25.0
Low socio-economic status	1	3.8	3	10.0	4	7.1
Social skills deficits	6	23.0	6	20.0	12	21.4

Language disorders were most common, especially in lower grades of primary school. It was also found that about 20 per cent of studied twins had poor graphomotor fluency, probably as a result of poor fine motor coordination and delayed or mixed laterality.

Twins' relationship with peers seems to be not very good. 21 per cent of them had social skills deficits (Table 4).

Results from analyses of the relationship of perinatal, familial and social variables to neurodevelopmental disorders and specific learning disability are shown in Table 5.

Neurodevelopmental dysfunction and/or learning disability in twins were significantly influenced primarily by perinatal factors, especially prematurity. Learning disorders in familial history were found in 25 per cent of children with the same condition. It was also found that 21 per cent of studied children with learning disability had poor relationships with peers.

DISCUSSION

Developmental dysfunctions and learning disabilities are the main reason of school-related problems. According to Nelson's Textbook of Pediatrics-neurodevelopmental dysfunctions are central nervous system impairments that generate frustration and anxiety for school-aged children who are struggling to feel effective [21]. Data regarding the incidence of these conditions in school-aged children are imprecise. It is estimated that 5-15% school children harbour these insidious handicaps [21, 26].

Although most of children having a developmental disabilities might be diagnosed earlier, detection usually follows academic failure, underachievement, and/or behavioural problems in school in children who seem bright. These pupils have a discrepancy between their intellectual capacity and their actual performance of the basic skills needed in the educational setting. They exhibit difficulty with reading, writing, thinking, spelling, arithmetic, or any combination of these activities. Learning-disabled children are not mentally retarded. On the contrary, they usually have average to superior intelligence. They may have an accompanying and demonstrable central nervous system dysfunction [12]. Since developmental handicaps express themselves in a broad range of severity, it is difficult to distinguish between statistical variations in behavioural or cognitive style and true obstacles to learning and performance [21]. Difficulty arises in understanding these often subtle developmental disabilities because there is a lack of uniform definition between the several disciplines responsible for the evaluation of these children. One reason for the lack of agreement is the inability to isolate and identify a specific biophysiological or biochemical defect. Despite on observed predominance in males (the most commonly quoted ratio being approximately 6 to 1), a familial tendency in over one third of the cases, and a suggestion of polygenic inheritance, the biologic defect or cellular mechanism responsible has eluded researchers [10, 19]. Most studies agree that possible causative factors may be prenatally or postnatally acquired [17]; the same kinds as those due to utero exposures, birth trauma, low birthweight, intraventricular hemorrhage, recurrent otitis media, meningitis, serious head trauma, hypothyroidism and iodine deficiency, and any other complications that cause mental retardation may also produce learning disabilities [2, 5, 7, 9, 12, 22, 25, 31]. It is important to emphasize, that even "mild" diseases, such as allergy rhinitis and iron deficiency, can cause educational difficulty [6, 30].

Our study suggests that twins are not a group at greater risk for educational disabilities. Seven of studied children (12.5%) had specific learning difficulties. This result con-

firm earlier studies, in which learning disabilities have been detected in 5 to 15 per cent of school-aged children [21, 26].

Among the spectrum of issues of concern in learning disabilities, the inability to read and comprehend is a major obstacle to learning and may have long-term educational, social and economic implications. We found that 12.5 per cent of twins had dyslexia, with the prevalence of boys. It supports the previous observation, that males are more often affected than female [14].

Developmental dyslexia is a heterogeneous disorder in which the prominent manifestation is a discrepancy between reading achievement and intelligence. It is a pervasive condition but with adequate help and spontaneous compensation [24], reading ability may improve.

Neuroimaging, mainly MRI, allows to demonstrate in two thirds, an absence of the usual symmetry of the planum temporale favouring the left side. Twenty to 25% of the remaining cases show asymmetry of the right side [23]. The pathology of dyslexia has revealed abnormalities of the cerebral cortex focal four-layer microgyria, microdysgenesis and arteriovenous malformations [17]. Galaburda [17] assumes that a pre – or perinatal adverse event produces a basic cognitive, progressive alteration, that eventually invades the perceptual elements (visual, phonological, semantic-syntaxis difficulties). However, there is no serious auditory, visual, psychiatric, or educational factor that could be responsible [8, 17]. Our study confirms these observations. None of studied child had visual or hearing defects.

Etiology of dyslexia is unknown, but heredity plays an important role [11, 19, 32]. This is also supported by the results of our study in which, 25 per cent of learning-disabled twins had fathers with dyslexia too.

Genetic studies have suggested the existence of quantitative-trait locus for reading disability on the short arm of chromosome 6 [11], but these findings should not be taken to mean that the gene for dyslexia has been discovered [18]. Most researchers agree that the difficulty in learning to read is of a multidimensional nature, of which the features are not yet unequivocally known [10, 18].

Little information is available about the frequency of neurodevelopmental dysfunction in school-aged twins. Results of our study have shown that the most common developmental dysfunction in twins was language disorders, especially in the lower grades of primary school. It might be caused by the development of a special “twin” language during infancy and pre-school years. Parents of more than one third of twin pairs (especially identical twins) reported about this trait.

It is known that children with delays in development of visual-spatial function may encounter problems in learning to read. We detected visuospatial disorganization in 16 per cent of studied twins, mainly boys.

It was also found that about 20% of examined children had troubles with fluent writing. It may be caused by poor fine motor dexterity and delayed or mixed eye-hand coordination.

It is important to emphasize that studied twins had poor relationships with their peers. Social skills deficits were observed in 21 per cent of children. Plight of a socially unskilled child can be tragic. He or she may sustain verbal abuse, bullying, and outright rejection, with various subtle forms of repudiation. Social skills deficits can exert negative effect on behavioral adjustment, mental health, and ultimately, success in a career

[21]. Environmental and sociocultural deprivations have also been implicated as etiologic factors, or at least potentiators, of neurodevelopmental dysfunction and learning disabilities [29]. It remains to determine whether social skill deficits produce learning difficulty or developmental dysfunction may contribute to poor relationships in the neighbourhood [20]. In our study all children with social skills deficits had learning disability.

Moreover, some emotional features, such as: irritability, need of domination and rivalry, between first and second child, were observed in twins [16]. They can impede contacts with peers, especially in younger twins.

Analysis of selected factors, probably associated with learning disabilities in examined twins, confirms a significance of adverse perinatal events and familial predisposition. Educational disorders were connected mainly with prematurity, low Apgar scores and neonatal complications. Results of our study are consistent with the study of Resnick et al. [27], who suggests that perinatal and sociodemographic factors are both associated with specific learning disabilities. Other researchers also emphasize a great influence of perinatal risk factors on poor school achievement [5, 15, 28].

We did not confirm a significance of previous illness (recurrent infections, meningitis, brain injury) as well as low socio-economic status in etiology learning disabilities in twins.

CONCLUSIONS

1. The frequency of learning disabilities in examined twins was 12.5 per cent. Thus, twins do not seem to be a group of greater risk for learning disabilities.
2. The most common neurodevelopmental dysfunction in school-aged twins were: language disorders, poor graphomotor fluency and poor fine motor dexterity. It was also revealed high frequency of social skills deficits among studied twins. Because of their possible adverse impact on school achievements, it is necessary to improve relationships between twins and their peers.
3. It was found that educational disabilities in studied twins were associated mainly with prematurity, low Apgar scores, neonatal complications and familial predisposition.

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