Clinical Characteristics of Children with Learning Disorders in Taiwan

Ya-Fen Huang, MD; Hsueh-Ling Chang, MD; Yu-Yu Wu, MD; Yu-Shu Huang, MD; Hsin-Yi Liang, MD

Background: Clinical studies of children with learning disorders (LD) in Chinese-speaking society are still very limited. The aim of this study was to obtain the clinical picture of children with LD in Taiwan.

Methods: Medical records of diagnoses-validated subjects in a local children's hospital from 1998 through 2005 were reviewed in detail. Relevant data were collected and analyzed. The diagnoses were made based on the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision (DSM-IV-TR) criteria for learning disorders.

Results: Among the 27 subjects (23 boys and 4 girls) identified, the average age upon diagnosis was 9.6 $\pm$ 2.0 years with school grade of 3.5 $\pm$ 1.9. The percentages of subjects with reading disorders (RD), mathematics disorders (MD) and disorders of written expression (DWE) were 66.7%, 11.1% and 77.8%, respectively. Over half (55.6%) of the subjects had two subtypes concurrently, and the majority of which had both RD and DWE. The overall, psychiatric, and medical comorbid rates were 88.9%, 81.5% and 22.2%, respectively. Attention-deficit/hyperactivity disorder (ADHD) was the most common (66.7%) co-existing condition. Subtypes were slightly different in terms of demographic data, IQ profile and comorbid conditions.

Conclusions: Our LD sample was predominantly male with average levels of intelligence and highly comorbid with ADHD. Each subtype of LD seemed to have its own unique feature in terms of cognitive function, comorbid condition, sexual differences, and other aspects. Further research is eagerly warranted. When evaluating learning problems, clinicians should keep in mind that ADHD often exists. Treating concomitant ADHD and other co-existing problems should bring more favorable outcomes. Due to the heterogeneity of LD, evaluation of each suggested case should be carefully monitored and individually tailored.

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Key words: learning disorder, learning disability, children, Chinese, clinical characteristic, comorbidity

From the Department of Child Psychiatry, Chang Gung Children's Hospital, Taipei, Chang Gung University College of Medicine, Taoyuan, Taiwan.

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Correspondence to: Dr. Hsueh-Ling Chang, Department of Child Psychiatry, Chang Gung Children's Hospital. 5, Fusing St., Gueishan Township, Taoyuan County 333, Taiwan (R.O.C.) Tel: 886-3-3281200 ext. 8541; Fax: 886-3-3280267; E-mail: chang0687@cgmh.org.tw

Learning disorders (LD) are characterized by academic functioning that is substantially below that expected given the person's chronological age, measured intelligence, and age-appropriate education. When the learning problem significantly interferes with academic achievement or daily activities that require basic academic skills such as reading, mathematical, or writing skills, a diagnosis of LD is made. According to the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision (DSM-IV-TR), there are three subtypes of LD: reading disorder (RD), mathematics disorder (MD), and disorder of written expression (DWE).[1] Among all, reading disorders (also called specific reading disability, or developmental dyslexia) have been the most thoroughly studied,[2-4] and some emerging evidence has been noticed during gene mapping[5] and brain image research.[6]

The current understanding of LD is based mostly on alphabetical languages, particularly English. In the literature, research about LD in nonalphabetical languages such as Chinese and Japanese were still very limited,[7-10] although the number of publications continues to increase, especially by researchers from Hong Kong and China.[11-13]

Most studies about LD in Taiwanese subjects were from educational and psychological viewpoints. Clinical aspects of the disorders have not been fully inspected in Taiwanese children; therefore more comprehensive studies are needed to obtain further understanding of this common and complex problem which crosses cultures in modern child psychiatry as well as adolescent psychiatry.

The aim of this study was to obtain the clinical picture of children and adolescents with LD in Taiwan. We hope the results of this pilot study can stimulate more ideas for further clinical research studies.

METHODS

Outpatients in a children's hospital (medical center), who had been diagnosed with any type of LD from 1998 through 2005, were enrolled as subjects through a search from the computer database of the hospital.

The diagnosis of LD was further validated by a careful review of these subjects' previous medical records, to see if clinical profiles and test results (i.e. the age when diagnosed, chief problem, clinical history, standardized psychological tests) fulfilled the criteria for LD according to the DSM-IV-TR.[1] Diagnostic subtypes of LD were confirmed using the results of psychological tests (WISC-III, B-G test, and basic reading and writing ability tests) when it was not recorded on the chart. A patient may have more than one subtype if his/her condition fulfilled the criteria of each subtype. Mentally retarded children (full-scaled IQ below 70) were excluded from the study. Patients whose diagnoses were not clinically relevant, or did not complete detailed psychological tests, were also excluded. Relevant data of the subjects, such as basic demographic data, age when diagnosed, detailed results of psychological tests and any previous or concurrent medical or psychiatric problems, were collected through chart review and further analyzed using SPSS 10.0 for windows (a commercial computerized statistical program).

RESULTS

A total of 791 outpatients, who had been diagnosed with the International Classification of Diseases, 9th Revision (ICD-9) codes 3150, 3151 and 3152, were identified using a search in the computer database of the hospital. After a detailed and serious chart review, 27 subjects (23 boys and 4 girls) were included in the present study. Upon diagnosis, the average age was 9.6 $\pm$ 2.0 years with an average school grade of 3.5 $\pm$ 1.9.

Among the subjects, RD consisted of 66.7% (N = 18), MD was 11.1% (N = 3), and DWE was 77.8% (N = 21). More than half (55.6%, N = 15) of the subjects had two subtypes concurrently, and the majority had RD and DWE.

The average IQ levels of these subjects, including full-scaled, verbal and performance IQ (FIQ, VIQ, PIQ) were 92.2 $\pm$ 12.0, 96.1 $\pm$ 12.4 and 89.8 $\pm$ 12.1, respectively. The degree of VIQ-PIQ split were varied among all subjects (ranging from -24 to 25), however, nearly 30% had significant VIQ-PIQ split (the absolute difference of VIQ and PIQ exceeds 15) (Table 1).

The overall comorbid rate was 88.9%. The psychiatric and medical comorbid rates were 81.5% and 22.2%, respectively. The median of the number of comorbid conditions was 1 (ranging from 0 to 4) for

Table 1. Demographic Data and IQ Profile of Different LD Subtypes

	Subtype	RD only	MD only	DWE only	RD＋DWE	RD ＋MD	Total
Demographic data	Total no. (%)	3 (11.11)	2 (7.41)	7 (25.93)	14 (51.85)	1 (3.70)	27 (100.00)
	Gender						
	Boys	3 (11.11)	0	7 (25.93)	12 (44.44)	1 (3.70)	23 (85.19)
	Girls	0	2 (7.41)	0	2 (7.41)	0	4 (14.81)
	Male-to-female ratio	3 : 0	0 : 2	7 : 0	6 : 1	1 : 0	5.75 : 1
	Age upon diagnosis	8.6 ± 0.4	12.1 ± 0.1	9.2 ± 2.4	9.6 ± 2.1	11.5	9.6 ± 2.1
	School year upon diagnosis	2.7 ± 0.6	6.5 ± 0.7	3.3 ± 2.3	3.2 ± 1.6	6.0	3.5 ± 1.9
IQ profile	Full IQ	81.0 ± 15.6	84.5 ± 10.6	96.7 ± 13.8	92.6 ± 11.0	92	92.2 ± 12.0
	Performance IQ	85.3 ± 11.9	73.0 ± 14.1	93.1 ± 15.2	91.8 ± 9.4	85	89.8 ± 12.1
	Verbal IQ	82.5 ± 12.0	98.5 ± 3.5	100.3 ± 11.3	95.4 ± 13.6	100	96.1 ± 12.4
	｜PIQ-VIQ｜	3.0 ± 1.4	1.0 ± 0.0	8.0 ± 8.6	10.6 ± 7.3	15	8.9 ± 7.5
	No. (%) of ｜PIQ-VIQ｜≥ 15	0	0	2 (7.41)	5 (18.52)	1 (3.70)	8 (29.63)

Abbreviations: RD: reading disorder; MD: math disorder; DWE: disorder of written expression; IQ: intelligent quotient.
Percentages are given in parentheses.

each subject. Among all co-existing psychiatric conditions, attention-deficit / hyperactivity disorder (ADHD) was the most common (66.7%, N = 18, mostly combined type), while other psychiatric disorders were rare. Several co-occurring medical problems with low morbidity rates were also identified (Table 2).

Subtypes were slightly different from each another in terms of demographic data, IQ profile and comorbid conditions. Among the subtypes, the most significant findings were the female predominance in MD, relatively low PIQ, and low comorbidity rate of ADHD in MD patients (including two groups: pure MD, and MD ＋ RD) compared with other groups.

DISCUSSION

The LD children in our sample were predominantly male (male to female ratio = 5.8:1). Previous studies in western countries also revealed a gender difference of 3:1 and higher. Some researchers suggested the results might be biased due to the sampling method used because boys tend to catch more clinical and educational attention due to their concurrent behavioral problems.[14,15] Until recently, findings from several large-scale epidemiological studies of RD children again supported the true difference of prevalence between boys and girls.[16-18] Since our samples were derived from the clinical setting, referral bias may have somewhat contributed to the differences observed. The next question might be, whether boys and girls are truly different in terms of cognitive functions or genetic vulnerabilities of learning problems. However, several genetic studies and neuropsychological exams failed to show the differences.[19,20]

Our MD subjects were mainly girls. In the literature, study results about sexual differences in MD were even more conflicting; some data showed girls were more common than boys to have MD, some data found the equal gender prevalence, but still others revealed boys outnumbering girls in MD just as in other LD subtypes.[21-24] The main differences of these studies might be the methods used. Research about MD is still in the infant stage and has a long way to go in the future. The gender difference we noticed in MD subjects should be clarified in the future to see whether Taiwanese girls are really more susceptible to developing MD than boys, or the results are due to a selection bias. In general, we believe there is some gender difference, at least in some subtypes of Taiwanese LD children, but the true ratio can not be obtained until a better designed study is made in the future.

The correlation between ADHD and LD in our sample was quite significant, while there was a lack of correlation between LD and other psychiatric or medical diagnoses. In terms of subtype comorbidity, we found a high co-occurrence of RD and DWE, which is consistent with previous studies.

When analyzing the comorbid rate with other psychiatric diseases among different subtypes, we

Table 2. Comorbidities of Different LD Subtypes

Subtypes	RD only	MD only	DWE only	RD+DWE	RD+MD	Total
Total no. (%)	3 (11.11)	2 (7.41)	7 (25.93)	14 (51.85)	1 (3.70)	27 (100.00)
Any Dz (-)	0	0	0	2 (7.41)	1 (3.70)	3 (11.11)
Any Dz (+)	3 (11.11)	2 (7.41)	7 (25.93)	12 (44.44)	0	24 (88.89)
Psy Dz (+) only	2 (7.41)	1 (3.70)	6 (22.22)	9 (33.33)	0	18 (66.67)
Med Dz (+) only	0	0	1 (3.70)	1 (3.70)	0	2 (7.41)
Both Psy & Med Dz (+)	1 (3.70)	1 (3.70)	0	2 (7.41)	0	4 (14.81)
Psychiatric disorder (-)	0	1 (3.70)	1 (3.70)	3 (11.11)	1 (3.70)	5 (18.52)
Psychiatric disorder (+)	3 (11.11)	2 (7.41)	6 (22.22)	11 (40.74)	0	22 (81.48)
ADHD (-)	0	2 (7.41)	3 (11.11)	3 (11.11)	1 (3.70)	9 (33.33)
ADHD (+)	3 (11.11)	0	4 (14.81)	11 (40.74)	0	18 (66.67)
Inattention type	1 (3.70)	0	0	2 (7.41)	0	3 (11.11)
Combined type	2 (7.41)	0	4 (14.81)	9 (33.33)	0	15 (55.56)
Other Psy Dz						
Enuresis	0	0	0	3 (11.11)	0	3 (11.11)
Coordination disorder	1 (3.70)		1 (3.70)	0	0	2 (7.41)
Asperger syndrome	0	0	1 (3.70)	0	0	1 (3.70)
Major depression	0	1 (3.70)	0	0	0	1 (3.70)
Selective mutism	1 (3.70)	0	0	0	0	1 (3.70)
Tic disorder	1 (3.70)	0	0	0	0	1 (3.70)
Medical disease (-)	2 (7.41)	1 (3.70)	6 (22.22)	11 (40.74)	1 (3.70)	21 (77.78)
Medical disease (+)	1 (3.70)	1 (3.70)	1 (3.70)	3 (11.11)	0	6 (22.22)
Cerebral palsy	0	1 (3.70)	0	1 (3.70)	0	2 (7.41)
Congenital heart disease	0		0	1 (3.70)	0	1 (3.70)
Arrhythmia	1 (3.70)	0	0	0	0	1 (3.70)
G6PD deficiency	0		0	1 (3.70)	0	1 (3.70)
EEG abnormality	0	0	0	1 (3.70)	0	1 (3.70)
Growth retardation	0	0	1 (3.70)	0	0	1 (3.70)
Astigmatism	0	1 (3.70)	0	0	0	1 (3.70)

Abbreviations: RD: reading disorder; MD: math disorder; DWE: disorder of written expression; Med: medical; Psy: psychiatric; Dz: disease; G6PD: glucose-6-phosphate dehydrogenase; EEG: electroencephalogram.
Percentages are given in parentheses.

found a significant lack of correlation between MD and ADHD, and a very high comorbid rate of ADHD with RD and DWE, whether the latter two existed concurrently or not. To explain this, many researchers in the English-speaking countries tried to clarify the relationship of RD and ADHD. Most of them suggested that the overlap between ADHD and LD was greater than expected by chance.[25-27] Silver suggested a continuum of neurologically based disorders with a high incidence of comorbidity, including: (1) cortical problems (language disorder, developmental coordination disorder, learning disorder, executive function disorder), (2) ADHD, and (3) modulating disorders (anxiety disorder, mood disorder, anger-regulation disorder, obsessive-compulsive disorder, and tic disorders).[28]

The suggestion that co-occurrence of ADHD and RD is in part due to shared genetic underpinnings is supported by recent evidence from twin and family studies. RD symptoms were found to be more associated with symptoms of inattention than symptoms of hyperactivity / impulsivity in a twin study.[29] A genetic linkage analysis study also suggested the comorbidity between RD and ADHD may be due at least in part to pleiotropic effects of a quantitative trait locus (QTL) on chromosome 6p.[30] Children

who suffered from both diseases usually showed more deficits when learning, as well as more difficulties in different aspects of their daily lives. Identifying comorbid conditions in LD children thus becomes a major issue and challenge in clinical practice, which also helps further remedial education planning for each affected child.

LD is also highly associated with emotional, antisocial and other behavioral problems according to previous studies,[25,31] although the results of our study did not show this strong correlation. Again, studies to clarify the relationship between ADHD, MD and DWE are still very limited, thus we look forward to further research to answer these questions.

The IQ profiles of our LD samples were quite interesting. Among all of the subjects, the pure RD and pure MD groups had lower FIQ, while DWE, RD + DWE and RD + MD groups had larger VIQ-PIQ splits. Most subjects in our study had slightly higher VIQ than their PIQ. This result is inconsistent with previous findings that LD patients often have lower scores in VIQ subtests than children without LD. However, some researchers argued that the patterns of performance on the IQ test alone were not reliable enough for the diagnosis of LD in individual children, because some normal children also showed this IQ profile.[32] There used to be a persistent belief in clinical psychology and neuropsychology that the VIQ-PIQ split can be used to reliably infer lateralized brain damage, however, later studies have challenged this rule.[33] Many researchers also suggested a role of atypical development of brain asymmetries in LD patients. Current evidence points to LD as a multi-system deficit, possibly based on a fundamental incapacity of the brain in performing tasks requiring processing of brief stimuli in rapid temporal succession. This "temporal processing impairment" theory could also account for some of the conditions associated with LD, such as perceptual, motor, and cognitive problems, however, the mechanism so far remains unexplained.[34,35]

The major limitations of our study resulted from the small sample size, incomplete records collected during chart reviews, and the difficulty of diagnosis validation from the relatively limited clinical data. Further clinical and community studies with larger sample sizes and longitudinal studies, as well as transdisciplinary studies are eagerly needed to facilitate the understanding of LD children especially in Taiwan and other Asian-Pacific areas, since they have higher risks of developing other psychiatric problems than those without the disorder. From a more practical and clinical viewpoint, when LD is properly recognized, diagnosed, and treated, the child has the potential for a reasonably successful future. Without help, the child's disabilities may become incapacitating and function as a major handicap throughout life.

The clinical implication of our study is: learning disorders consist of a relative heterogeneous group of people. Individualized evaluations should be tailored carefully to each suggested case. During the initial and follow-up phases of clinical assessment, clinicians should also watch for any existing comorbid psychiatric disorder, especially ADHD, as well as any medical illness. Although there is still no medication effective in managing the core symptoms of LD, treating concomitant ADHD and medical problems should bring more favorable outcomes to patients with LD.[36]

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台灣學習疾患兒童的臨床特徵

黃雅芬 張學岭 吳佑佑 黃玉書 梁歆宜

背 景：有鑑於國內醫界對於學習疾患(learning disorder)的相關研究至今仍十分缺乏，我們希望藉由本研究了解學習疾患兒童青少年之相關臨床特質，爲後續研究提供參考。

方 法：採用病歷回溯法，從本院健保電腦資料庫收集87年12月至94年2月間至本院兒童心智科就診之學習疾患兒童青少年，逐一進行病歷查閱，從中篩選符合精神疾病診斷與統計手冊第四版-內文修正版(Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision, DSM-IV-TR)學習疾患診斷，並已接受相關心理衡鑑之個案。在確認亞型診斷之後，更進一步收集基本人口學資料、詳細心理衡鑑資料、疾病史以及其他相關資料，並加以統計分析。

結 果：確立診斷且資料完全之個案共27位(男23人，女4人)。初診年齡9.6±2.0歲。就讀年級：3.5±1.9。個案的智商平均爲92.2±12.0，屬於中等程度。符合亞型的比例爲：閱讀疾患66.7%、數學疾患11.1%、書寫表達疾患77.8%。半數以上個案(55.6%)同時符合閱讀疾患和書寫表達疾患兩種亞型。總共病率(comorbidity rate)爲88.9%：精神疾病共病率81.5%，其中以注意力不足／過動症爲主(66.7%)；身體疾病之共病率爲22.2%，包含各種系統疾病；共病症中，同時合併生理與精神疾病者佔14.8%。

結 論：本研究樣本的特徵爲：(1)學習疾患與注意力不足／過動症的共病率甚高；(2)除了數學疾患之外，其餘各亞型的性別差異懸殊，以男性爲多。這些現象的相關臨床意涵仍需後續研究加以確認。臨床醫師應仔細評估以學習障礙爲表現之兒童，是否尚有共存之注意力不足／過動症或其他身心相關疾患，導致其更加適應不良。治療或處理共病症，可望提升整體治療的效果，並降低其他精神相關問題發生的風險。
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關鍵詞：學習疾患，學習障礙，兒童，中文，臨床表徵，共病症

長庚兒童醫院 台北院區 兒童心智科；長庚大學 醫學院
受文日期：民國95年8月2日；接受刊載：民國96年1月25日
通訊作者：張學岭醫師，長庚兒童醫院 兒童心智科。桃園縣333龜山鄉復興街5號。Tel: (03)3281200轉8541; Fax: (03)3280267; E-mail: chang0687@cgmh.org.tw