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CLINICAL & BASIC RESEARCH

Comorbidity of Learning Disorders and Attention Deficit Hyperactivity Disorder in a Sample of Omani Schoolchildren

*Watfa S. Al-Mamari,[1] Mahmoud M. Emam,[2] Amna M. Al-Futaisi,[1] Ali M. Kazem[2]

التلازم بين اضطرابات التعلم واضطراب نقص الانتباه المصاحب بالحركة الزائدة في عينة من تلاميذ المدارس في سلطنة عمان

وطفة المعمرية، محمود محمد إمام، أمنة الفطيسية، علي مهدي كاظم

abstract: ***Objectives:*** The estimated worldwide prevalence of learning disorders (LDs) is approximately 2–10% among school-aged children. LDs have variable clinical features and are often associated with other disorders. This study aimed to examine the comorbidity of LDs and attention deficit hyperactivity disorder (ADHD) among a sample of schoolchildren in Oman. ***Methods:*** This study was conducted between January 2014 and January 2015 at the Sultan Qaboos University, Muscat, Oman. The Learning Disabilities Diagnostic Inventory (LDDI) and the 28-item version of the Conners' Teacher Rating Scale was completed by classroom teachers to determine the existence of LD and ADHD symptoms in 321 children in grades 1–4 who had been referred to a learning support unit for LDs from elementary schools in Muscat. ***Results:*** The mean age of the students was 8.5 years. Among the cohort, 30% were reported to have symptoms of ADHD, including conduct problems (24%), hyperactivity (24%) and inattentive-passive behaviours (41%). Male students reportedly exhibited greater conduct problems and hyperactivity than females. However, there were no gender differences noted between LDDI scores. ***Conclusion:*** This study suggests that Omani schoolchildren with LDs are likely to exhibit signs of ADHD. The early identification of this disorder is essential considering the chronic nature of ADHD. For interventional purposes, multidisciplinary teams are recommended, including general and special educators, clinical psychologists, school counsellors, developmental or experienced general paediatricians and child psychiatrists.

Keywords: Learning Disorders; Attention Deficit Hyperactivity Disorder; Comorbidity; Children; Oman.

الملخص: الهدف: تقدر معدلات إنتشار اضطرابات التعلم في مختلف أنحاء العالم بحوالي 2–10% لدى تلاميذ المدارس. وتتسم إضطرابات التعلم بسمات سريرية متباينة كما ترتبط باضطرابات أخرى. وقد هدفت الدراسة الحالية إلى فحص التلازم الموجود بين إضطرابات التعلم واضطراب نقص الإنتباه المصاحب لفرط النشاط لدى عينة من تلاميذ المدارس بسلطنة عمان. **الطريقة:** تم إجراء الدراسة بين شهر يناير من عام 2014 وشهر يناير عام 2015 في جامعة السلطان قابوس بمدينة مسقط بسلطنة عمان. وقد اشتملت أدوات الدراسة على قائمة تشخيص صعوبات التعلم ومقياس كونرز لتقدير المعلمين (النسخة المكونة من 28 نقطة). وقد قام المعلمون بملىء المقياسين لتقييم عينة الدارسة من أجل فحص سمات اضطرابات التعلم واضطراب نقص الإنتباه المصاحب لفرط النشاط في عينة قوامها 321 في الصفوف من 1–4 والذين تمت إحالتهم إلى وحدات صعوبات التعلم بالمدارس الإبتدائية في مسقط. ، وقد كان متوسط عمر العينة حوالي 8.5سنوات. **النتائج:** أظهرت النتائج أن حوالي 30% من التلاميذ أظهروا أعراض اضطراب نقص الإنتباه المصاحب لفرط النشاط مشتملاً على (24%) مشكلات سلوكية، (24%) حركة زائدة، (41%) سلوكيات عدم الانتباه السلبية. وقد أظهر الذكور سمات أعلى من الإناث في بعدي المشكلات السلوكية و فرط النشاط. ولم توجد أية فروق ذات دلالة إحصائية بين الذكور والإناث في المقاييس الفرعية لقائمة تشخيص صعوبات التعلم. **الخلاصة:** خلصت هذه الدراسة إلى أن تلاميذ المدارس الإبتدائية المحالين لوحدات صعوبات التعلم في مسقط بسلطنة عمان يظهروا سمات اضطراب نقص الإنتباه المصاحب لفرط النشاط. كما أكدت الدراسة على ضرورة التعرف المبكر على هذا الاضطراب وخاصة مع الوضع في الإعتبار تداخله مع اضطراب نقص الإنتباه المصاحب لفرط النشاط. كما ينبغي قيام فريق متعدد التخصصات يتكون من المدرسين العامين ومدرسي التربية الخاصة واخصائي علم النفس السريري ومرشد المدرسة وأخصائي طب الأطفال التطوري واخصائي الطب النفسي للأطفال القيام بعمليات التشخيص من أجل البدء في تقديم خدمات التدخل العلاجي.

مفتاح الكلمات: إضطرابات التعلم؛ إضطراب نقص الانتباه المصاحب لفرط النشاط؛ التلازم؛ الأطفال؛ عمان.

Advances in Knowledge

- *The co-occurrence of learning disorders (LD) and attention deficit hyperactivity disorder (ADHD) is well known. However, data on this topic are still lacking in Oman. To the best of the authors' knowledge, this is the first study that reports the coexistence of ADHD in a group of Omani schoolchildren with LDs.*
- *The current study provides evidence that approximately one-third of Omani children referred to a learning support unit for LDs exhibited ADHD symptomatology as rated by their teachers.*

[1]Department of Child Health, Sultan Qaboos University Hospital; [2]Department of Psychology, College of Education, Sultan Qaboos University, Muscat, Oman

**Corresponding Author e-mail: watfa.almamari@gmail.com*

Application to Patient Care

- *The identification and management of ADHD in children with LD may have a positive outcome on their academic performance. The findings of this study encourage the use of multidisciplinary teams to manage and support children with ADHD in Oman.*

Learning disorders (LDs) are neurodevelopmental conditions that affect approximately 2–10% of school-aged children worldwide.[1] Children with LDs frequently exhibit comorbidities with other disorders, including attention deficit hyperactivity disorder (ADHD). The high comorbidity of LDs and ADHD has been well delineated in the literature while the overall estimate of LDs in children with ADHD ranges from 7–92%.[2,3] Research has shown that the prevalence of ADHD in schoolchildren with LDs ranges from 18–60%, which is seven times higher than that of the general population.[4] Multiple factors contribute to this wide range, including differences in methodologies, definitions of LDs and ADHD and population samples. Most epidemiological information is gathered from clinically referred samples compared to school-based samples; it is well known that clinically referred students usually have multiple comorbidities.[2]

There is a lack of data from Middle Eastern countries with regards to the prevalence of ADHD among children with LDs. In Oman, a cross-sectional study carried out in 2008 screened 1,502 Omani schoolboys for ADHD using the short version of the Conners' Teacher Rating Scale (CTRS).[2] The findings showed that 7.8% of the sample exhibited hyperactivity, which was strongly associated with conduct disorder, poor academic performance and behavioural problems.[2] Other research noted that the observed rate of ADHD among Omani schoolgirls was 5.1%.[3] This rate is lower than those reported in similar studies of other populations (11.0–19.8%).[5–7] The high variability of ADHD prevalence rates between Omani and other populations has been attributed to sociocultural, ecological and/or methodological factors.[2]

In Oman, schoolchildren with LDs receive their education in regular classroom settings alongside their non-affected peers. However, they are sometimes removed from the classroom to receive instruction from specialist teachers within a specialised learning support unit. These units were established in every elementary school in Oman in order to cater for the needs of children with LDs.[8,9] Students with LDs are also eligible for additional drop-in support if needed. A referral to a learning support unit is based on a teacher's nomination due to the student's non-responsiveness to instruction as shown by their monthly reading and mathematics grades. Within the learning support unit, students typically receive approximately eight hours of support per week from a specialised LD teacher, including assistance with reading, writing and mathematical activities and problem-solving. The Omani Ministry of Education initiated the inclusion and support programme for children with LDs in 2007 in Omani elementary schools.[8,9] In most cases, LD teachers have a specialised diploma. Some hold a Master's degree and/or have received specialised in-house training.

Children with ADHD can exhibit academic, educational and neurobehavioural problems such as anxiety, depression, disruptive behaviours and tics. These associations often result in higher rates of school suspension, grade retention and the use of special education or ancillary services.[7] It is therefore important to recognise ADHD symptoms in order to effectively plan for and manage affected children.[10] As such, the present study was designed to examine the relationship between LDs and ADHD among an Omani school-based sample referred to a learning support unit for LDs.

Methods

This study was conducted between January 2014 and January 2015 at the Sultan Qaboos University, Muscat, Oman. Students between grades 1–4 from elementary public schools across Muscat, Oman, who had been referred for LDs to a learning support unit from elementary schools in Oman were recruited for inclusion in the study. The sample was drawn from a large pool of students referred for learning support in elementary schools across Oman. General classroom teachers were requested to complete two questionnaires rating the existence of LD and ADHD symptoms in a particular child based on their personal views and experiences teaching the child.

The Learning Disabilities Diagnostic Inventory (LDDI) is a rating scale designed to examine the presence of LDs in students between the ages of 0–8 and 11–17 years and consists of six independent 15-item subscales (listening, speaking, reading, writing, mathematics and reasoning).[11] Each item is rated on a 9-point Likert scale. The normalisation sample of the inventory includes 2,152 students with LDs from the USA.[11] Teachers were requested to complete an adapted Arabic version of the LDDI following two rounds of consecutive translation and one round of back-translation.[11] The back-translation

Table 1: Correlation matrix between learning disorders* and attention deficit hyperactivity disorder† among Omani schoolchildren referred for learning disorders (N = 321)

Correlation matrix‡	LDDI subscale	CTRS-28 subscale			
		Conduct problems	Hyperactivity	Inattentive-passive behaviours	Hyperactivity index
Total	Listening	0.243	0.193	0.367	0.260
	Speaking	0.259	0.206	0.421	0.291
	Reading	0.278	0.218	0.461	0.325
	Writing	0.297	0.229	0.457	0.339
	Mathematics	0.205	0.172	0.347	0.242
	Reasoning	0.294	0.246	0.503	0.366
Male (n = 203)	Listening	0.215	0.138§	0.290	0.201
	Speaking	0.250	0.183	0.376	0.260
	Reading	0.260	0.156§	0.385	0.263
	Writing	0.255	0.146§	0.370	0.253
	Mathematics	0.236	0.163§	0.303	0.248
	Reasoning	0.286	0.227	0.448	0.330
Female (n = 118)	Listening	0.328	0.305	0.487	0.382
	Speaking	0.288	0.248	0.494	0.351
	Reading	0.344	0.336	0.578	0.451
	Writing	0.394	0.365	0.586	0.487
	Mathematics	0.227§	0.248	0.421	0.295
	Reasoning	0.324	0.281	0.594	0.441

LDDI = Learning Disabilities Diagnostic Inventory; CTRS-28 = 28-item version of the Conners' Teacher Rating Scale.

**Learning disorders were scored by teachers using an Arabic version of the LDDI.[11] †Attention deficit hyperactivity disorder was scored by teachers using an Arabic version of the CTRS-28.[13,14] ‡All values except those otherwise marked were significant at the 0.01 level using an independent two-sample t-test. §Significant at the 0.05 level using an independent two-sample t-test.*

was conducted by a translator with a background in a related discipline and without access to the original questionnaire. A number of items from the original inventory were modified in order to fit the structure, morphology and phonology of the Arabic language.[12] The questionnaire items originally included English examples which were replaced by Arabic examples. Examples were provided to the teachers in order to help them understand statements before rating the pupil. These examples increased the face validity of the Arabic version of the LDDI. Additionally, Cronbach's alpha for the validated Arabic versions of the subscales used were as follows: α = 0.95 (listening); α = 0.96 (speaking, writing and mathematics); α = 0.97 (reading and reasoning). Scores were reported in percentiles or scaled on a 9-point standard scale with a mean of five and a standard deviation of two.

The CTRS is a widely used measure to assess the presence of ADHD in children and adolescents. The 28-item version of the CTRS (CTRS-28) assesses behaviour on four subscales (hyperactivity, conduct problems, inattentive-passive behaviours and hyperactivity index) as defined in the psychiatric nomenclature.[13] The items on the hyperactivity index subscale are drawn from the other three subscales and provide a sensitive indicator of ADHD symptoms in children. Each item is rated on 3-point Likert scale.[13] General classroom teachers were requested to complete an adapted Arabic version of the CTRS-28 following forward- and back-translation.[14] The back-translation was conducted by an external translator with a background in educational psychology and without the original questionnaire. An empirical study validated the CTRS-28 on a large Egyptian sample and found moderate internal consistency (α = 0.76).[15] Test-retest reliability of the validated Arabic version of the four subscales was as follows: hyperactivity = 0.48; conduct problems = 0.46; inattentive-passive behaviours = 0.59; and hyperactivity index = 0.52. Internal consistency estimates for the hyperactivity, conduct problems, inattentive-passive behaviours and hyperactivity index subscales were α = 0.80, 0.85, 0.82 and 0.85, respectively.

Data were collected, coded and analysed using the Statistical Package for the Social Sciences (SPSS), Version 21.0 (IBM Corp., Chicago, Illinois, USA). The association between LD and ADHD was measured using the correlation coefficient of the LDDI and CTRS-28 scores. Gender differences among LD and ADHD symptoms were estimated using an independent two-sample t-test after calculating the mean scores and standard deviation.

This study was approved by the Research Ethical Committee Board of the Sultan Qaboos University (#SR/EDU/PSYC/12/01). Consent was obtained from the administration of the involved elementary schools

Table 2: Gender differences between learning disorders* and attention deficit hyperactivity disorder† among Omani schoolchildren referred for learning disorders (N = 321)

	Mean ± SD		T	*P* value
	Male (n = 203)	Female (n = 118)		
LDDI subscale				
Listening	5.11 ± 1.58	5.10 ± 1.74	0.04	0.970
Speaking	5.42 ± 1.58	5.32 ± 1.68	0.50	0.617
Reading	5.83 ± 1.65	5.79 ± 1.86	0.21	0.833
Writing	6.04 ± 1.50	5.89 ± 1.78	0.81	0.422
Mathematics	5.90 ± 1.56	6.20 ± 1.63	1.64	0.103
Reasoning	6.12 ± 1.55	6.02 ± 1.63	0.54	0.592
CTRS-28 subscale				
Conduct problems	0.81 ± 0.55	0.59 ± 0.41	3.80	0.001
Hyperactivity	0.82 ± 0.61	0.60 ± 0.53	3.32	0.001
Inattentive-passive behaviours	1.21 ± 0.58	1.23 ± 0.59	0.27	0.790
Hyperactivity index	0.97 ± 0.54	0.77 ± 0.47	3.23	0.001

SD = standard deviation; LDDI = Learning Disabilities Diagnostic Inventory; CTRS-28 = 28-item version of the Conners' Teacher Rating Scale.

**Learning disorders were scored on a 9-point Likert scale by teachers using an Arabic version of the LDDI.[11,12] †Attention deficit hyperactivity disorder was scored on a 3-point Likert scale by teachers using an Arabic version of the CTRS-28.[13,14]*

and from all parents of the participating children before data collection began.

Results

Among the cohort, there were 118 female students (36.8%) and 203 male students (63.2%). The mean age of the children was 8.53 ± 0.76 years. The subjects were predominantly Arabic-speaking and of Omani nationality. According to their teachers, 30.0% of pupils referred to the learning support unit for suspected LDs exhibited significant ADHD symptomatology. These included conduct problems (24.0%), hyperactivity (24.0%) and inattentive-passive behaviours (41.0%).

The correlation matrix for the LDDI and CTRS-28 subscales is shown in Table 1. There were positive correlation coefficients between all of the subscales for the total sample as well as by gender. Gender differences between LD and ADHD symptoms are shown in Table 2. There were no gender differences observed in LDDI scores. However, there were gender differences observed in three of the CTRS-28 subscales, with males displaying greater conduct problems, hyperactivity and hyperactivity indexes according to their teachers. There were no reported gender differences with regards to the inattentive-passive behaviours subscale.

Discussion

In the current study, the majority of the referred children with LDs were boys. This is consistent with a previous study on LDs carried out in Oman.[2] However, no significant gender differences were observed among the current cohort regarding teachers' ratings of LD symptoms as expressed within the LDDI. Previous research has suggested that boys are more likely to be referred for LDs associated with difficulties in reading, comprehension and mathematics.[15] However, gender differences in LDs are still controversial and have yet not been confirmed by recent epidemiological studies.[16] It is likely that behavioural problems which result in a referral among girls are seen as more extreme. Interestingly, gender differences in the manifestation of ADHD were also observed in the current study. Boys were reported to exhibit greater conduct problems, hyperactivity and hyperactivity indexes than girls. Additionally, more boys met the diagnostic criteria for both LDs and ADHD. However, the reported male-to-female ratio for ADHD varies widely.[17]

The findings of the present study suggest that ADHD has a significant correlation with LDs among schoolchildren. Although a number of studies have examined the coexistence of LDs and ADHD, only a few have studied the prevalence of ADHD in a cohort of school-aged children diagnosed with LDs.[4] Positive correlation coefficients were noted in the current study between all of the subscales for the total sample as well as according to gender. This finding suggests that there are common symptoms identified by both the LDDI and CTRS-28 questionnaires.

Nevertheless, it is not surprising that ADHD and LDs were interconnected in the current study. The overall effect of psychological and educational difficulties has been previously confirmed in children from the general population. Research has provided substantial evidence that children with internalised and externalised psychological problems are poor learners.[18] Additionally, educational difficulties are likely to affect academic performance as well as self-esteem. However, researchers have yet to agree on implications for children at risk of developing LDs.[18] A detailed examination of such associations in previous studies has indicated that literacy difficulties are predicted by both hyperactivity and conduct problems.[19] Another study also postulated that the link between conduct problems and literacy difficulties is mediated by ADHD, of which hyperactivity is

a marker.[16] Alternatively, several researchers have argued that the association between ADHD and literacy difficulties has a genetic basis and that one disorder cannot be entirely explained as a consequence of the other.[20,21] The comorbid association between LD and ADHD symptoms highlights the need for caution in assigning the LD label to children during the referral process.[18]

Several limitations should be considered with regards to the findings of the current study. The results were obtained from a sample of children referred to a learning support unit based on teacher nominations. Potential teacher bias and subjectivity in rating ADHD symptoms should therefore be kept in mind. An independent non-LD school-aged sample should be used to test whether the findings of the current study can be generalised to all children in Oman. Furthermore, only one measure of ADHD was used; the generally accepted practice involves using multiple measures (such as parental ratings or expert evaluation) to reach a definitive ADHD diagnosis.[22] In addition, the presence of ADHD was assessed in a general LD group with subjects not classified according to the specific type of LD.[10] It is therefore recommended that future studies examine the association between different LD subtypes and ADHD symptoms.

Regardless of the aforementioned limitations, the findings of ADHD symptoms in students with possible LDs have several implications for physicians and educators in Oman. Within their meta-analysis of behavioural treatments for ADHD, Fabiano *et al*. found that students with low academic performance tend to exhibit ADHD symptoms; the poor academic performance usually increases as the behavioural manifestations of the ADHD become more severe.[23] Considering the chronic nature of ADHD, its varied forms and impact on multiple areas of functioning, it is critical that it is identified early in affected children. Moreover, different treatment modalities are needed and should be provided by various members of a multidisciplinary team, including general/special educators, clinical psychologists/psychoeducators, school counsellors, developmental or experienced general paediatricians and child psychiatrists.

Conclusion

Among the studied sample of schoolchildren in Oman referred for LDs, 30.0% were reported to have symptoms of ADHD by their teachers, including conduct problems, hyperactivity and inattentive-passive behaviours. Male students were reported to show greater conduct problems and hyperactivity than the females. However, there were no gender differences noted between LDDI scores. These findings suggest that Omani children referred for LDs are likely to exhibit ADHD symptomatology. As ADHD can have serious implications for paediatric development, it is vital that these children are assessed and treated by a multidisciplinary team including experts in the fields of education and child psychology.

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CONFLICT OF INTEREST

The authors declare no conflicts of interest.

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