

Mathematical Learning Disorder in School-Age Children With Attention-Deficit Hyperactivity Disorder

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Objectives: To explore the prevalence of mathematics disorder (MD) relative to reading disorders (RD) in school-age children with attention-deficit hyperactivity disorder (ADHD) and examine the effects of age, sex, cooccurring conduct disorder (CD), and ADHD subtype on this comorbidity.

Methods: Participants were school-age children ($n = 476$) with confirmed DSM-IV diagnosis of ADHD. The assessment included semistructured parent and teacher interviews and standardized measures of intelligence, academic attainment, and language abilities. Based on the presence or absence of concurrent learning disorders, we compared the emerging 4 groups: ADHD-only, ADHD + MD, ADHD + RD, and ADHD + MD + RD.

Results: Overall prevalence of comorbid ADHD + MD was 18.1%. Age, sex, ADHD subtypes, or comorbid CD did not affect the frequency of MD. Children with concurrent ADHD and either MD or RD attained lower IQ, language, and academic scores than those with ADHD alone. Children with ADHD + MD + RD were more seriously impaired and demonstrated distinct deficits in receptive and expressive language.

Conclusion: MDs are relatively common in school-age children with ADHD and are frequently associated with RDs. Children with ADHD + MD + RD are more severely impaired. These deficits simply cannot be explained as consequences of ADHD and might have unique biological underpinnings, with implications for diagnostic classification and therapeutic interventions.

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Clinical Implications

- MD in children with ADHD occur frequently and are often associated with impairments in reading.
- Children with ADHD + MD + RD are more severely impaired and exhibit significant deficits in both receptive and expressive language.
- A minimal standard of clinical practice for evaluation of suspected ADHD in children and adolescents should include obtaining a detailed history of cognitive and language development, and mathematics and reading skills attainment. Formal psychological testing is recommended when comorbid learning disorder, language disorder, or intellectual disability is suspected.

Limitations

- The tertiary care nature of our sample may be subject to a referral bias toward more severe cases of ADHD and higher MD and RD comorbidity.
- Comparison of older and younger children is limited because referral at a younger age may indicate greater functional impairment and group sizes were uneven.
- The number of males largely outnumbered females, which is typical in ADHD–clinic-referred samples.
- Clinical information from teachers was obtained, in part, through the teacher telephone interview; an instrument in process of development and not fully validated.

Key Words: *attention-deficit hyperactivity disorder, mathematical learning disorder, dyscalculia, math disabilities, dyslexia, reading disorder, reading disabilities, learning disabilities*

ADHD is a common childhood onset neuropsychiatric disorder characterized by developmentally inappropriate and impairing levels of inattention, hyperactivity, and impulsivity affecting about 5% of school-age children¹; ADHD is often comorbid with LD, CD, ODD, anxiety, and depression.^{2,3} The focus of this study is on the mathematic learning impairments associated with ADHD.

Most research efforts in the area of LDs have concentrated on RD while MD has received less consideration. A major obstacle for progress has been the lack of uniformity among studies regarding defining criteria. Several factors appear to complicate MD classification. First, as discussed by Mazzocco and Myers,⁴ an empirical definition of RD is possible given the knowledge that phonological decoding deficits are central to the disability. In contrast, a core deficit in MD has not been identified, and poor reading-related skills, memory, visuospatial skills, and executive skills are all associated with poor mathematics achievement, making an empirical definition difficult. Second, unlike reading, mathematics requires cumulative qualitative and quantitative changes that occur during and after the elementary school years. Thus deficits in mathematics may be manifested at different points during a child's developmental trajectory in the acquisition of this ability.

Assessment methods for identifying children with LDs are controversial; classification is usually based on results of standardized measures of intelligence and achievement, and a central point of debate is whether definitions require a discrepancy between these 2 sets of scores. The argument against

the discrepancy definition is based on the notion that a discrepancy approach does not distinguish any different groups from those selected based on low achievement alone,^{5,6} and further contend that classifications of children with LD based on discrepancy models lack validity and have poor coverage. Additionally, longitudinal studies have shown that compared with the low achievement criterion, the discrepancy criterion is far less stable as a measure over time.^{7,4}

Younger children generally show greater variability acquiring cognitive skills and many tend to later demonstrate achievement comparable to their peers. In this regard, longitudinal studies provide useful information. For instance, in a sample of primary school children, Mazzocco and Myers⁴ found that 63% classified with MD in one grade were reclassified in more than 2 subsequent grades. In a study by Shalev et al,⁸ of children classified as having developmental dyscalculia in grade 5, 50% met the defining criteria in grade 8, and 40% in grade 11.^{8,9} This latter study identified factors associated with persistence of mathematical difficulties: severity of arithmetic disorder at the time of diagnosis, lower IQ, inattention, and writing problems.

Despite variation in definitions of MD, comparable prevalence rates were reported across several studies in nonclinical populations, and estimated to be about 6% with a range of 3% to 13%.^{4,10-12} These values are similar to the prevalence of RD, estimated at 5% to 9%.¹³ Available information on MD in the context of ADHD, suggests that MDs are seen in individuals with ADHD more frequently than what is observed in the general population, and identify a prevalence rate of 11% to 26%.¹⁴⁻¹⁶ Some of the limitations of these early studies include: ADHD diagnosis based exclusively on behavioural questionnaires,¹⁵ relying on a single arithmetic measure,^{14,16} and exclusion of children with RD from their analyses.¹⁶ The latter is of particular importance, given the fact that RD and MD frequently cooccur, with estimates ranging from 17% to 64%.¹¹ It is unclear why these 2 disorders cooccur at such a high rate; however, selecting for one while excluding the other may result in an underestimate of true prevalence.¹⁷

Some children with cooccurring MD + RD may constitute a specific MD subtype, defined by Geary¹⁸ as semantic memory MD. This subgroup of MD tends to coexist with RD and is characterized by poor math fact retrieval. Geary¹⁸ also proposed 2 additional MD subgroups: procedural and visuospatial. The former is characterized by immature strategies, errors in math problem execution, and delay in acquiring arithmetic concepts. The latter involves difficulty with poorly aligning numeric information, sign confusion, and misinterpretation of spatially relevant numerical information such as place value.

Abbreviations used in this article

ADHD	attention-deficit hyperactivity disorder
CD	conduct disorder
CELF-3	Clinical Evaluation of Language Fundamentals
LD	learning disorder
MD	mathematics disorder
ODD	oppositional defiant disorder
PICS	parent interview for child symptoms
RD	reading disorder
TTI	teacher telephone interview
WIAT	Wechsler Individual Achievement Test
WRAT	Wide Range Achievement Test—Third Edition
WRMT	Woodcock Reading Master Tests—Revised

In addition to the heterogeneous cognitive profiles evident in children with MD, symptoms of ADHD itself may be the sole cause of math difficulties in children with ADHD. Some argue that the inattentive subtype is more strongly associated with MD and other LDs.^{19–21} On the other hand, frequently comorbid CD may account for MD in this population, as an association between CD and MD was documented in the past.^{22,23}

Lastly, an additional area meriting reflection is the overlap between language development and mathematical abilities; in typically developing children, language and numerical understanding appear to develop at the same time.²⁴ However, children with specific language impairments appear to have problems with phonological memory, number recall, working memory, and automatic retrieval of items stored in long-term memory. In turn, these impairments may interfere with the learning and recall of mathematical facts, and the procedural knowledge to solve calculation problems.^{25,26}

The main objective of this study is to explore the prevalence of MD relative to RD in a large sample of school-age children with ADHD using a comprehensive diagnostic approach. This includes tests of arithmetic computations, mathematical reasoning, and language abilities, and examines the effect of age, sex, ADHD subtype, and CD comorbidity on this specific learning disability.

Methods

Subjects

The clinical sample consisted of 476 children with ADHD ranging in age from 7.0 to 12.9 years (mean 8.7, SD 1.5). Participants were 389 boys and 87 girls (male:female ratio of 4.5:1). The sample was drawn from 1153 consecutive referrals to an outpatient clinic for assessment of learning or behavioural disorders at a tertiary care pediatric hospital serving a large metropolitan area. The sample was predominantly Caucasian and broadly representative of the community from which it was drawn. The Hospital for Sick Children's Research Ethics Board provided scientific and ethical review and gave approval to the study. Parents of all subjects gave written consent for their children to participate in the study, and all subjects gave verbal assent.

Diagnostic Assessment

We assessed all participants using the same procedure. Parents and children attended a full-day diagnostic assessment consisting of two, 3-hour evaluation sessions with a 1-hour lunch break. We based clinical diagnoses on DSM-IV criteria, informed by semistructured interviews conducted with the children's parents (PICS)²⁷ and their classroom teacher (TTI; Tannock et al, 2002, unpublished manuscript). Both parent and teacher interviews were administered by trained masters-

or doctoral-level mental health professionals; the PICS was administered on the day of assessment, whereas the TTI was arranged within 2 weeks of the clinic visit. In addition, parent and teacher versions of the Conners' Rating Scale–Revised, a standardized behavioural questionnaire, were administered.^{28,29} Psychometric testing was administered under medication-free conditions, participants receiving active psychostimulant treatment were asked to discontinue these medications for a minimum of 48 hours prior to the evaluation.

We established the diagnosis of ADHD according to DSM-IV criteria. We excluded individuals with a full-scale IQ score of less than 80; history or evidence of a neurological disorder; poor physical health; uncorrected sensory impairments; or history of a chronic tic disorder, Tourette syndrome, psychotic disorder, major mood disorder, or pervasive developmental disorder.

Measures of intelligence, academic attainment, and language abilities were administered to children, individually, by a masters- or doctoral-level psychologist. Intellectual abilities were measured with the Wechsler Intelligence Test for Children—Third Edition.³⁰ Academic attainment was evaluated with the WRAT-3,³¹ the word attack and word identification subtests of the WRMT,³² and the mathematics reasoning subtest of the WIAT.³³ Language abilities were assessed with the Clinical Evaluation of Learning Fundamentals—Third Edition.³⁴

MD was defined either as a score of at least SD 1 below the mean on the 2 administered standardized measures of mathematics achievement (that is, WRAT-3 arithmetic subtest, WIAT mathematical reasoning subtest), or as a score of SD 1.5 below the mean on either measure of mathematics achievement. RD was defined as either a score of SD 1 below the mean on 2 of 3 reading achievement tests (WRAT-3 reading subtest, word attack and word identification subtests of the WRMT-3) or a score of SD 1.5 below the mean on any one of these 3 reading achievement tests. Using these defining criteria, 4 groups were delineated: ADHD-only, ADHD + RD, ADHD + MD, and ADHD + MD + RD.

Statistical Analyses

Statistical analyses were performed using the Statistical Package for Social Sciences, version 13 software. Analysis of variance with post hoc multiple comparisons (Tukey test) was used to test the difference among the comparison groups on continuous variables. Chi-square analysis was used to examine the difference on categorical variables.

Results

Distribution of subjects based on presence or absence of comorbid MD and RD is detailed in Table 1. Overall, we

Table 1 Prevalence of MD and RD in school-age children with ADHD

Age, years	ADHD	ADHD + RD	ADHD + MD	ADHD + MD + RD
7.0 to 9.9	<i>n</i> = 213	<i>n</i> = 67	<i>n</i> = 23	<i>n</i> = 34
<i>n</i> = 337, %	63.2	19.9	6.8	10.1
10.0 to 12.9	<i>n</i> = 100	<i>n</i> = 10	<i>n</i> = 16	<i>n</i> = 13
<i>n</i> = 139, %	71.9	7.2	11.5	9.4
Total sample	<i>n</i> = 313	<i>n</i> = 77	<i>n</i> = 39	<i>n</i> = 47
<i>n</i> = 476, %	65.7	16.2	8.2	9.9

found an 18.1% prevalence of MD and a 26.1% prevalence of RD in this sample of school-age children with ADHD. One of every 10 children diagnosed with ADHD was also classified as having both a MD and a RD; while 8% had MD without RD and 16% were singled out as RD exclusive of MD. Comparing a younger group (aged 7.0 to 9.9 years) against an older group (aged 10.0 to 12.9 years) a slight, nonsignificant, increase in the proportion of older children with MD was observed (16.9% and 20.9%; $\chi^2 = 1.04$, $P > 0.05$). In contrast, the proportion of children with ADHD + RD was significantly lower in the older group relative to the younger group (16.5% and 30.0%; $\chi^2 = 9.205$, $P < 0.01$).

Table 2 compares 4 emerging groups based on presence or absence of MD and (or) RD on measures of intellectual and language abilities, and reading and mathematical achievement. Highly significant differences among groups are present in all measures. Post hoc comparisons demonstrate that the ADHD group free of MD or RD comorbidity performed significantly higher on measures of intelligence and language abilities. As expected, the ADHD + MD group demonstrated better achievement on reading skills than the ADHD + RD group, and was worse on mathematics. The ADHD + RD group performed worse than the ADHD + MD group on measures of component reading skills, and was better on mathematical skills. The ADHD + MD + RD group stands out as having the greatest degree of impairment on this set of measures.

We contrasted the ADHD groups with and without comorbid reading and mathematics disorder on parent and teacher reports of inattentive and hyperactive-impulsive symptoms. The 4 groups were similar regarding presence of inattentive and hyperactive-impulsive symptoms measured by the semistructured interviews and standardized questionnaires administered to parents and teachers (Table 3). Using a categorical approach, we examined the prevalence of MD and RD in children classified according to the DSM-IV ADHD subtypes (that is, predominantly inattentive, predominantly hyperactive-impulsive, and combined) and found no

significant differences in prevalence of either MD or RD among the different subtypes. Among the 126 predominantly inattentive type, 21 (16.7%) were classified with MD and 35 (27.8%) with RD; among the 81 predominantly hyperactive-impulsive type, 13 (16%) had an MD and 23 (28.4%) an RD; and, among the 286 combined type, 52 (19.4%) had an MD and 66 (24.6%) an RD. In addition, we found nonsignificant differences in MD prevalence among ADHD children with and without comorbid ODD/CD: 17% and 20.0%, respectively. In this sample of ADHD children, the prevalence of MD and RD among females and males was similar (18.4% and 18.0% for MD; 25.2% and 25.8% for RD).

Discussion

Our study confirms earlier reports suggesting that the prevalence of MD in ADHD-affected individuals markedly exceeds the prevalence of MD observed in the general population. In our sample, MD was present in almost one of 5 children with ADHD, or 3 times what is expected in nonclinical populations.¹⁰ Several factors may explain this overrepresentation. The impact of the cognitive deficits associated with ADHD on all aspects of learning has to be brought under consideration; however, ADHD alone cannot explain the presence of mathematical deficits. A case in point, MD is not present in 80% or more of the subjects with ADHD. Zental et al³⁵ examined contributors to math difficulties in a group of boys with ADHD, and found that increased hyperactivity certainly affected math performance. Additionally, a surprising finding was that the ADHD group had difficulty with math problem-solving when reorganization was required and when it was not required, demonstrating that the straightforward application of mathematical rules and principles was also difficult for this group. Further, difficulties with math concepts was not explained by IQ, reading, or computational differences.

Converging and compelling evidence indicates that RD represents a disorder within the language system, specifically

Table 2 Comparison of ADHD with and without comorbid RD and MD on measures of intelligence, language, reading, and mathematical achievement

Measure	Group 1 ADHD <i>n</i> = 313 Mean (SD)	Group 2 ADHD + RD <i>n</i> = 77 Mean (SD)	Group 3 ADHD + MD <i>n</i> = 39 Mean (SD)	Group 4 ADHD + MD + RD <i>n</i> = 47 Mean (SD)	Statistic ANOVA <i>P</i> = 0.01	Statistic post hoc comparisons
Intelligence						
WISC-FSIQ	106.0 (12.3)	97.7 (9.1)	93.5 (9.4)	91.8 (8.1)	<i>F</i> = 36.91	1 > 2, 3, 4 2 > 4
WISC-VIQ	106.5 (12.2)	97.2 (10.9)	94.9 (12.2)	90.0 (9.7)	<i>F</i> = 38.69	1 > 2, 3, 4 2 > 4
WISC-PIQ	104.6 (14.3)	99.1 (10.8)	93.4 (11.7)	95.1 (10.3)	<i>F</i> = 14.52	1 > 2, 3, 4
Language						
CELF-3 receptive	102.7 (14.7)	92.1 (11.7)	93.0 (14.3)	81.9 (13.3)	<i>F</i> = 33.80	1 > 2, 3, 4 2, 3 > 4
CELF-3 expressive	105.3 (12.9)	93.0 (14.8)	100.4 (15.6)	85.3 (13.0)	<i>F</i> = 34.78	1 > 2, 4 2, 3 > 4
Component reading						
WRAT-reading	104.6 (10.7)	82.5 (7.2)	96.7 (9.3)	76.7 (8.6)	<i>F</i> = 180.47	1 > 2, 3, 4 2 < 3 2, 3 > 4
WRMT-R word attack	96.6 (9.5)	78.0 (7.9)	95.5 (8.9)	73.9 (9.5)	<i>F</i> = 187.89	1 > 2, 3, 4 2 < 3 3 > 4
WRMT-R word identification	102.4 (11.4)	80.2 (8.4)	95.6 (8.4)	73.6 (9.7)	<i>F</i> = 158.67	1 > 2, 3, 4 2 < 3 2, 3 > 4
Mathematical skills						
WRAT arithmetic	97.4 (9.9)	91.7 (6.4)	75.5 (11.2)	75.8 (8.8)	<i>F</i> = 118.88	1 > 2, 3, 4 2 < 3, 4
WIAT math reasoning	102.4 (11.7)	93.5 (7.9)	86.1 (12.3)	80.7 (6.6)	<i>F</i> = 77.25	1 > 2, 3, 4 2 > 3, 4 3 > 4

within the component of language known as phonological processing (for a review³⁶). It has also been proposed that cooccurring RD + MD is most likely a language-based LD, and as RD + MD and MD do not share a common underlying cognitive profile, they therefore constitute distinct conditions.^{37,38} Exploring the profiles of children with impairments in either (or) word recognition, math computations, and attention, Fletcher³⁷ suggests that RD and RD + MD, and different combinations of RD and MD with ADHD, appear to be distinct comorbid conditions, and our study findings provide support for this hypothesis. In particular, the ADHD + MD + RD group demonstrates significant impairments in both receptive and expressive language, suggesting that this group

is divergent from both ADHD + MD and ADHD + RD. This particular finding has not been addressed in available studies and requires further exploration.

We also explored the relation between ADHD subtypes RD and MD and found no differences in the prevalence of either LD by subtype; this result differs from other studies that have found such relations.¹⁹⁻²¹ This is a discrepancy that might be explained by differences in approach to diagnosis, type of mathematics achievement test used, ascertainment biases, and the heterogeneity of children with ADHD. Consistent with observations of MD in nonclinical populations,¹⁰ the prevalence of MD was similar in males and females in this ADHD sample. We also found that diagnoses of comorbid

Table 3 Comparison of ADHD with and without comorbid RD and MD on parent and teacher report of inattentive and hyperactive-impulsive symptoms

	Group 1 ADHD <i>n</i> = 313	Group 2 ADHD + RD <i>n</i> = 77	Group 3 ADHD + MD <i>n</i> = 39	Group 4 ADHD + MD + RD <i>n</i> = 47	ANOVA
Parent report					
PICS inattentive, mean (SD)	5.83 (1.9)	5.30 (2.2)	6.17 (2.3)	5.68 (2.0)	<i>F</i> = 1.552 (ns)
PICS hyperactive-impulsive, mean (SD)	6.23 (2.3)	6.10 (2.3)	5.78 (2.0)	6.06 (2.3)	<i>F</i> = 0.316 (ns)
CPRS-R-inattentive, mean T score (SD)	73.20 (9.8)	69.20 (11.1)	71.00 (10.2)	72.70 (11.2)	<i>F</i> = 2.588 (ns)
CPRS-R-hyperactive-impulsive, mean T score (SD)	73.10 (12.1)	71.20 (13.1)	73.20 (10.3)	69.20 (13.6)	<i>F</i> = 1.154 (ns)
Teacher report					
TTI-inattentive, mean (SD)	5.29 (2.5)	5.51 (1.8)	6.26 (2.2)	6.00 (1.5)	<i>F</i> = 2.016 (ns)
TTI-hyperactive-impulsive, mean (SD)	4.17 (2.6)	4.38 (2.5)	4.17 (2.8)	4.09 (2.4)	<i>F</i> = 0.133 (ns)
CTRS-R-inattentive, mean T score (SD)	67.80 (8.6)	68.40 (8.5)	71.50 (7.0)	70.40 (10.2)	<i>F</i> = 1.841 (ns)
CTRS-R-hyperactive-impulsive, mean T score (SD)	66.80 (11.4)	66.70 (12.0)	70.26 (11.8)	65.34 (14.0)	<i>F</i> = 0.811 (ns)

CPRS-R = Conners Parent Rating Scale—Revised; CTRS-R = Conners Teacher Rating Scale—Revised; ns = not significant

ODD/CD and ADHD are not associated with a greater prevalence of MD, compared with children with ADHD without disruptive behaviour comorbidity.

Recent studies provide persuasive evidence for a genetic predisposition to RD and ADHD.³⁹⁻⁴¹ Family and twin studies also point in the direction of a genetic etiology for MD,⁴² and shared genetic risk factors in MD and RD were proposed.⁴³ The identification and study of a group characterized by concurrent ADHD + RD + MD creates additional challenges and potential rewards toward the elucidation of these disorders of complex inheritance.

We noted previously that our sample is not ideal for comparison of younger and older children because referral at a younger age may indicate greater functional impairment; however, despite this difference between younger and older groups, the prevalence of MD was unchanged, strongly suggesting its persistence in time. As it is typical of clinic-referred samples of ADHD children, the number of males largely outnumbered females, and as a consequence our suggestion of no gender bias in MD frequencies should be entertained with caution.

A point of debate is whether all children and adolescents undergoing evaluation for suspected ADHD should receive a formal psychoeducational evaluation of intellectual abilities and reading, writing, and mathematics achievement. Practice parameters for assessment of ADHD developed by the American Academy of Child and Adolescent Psychiatry⁴⁴ recommend these psychological tests should be performed if the patient's history suggests low general cognitive ability or low

achievement in language or mathematics. Given the relative high prevalence of MD and RD in children with ADHD, a minimal standard of clinical practice should include a detailed history of cognitive and language development as well as mathematics and reading skills attainment.

MD in children with ADHD occur frequently and are associated with greater impairments in learning and academic achievement than has commonly been recognized. These academic deficits are not simply a consequence of ADHD and likely have distinct biological underpinnings with implications for intervention and remediation. Although the developmental course of MD in the context of ADHD is not well understood, our findings of similar prevalence in younger and older children is suggestive of persistence and underscores the need for intervention strategies appropriately adapted to address the mathematics difficulties of children with ADHD. As the cognitive deficits specific to MD are elucidated, comparisons of children with ADHD alone, ADHD + MD, and MD alone will provide greater insight into the etiology of these conditions.

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Résumé : Le trouble d'apprentissage en mathématiques chez les enfants d'âge scolaire souffrant du trouble d'hyperactivité avec déficit de l'attention

Objectifs : Explorer la prévalence du trouble d'apprentissage en mathématiques (TM) relativement aux troubles de lecture (TL) chez les enfants d'âge scolaire souffrant du trouble d'hyperactivité avec déficit de l'attention (THADA), et examiner les effets de l'âge, du sexe, du trouble des conduites (TC) co-occurent et des sous-types du THADA sur cette comorbidité.

Méthodes : Les participants étaient enfants d'âge scolaire ($n = 476$) ayant un diagnostic de THADA confirmé selon le DSM-IV. L'évaluation comprenait des entrevues semi-structurées des parents et enseignants, et des mesures normalisées de l'intelligence, de la réussite scolaire et des aptitudes linguistiques. D'après la présence ou l'absence de troubles d'apprentissage co-occurents, nous avons comparé les 4 groupes qui ressortaient : THADA-seulement, THADA + TM, THADA + TL, et THADA + TM + TL.

Résultats : La prévalence globale du THADA + TM était de 18,1 %. L'âge, le sexe, les sous-types du THADA ou le TC comorbide n'affectaient pas la fréquence du TM. Les enfants souffrant de THADA et soit d'un TM, soit d'un TL co-occurent avaient un QI, un langage et des résultats scolaires plus faibles que ceux souffrant seulement de THADA. Les enfants souffrant de THADA + TM + TL étaient plus gravement handicapés et démontraient des déficiences distinctes d'expression et du versant réception du langage.

Conclusion : Les TM sont relativement répandus chez les enfants d'âge scolaire souffrant du THADA et sont fréquemment associés au TL. Les enfants souffrant de THADA + TM + TL sont plus gravement handicapés. Ces déficiences ne peuvent pas s'expliquer simplement comme étant des conséquences du THADA et peuvent avoir des bases biologiques uniques, ainsi que des implications pour la classification diagnostique et les interventions thérapeutiques.